

Quantifying the Contribution of Occupational Segregation to Racial Disparities in Health

A Gap-Closing Perspective

Ian Lundberg

University of California, Los Angeles
ianlundberg@ucla.edu

Research reported in this publication was supported by the National Science Foundation under Award Number 2104607 and by the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under Award Number P2CHD047879 and P2CHD041022.
Replication code is available at github.com/ilundberg/replication

Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

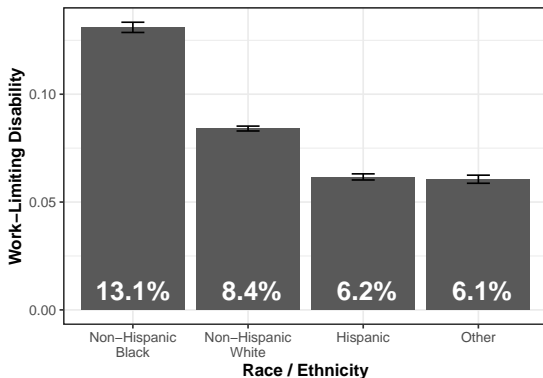
Race

Work-Limiting Disability

Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race

Work-Limiting Disability



Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race

Occupation

Work-Limiting Disability

Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race (reported at year 1)

Occupation (reported at year 1)

Work-Limiting Disability

Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

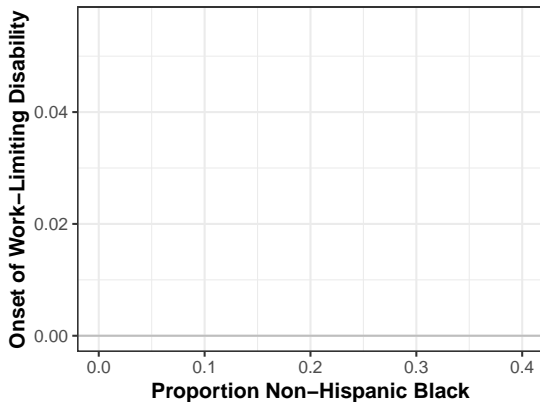
Race (reported at year 1)
Occupation (reported at year 1)
Work-Limiting Disability (reported at year 2)

Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race (reported at year 1)

Occupation (reported at year 1)

Work-Limiting Disability (reported at year 2)

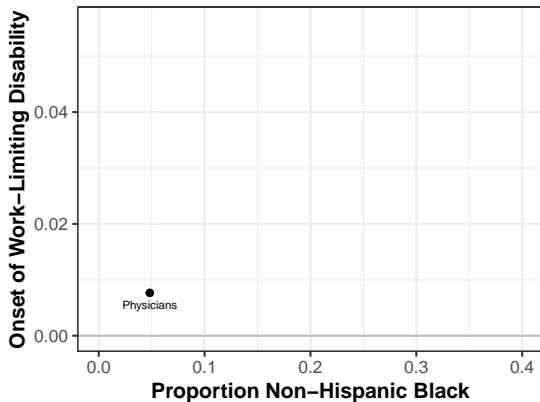


Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race (reported at year 1)

Occupation (reported at year 1)

Work-Limiting Disability (reported at year 2)

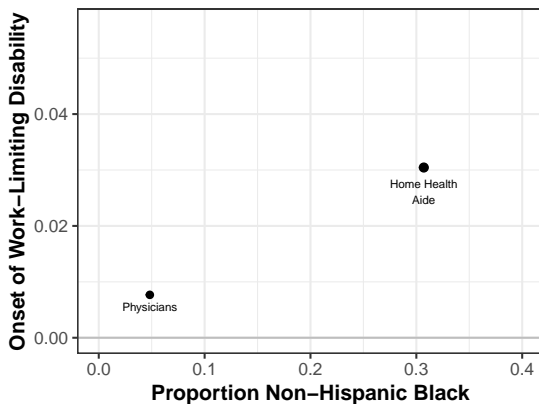


Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race (reported at year 1)

Occupation (reported at year 1)

Work-Limiting Disability (reported at year 2)

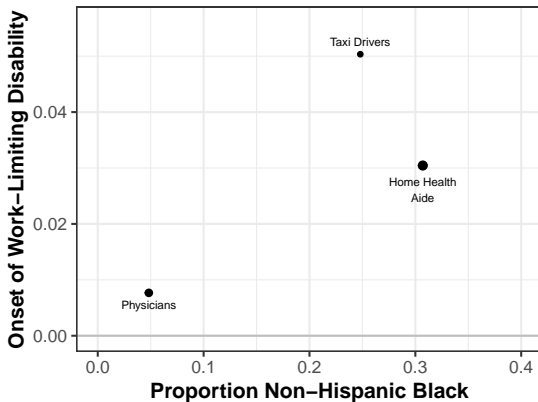


Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race (reported at year 1)

Occupation (reported at year 1)

Work-Limiting Disability (reported at year 2)

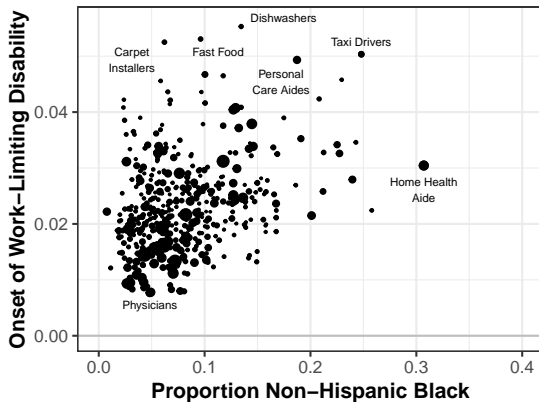


Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race (reported at year 1)

Occupation (reported at year 1)

Work-Limiting Disability (reported at year 2)

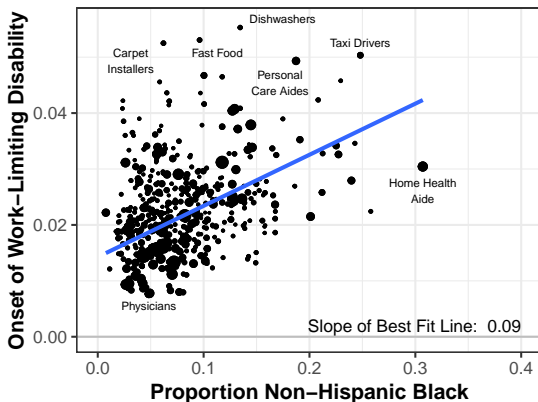


Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

Race (reported at year 1)

Occupation (reported at year 1)

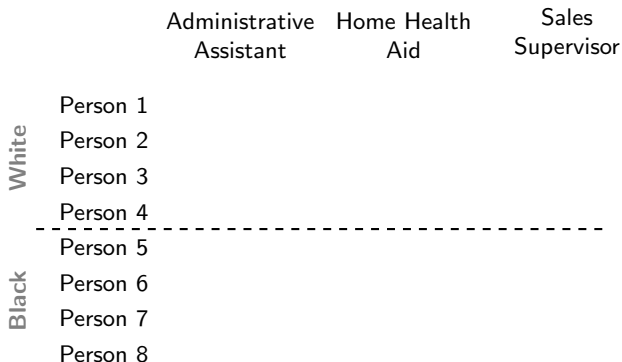
Work-Limiting Disability (reported at year 2)



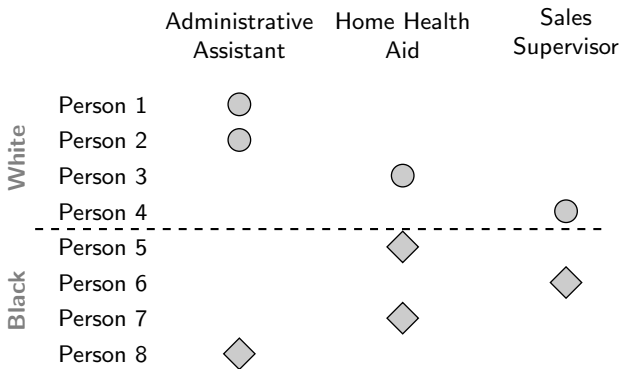
Current
Population Survey
Annual Social and
Economic Supplement
Ages 25–60
2005–2020

A Counterfactual Setting: Eliminate occupational segregation

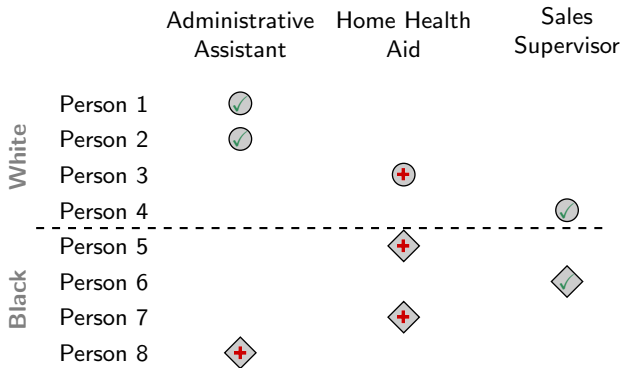
A Counterfactual Setting: Eliminate occupational segregation



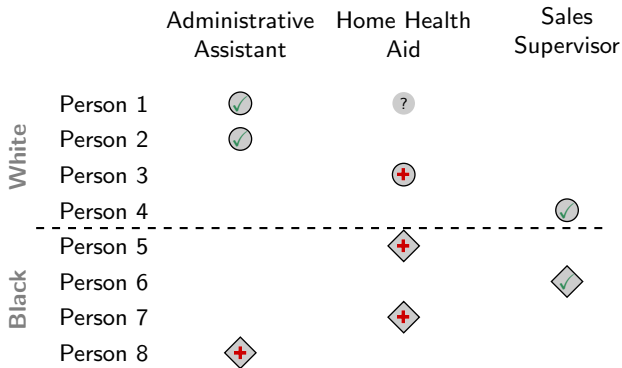
A Counterfactual Setting: Eliminate occupational segregation



A Counterfactual Setting: Eliminate occupational segregation



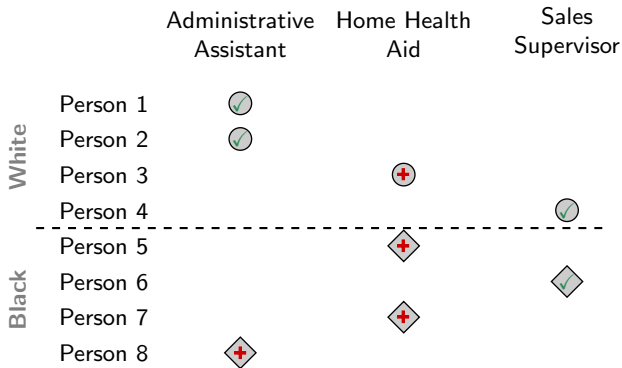
A Counterfactual Setting: Eliminate occupational segregation



A Counterfactual Setting: Eliminate occupational segregation

		Administrative Assistant	Home Health Aid	Sales Supervisor
White	Person 1			
	Person 2			
	Person 3			
	Person 4			
Black	Person 5			
	Person 6			
	Person 7			
	Person 8			

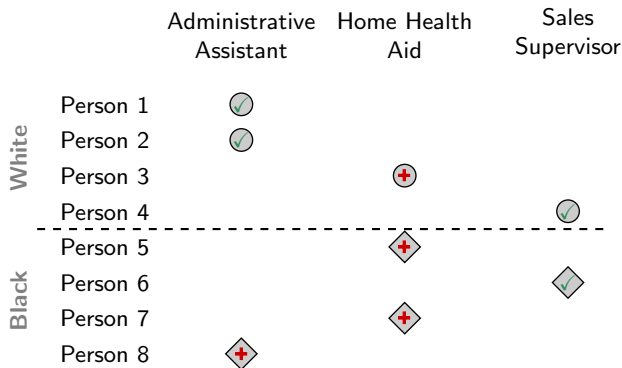
A Counterfactual Setting: Eliminate occupational segregation



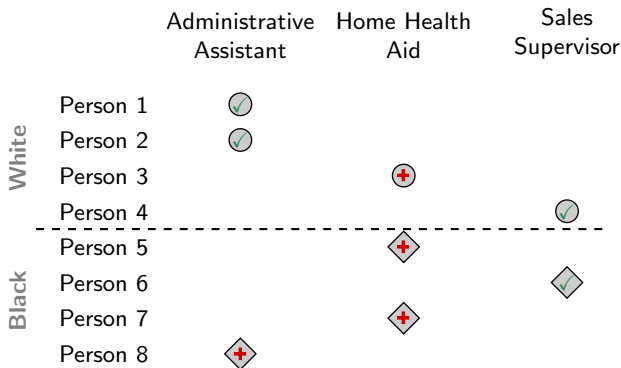
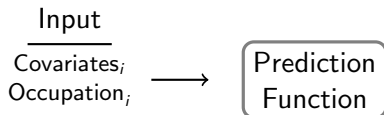
A Counterfactual Setting: Eliminate occupational segregation

Input

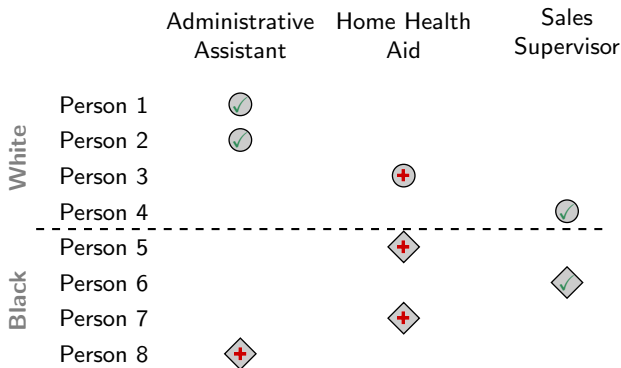
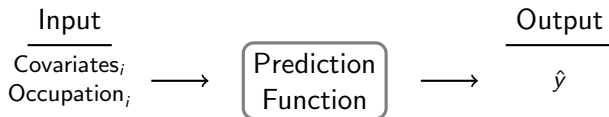
Covariates;
Occupation;



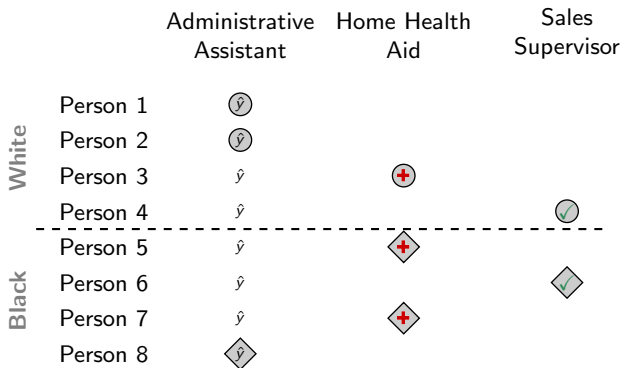
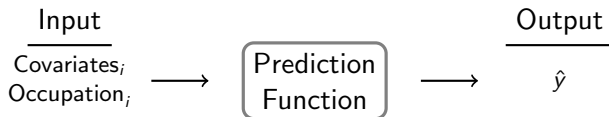
A Counterfactual Setting: Eliminate occupational segregation



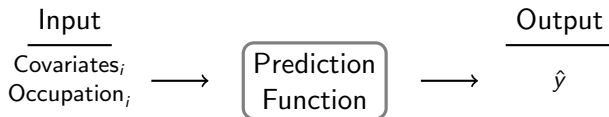
A Counterfactual Setting: Eliminate occupational segregation



A Counterfactual Setting: Eliminate occupational segregation

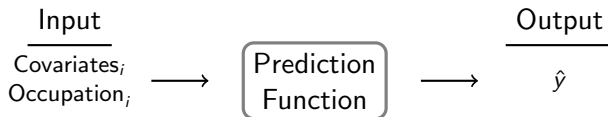


A Counterfactual Setting: Eliminate occupational segregation



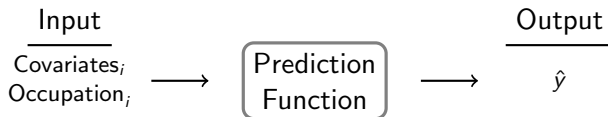
		Administrative Assistant	Home Health Aid	Sales Supervisor
White	Person 1	\hat{y}	\hat{y}	
	Person 2	\hat{y}	\hat{y}	
	Person 3	\hat{y}	\hat{y}	
	Person 4	\hat{y}	\hat{y}	\checkmark
Black	Person 5	\hat{y}	\hat{y}	
	Person 6	\hat{y}	\hat{y}	\checkmark
	Person 7	\hat{y}	\hat{y}	
	Person 8	\hat{y}	\hat{y}	

A Counterfactual Setting: Eliminate occupational segregation



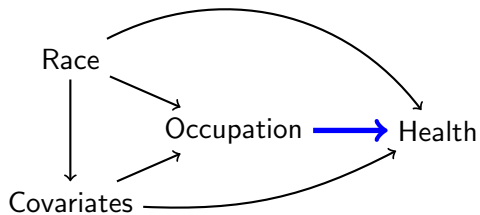
		Administrative Assistant	Home Health Aid	Sales Supervisor
White	Person 1	\hat{y}	\hat{y}	\hat{y}
	Person 2	\hat{y}	\hat{y}	\hat{y}
	Person 3	\hat{y}	\hat{y}	\hat{y}
	Person 4	\hat{y}	\hat{y}	\hat{y}
Black	Person 5	\hat{y}	\hat{y}	\hat{y}
	Person 6	\hat{y}	\hat{y}	\hat{y}
	Person 7	\hat{y}	\hat{y}	\hat{y}
	Person 8	\hat{y}	\hat{y}	\hat{y}

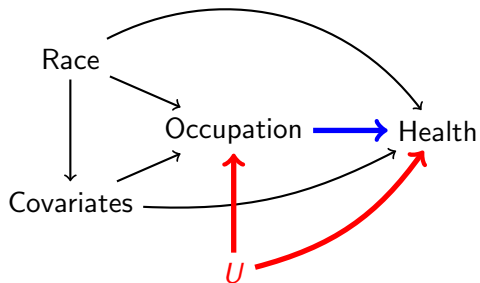
A Counterfactual Setting: Eliminate occupational segregation

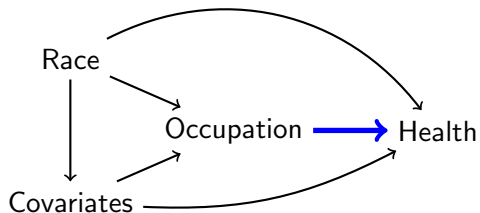


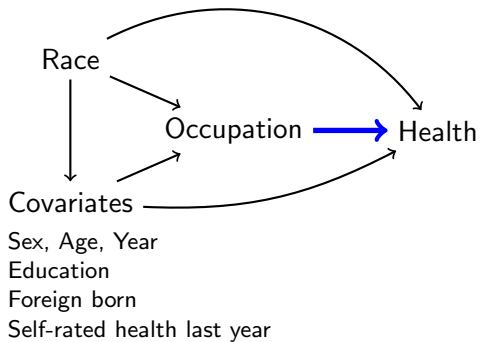
		Administrative Assistant	Home Health Aid	Sales Supervisor
White	Person 1	\hat{y}	\hat{y}	\hat{y}
	Person 2	\hat{y}	\hat{y}	\hat{y}
	Person 3	\hat{y}	\hat{y}	\hat{y}
	Person 4	\hat{y}	\hat{y}	\hat{y}
Black	Person 5	\hat{y}	\hat{y}	\hat{y}
	Person 6	\hat{y}	\hat{y}	\hat{y}
	Person 7	\hat{y}	\hat{y}	\hat{y}
	Person 8	\hat{y}	\hat{y}	\hat{y}

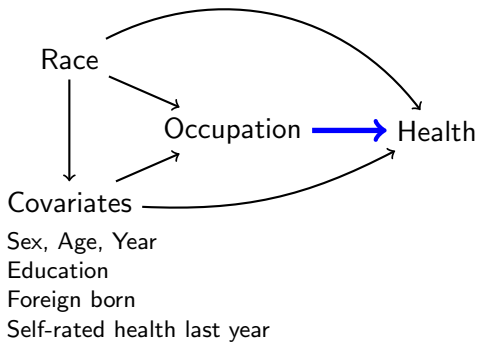
Robins 1986
Hahn 1998











In a sample restricted to those employed
with no work limitation last year

A Counterfactual Setting: Eliminate occupational segregation

		Administrative Assistant	Home Health Aid	Sales Supervisor
White	Person 1	\hat{y}	\hat{y}	\hat{y}
	Person 2	\hat{y}	\hat{y}	\hat{y}
	Person 3	\hat{y}	\hat{y}	\hat{y}
	Person 4	\hat{y}	\hat{y}	\hat{y}
Black	Person 5	\hat{y}	\hat{y}	\hat{y}
	Person 6	\hat{y}	\hat{y}	\hat{y}
	Person 7	\hat{y}	\hat{y}	\hat{y}
	Person 8	\hat{y}	\hat{y}	\hat{y}

A Counterfactual Setting: Eliminate occupational segregation

		Administrative Assistant	Home Health Aid	Sales Supervisor
White	Person 1	\hat{y}	\hat{y}	\hat{y}
	Person 2	\hat{y}	\hat{y}	\hat{y}
	Person 3	\hat{y}	\hat{y}	\hat{y}
	Person 4	\hat{y}	\hat{y}	\hat{y}
Black	Person 5	\hat{y}	\hat{y}	\hat{y}
	Person 6	\hat{y}	\hat{y}	\hat{y}
	Person 7	\hat{y}	\hat{y}	\hat{y}
	Person 8	\hat{y}	\hat{y}	\hat{y}

A Counterfactual Setting: Eliminate occupational segregation

		Administrative Assistant	Home Health Aid	Sales Supervisor	Average outcome if assigned an occupation equitably ↓ $\bar{\hat{y}}$
White	Person 1	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 2	\hat{y}	\hat{y}	\hat{y}	
	Person 3	\hat{y}	\hat{y}	\hat{y}	
	Person 4	\hat{y}	\hat{y}	\hat{y}	
Black	Person 5	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 6	\hat{y}	\hat{y}	\hat{y}	
	Person 7	\hat{y}	\hat{y}	\hat{y}	
	Person 8	\hat{y}	\hat{y}	\hat{y}	

A Counterfactual Setting: Eliminate occupational segregation

		Administrative Assistant	Home Health Aid	Sales Supervisor	Average outcome if assigned an occupation equitably ↓
White	Person 1	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 2	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 3	\hat{y}	\hat{y}	\hat{y}	
	Person 4	\hat{y}	\hat{y}	\hat{y}	
Black	Person 5	\hat{y}	\hat{y}	\hat{y}	
	Person 6	\hat{y}	\hat{y}	\hat{y}	
	Person 7	\hat{y}	\hat{y}	\hat{y}	
	Person 8	\hat{y}	\hat{y}	\hat{y}	

A Counterfactual Setting: Eliminate occupational segregation

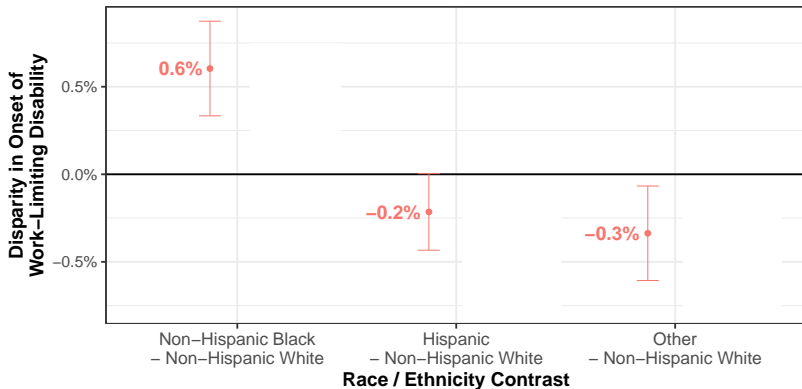
		Administrative Assistant	Home Health Aid	Sales Supervisor	Average outcome if assigned an occupation equitably ↓
White	Person 1	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 2	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 3	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 4	\hat{y}	\hat{y}	\hat{y}	
Black	Person 5	\hat{y}	\hat{y}	\hat{y}	
	Person 6	\hat{y}	\hat{y}	\hat{y}	
	Person 7	\hat{y}	\hat{y}	\hat{y}	
	Person 8	\hat{y}	\hat{y}	\hat{y}	

A Counterfactual Setting: Eliminate occupational segregation

		Administrative Assistant	Home Health Aid	Sales Supervisor	Average outcome if assigned an occupation equitably ↓
White	Person 1	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 2	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 3	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 4	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
Black	Person 5	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 6	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 7	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 8	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$

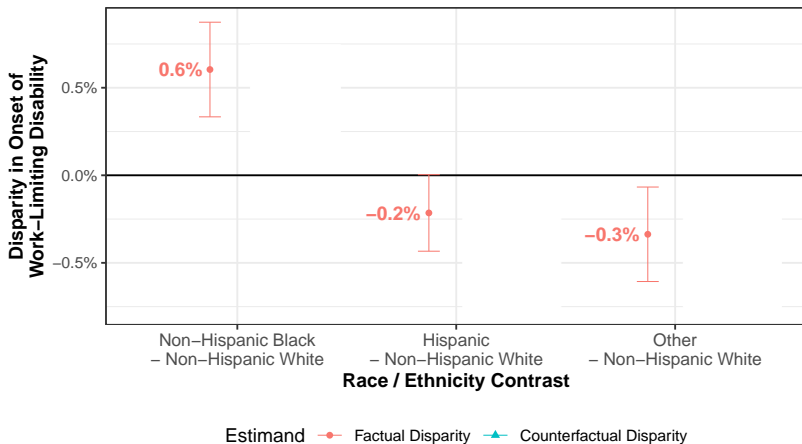
Average outcome if
assigned an occupation
equitably

		Administrative Assistant	Home Health Aid	Sales Supervisor	
White	Person 1	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 2	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 3	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 4	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
Black	Person 5	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 6	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 7	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$
	Person 8	\hat{y}	\hat{y}	\hat{y}	$\bar{\hat{y}}$

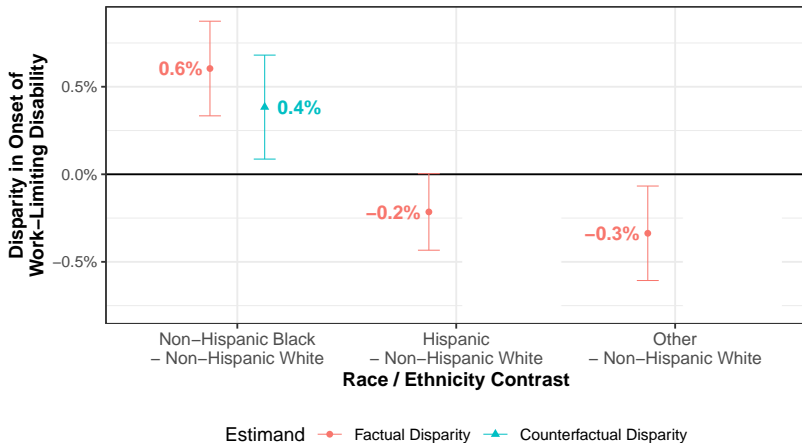


Estimand — Factual Disparity — Counterfactual Disparity

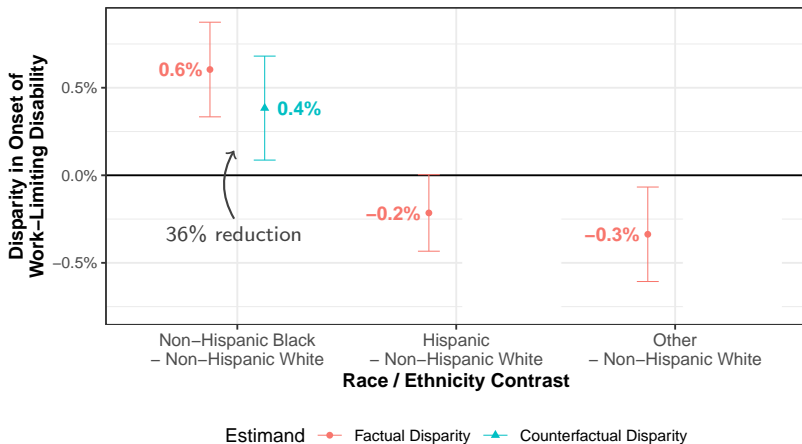
Counterfactual: Assign occupation as a function of education alone



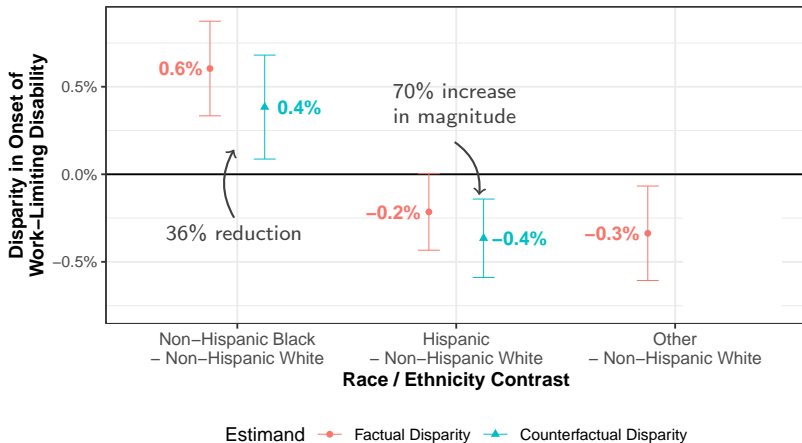
Counterfactual: Assign occupation as a function of education alone



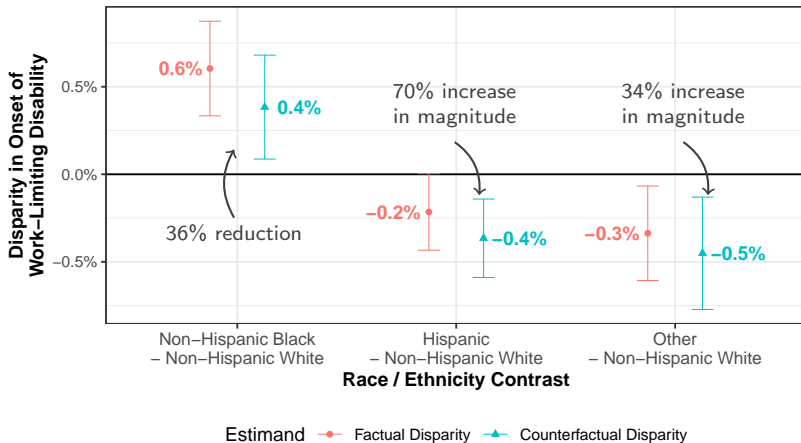
Counterfactual: Assign occupation as a function of education alone



Counterfactual: Assign occupation as a function of education alone



Counterfactual: Assign occupation as a function of education alone



Big picture Counterfactual causal inference can help us answer new questions about racial disparities

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

5

Causation and Race

Paul W. Holland

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

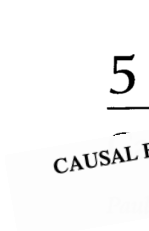
5

CAUSAL EFFECTS OF PERCEIVED IMMUTABLE CHARACTERISTICS

D. James Greiner and Donald B. Rubin*

Paul W. Holland

Big picture Counterfactual causal inference can help us answer new questions about racial disparities



Race as a Bundle of Sticks: Designs that Estimate Effects of Seemingly Immutable Characteristics

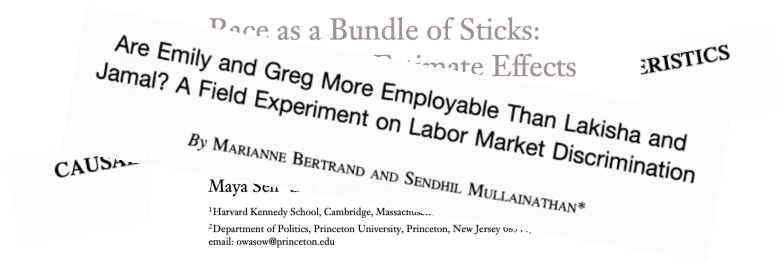
ERISTICS

Maya Sen¹ and Omar Wasow²

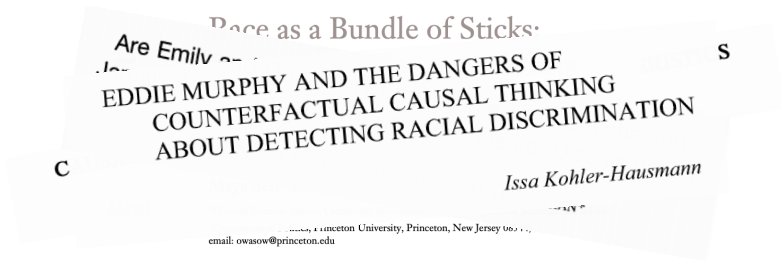
¹Harvard Kennedy School, Cambridge, Massachusetts 02138; email: maya_sen@hks.harvard.edu

²Department of Politics, Princeton University, Princeton, New Jersey 08544;
email: owasow@princeton.edu

Big picture Counterfactual causal inference can help us answer new questions about racial disparities



Big picture Counterfactual causal inference can help us answer new questions about racial disparities



Big picture Counterfactual causal inference can help us answer new questions about racial disparities

	Treatment Condition	
	Black	White
Person 1	$Y_1(\text{Black})$	$Y_1(\text{White})$
Person 2	$Y_2(\text{Black})$	$Y_2(\text{White})$
Person 3	$Y_3(\text{Black})$	$Y_3(\text{White})$
Person 4	$Y_4(\text{Black})$	$Y_4(\text{White})$
Person 5	$Y_5(\text{Black})$	$Y_5(\text{White})$
Person 6	$Y_6(\text{Black})$	$Y_6(\text{White})$

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

Black	Person 1
	Person 2
	Person 3
White	Person 4
	Person 5
	Person 6

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

		<u>As observed</u>
Black	Person 1	Y_1
	Person 2	Y_2
	Person 3	Y_3
White	Person 4	Y_4
	Person 5	Y_5
	Person 6	Y_6

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

		As observed
Black	Person 1	Y_1
	Person 2	Y_2
	Person 3	Y_3
White	Person 4	Y_4
	Person 5	Y_5
	Person 6	Y_6

Descriptive
Disparity

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

		As observed	Under intervention
Black	Person 1	Y_1	$Y_1(t)$
	Person 2	Y_2	$Y_2(t)$
	Person 3	Y_3	$Y_3(t)$
White	Person 4	Y_4	$Y_4(t)$
	Person 5	Y_5	$Y_5(t)$
	Person 6	Y_6	$Y_6(t)$

Descriptive
Disparity

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

		As observed	Under intervention
Black	Person 1	Y_1	$Y_1(t)$
	Person 2	Y_2	$Y_2(t)$
	Person 3	Y_3	$Y_3(t)$
White	Person 4	Y_4	$Y_4(t)$
	Person 5	Y_5	$Y_5(t)$
	Person 6	Y_6	$Y_6(t)$

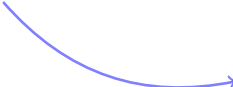
Descriptive
Disparity

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

		As observed	Under intervention
Black	Person 1	Y_1	$Y_1(t)$
	Person 2	Y_2	$Y_2(t)$
	Person 3	Y_3	$Y_3(t)$
White	Person 4	Y_4	$Y_4(t)$
	Person 5	Y_5	$Y_5(t)$
	Person 6	Y_6	$Y_6(t)$

Descriptive
Disparity

Big picture Counterfactual causal inference can help us answer new questions about racial disparities



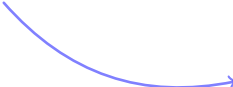
A blue curved arrow points from the underlined text 'new questions' in the title to a text box on the right.

		As observed	Under intervention
Black	Person 1	Y_1	$Y_1(t)$
	Person 2	Y_2	$Y_2(t)$
	Person 3	Y_3	$Y_3(t)$
White	Person 4	Y_4	$Y_4(t)$
	Person 5	Y_5	$Y_5(t)$
	Person 6	Y_6	$Y_6(t)$

How much would
the gap close
if we intervene?

**Descriptive
Disparity**

Big picture Counterfactual causal inference can help us answer new questions about racial disparities



		As observed	Under intervention
Black	Person 1	Y_1	$Y_1(t)$
	Person 2	Y_2	$Y_2(t)$
	Person 3	Y_3	$Y_3(t)$
White	Person 4	Y_4	$Y_4(t)$
	Person 5	Y_5	$Y_5(t)$
	Person 6	Y_6	$Y_6(t)$

How much would
the gap close
if we intervene?

Descriptive
Disparity

Gap-Closing
Estimand

Lundberg 2021

Big picture Counterfactual causal inference can help us answer new questions about racial disparities

		As observed	Under intervention
Black	Person 1	Y_1	$Y_1(t)$
	Person 2	Y_2	$Y_2(t)$
	Person 3	Y_3	$Y_3(t)$
White	Person 4	Y_4	$Y_4(t)$
	Person 5	Y_5	$Y_5(t)$
	Person 6	Y_6	$Y_6(t)$
		Descriptive Disparity	Gap-Closing Estimand

How much would
the gap close
if we intervene?

Vanderweele & Robinson 2014

Jackson & Vanderweele 2018

Lundberg 2021

Ian Lundberg
ianlundberg@ucla.edu

Paper on SocArXiV osf.io/x9evk/
Code on GitHub github.com/ilundberg/replication