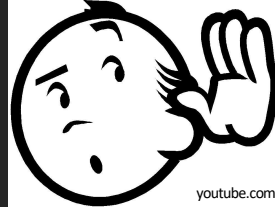


RACIAL SEGREGATION, ENVIRONMENTAL INJUSTICE, NOISE AND GREENSPACE IN THE U.S.



October 27, 2021

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To be discussed

- Racial segregation
- Environmental injustice
- Application: noise pollution
- Application: redlining and greenspace

2

Racial segregation

def. the distribution and separation of a specific demographic group across a geographic region, such as a metropolitan area; spatial form of **social inequality**

3

Why segregation matters

- Separates groups from opportunity, amenities, and resources to the **detriment** of social, political, and economic standing, and environmental health

4

Racial segregation visualized

The city of San Francisco is

- 45% Non-Hispanic White
- 14% Hispanic
- 7% Black
- 31% Asian
- 3% Other



Dustin Cable at University of Virginia's Weldon Cooper Center for Public Service

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Racial segregation visualized

The New York Times
Published: July 8, 2015

Mapping

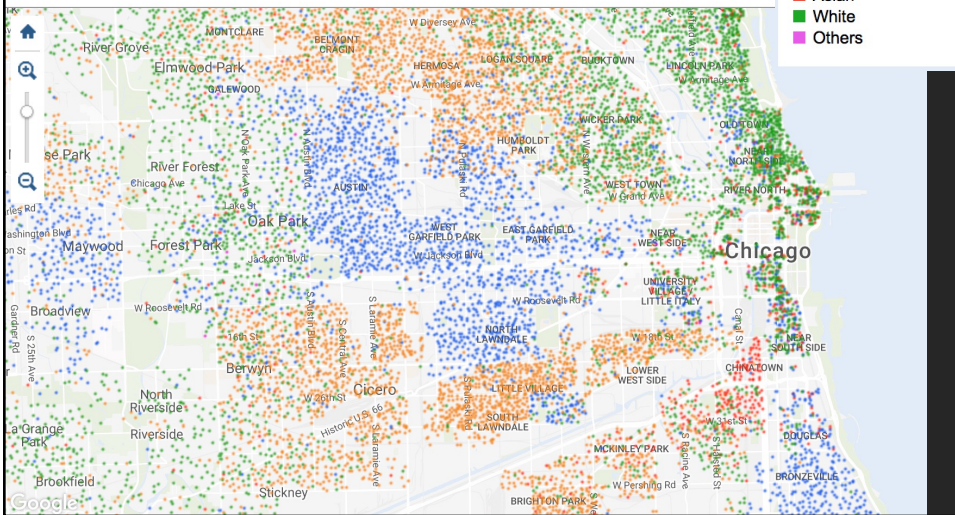
New government rules will require all cities and towns to

Map Key

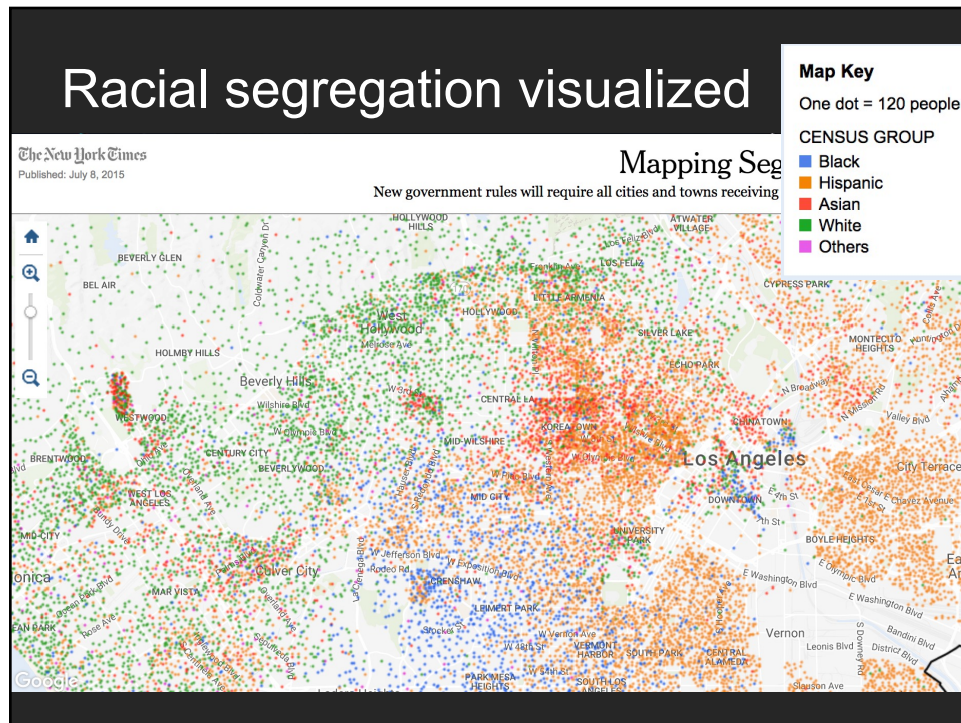
One dot = 120 people

CENSUS GROUP

- Black
- Hispanic
- Asian
- White
- Others



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Dimensions of segregation

1. Evenness
2. Isolation
3. Concentration
4. Centralization
5. Clustering

Massey DS, Denton NA. 1989. Hypersegregation in U.S. metropolitan areas: black and Hispanic segregation along five dimensions. *Demography* 26(3):373-391.

Morello-Frosch R, Lopez R. 2006. The riskscape and the color line: examining the role of segregation in environmental health disparities. *Environ Res* 102(2):181-196.

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Composition vs. segregation

- If we use composition to operationalize segregation we assume that composition directly reflects racial/ethnic unevenness in a metro area (not necessarily true!)
- Likely better to compare neighborhood composition to the racial distribution of a larger area

Morello-Frosch R, Lopez R. 2006. The riskscape and the color line: examining the role of segregation in environmental health disparities. *Environ Res* 102(2):181-196.

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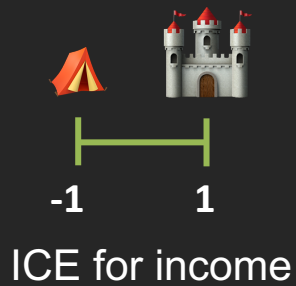
Local Residential Segregation Matters: Stronger Association of Census Tract Compared to Conventional City-Level Measures with Fatal and Non-Fatal Assaults (Total and Firearm Related), Using the Index of Concentration at the Extremes (ICE) for Racial, Economic, and Racialized Economic Segregation, Massachusetts (US), 1995–2010

Nancy Krieger  • Justin M. Feldman •
Pamela D. Waterman • Jarvis T. Chen •
Brent A. Coull • David Hemenway

- D_m – Dissimilarity index
- ICE – index of concentration at the extremes

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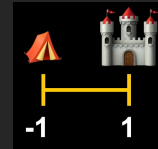
Index of concentration at the extremes



Massey 2001; Krieger et al. 2015 *Health & Place*; Krieger et al. 2016 *AJPH*

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ICE for income



$$ICE_{ij} = (A_{ij} - P_{ij}) / T_{ij}$$

$\uparrow$ $\uparrow$ $\swarrow$
 $\geq$ $\leq$ Total #
 80th- 20th- households
 %tile %tile

i = census tract
 j = metro area

Massey 2001; Krieger et al. 2015 *Health & Place*; Krieger et al. 2016 *AJPH*

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Segregation and health

- **Place-level:** food security, proximity to health services, parks, and open space; social capital, cohesion, and crime; traffic density, abandoned properties, and housing quality
- **Individual-level:** social support, income, poverty, working conditions, educational status, diet/nutritional status, psychosocial stress, health behaviors

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Environmental injustice

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Environmental injustice

Any circumstance where one population avoids hazards from a practice that negatively impacts the environment of another population

Evans 2002; Kelly-Reif & Wing 2016

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Categories of environ injustice

1. **Rights-based** (Agyeman 2005)
2. **Distributive** (Bell 2004) *Most common
3. **Procedural** (Fry 2015)

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Calf Source, Wisconsin

Source: George Steinmetz for NYTimes Magazine, 2016

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Gary's Gobbler's, Iowa

Source: George Steinmetz for NYTimes Magazine, 2016

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EJ example



- CAFOs more likely to be sited in areas of poverty
- Often also areas with many minorities
- Mirabelli found that schools in North Carolina with low SES/low white enrollment were 3x more likely to be located within 3 miles of a CAFO

Wing 2000; Wing 2002; Mirabelli 2005

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EJ example

Mississippi CAFOs and poverty, 1990

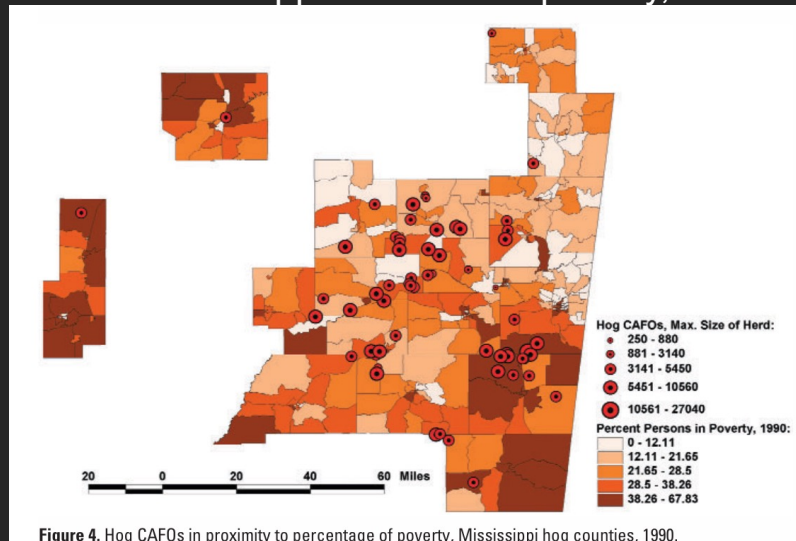
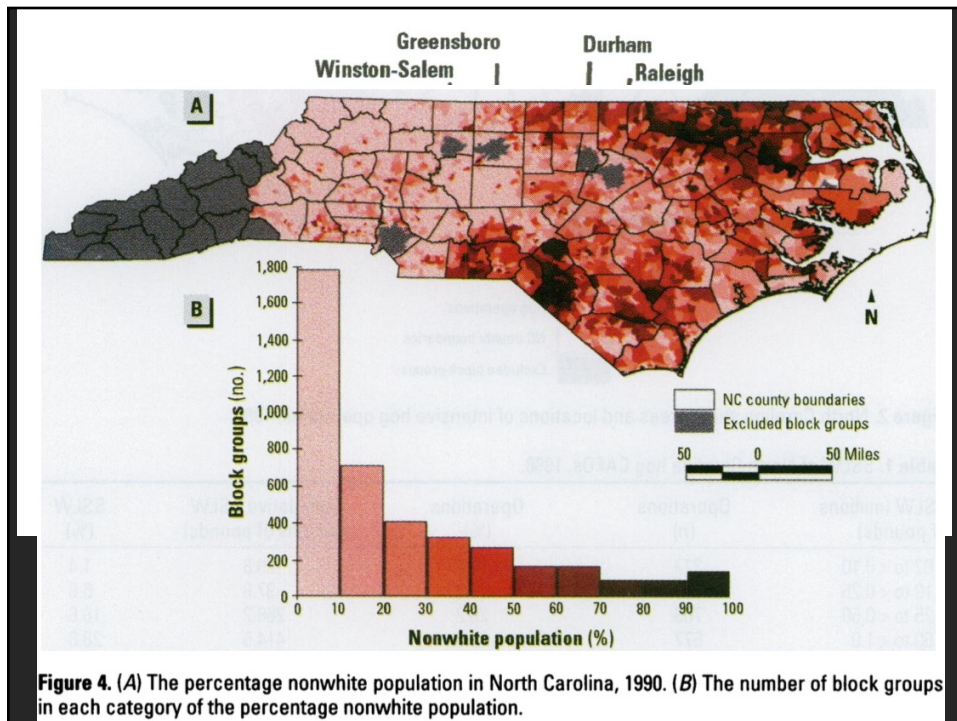


Figure 4. Hog CAFOs in proximity to percentage of poverty, Mississippi hog counties, 1990.

Wing 2000; Wing 2002; Mirabelli 2005

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Mechanisms for environmental Eij

- **Rational choice:** economics; cheaper to site in these neighborhoods because of zoning and land prices
- **Sociopolitical:** follow the path of least political resistance
- **Racial discrimination:** minority communities are purposely targeted

Mohai and Saha 2015 Environ Res Lett

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A case study

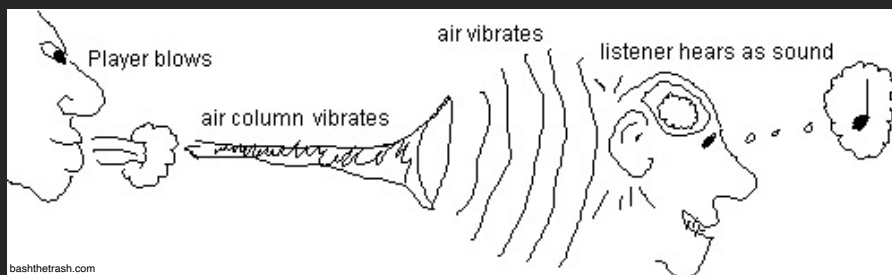
Race/Ethnicity, Socioeconomic Status, Residential Segregation, and Spatial Variation in Noise Exposure in the Contiguous United States

Joan A. Casey,¹ Rachel Morello-Frosch,² Daniel J. Mennitt,³ Kurt Fristrup,⁴ Elizabeth L. Ogburn,⁵ and Peter James⁶

Casey JA, Morello-Frosch R, Mennitt DJ, Fristrup K, Ogburn EL, James P. 2017. Race/ethnicity, socioeconomic status, residential segregation, and spatial variation in noise exposure in the contiguous United States. *Environ Health Perspect* 125(7):077017. 10.1289/EHP898.

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Sound waves, they're how we hear!



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Sound pressure is
measured in decibels (dBA)

AVERAGE ABILITY TO PERCEIVE CHANGES IN NOISE LEVELS

Change (dBA)	Human Perception of Sound
2-3	Perceptible
5	Readily noticeable, increase in noise complaints
10	A doubling or halving of the loudness of sound

Source: Beranek and Neuman. *Fundamentals and Abatement of Highway Traffic Noise* (1973).

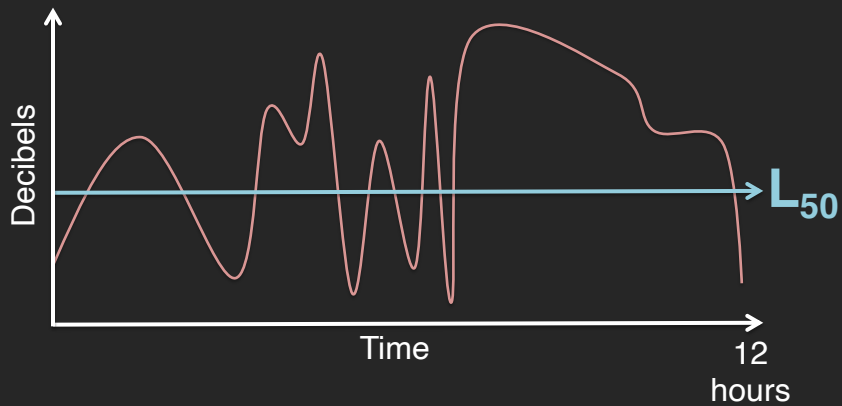
25

Noise is **unwanted** sound

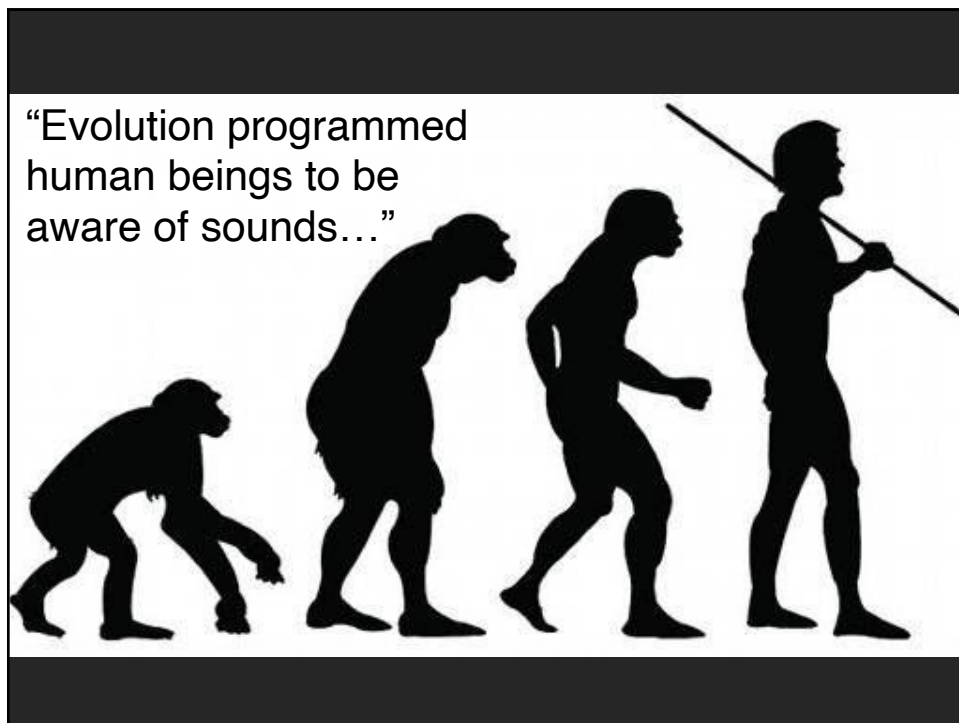


26

Noise is not constant

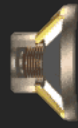


27



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“....as possible
sources of
danger”
(Basner et al. *Lancet* 2014)



Pinterest.com

29

Noise **activates** the
autonomic nervous system



ubm.org

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The WHO estimated
> 1 million
disability adjusted life years
lost annually due to
environmental noise



World Health Organization 2009

31

Noise is associated with
multiple health outcomes

- sleep disturbance
- stress/annoyance
- impaired cognitive performance
- increased blood pressure
- cardiovascular disease
- adverse birth outcomes

Basner 2014; Lusk 2004; Ismaila 2014; Gehring 2014

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In the United States, we observe
disparities in many of these same
health outcomes

race/ethnicity
socioeconomic status

Adler & Rehkopf 2008

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Double jeopardy

socioeconomic disadvantage and
disproportionate environmental
exposures

seen with air pollution, hazardous waste
facilities, animal feeding operations

Evans 2002; Morello-Frosch 2006; Cushing 2015; Kelly-Reif & Wing 2016

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What about **noise**?

Research question

are there racial/ethnic or socioeconomic disparities in noise exposure in the United States?

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PRIOR STUDIES

old, relatively small, mixed results

recent Minnesota study reported neighborhood level nonwhite race and poverty were associated with more noise

Noise last characterized nationwide in the 1970s

Sherman 1977; Nega 2013; Dale 2015; Carrier 2016; Hoffman 2003; Kohlhuber 2006; Lam & Chan 2008; Poortinga 2008; Havard 2011; Bocquier 2013; Brainard 2004; Lakes 2013

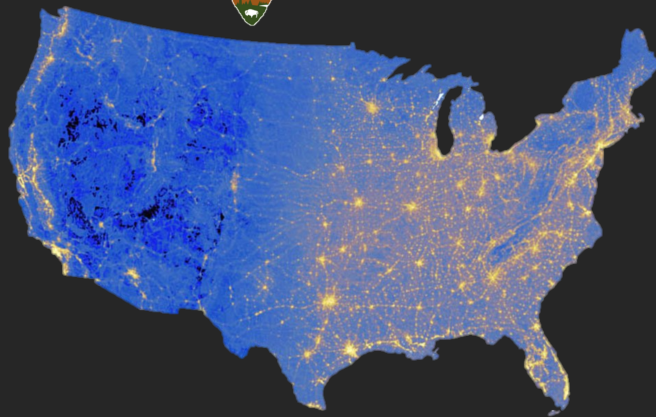
36

METHODS

1. Outcome: nighttime L₅₀ noise



National Park Service



Mennitt et al. 2014

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METHODS

2. Racial and socioeconomic data

American Community Survey 5-year estimates (2008-2012)

Race/ethnicity
Poverty
Household income
Education
Housing tenure
Linguistic isolation
Unemployment
Racial segregation



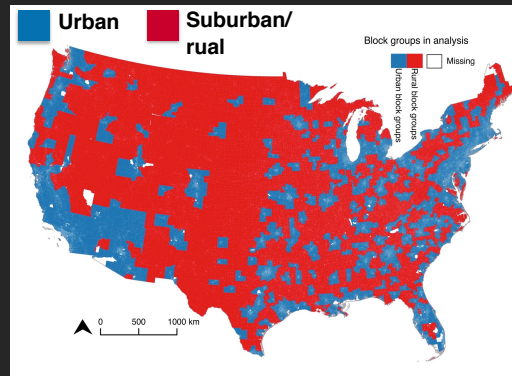
38

METHODS

3. Block group = unit of analysis

excluded block groups missing data (<1%)
stratified by urban and suburban/rural

today, only urban results,
n = 175,373 (82%)



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METHODS

4. Statistical analysis

spatial error model
14 separate regressions
polynomial terms
accounted for population density

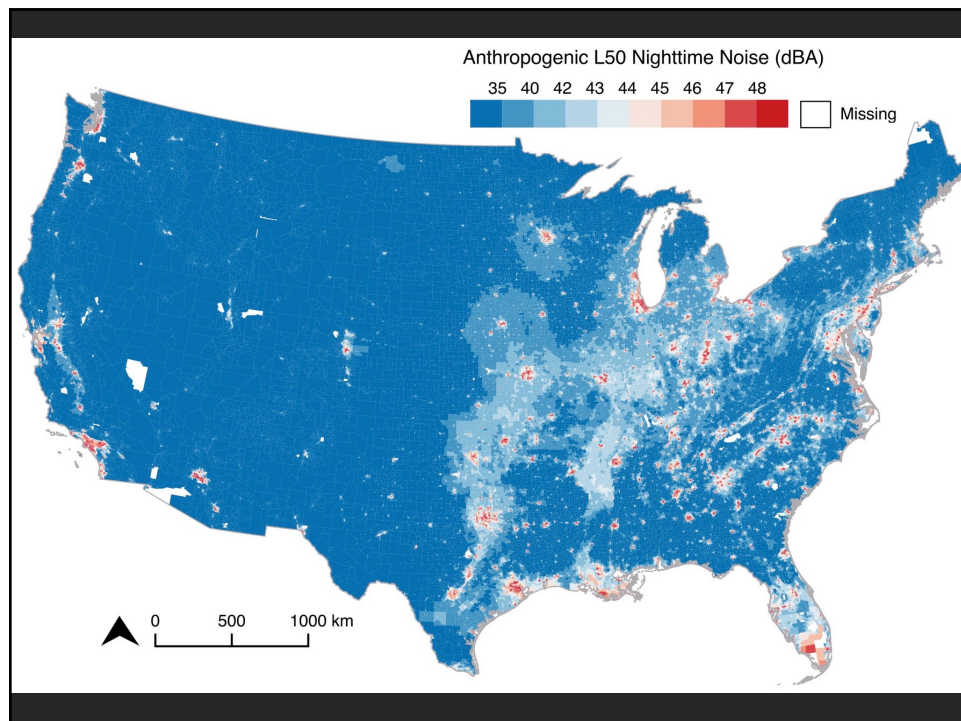
40

RESULTS

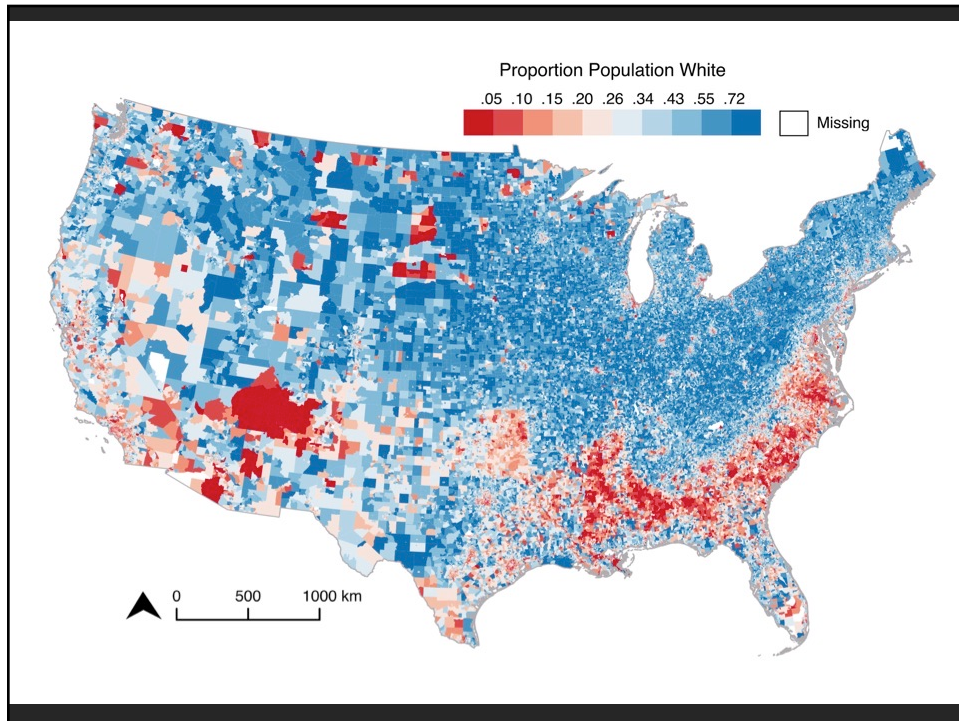
non-linear relationships

generally observed evidence of
disparities

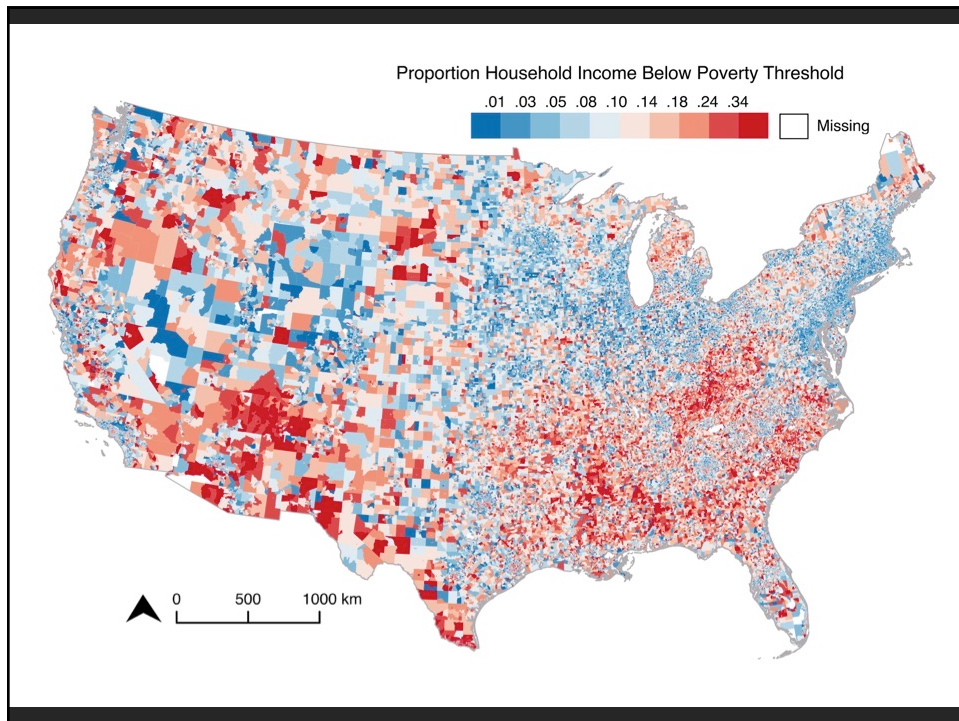
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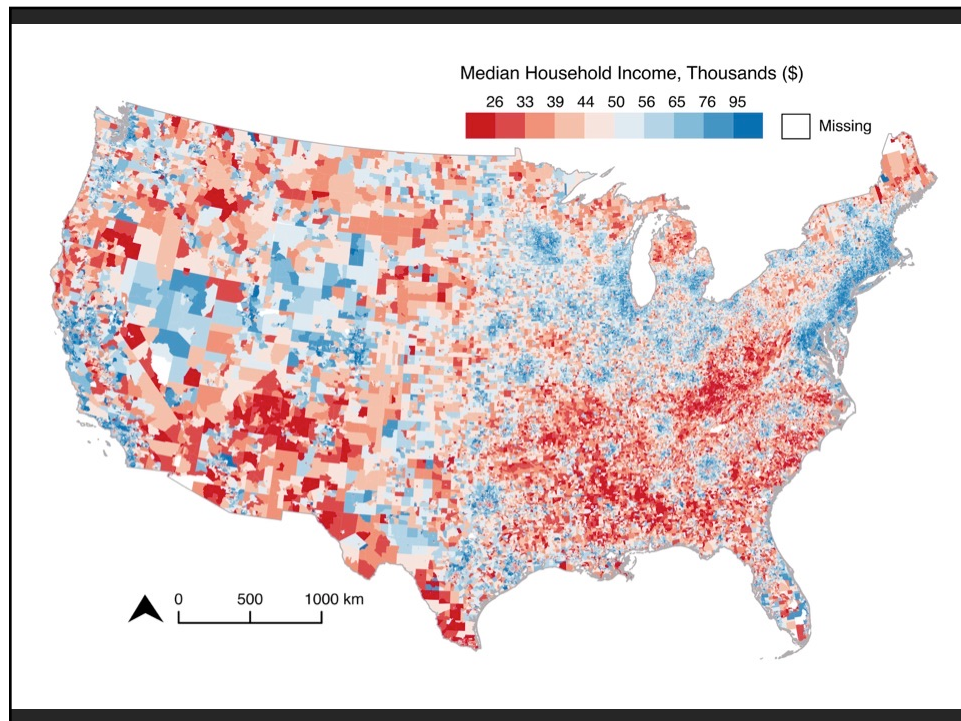
42



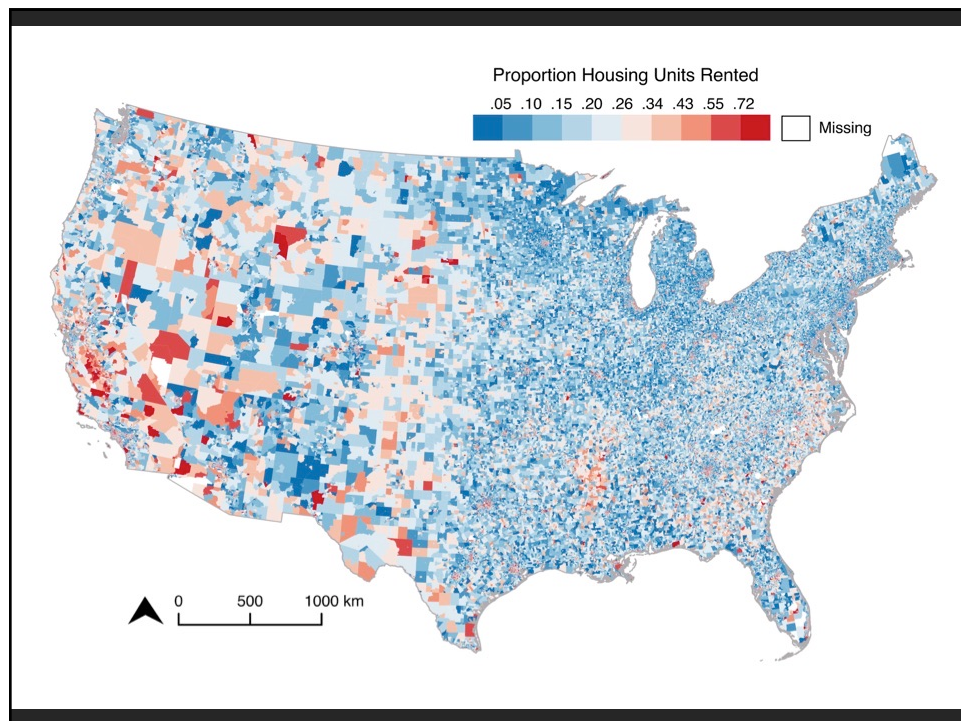
43



44

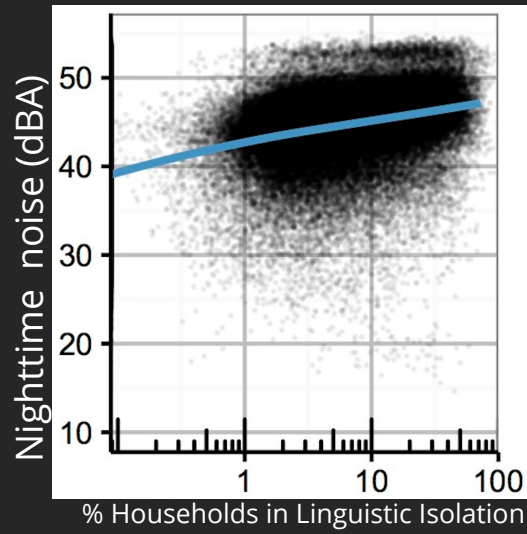


45



46

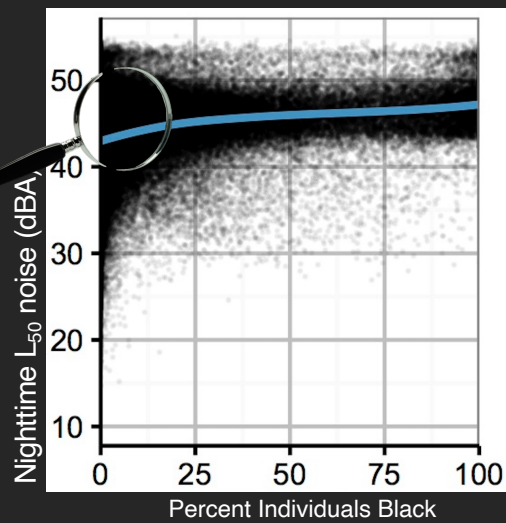
Linguistically
isolated
households



Casey, J. A. *et al.* Environ Health Perspect **125**, 077017 (2017).

47

Black
race/
ethnicity

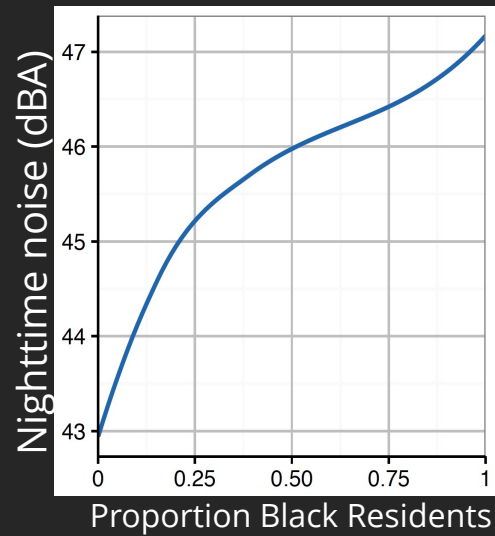


Casey, J. A. *et al.* Environ Health Perspect **125**, 077017 (2017).

48

Black race/ ethnicity

Casey, J. A. *et al.* Environ Health
Perspect **125**, 077017 (2017).

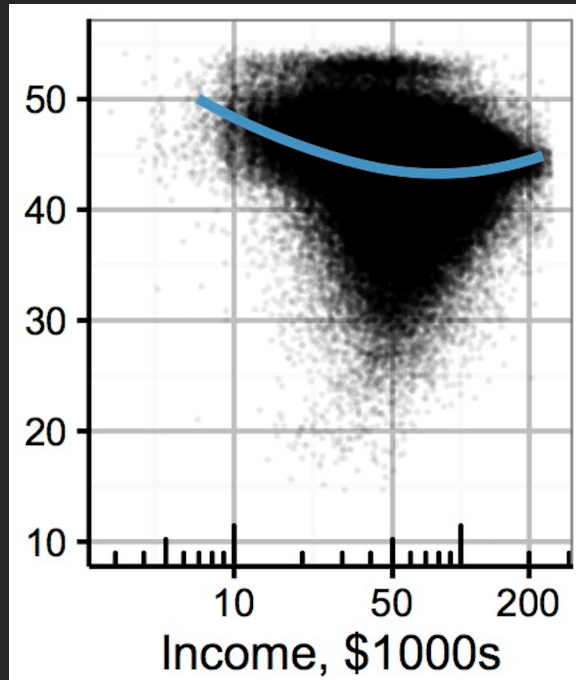


49

Median income

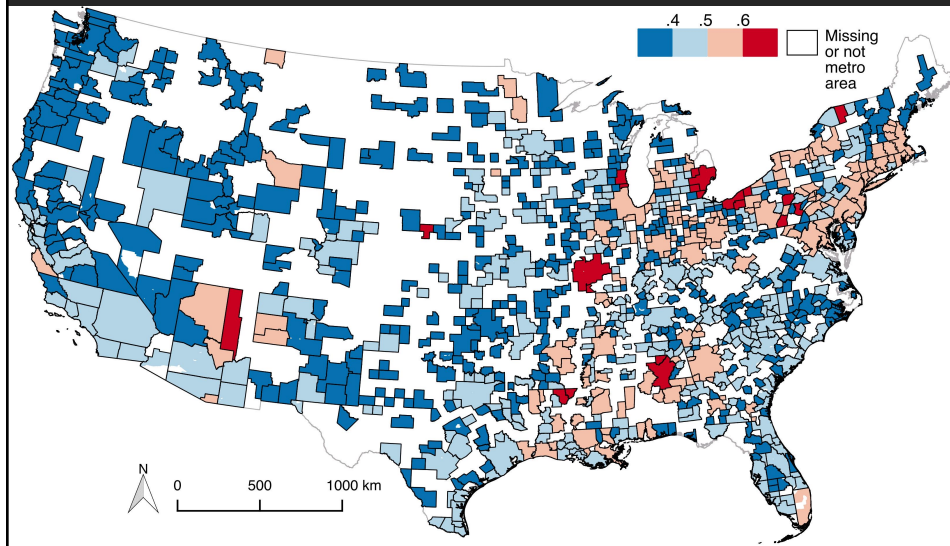
Neighborhoods
with median
annual incomes
< \$25,000 were
~2 dBA louder
than those with
incomes
> \$100,000

Nighttime L_{50} noise (dBA)



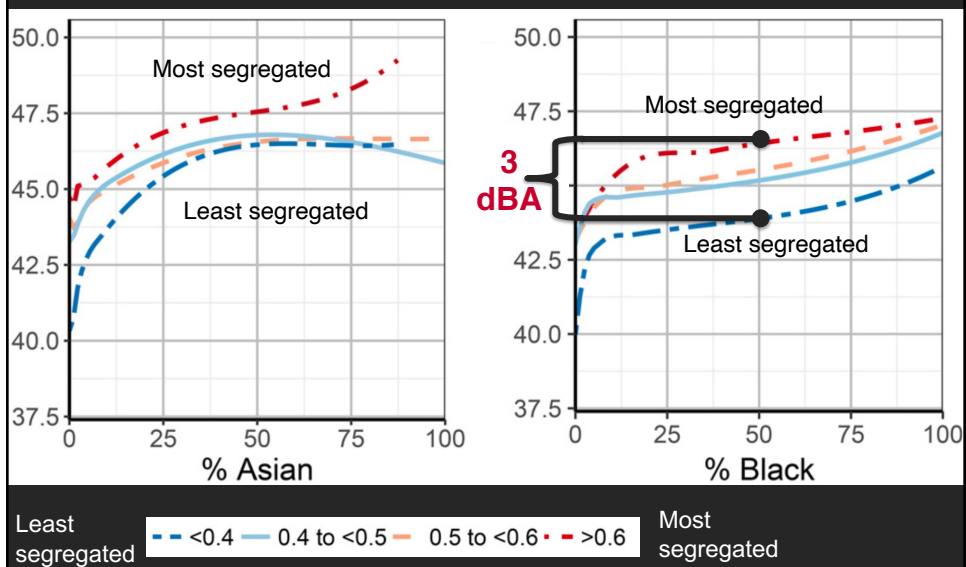
50

Residential racial segregation



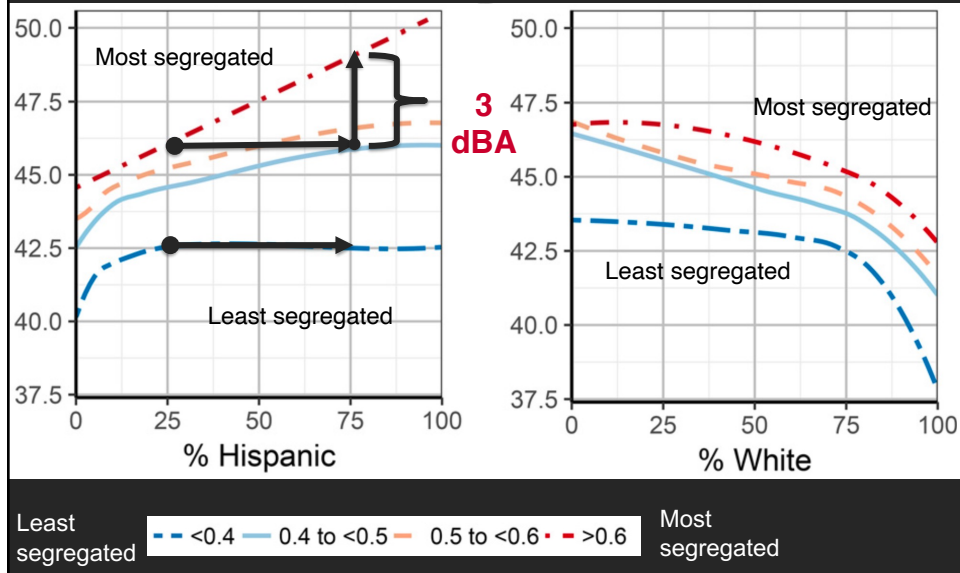
51

Race/ethnicity and nighttime noise, by segregation



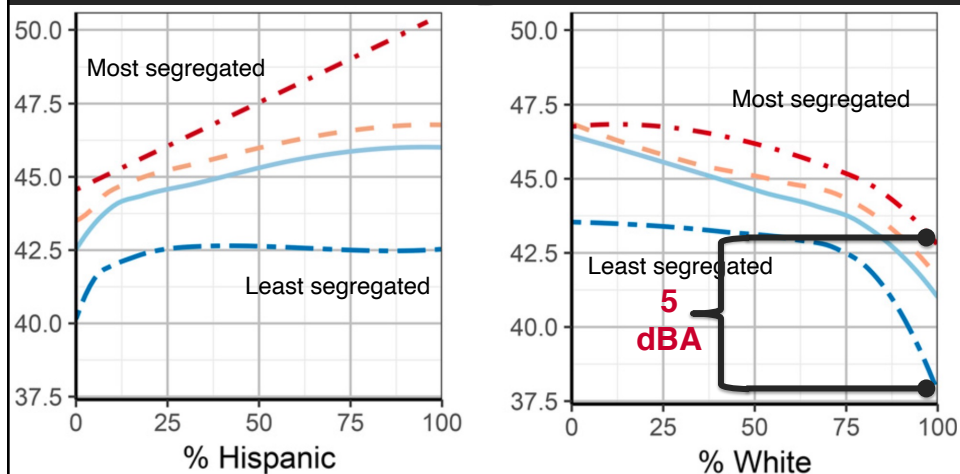
52

Race/ethnicity and nighttime noise, by segregation



53

Race/ethnicity and nighttime noise, by segregation



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CONCLUSION

fairly consistent **inequities** in noise exposure across the continental U.S.

block groups in more segregated metro areas were **noisier** for everyone, but racial/ethnic disparities persisted

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CONCLUSION

poorer individuals might have less ability to cope with noise

triple jeopardy?

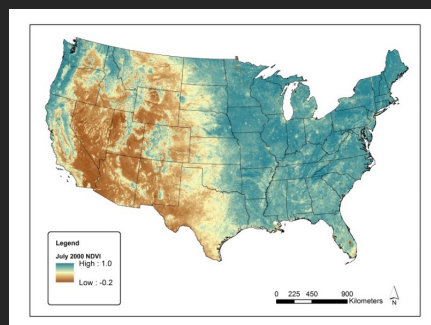
time to consider new **noise regulation** in the United States

56

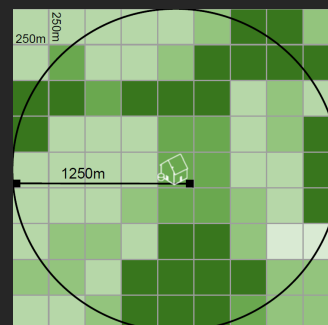
greenspace



57

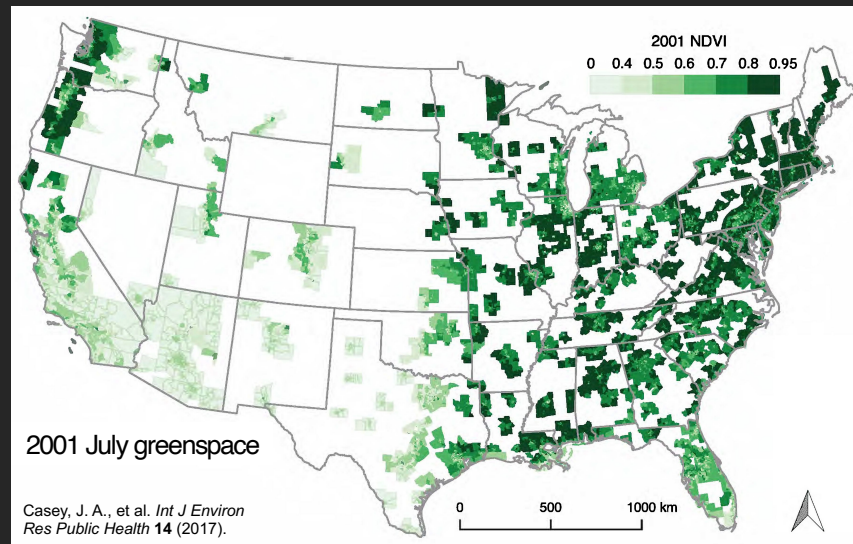


Greenspace across the United States

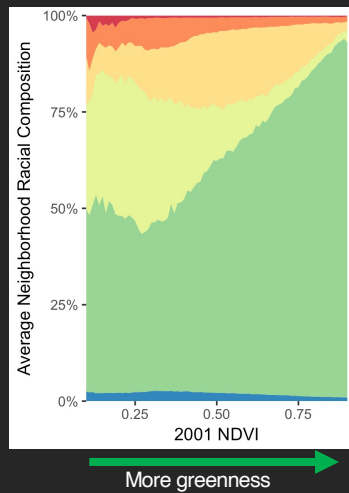


How we measure greenness

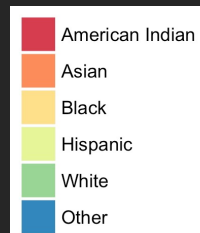
58



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Whiter communities, greener communities in 2001



Source: Casey JA, James P et al. Race, ethnicity, income concentration and 10-Year change in urban greenness in the U.S. *Int J Environ Res Public Health*. 2017;14(12).

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REDLINING

Home Owner's Loan Corporation (HOLC)
formed in 1933

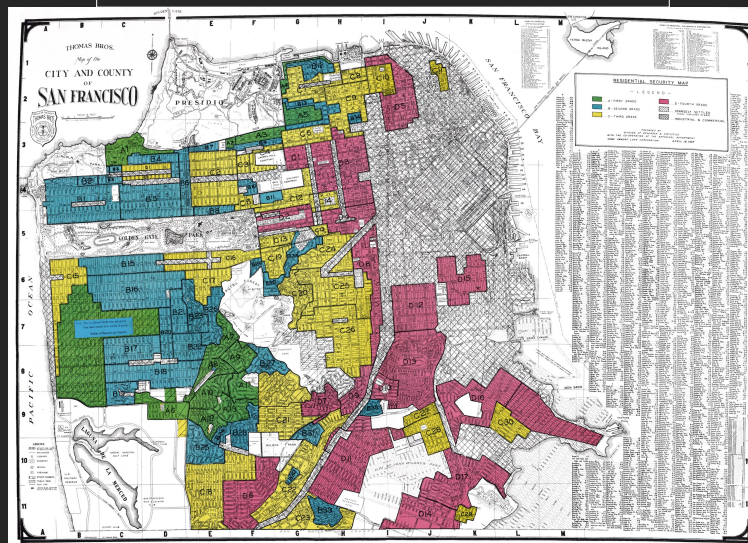
Created Security Maps

Discriminatory
mortgage lending
practice



61

REDLINING



Source: Dustin Cable at University of Virginia's
Weldon Cooper Center for Public Service

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NS FORM-8
2-3-37

AREA DESCRIPTION
(For Instructions see Reverse Side)

1. NAME OF CITY OAKLAND SECURITY GRADE R E D AREA NO. D-8

2. DESCRIPTION OF TERRAIN L e v e l

3. FAVORABLE INFLUENCES. Convenience to local and San Francisco transportation, local shopping districts; convenient to local industry (walking distance for laboring people who live in this area)

4. DETRIMENTAL INFLUENCES. Odors from bay flats; smoke and grime from railroad shops and local industry. Old type houses and cottages, tenement tendencies. Heterogeneous mixture of all races. City taxes too high in proportion to income and value

5. INHABITANTS: Wage earners, shop
a. Type keepers, clerical help; b. Estimated annual family income \$1,000 - 1,800
c. Foreign-born Latin, Slavic, etc. 20%; d. Negro Yes (Yes or No); 40%;
e. Infiltration of Negro, Orientals, etc.; f. Relief families Many; g. Population is increasing -; decreasing -; static. yes

6. BUILDINGS: Detached cottages and
a. Type or types two-story homes; b. Type of construction Frame, brick foundation; c. Average age 35 years; d. Repair Poor

7. HISTORY: 5-room cottage; SALE VALUES RENTAL VALUES

YEAR	RANGE	PREDOMINATING	%	RANGE	PREDOMINATING	%
1929 level	2,500 - 4,000	3,500	100%	25.00 - 40.00	35.00	100%

Source: Anthony Nardone - UCSF

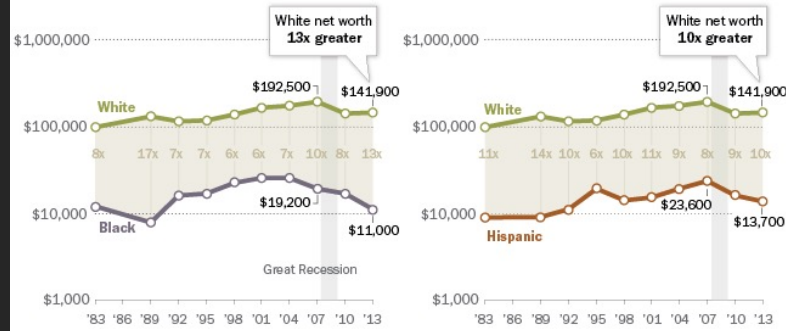
63

Does this matter today?

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Racial, Ethnic Wealth Gaps Have Grown Since Great Recession

Median net worth of households, in 2013 dollars

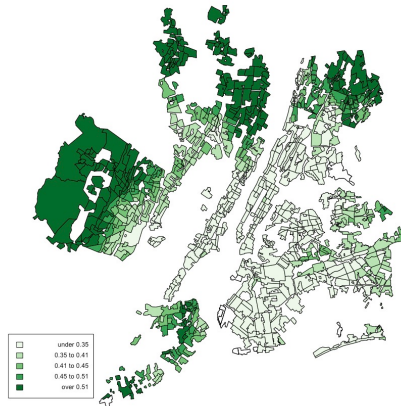
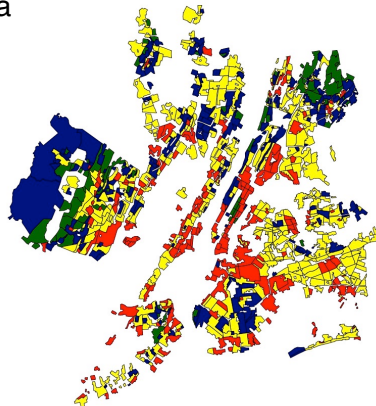


Notes: Blacks and whites include only non-Hispanics. Hispanics are of any race. Chart scale is logarithmic; each gridline is ten times greater than the gridline below it. Great Recession began Dec. '07 and ended June '09.
Source: Pew Research Center tabulations of Survey of Consumer Finances public-use data

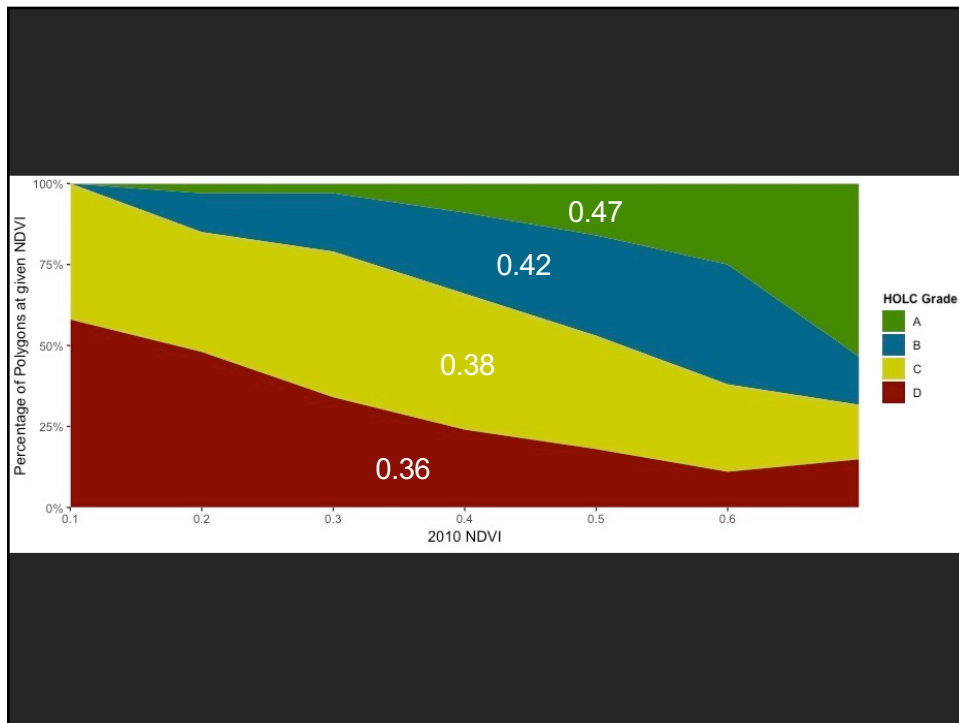
PEW RESEARCH CENTER

65

New York City Area



66



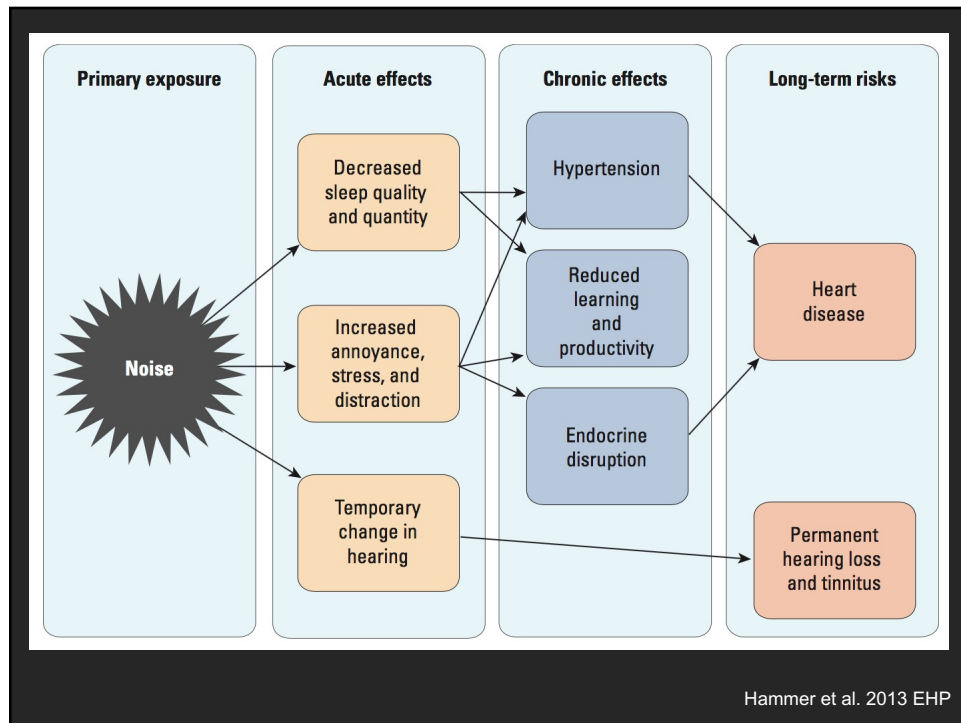
67

Thank you!

jac2250@cumc.columbia.edu

@joanacasey

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Race/Ethnicity, Residential Segregation, and Exposure to Ambient Air Pollution: The Multi-Ethnic Study of Atherosclerosis (MESA)

Miranda R. Jones, PhD, Ana V. Diez-Roux, MD, PhD, Anjum Hajat, PhD, Kiarri N. Kershaw, PhD, Marie S. O'Neill, PhD, Eliseo Guallar, MD, DrPH, Wendy S. Post, MD, MS, Joel D. Kaufman, MD, MPH, and Ana Navas-Acien, MD, PhD

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Race/Ethnicity, Residential Segregation, and Exposure to Ambient Air Pollution: The Multi-Ethnic Study of Atherosclerosis (MESA)

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• G-score

Kershaw KN, Robinson WR, Gordon-Larsen P, Hicken MT, Goff DC, Carnethon MR, Kiefe CI, Sidney S, Diez Roux AV. Association of Changes in Neighborhood-Level Racial Residential Segregation With Changes in Blood Pressure Among Black Adults The CARDIA Study.

Developed by Getis and Ord,¹ the local G_i^* statistic is calculated as:

$$G_i^* = \frac{\sum_{j=1}^n w_{ij} x_j - \bar{x} \sum_{j=1}^n w_{ij}}{S \sqrt{\frac{N \sum_{j=1}^n w_{ij}^2 - (\sum_{j=1}^n w_{ij})^2}{N-1}}}$$

Where, in this study, i is the focal census tract for which the local G^* index is estimated, x_j is the proportion of Blacks in tract j (which is a neighboring tract when it does not equal the focal tract), w_{ij} is a spatial weight between focal tract i and neighboring tract j (used to weight the contribution of the racial/ethnic composition of each tract j to the estimation of G_i^*), $\bar{x}$ is the mean proportion of Blacks across all N tracts in the surrounding metropolitan area or county, and

$$S = \sqrt{\frac{\sum_{j=1}^n x_j^2}{N} - (\bar{x})^2}$$