Spatial Analysis of Risk Factors Affecting State Rates of Suicide in Young Americans

Our Questions

- Why this topic?
- Why is this important?
  - Suicide is one of the top three causes for young American mortality.
  - Source: https://www.jhsph.edu/research/centers-and-institutes/center-for-adolescent-health/_images/_pre-redesign/az/US%20Fact%20Sheet_FINAL.pdf
- What state characteristics have we focused on:
  - Gun Laws
  - Race
  - Mental Health Facilities

Gathering Data

- Main Resource: Centers for Disease Control
- Data from CDC was able to be broken down by state, race, method of suicide, urbanicity.
- If there were less than ten suicides in a certain area, that data was marked suppressed.

- https://wonder.cdc.gov/controller/datarequest/D76

Methods
Poisson Regression

Poisson Regression: Is a generalized linear model (GLM) used to model count data. It assumes that the response variable Y has a Poisson distribution, and assumes the logarithm of its expected value can be modeled by a linear combination of predictor variables.

$$\text{Log}(E(Y_i)/t) = \beta_0 + \beta_1 X_{1i} + \ldots + \beta\square X\square_i$$

$$\text{Log}(E(Y_i)) = \beta_0 + \beta_1 X_{1i} + \ldots + \beta\square X\square_i + \log(t)$$

β: Coefficient

t: offset

https://onlinecourses.science.psu.edu/stat504/node/168/

Spatial Generalized Linear Mixed Models

Spatial Generalized Linear Mixed Models: Fits the Bayesian conditional auto regression model and uses the Monte Carlo Markov Chain algorithm. In addition to the fixed predictors, it also contains random effects, which account for the spatial correlation among values measured on the states. We used the sparse.sglmm function from the ngspatial package in R.

John Hughes(2018)

Gun Laws as a Factor for Suicide

Emily Risley

Data and Variables

State Characteristics

- Number of registered guns per state from the US Dept. Justice
- Percent of people below the poverty line from the US Census Bureau
- Urbanicity

Gun Laws

- Required to report missing guns
- Required to purchase locking device with gun
- Required to perform a background check on private sales
- Required to perform a background check on gun show sales
- Required rifle license
- Required hand gun license

  Source: https://www.theguardian.com/world/interactive/2013/jan/15/gun-laws-united-states

Candidate Models

- Used glm and sparse.sglmm
- By individual laws
- By a total score
- Not significant: poverty, race

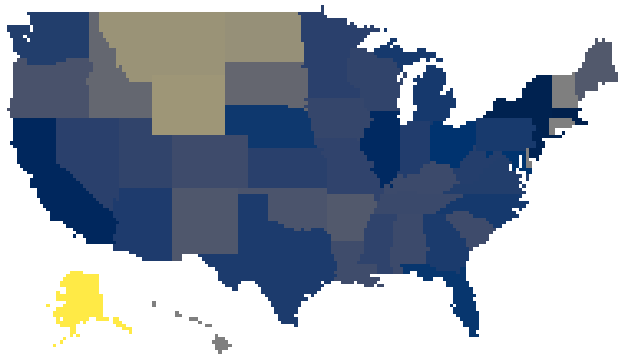
	Estimate	Lower	Upper	MCSE
(Intercept)	-9.4130	-9.5240	-9.30700	0.001859
Large.central.metro.pop	-1.2820	-1.6060	-0.96870	0.006684
Large.fringe.metro.pop	-0.3943	-0.7227	-0.02781	0.006550
miss.gun	-0.2906	-0.4942	-0.08791	0.004102
rifle.lic	-0.5263	-0.7793	-0.28560	0.002779

Coefficients:

	Estimate	Lower	Upper	MCSE
(Intercept)	-9.5190	-9.6210	-9.4130	0.0020820
Large.fringe.metro.pop	-0.4998	-0.8331	-0.1471	0.0053280
gunLawScore	-0.1793	-0.2227	-0.1351	0.0009452

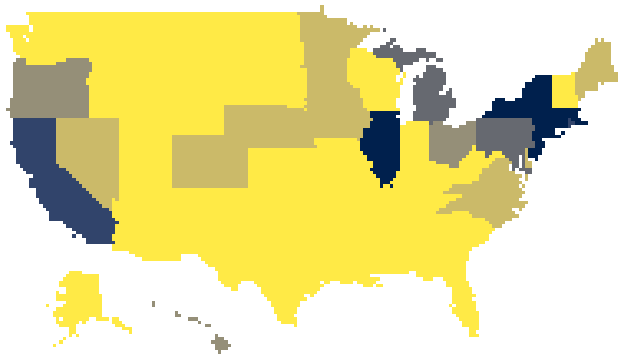
John Hughes and Xiaohui Cui. (2018).

Suicide Rate and Significant Variables



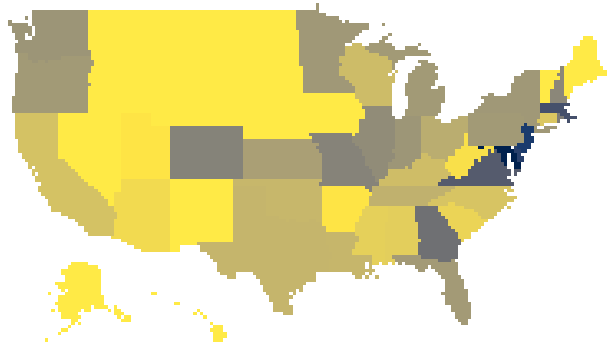
Rate of Suicide Per 10000

1 2



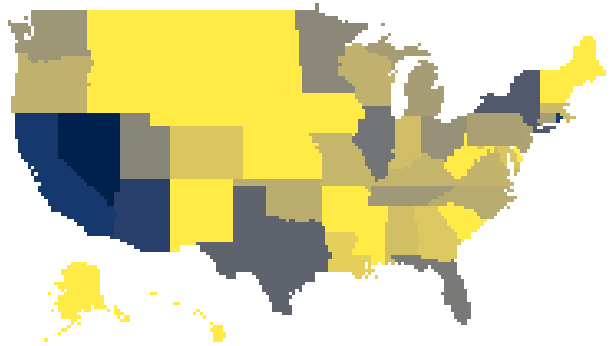
Gun Laws

0 1 2 3 4 5



Large Fringe/Pop

0.0 0.2 0.4 0.6



Large Metro/Pop

0.0 0.2 0.4 0.6

H. Wickham. 2009.

Access to Mental Health Facilities as a Risk of Suicide Rate

Emely Garcia

Data

What Data did I use?

- The National Directory of Mental Health Treatment Facilities 2015
- I used the number of health facilities per state
- I used the proportions of counties in each state that have no facilities.
- The suicide data was gathered by the CDC data

Difficulties I encountered with my Data

- The mental health facilities data was not available as an electronic table
- I wanted to do my calculations by county but the CDC data had suppressed values to protect the victim's identity

https://www.samhsa.gov/data/sites/default/files/2015_National_Directory_of_Mental_Health_Treatment_Facilities.pdf

https://wonder.cdc.gov/ucd-icd10.html

Methods

I first used the GLM function

```
GLM <- glm(Deaths ~ PropZero + per10000 + PercentUrban + ProportionOfWhite +
           offset(log(Population)), family = poisson(link="log"), data = suicide.df)
```

If it showed significance we then used the SGLMM function to adjust for the spatial correlation.

```
SGLMM <- sparse.sglmm(Deaths ~ PropZero + per10000 + PercentUrban + ProportionOfWhite +
           offset(log(Population)), family = poisson(link="log"), data = suicide.df,
           attractive = 10, A = stateAdjMat, minit = 1000, maxit = 100000)
```

Results

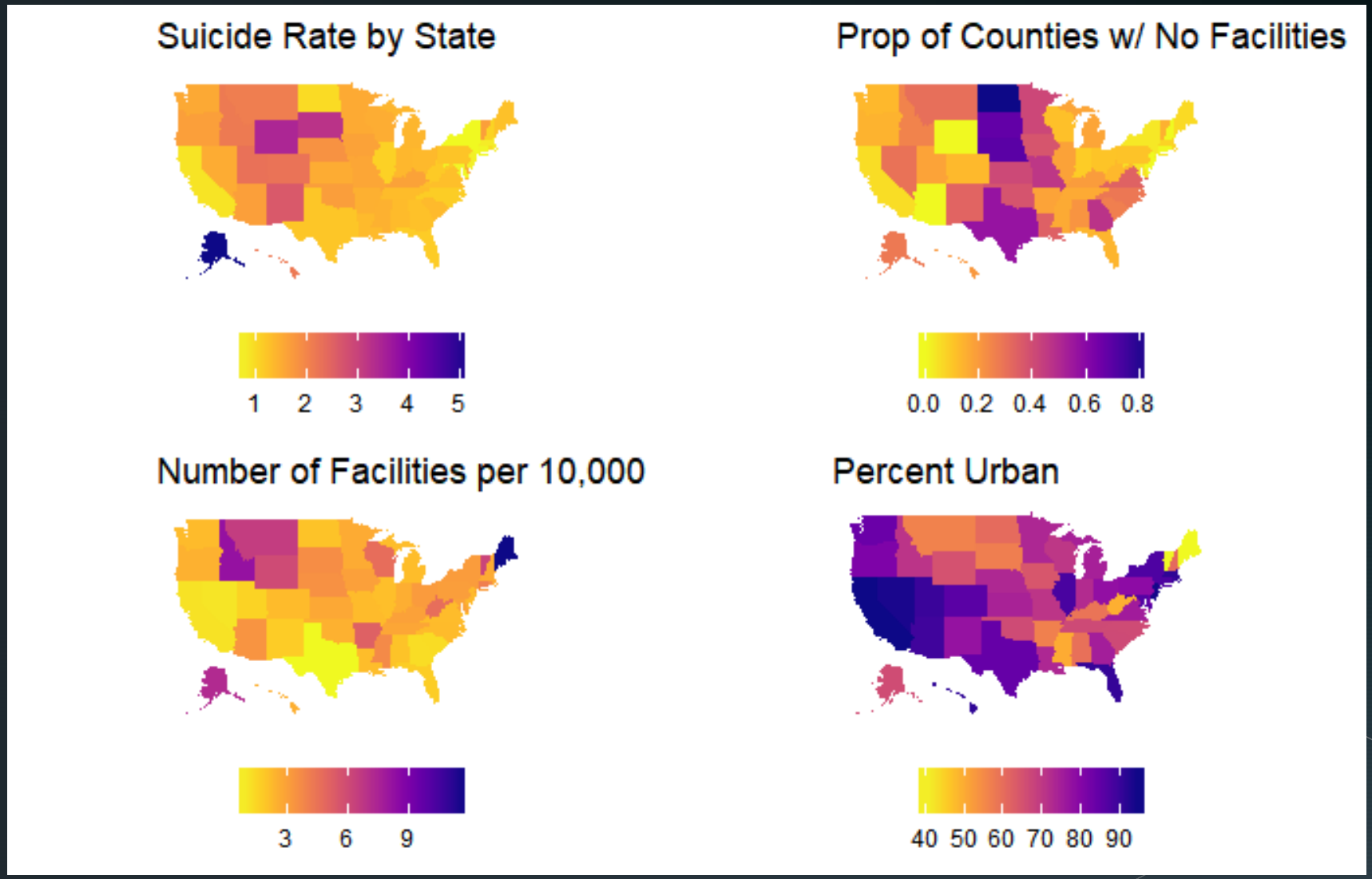
GLM: This result shows that all of predictor variables are significant

```
Coefficients:
                  Estimate Std. Error z value Pr(>|z|)
(Intercept)      -9.319704   0.177292 -52.567  < 2e-16 ***
PropZero          0.508464   0.092186   5.516 3.48e-08 ***
per10000          0.047276   0.013618   3.472 0.000517 ***
PercentUrban     -0.005734   0.001553  -3.693 0.000222 ***
ProportionOfWhite  0.761491   0.129102   5.898 3.67e-09 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

SGLMM: Proportionof counties with no facilities has a positive correlation. After controlling for those 3 variables, the facilities per 10,000 appears to have a positive correlation. This can be seen as a spurious result.

```
Coefficients:

                   Estimate    Lower     Upper      MCSE
(Intercept)      -8.626000 -9.11500 -8.108000 0.0110000
PropZero          0.277900  0.01247  0.549800 0.0055720
per10000          0.051340  0.01865  0.083300 0.0006171
PercentUrban     -0.006609 -0.01091 -0.002489 0.0000807
ProportionOfWhite  0.020230 -0.29740  0.336100 0.0055780
```

Map Representation



H. Wickham. 2009.

Race as a risk factor in Suicide Rates

Ian R

Do races tend to have equal suicide rates? Especially the races typically associated with certain risk factors (poverty, drug use)

How I gathered the data

- Gathered income data from American Community Survey
- Gathered suicide by race and population data from CDC website
  - Problems with data gathering - Rhode Island
  - Many suicide rates for minority races were missing due to data suppression
- Suicide rate by race given below:

Race	Suicide per 10000
American Indian or Alaska Native	3.2096994
Asian or Pacific Islander	0.7834403
Black or African American	0.6800065
White	1.2093741

Calculations

- Due data suppression, lots of minority race data was not available for many states
  - Simplify race into one variable: proportion of whites in population
- Analyze suicide rate and proportion of whites while controlling for income, urbanicity and state
- Significant!

```
Call:
glm(formula = All.Suicides ~ Proportion.of.Whites + Median.Household.Income +
    PercentUrban + offset(log(Population)), family = poisson(link = "log"),
    data = v2suicide)
Coefficients:
                          Estimate Std. Error z value Pr(>|z|)
(Intercept)             -8.341439   0.143131 -58.278  < 2e-16 ***
Proportion.of.Whites     1.205610   0.122371   9.852  < 2e-16 ***
Median.Household.Income  0.013325   0.002023   6.586 4.51e-11 ***
PercentUrban            -0.027822   0.001246 -22.320  < 2e-16 ***
```

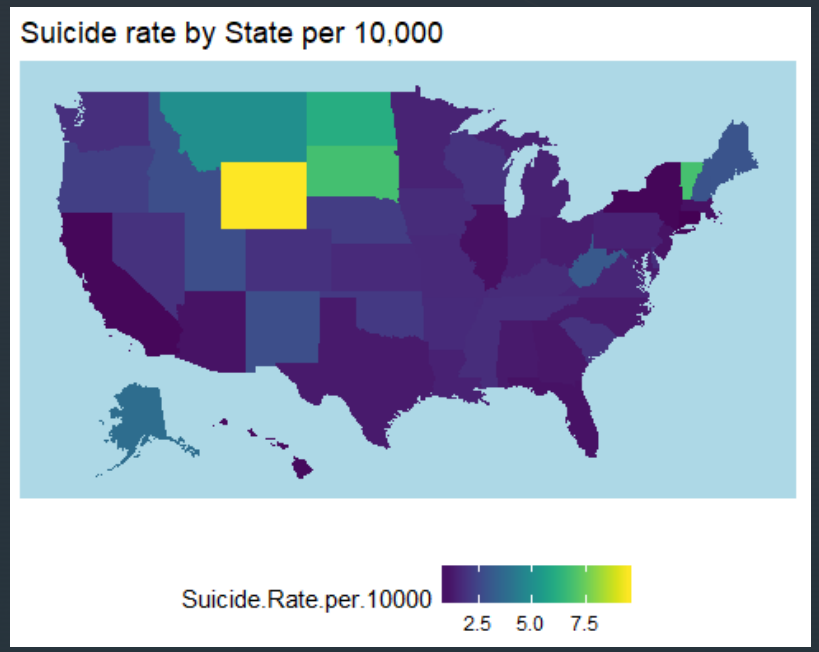
Results

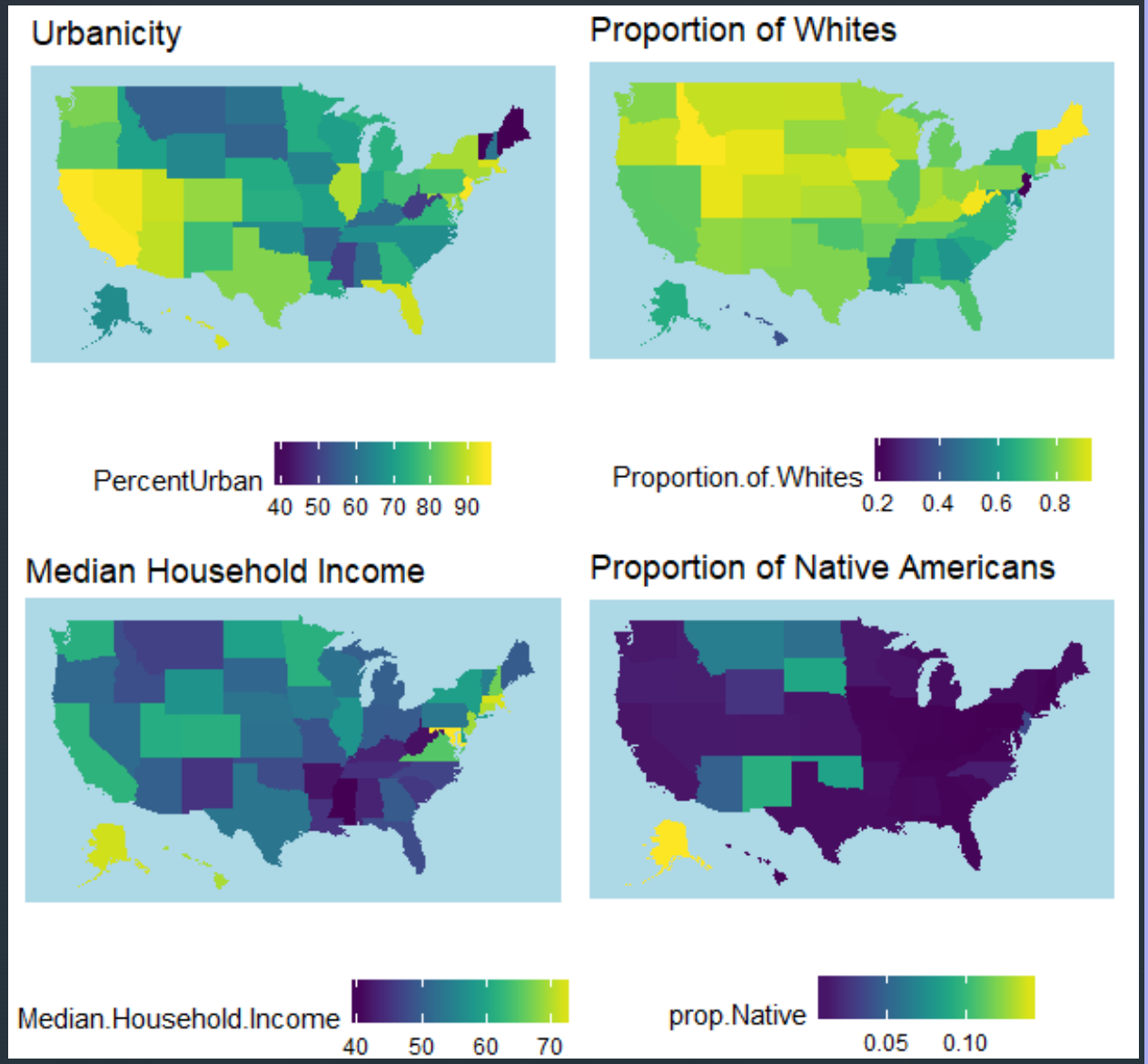
- Signs of variables all the same
- Zero not in lower-upper bound -> Still significant after spatial analysis
- Prop of whites influence lowers when spatial is taken into account

```
Call:

sparse.sglmm(formula = All.Suicides ~ Proportion.of.Whites +
    Median.Household.Income + PercentUrban + offset(log(Population)),
    family = poisson(link = "log"), data = v2suicide, A = stateAdjMat,
    attractive = 10, minit = 1000, maxit = 1e+05)

                         Estimate    Lower    Upper      MCSE
(Intercept)            -7.516000 -7.94700 -7.01900 1.492e-02
Proportion.of.Whites    0.408700  0.08435  0.69800 1.009e-02
Median.Household.Income 0.009539  0.00360  0.01536 1.184e-04
PercentUrban           -0.026980 -0.03049 -0.02341 7.935e-05
```

Graphical view of variables

High suicide rates in western States explained by rural factors, as well as prop of whites and native Vermont due to guns, rural, drug issues





In Conclusion:

- Data suppression as a limitation - prevented us from analyzing more
  - Had to analyze by State instead of County
- All three main risk factors highly correlated with one another
- Variables proved to be significant
  - Certain gun laws, proportion of mental health facilities protective
  - Proportion of whites not protective

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Questions

Citations

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Citations

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FOLLOW UP QUESTION: Race Reasoning

- All races suffer from drug abuse, depression and/or bullying in differing amounts (most obvious risk factors)

- Why are Amerindian and White proportions so high?

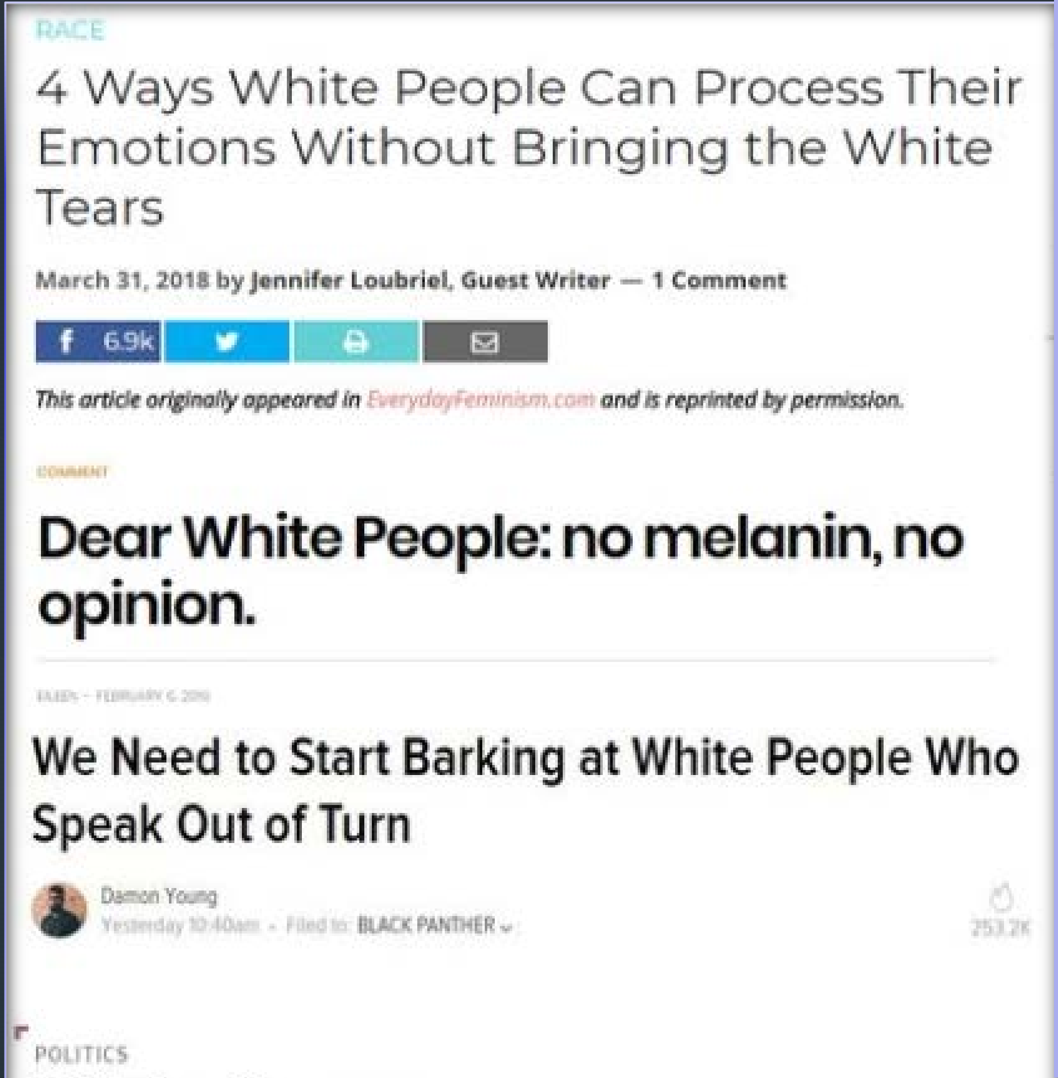
Follow up question: Amerindian suicide rates

- Many factors:
  - Rural lifestyle (reservations), high drug abuse, suicide of close relative/friends leads to suicide in response
- Historical Cultural Reasons:
  - Reasons specific to Amerindians Include:
    - Historical trauma
    - Feelings of alienation
    - Those who adapt to mainstream culture have higher rates than those who do not

Follow up question: White suicide rates

- Factors are less clear:
  - Some point to recession woes as well as drug use as factors
  - Racism against whites
  - White guilt over historical atrocities
    - Bullying over this fact

https://thebodyisnotanapology.com/magazine/4-ways-white-people-can-process-their-emotions-without-bringing-the-white-tears/
https://beaveronline.co.uk/dear-white-people-no-melanin-no-opinion/
https://verysmartbrothas.theroot.com/we-need-to



Follow Up Question: Urbanicity

- Large central metro—Counties in metropolitan statistical areas (MSAs) of 1 million or more population that: 1. Contain the entire population of the largest principal city of the MSA, or 2. Have their entire population contained in the largest principal city of the MSA, or 3. Contain at least 250,000 inhabitants of any principal city of the MSA. Large fringe metro—Counties in MSAs of 1 million or more population that did not qualify as large central metro counties. Medium metro—Counties in MSAs of populations of 250,000 to 999,999. Small metro—Counties in MSAs of populations less than 250,000. Nonmetropolitan categories Micropolitan—Counties in micropolitan statistical areas. Noncore—Nonmetropolitan counties that did not qualify as micropolitan.
- Source: https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf