FAIRFAX COUNTY COMMUNITYSCAPE: OBESOGENIC ENVIRONMENTS

DSPG Team: Cong Cong and Victoria Halewicz (University of Illinois at Urbana-Champaign), Quinton Neville (Columbia University), Eliza Tobin (University of Virginia)

SDAD Team: Teja Pristavec, Josh Goldstein, Brandon Kramer, Joy Tobin, Stephanie Shipp

Sponsors: Michelle Gregory and Sophia Dutton, Fairfax County Health and Human Services; Kathi Huddleston and Sahel Hazrati, Inova Translational Medicine Institute

Project Introduction

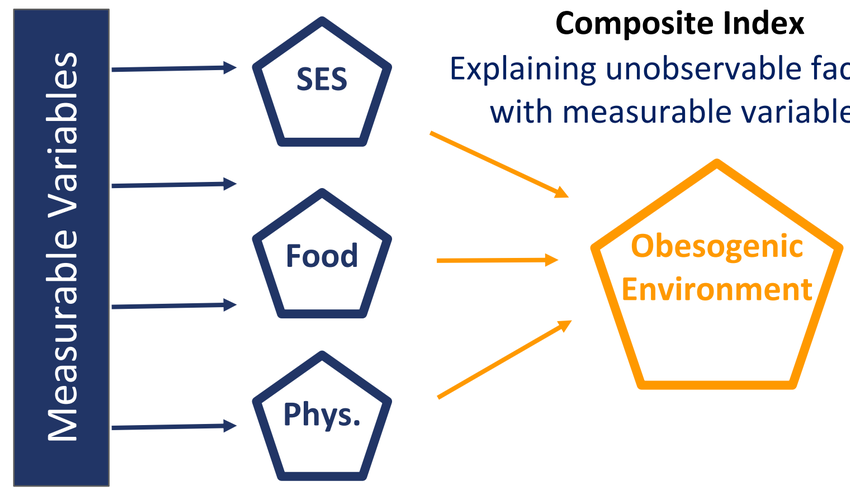
Fairfax County and Inova Health System would like to identify where obesity risk factors for vulnerable populations are high, offering health officials and policymakers an actionable resource to inform policy.

Objective: Create an obesogenic index to measure obesity risk quantitatively in Fairfax County and establish a baseline for measuring change.

Framework

Obesogenic Environment

"The sum of influences that" the social determinants of health "have on promoting obesity in individuals or populations." (Swinburn et al. 1999)



Data Sources

OpenStreetMap (OSM): Geospatial locations of physical features

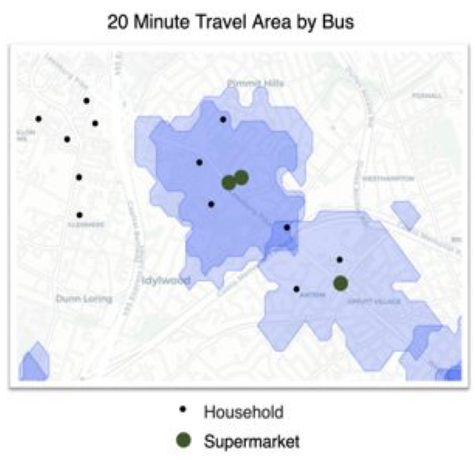
American Community Survey (ACS): Demographics, Financial Conditions, Employment Status, Transportation, Synthetic Population.

Fairfax County Housing Stock: Domicile Locations, Housing Conditions

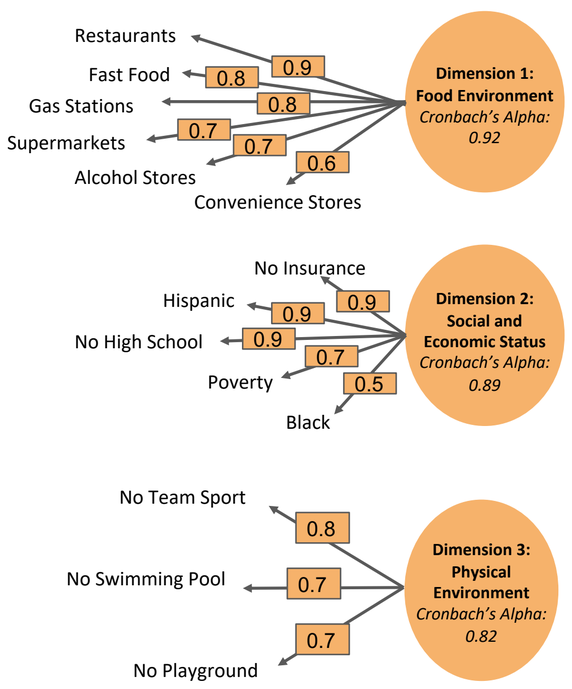
Methods

Variable Construction

1. ACS & Fairfax variable exploration → selection
2. Distance-time mutation from OSM data and travel-time isochrones

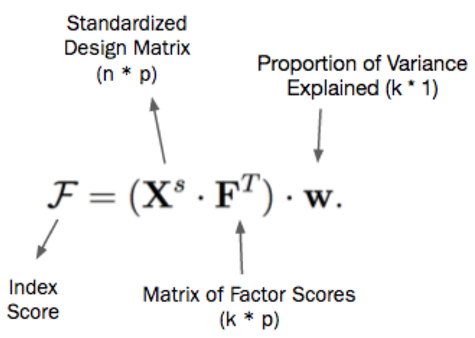


Factor Analysis



Index Construction

1. Standardize features
2. Factor loading weights
3. Proportions variance weights
4. Weighted sum score
5. Normalize score scale (0, 1)



Results

Regions at high risk (darker color) of exposure to obesogenic environments:
Supervisor Districts: Mason, Providence, Lee.
High School Districts: Justice, Annandale, Falls Church.
Census Tracts: Arlington and Dulles Airport adjacent.

Obesogenic Environments

Supervisor Districts

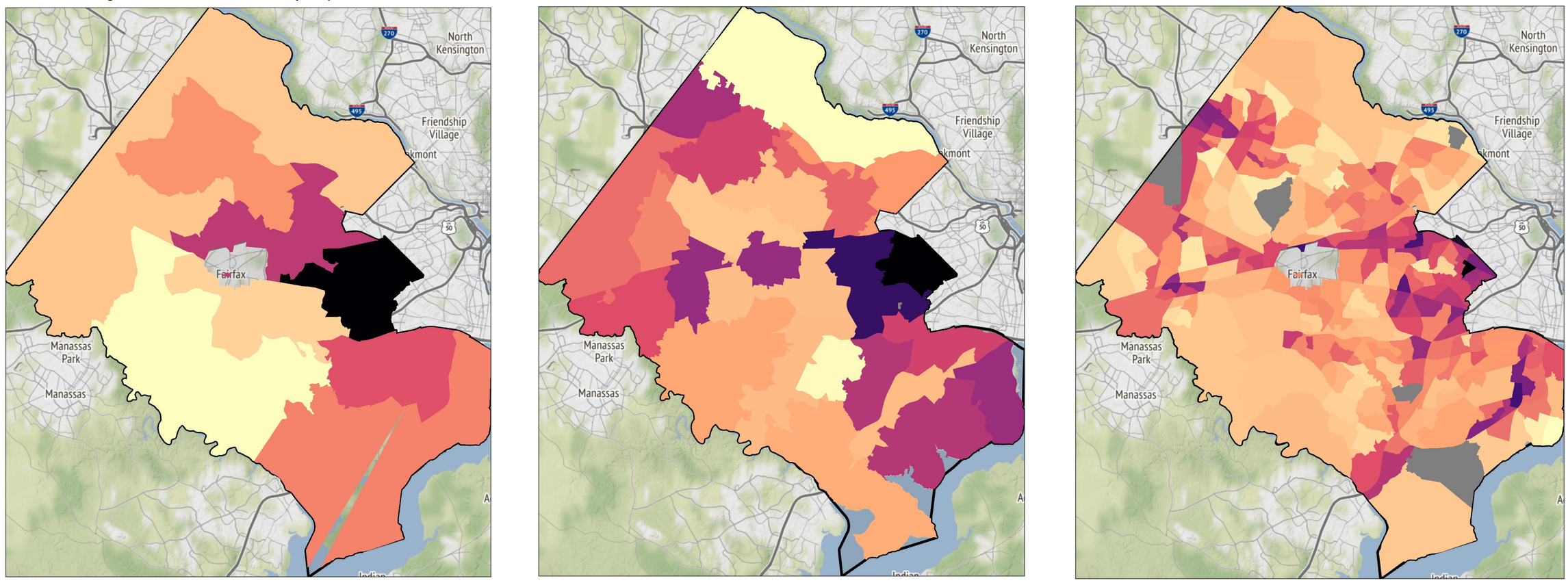
Obesogenic Environment Index by Supervisor District

High School Districts

Obesogenic Environment Index by High School Attendance Area

Census Tracts

Obesogenic Environment Index by Census Tract



Limitations

1. Quality of OSM data
2. Quality of TravelTime application programming interface (API)
3. Index weights and validation

Conclusions

1. Interdisciplinary method for index construction provides new measurement for health inequities
2. Low-income racial and ethnic minority groups have high risk, especially Hispanics
3. Policy intervention and resource allocation requires analysis at multiple geographic units

Next Steps

1. Overlaying findings with Inova health data to better understand patient population
2. Conduct sensitivity analysis (robustness of index)
3. Compare current policy initiatives with maps to enhance existing measures and to create evidence-based policy

Resources

1. Centers for Disease Control and Prevention (2019). Social determinants of health. Available at https://www.cdc.gov/socialdeterminants/index.htm (7/31/2019).
2. Swinburn, B., Egger, G., & Raza, F. (1999). Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity. *Preventive Medicine, 29,* 563-70. doi:10.1006/pmed.1999.0585

University of Virginia Biocomplexity Institute | Data Science for the Public Good

FAIRFAX COUNTY COMMUNITYSCAPE: ECONOMIC VULNERABILITY

DSPG Team: Eliza Tobin (University of Virginia), Victoria Halewicz and Cong Cong (University of Illinois at Urbana-Champaign), Quinton Neville (Columbia University)

SDAD Team: Teja Pristavec, Josh Goldstein, Brandon Kramer, Vicki Lancaster, Joy Tobin, Stephanie Shipp

Sponsors: Michelle Gregory and Sophia Dutton, Fairfax County Health and Human Services; Kathi Huddleston and Sahel Hazrati, Inova Translational Medicine Institute

Introduction

Fairfax County and the Inova Health System seek to better understand the context in which their citizens and patients live, learn, work, and play. Both stakeholders would benefit from a **Fairfax CommunityScape**, a quantitative characterization of the county's social determinants of health and wealth.

Objective: Create an **economic vulnerability** index to identify populations at risk, promote informed policy in Fairfax County, and establish a baseline for measuring change.

Data sources

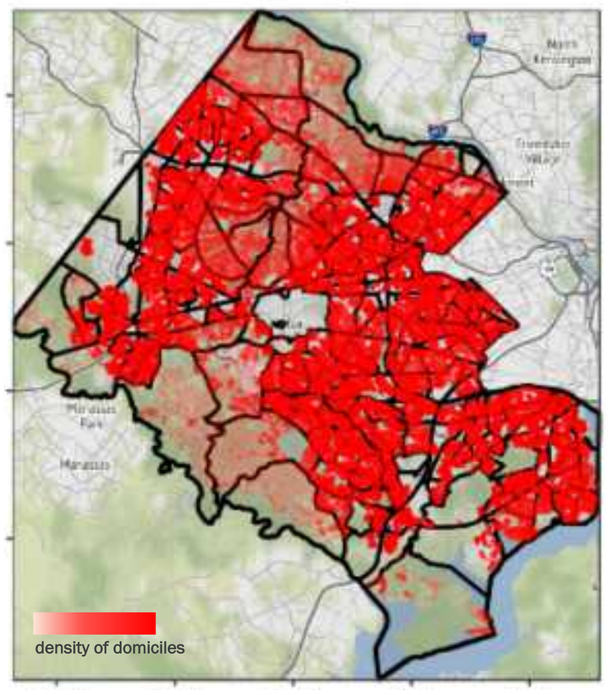
AMERICAN COMMUNITY SURVEY, U.S. CENSUS BUREAU

Demographics
Financial conditions
Employment status
Transportation

Domicile locations
Housing conditions

Measures

Location of ACS Domiciles by Fairfax Census Tract



According to the **literature**, e.g. educational attainment,[1] English proficiency,[2] and access to medical care,[3] are proxies for economic vulnerability. This information informed our variable selection.

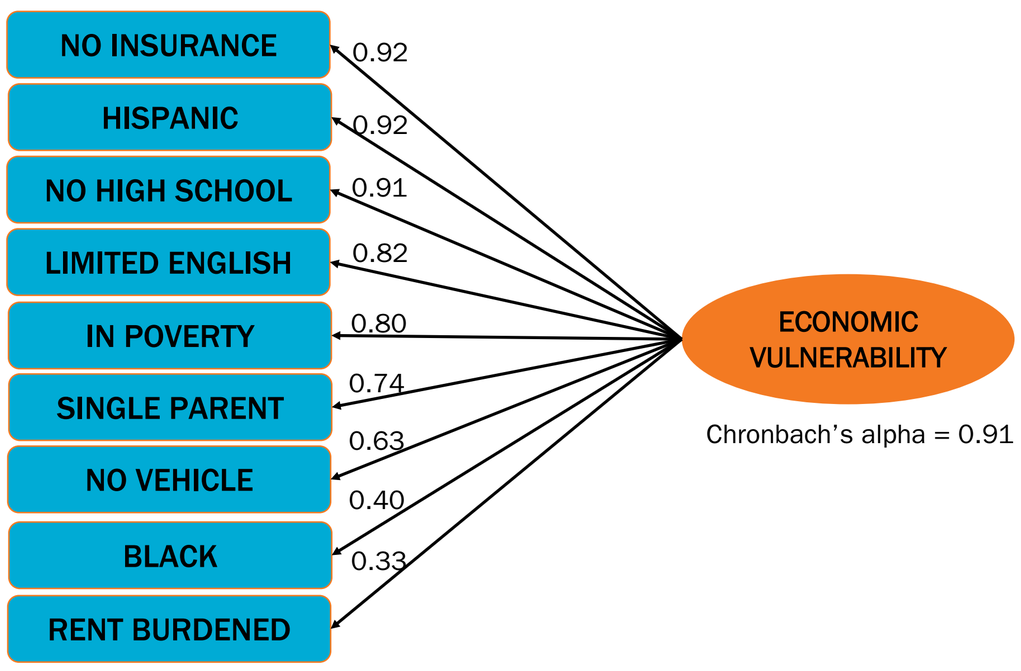
We combined American Community Survey (ACS) data with Fairfax housing stock data using a **population synthesis technique** to obtain ACS data at three geographic levels (census tract, supervisor district, high school attendance zone).

We created variables (e.g. proportions, medians as appropriate) at each geography of interest.

Composite Index Construction

INDICATORS AND LOADINGS

Proportion of geography with...



Chronbach's alpha = 0.91

Our final model uses a varimax rotation with the principal factor solution method.

Using the loadings from the model, we computed the economic vulnerability index using the following formula:

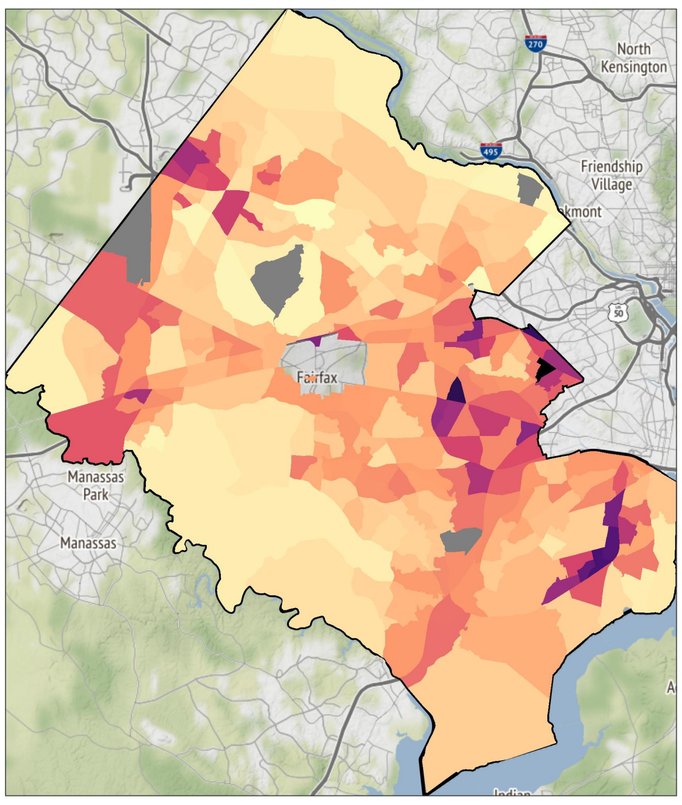
$$\mathcal{F} = \mathbf{X}^s \cdot \mathbf{F}^T \cdot \mathbf{w}.$$

$\mathcal{F}$: Index score
$\mathbf{X}^s$: Standardized design matrix (n * p)
$\mathbf{F}^T$: Matrix of factor scores (k * p)
$\mathbf{w}$: Proportion of variance explained (k * 1)

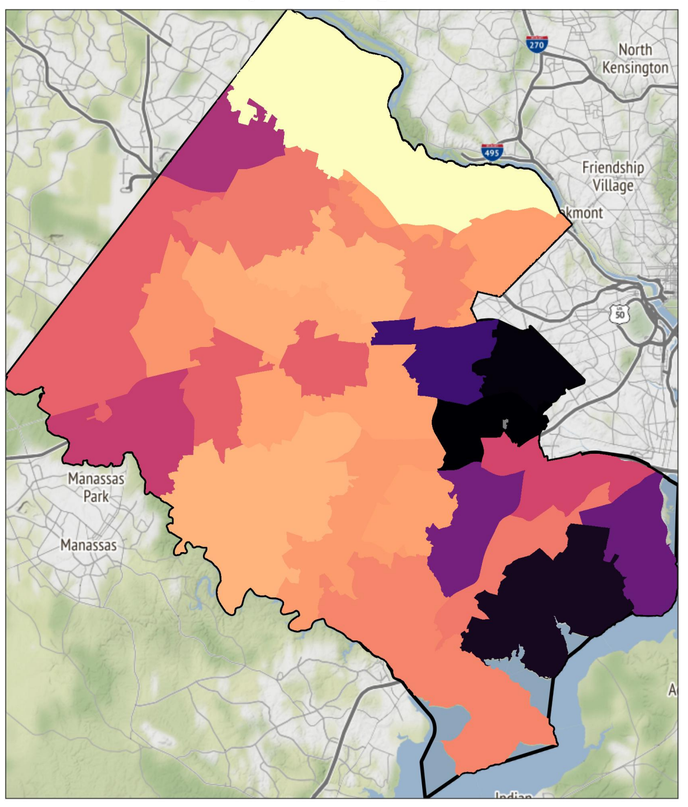
Results

Vulnerability: Low — Medium — High

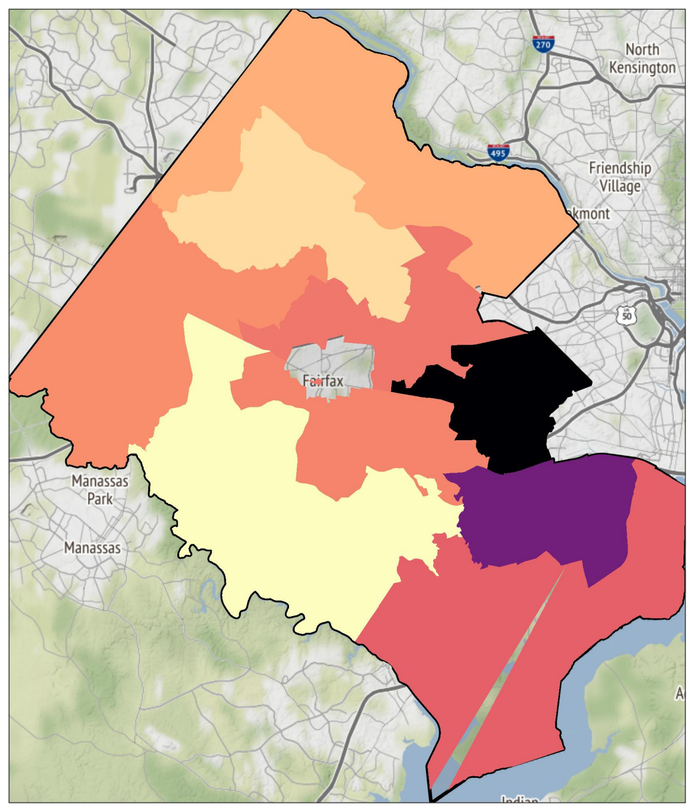
Economic Vulnerability Index by Census Tract



Economic Vulnerability Index by High School Attendance Area



Economic Vulnerability Index by Supervisor District



Regions with high levels of economic vulnerability:
Census tracts: Dulles and Arlington adjacent
High school districts: Annandale, Justice, Mt. Vernon
Supervisor districts: Mason, Lee

Future Directions

- Further **collaboration** with Inova and Fairfax County: Place citizens and patients in context.
- Index **refinement**: Develop stakeholder weights and compare results.
- Index **validation**: How can we ensure our CommunityScape reflects reality? Does the index predict citizen and patient outcomes?

FOOTNOTES
[1]Malecki, C. K., Demaray, M. K. (2006). Social support as a buffer in the relationship between socioeconomic status and academic performance. *School Psychology Quarterly, 21* (4), 375-395.
[2]Fry, R. (2008). The role of schools in the English language learner achievement gap. Washington, DC: Pew Hispanic Center.
[3]Shi, L., Lebrun, L. A., & Tsai, J. (2009). The influence of English proficiency on access to care. *Ethnicity & health*, *14*(6), 625-642.

UNIVERSITY of VIRGINIA BIOCOMPLEXITY INSTITUTE | Data Science for the Public Good