Considering Path Quality When Exploring Environmental Determinants of Walking to School

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Physical Activity and the Environment

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- Physical – Sidewalks, distance, traffic
- Economic – Car ownership, Occupational status
- Socio-cultural – Attitudes toward physical activity, walking partners
- Political – School policies on walking, local/state laws

Measuring the Environment

- Perceptions of Environment – ex. "How safe is the neighborhood for walking?"
- Archival Databases – ex. Data from city planning department with presence/absence of sidewalks, street width, population density, etc.
- Objective Measurement – ex. Raters collect information on physical structures, layout, street activity, etc.

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Goal & Aims

Goal: Use an objective measure of physical and social disorder, spatial statistics, and a Geographic Information System (GIS) to create a detailed measure of path quality for each study individual.

- Use sample of objectively measured values to predict values at unsampled locations
- Use values at sampled locations and predictions at unsampled locations to calculate a measure of path quality
- Demonstrate the use of path quality variable in a walking to school analysis in Baltimore City.

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Data Sources

Data from two main sources:

- Neighborhood Inventory of Environmental Typology (NIfETy) – City block level audit of physical and social environment & violence, alcohol and other drugs. n=1173
- Multiple Opportunities to Reach Excellence (MORE) study – Longitudinal epidemiological study to assess impact of long term exposure to violence on youth in Baltimore City. n=365

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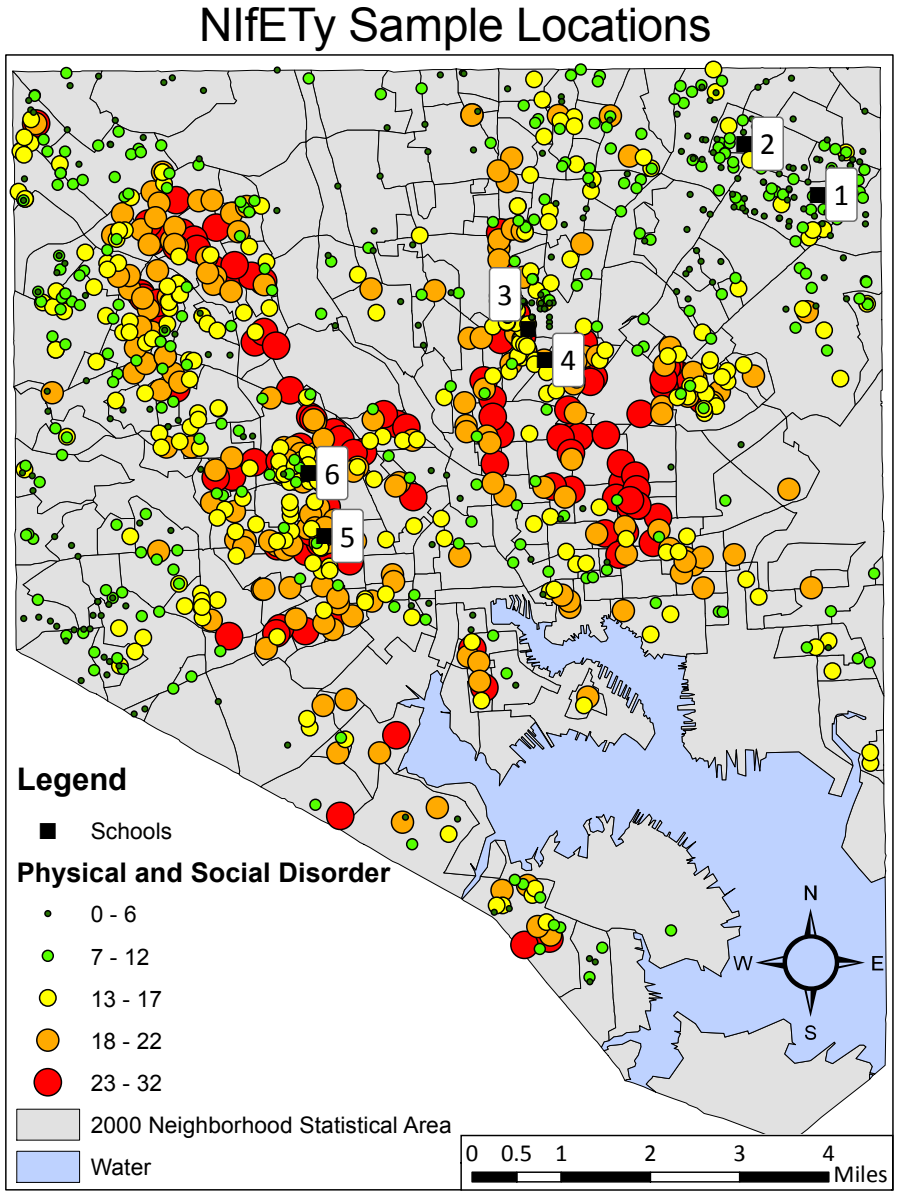
Summary of MORE participants

Variable	**No.**	**Mean (sd)**
Age (years)	362	9.60 (1.04)
Variable	**No.**	**Proportion**
Male	167	0.46
African American	313	0.86
Grade		
2nd	9	0.02
3rd	127	0.35
4th	123	0.34
5th	103	0.28
Child Free and Reduced meals		
No Free or Reduced Meals	52	0.14
Free Lunch	247	0.68
Reduced Meals	46	0.13
Missing	17	0.05

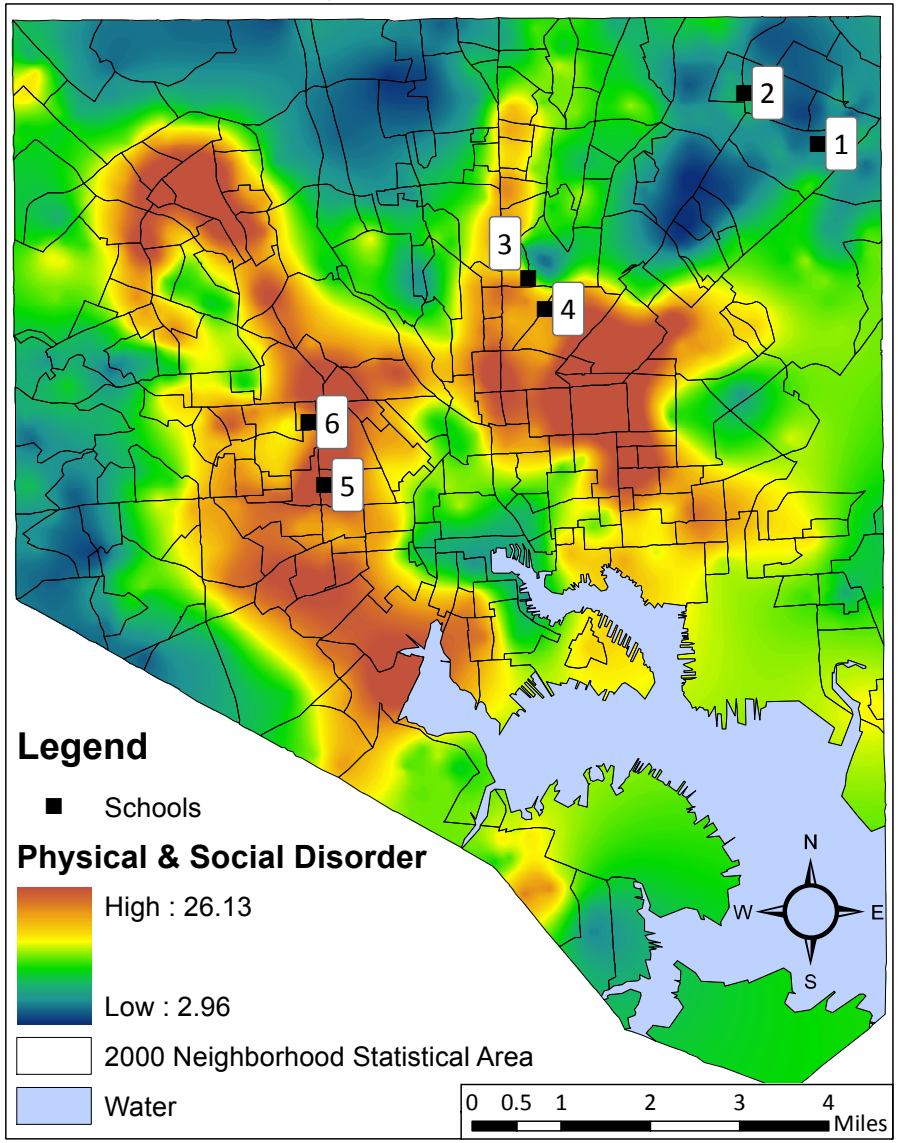
Variable	**No.**	**Proportion**
How safe are the neighborhoods on the way to school? (child)		
Very safe	131	0.36
Safe	137	0.38
A little safe	66	0.18
Not safe at all	26	0.07
Missing	2	0.01
Neighborhood is safe (child)	268	0.74
Neighborhood is safe (parent)	100	0.28
Child feels safe at home	249	0.69
Parent Annual Household Income		
Less than $9,999	52	0.14
Between $10,000 and $29,999	79	0.22
Between $30,000 and $49,999	52	0.14
Between $50,000 and $99,999	39	0.11
More than $100,000	7	0.02
Missing	133	0.37

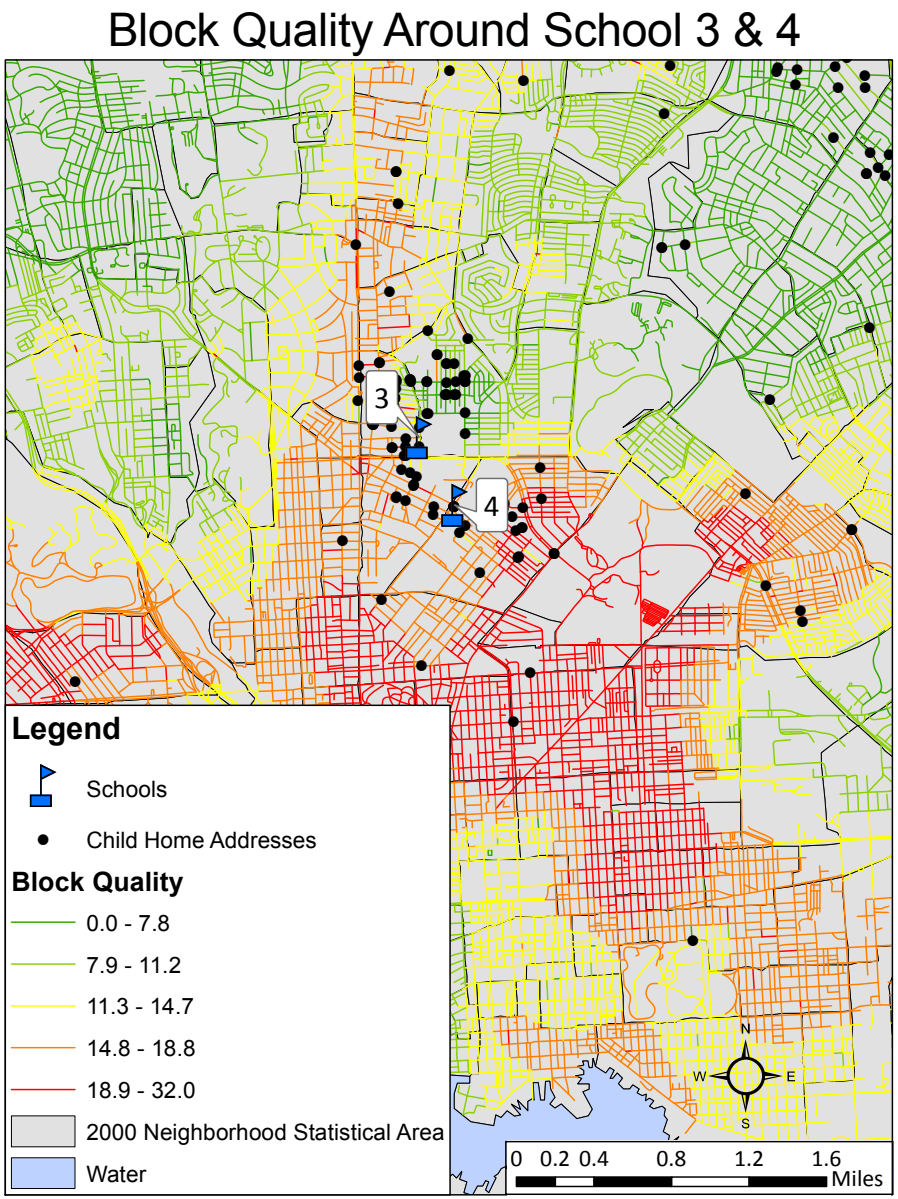
We have a sample of objectively measured physical and social disorder for Baltimore City.



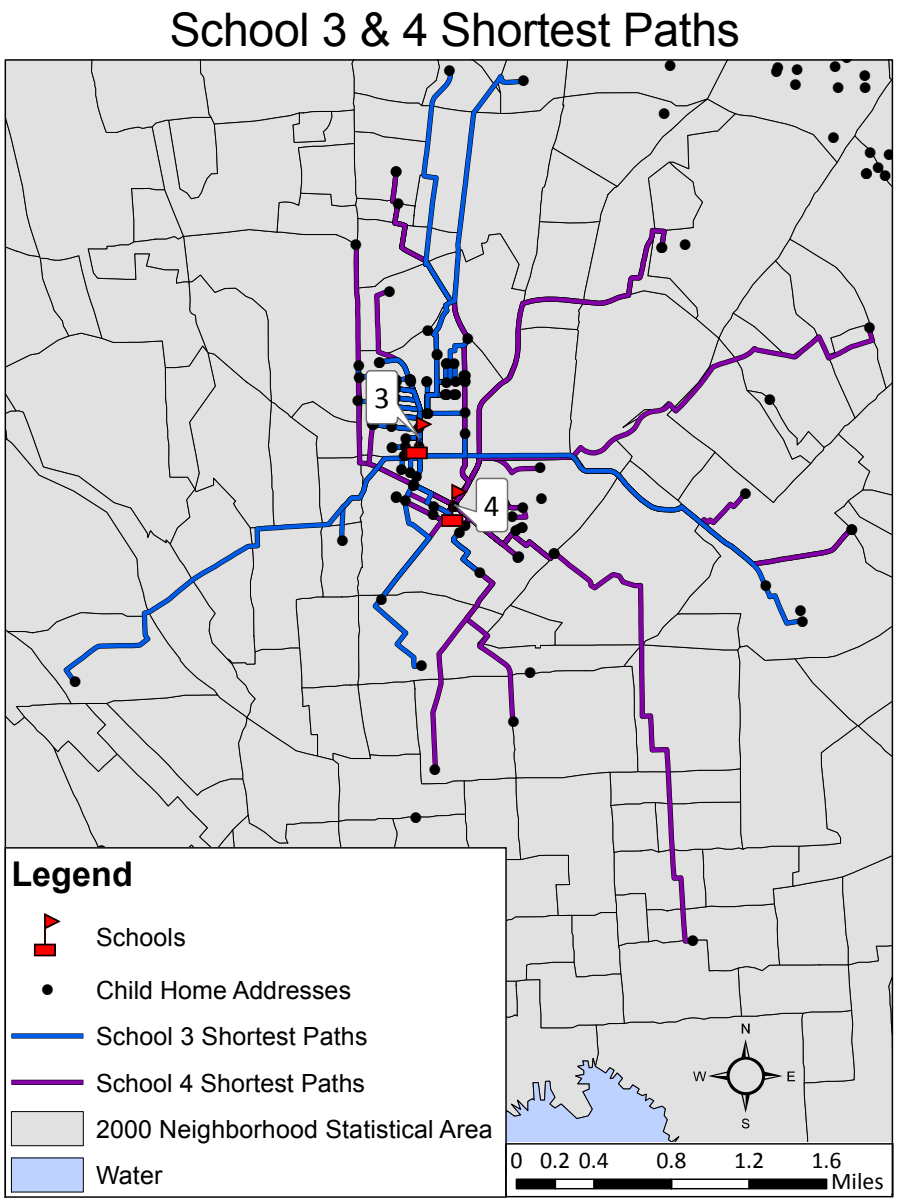
Using ordinary kriging, a geostatistical technique for spatial prediction, we get values of physical and social disorder across all of Baltimore City.

Predicted Physical and Social Disorder

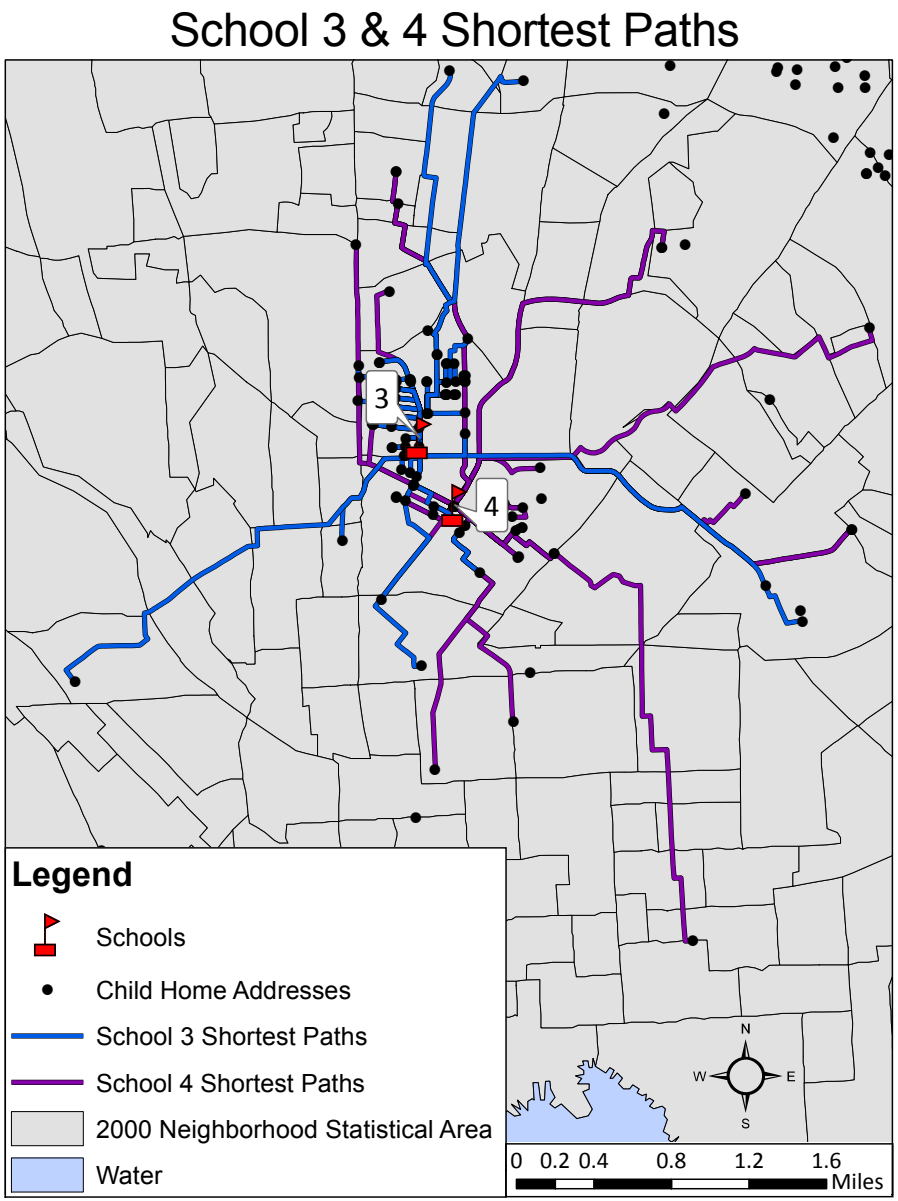




Since we now have a physical and social disorder value for every block, we can estimate path quality for any path through the study region.



- Locations of schools and MORE participants homes geocoded with a 99% match rate for MORE addresses.
- Network Analyst (an ArcGIS extension) was used to generate the shortest paths along defined roadways.



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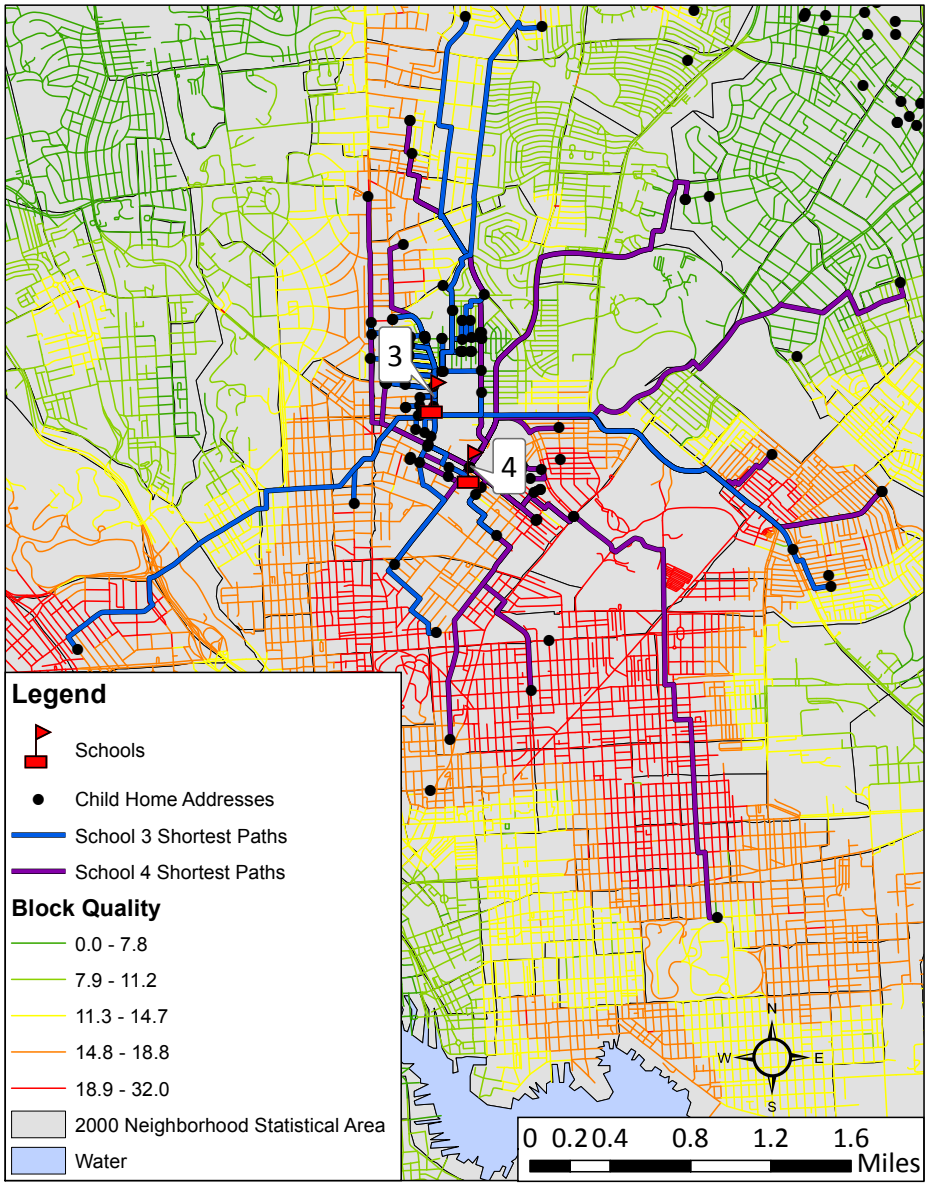
School 3 & 4 Shortest Paths and Block Quality



Walking to School example

The path quality was included in multivariable logistic and GEE models along with other potentially important factors[1].

- The average path quality variable was significant in univariate analysis (Odds Ratio; $_{1.054}1.145_{1.250}$).
- Average path quality was not significant in multivariable models accounting for clustering at neighborhood level (Odds Ratio; $_{0.72}0.88_{1.07}$).

In this example, path quality was likely a proxy for neighborhood level socioeconomic status and was not significant when adjusting for neighborhood SES and clustering.

[1] Statistical analysis performed in the R Statistical Computing Environment

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Implications for policy and environmental change

- Path quality is a potentially important measure of the influence of environment on walking
- Supports a need to implement Safe Routes to School programs in these neighborhoods
- Translate these results to key stakeholders (education, transportation, City Council, etc.) with the power to make environmental and policy changes

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Future Research

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- Path Definition – Average over multiple potential paths, GPS
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- Physical Activity models – Structural Equations Modeling, more complex multilevel models

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