

# Using EMA and GPS to Understand the Occurrence of Risk Behavior in Activity Space Context

Christopher R. Browning<sup>1</sup>

Catherine A. Calder<sup>2</sup>

1. Ohio State University

2. University of Texas at Austin

5th Mobile Apps and Sensors in Surveys  
(MASS) Workshop

Washington, DC

March 6, 2024



# Outline

- *Research question:* Do racially isolated/Black-segregated everyday exposures increase the likelihood of engaging in risk behavior among urban Black youth?
- *Methodological question:* Does Ecological Momentary Assessment yield valid estimates of risk behavior in or near real time?



# Background & Theory

- Racial Isolation perspective
  - Segregated neighborhood *residence* increases time spent in concentrated poverty neighborhoods with limited resources
  - Rates of risk behavior are expected to *increase* with activity space exposure to racially isolated activity spaces
  - Access to “mainstream” (lower proportion Black – often whiter/more affluent) communities and associated organizational resources *decreases* likelihood of risk behavior
- Compelled Mobility perspective
  - Segregation-driven lack of institutions and resources leads to more time spent outside the neighborhood to seek resources
  - Additional resources are beneficial, *but...*
  - Increased time spent in lower proportion Black areas may increase experiences of racial exclusion for Black youth – **particularly Black boys**, leading to more stress, negative affect, and in turn, more risk behavior



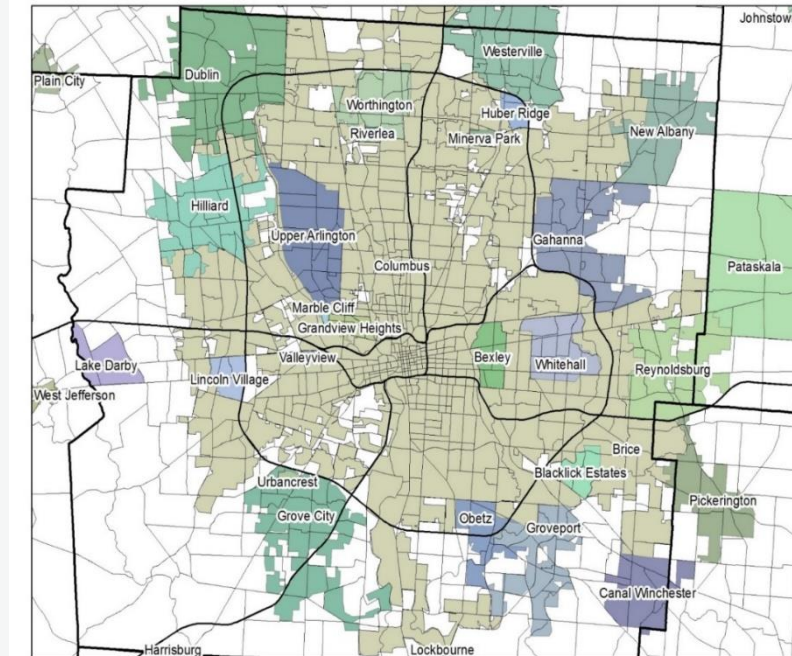
## Key Objective

- Link **GPS-derived** measures of everyday exposure to low proportion Black neighborhoods *across a 5-day period* to **in-home survey-** and **EMA-reported** risk behavior using data from the *Adolescent Health and Development in Context I* study



# Adolescent Health & Development in Context (AHDC) Wave 1 2014-2016

- Representative sample of 1,405 urban youth ages 11-17 living within area of Franklin County, Ohio.
- Self-reported survey from youth and a caregiver on wide range of demographics, family contexts, risk behaviors, attitudes, and health outcomes
- Seven-day smartphone-based GPS tracking and brief phone-based questionnaires (EMA) to examine youth perceptions, behaviors, and activity space locations in real time across the study week



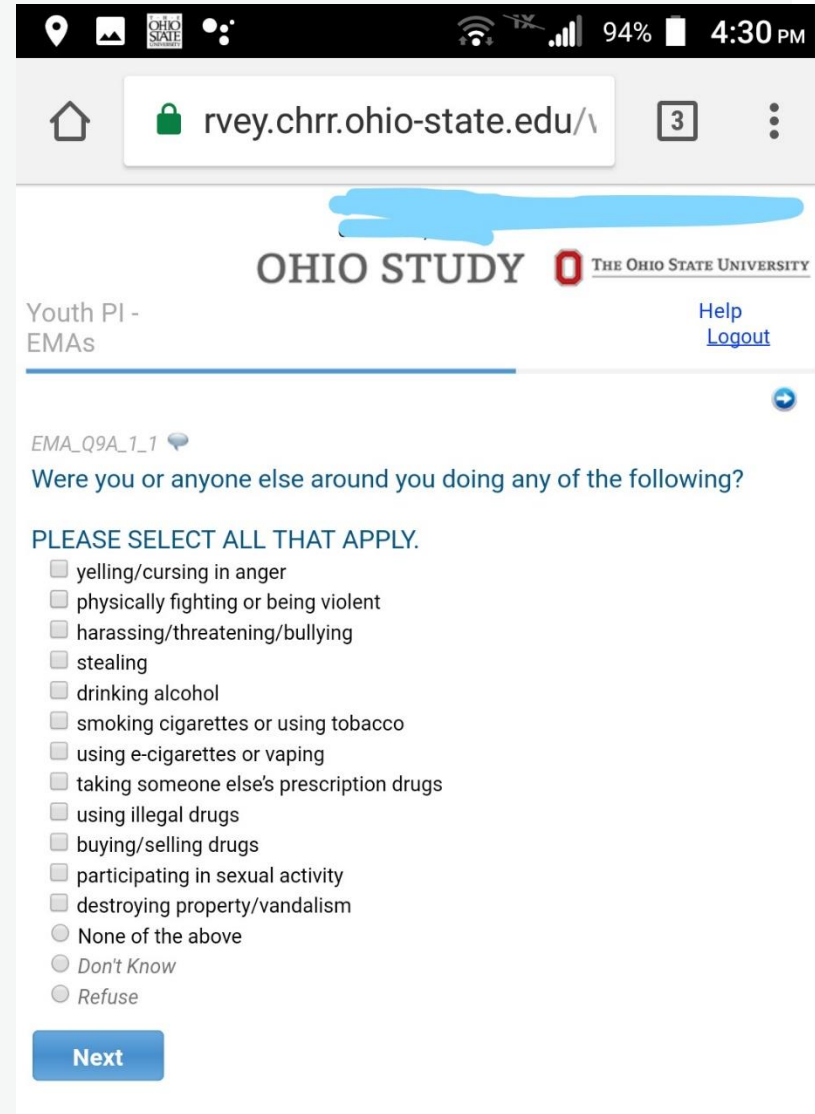
# AHDC Data – GPS Data Collection

- Study provided Android phones during participation
- Continuous passive GPS collection over 7 days of the Geographic Ecological Momentary Assessment (GEMA)
- 91% coverage rate over the week
- Space-time budget: Recall-aided GPS cleaning using study designed software to infer stable and travel periods for 5 of the 7 days
- **Measure of activity space racial isolation:** Proportion of waking time, including home, across the 5-day period spent in block groups with less than 20% Black population



# EMA Data Collection

- 5 prompts per day; app opens to a web-based survey
  - Randomly chosen times within each time block
  - No prompts during weekday school hours
  - 20 minutes to acknowledge prompt; 20 minutes to answer
- Questions on location, affect, safety, risk behaviors, network partner presence, social control at the time of the prompt
- EMA response rate is 53%



OHIO STUDY THE OHIO STATE UNIVERSITY

Youth PI - EMAs [Help](#) [Logout](#)

EMA\_Q9A\_1\_1

Were you or anyone else around you doing any of the following?

PLEASE SELECT ALL THAT APPLY.

- yelling/cursing in anger
- physically fighting or being violent
- harassing/threatening/bullying
- stealing
- drinking alcohol
- smoking cigarettes or using tobacco
- using e-cigarettes or vaping
- taking someone else's prescription drugs
- using illegal drugs
- buying/selling drugs
- participating in sexual activity
- destroying property/vandalism
- None of the above
- Don't Know
- Refuse

Next



# Sample Descriptives

	Full AHDC	Black Youth
White	47%	
Black	38%	
Other Race	15%	
Female	53%	52%
Age in years	14.2 (1.9)	14.1 (1.8)
Proportion of waking time spent in block groups with <20% Black population	.53 (.44)	.20 (.31)
N	1,315	490



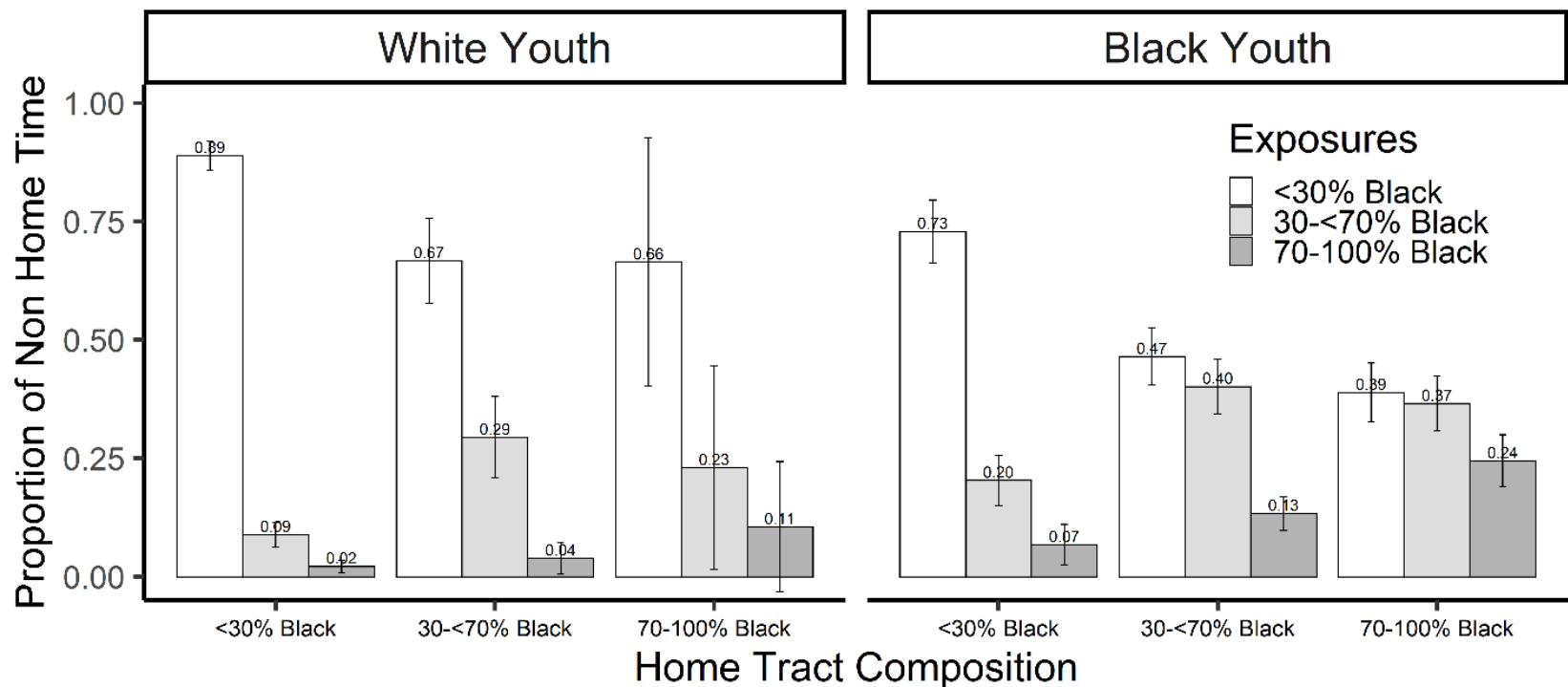


# Outcomes

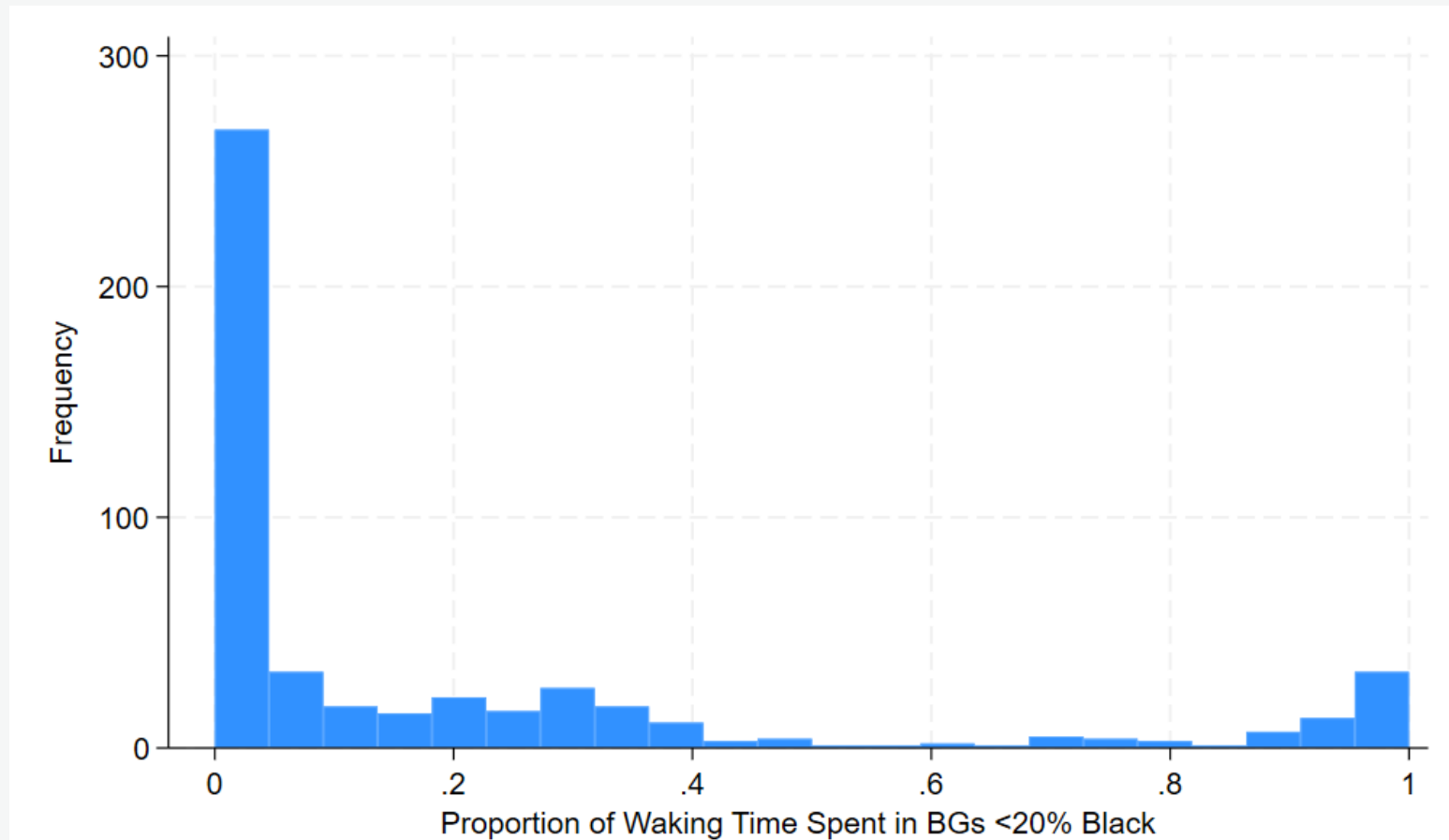
	Full AHDC	Black Youth
Survey Reports in the last 30 days		
Violence (average count of 14 items reported, incl hitting, fighting, harassment, chasing)	.71	.89
Delinquency (average count of 10 items reported, incl stealing, B&E, damaging property)	.19	.20
Drinking alcohol (average number of days)	.33	.10
Marijuana Use (average number of days)	.53	.50
EMA Reports in the moment	N=18,943	N=6,623
Any violence, delinquency, drinking alcohol, or illegal drug use reported on that EMA	0.31%	0.26%



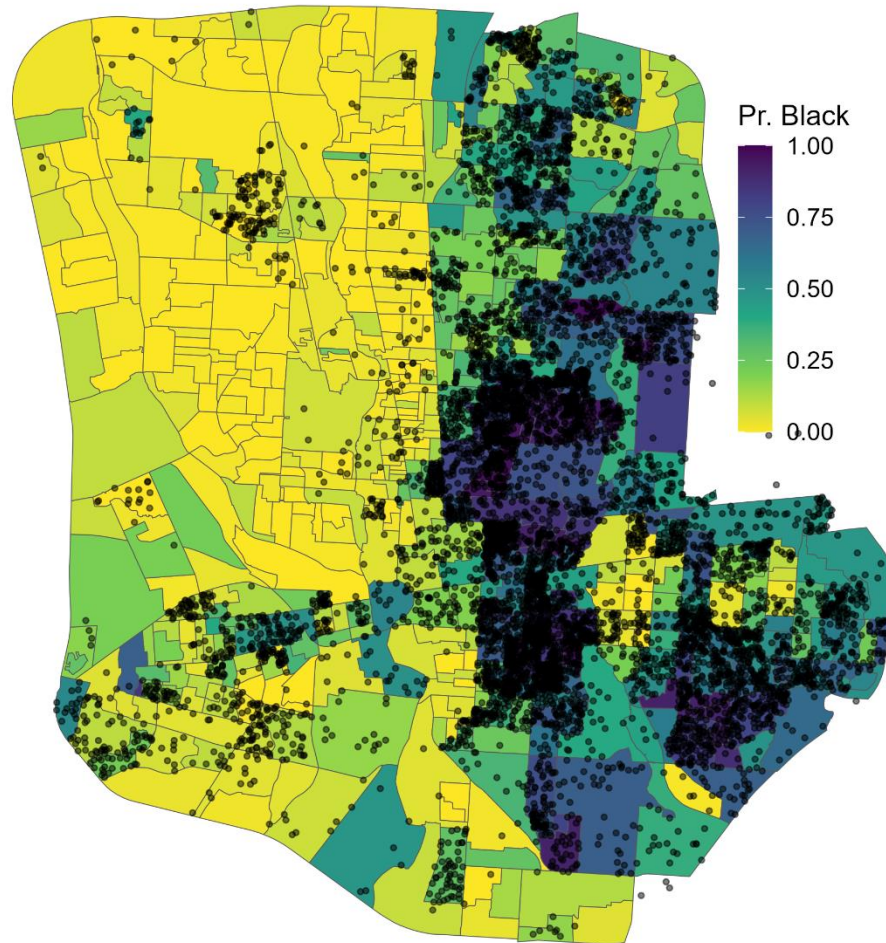
# Predicted Allocation of Non-home Time in <30% Black, 30-<70% Black, and >=70% Black Locations



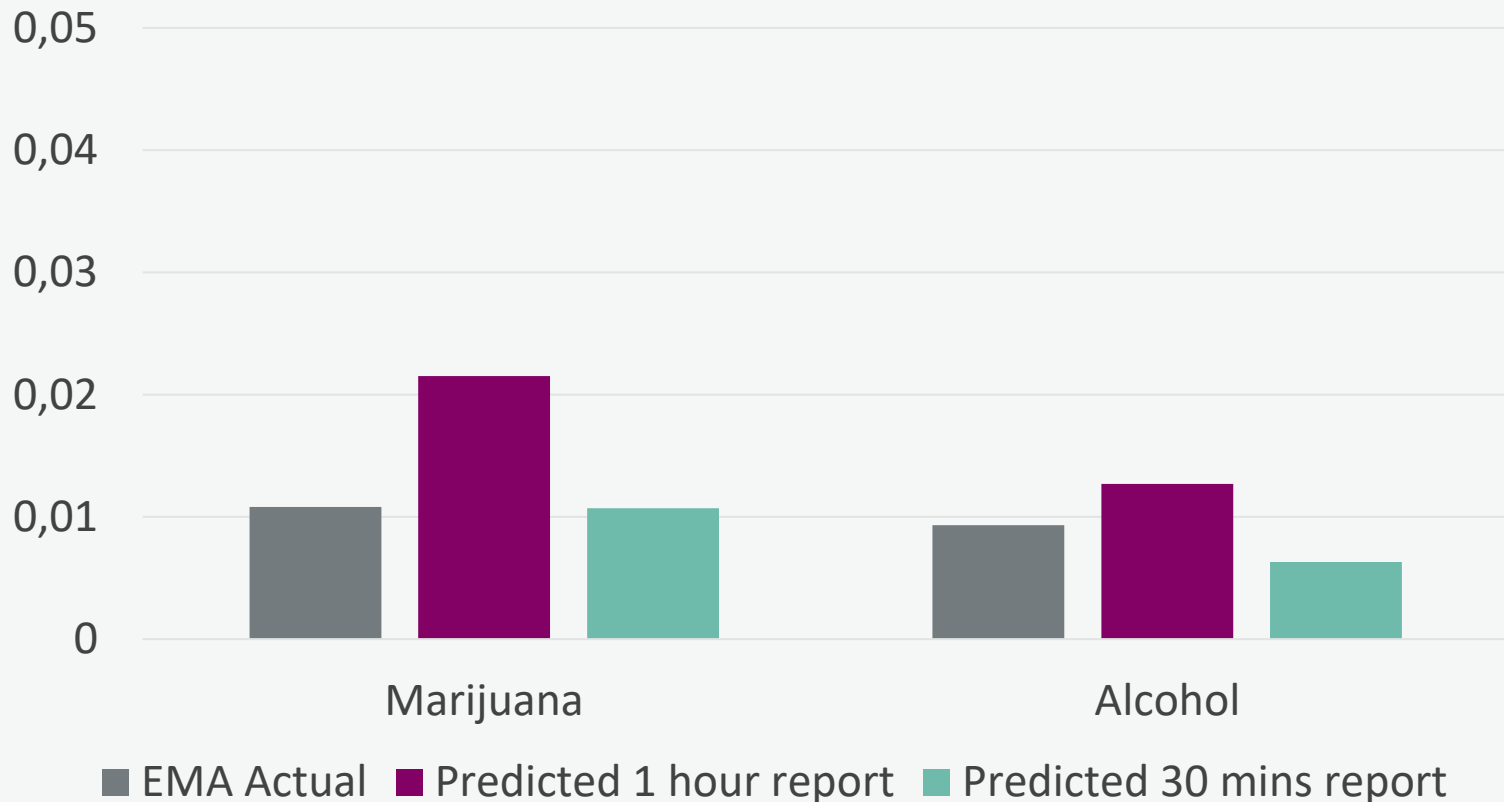
# Distribution of Mean (5-Day) Exposure to Low Proportion Black Block Groups among Black Youth



# EMA Locations of Black Youth by Block Group Proportion Black



# EMA Substance Use Validation with Survey Reports<sup>1</sup>



- (1) EMA Actual: Proportion of youth who ever report use on an EMA  
(2) Predicted proportion of youth with EMA use based on Survey frequency using 1 hr recall  
(3) Predicted prop. of youth with EMA use based on Survey frequency using 30 minutes recall

<sup>1</sup> Assuming missing EMA are MAR, likelihood of risk behavior is equally distributed across waking hours



# Multilevel Logistic Regression on EMA-Reported Risk Behaviors

	Coefficient / SE
Female	0.34 (0.68)
Prop. Time spent in <20% Black BGs	2.13** (0.76)
Female * Time spent in <20% Black BGs	-1.50 (1.31)

\*\*  $p < 0.01$ ; \*  $p < 0.05$ ; BG = Block Group.

Analyses control for whether it is a school day, age, self-control, and lifetime risk behaviors.



# Multilevel Regression on Survey-Reported Risk Behaviors – Last 30 Days

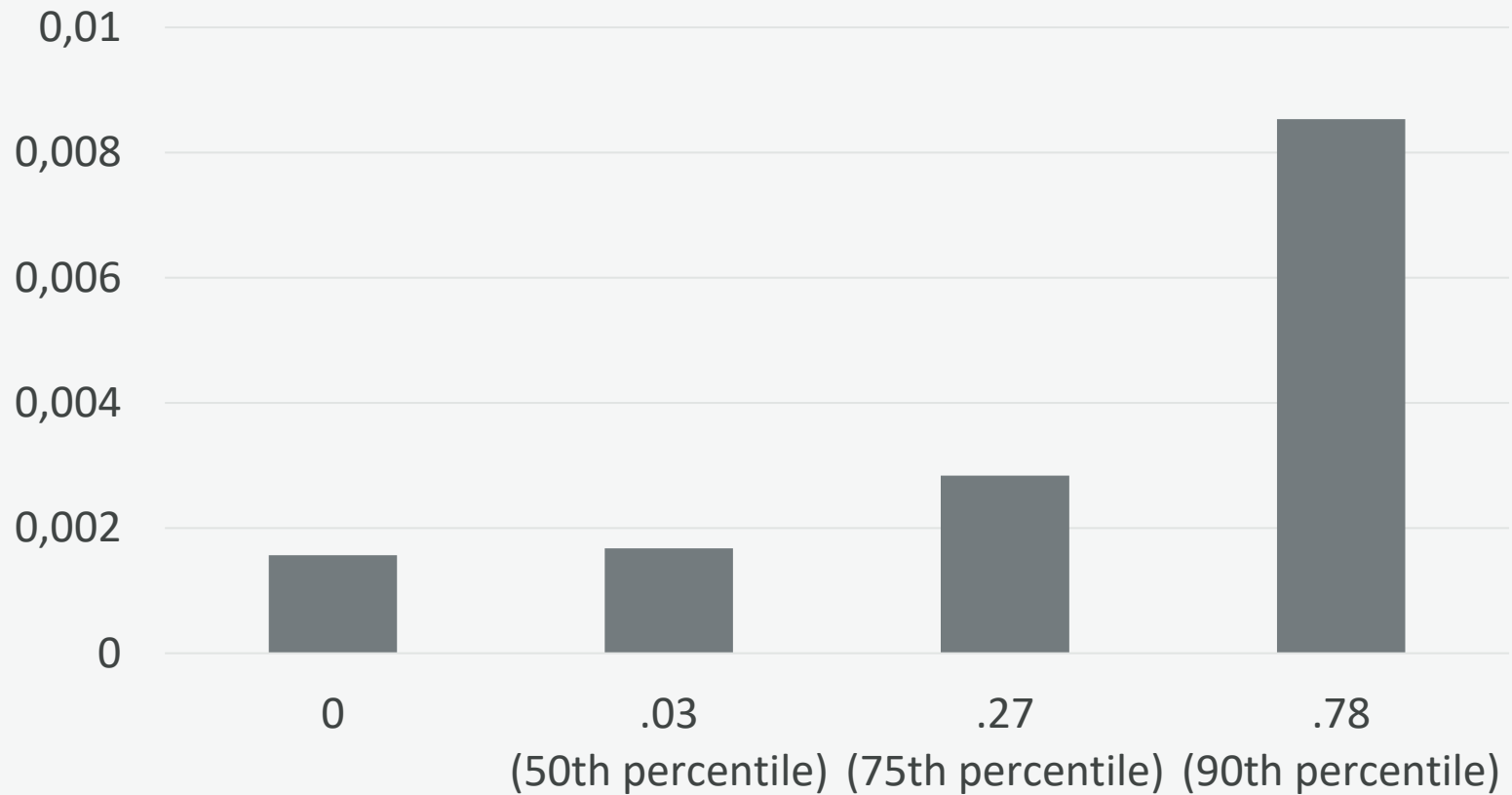
	Delinquency	Violence	Alcohol	Marijuana
Female	0.55 (0.42)	0.16 (0.17)	0.67 (0.06)	-0.11 (0.83)
Prop. Time spent in <20% Black BGs	1.56* (0.62)	0.66* (0.27)	0.06 (0.13)	0.02 (0.23)
Female * Time spent in <20% Black BGs	-1.27 (0.86)	-0.61 (0.39)	0.04 (0.17)	0.00 (0.23)

\*  $p < 0.05$ ; BG = Block Group.

Analyses control for whether it is a school day, age, self-control, and lifetime risk behaviors.

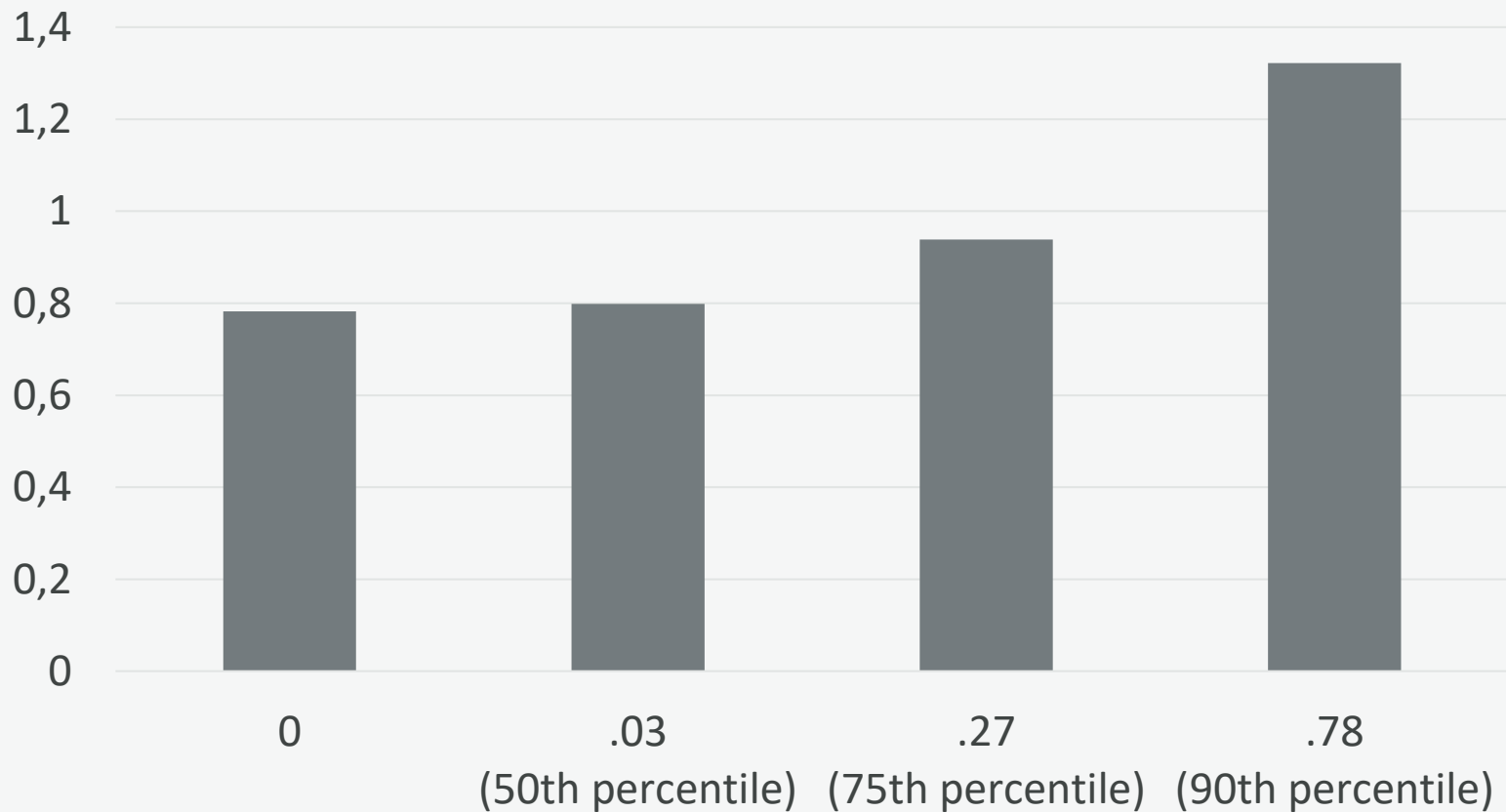


# Predicted Probability of EMA Risk Behavior Report Among Black Boys by Proportion of Time spent in Block Groups with <20% Black Population

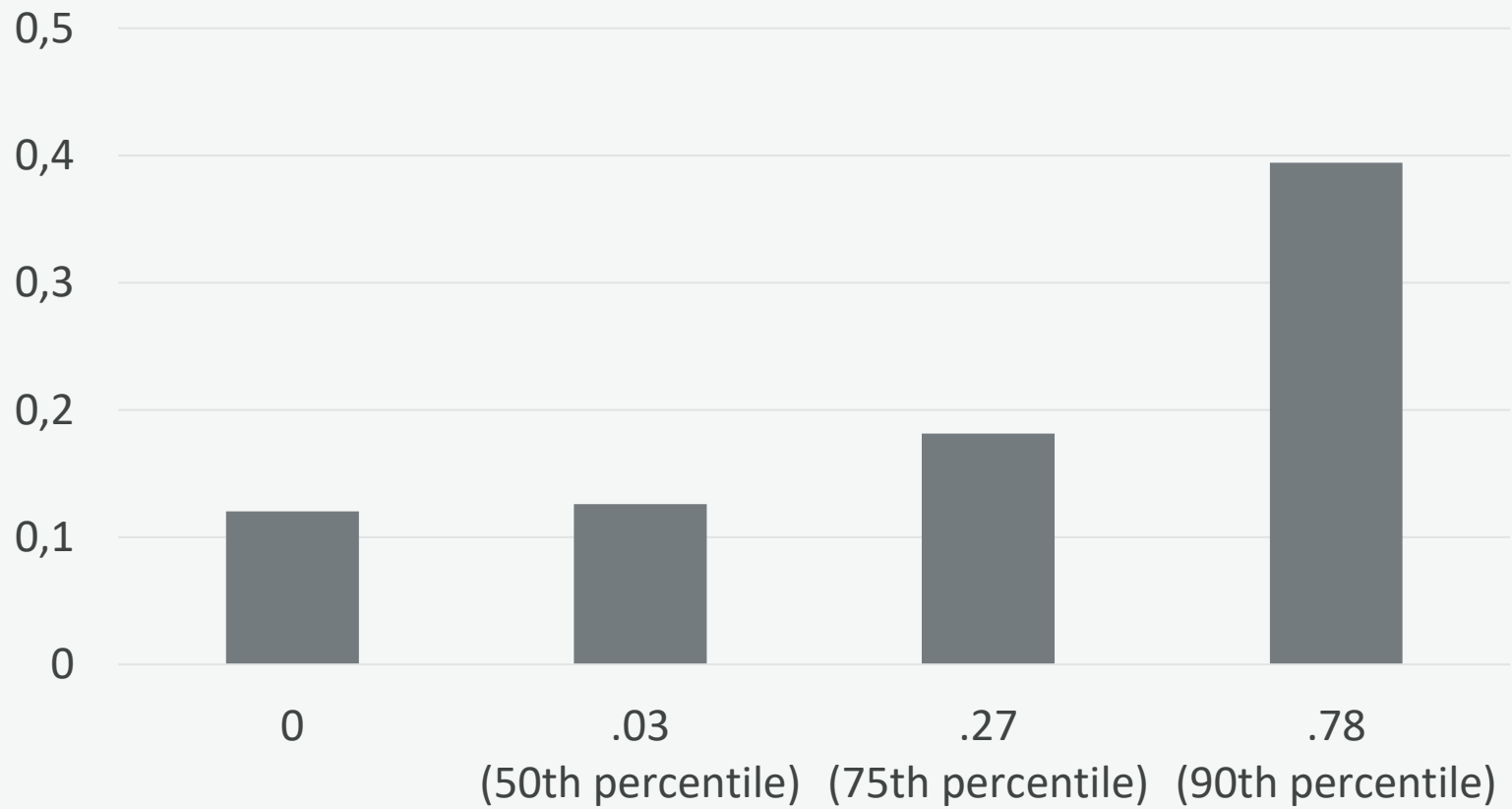




## Predicted Last-30-Day Counts of Violent Behaviors Among Black Boys by Proportion of Time spent in Block Groups with <20% Black Population



## Predicted Last-30-Day Counts of Delinquent Behaviors Among Black Boys by Proportion of Time spent in Block Groups with <20% Black Population



## Conclusions/Discussion

- More time spent in lower percent Black activity spaces is associated with higher likelihood of risk behaviors for Black males, for both the last 30-day survey reports of violence and delinquency as well as the combined EMA risk reports
- Findings consistent with the *compelled mobility* model expectations that higher levels of exposure to compositionally lower proportion Black (typically whiter/more affluent) areas is positively associated with risk behavior among Black (male) youth
- AHDC II
  - More extended smartphone period
  - Measurement of risk behavior



# Funding Acknowledgements

- NIDA R01DA032371; R21DA034960
  - NICHD OSU IPR P2CHD058484
  - NICHD UT Austin PRC P2CHD042849
  - W.T. Grant Foundation
- 
- Email: [browning.90@osu.edu](mailto:browning.90@osu.edu)



# Appendix Slides



# Risk Behavior Outcomes - details

## Survey Reports in the last 30 days

- Violence
  - 14 items including physically fighting, harassing or bullying
- Delinquency
  - 12 items including stealing, breaking and entering, damaging property
- Drinking alcohol
- Marijuana use

## EMA Reports by Youth at the prompt

- Violence
  - physically fighting, harassing or bullying
- Delinquency
  - stealing or damaging property
- Drinking alcohol
- Using illegal drugs



# Predictor & Control Variables

- Main Predictor: Activity space racial isolation
  - Calculated from the interactive space-time budget based on continuous GPS data over 5 of the 7 GEMA days
  - the percent of total waking time including home spent in block groups with populations that have less than 20% Black populations
- Gender
- Youth: age, self-control
- SES and Family: Household income, caregiver marital status, caregiver education
- Residential neighborhood concentrated disadvantage
- EMA: school day, lifetime risk behavior reports from the survey



# EMA Substance Use Validation with Survey Results

- Proportion of AHDC youth that report any alcohol use in the moment on the EMA is 0.0093
- Given the survey reports of alcohol use in the last 30 days (average is about .33 days), the expected probability of drinking alcohol on a given day in the last month is 0.011
- Assuming the rate of alcohol drinking is equivalent across hours of the day, the hourly rate for 16 waking hours in a day is

$$0.011 / 16 = 0.0007$$

- Adjusting for the number of EMAs delivered per day (5) across 7 days of the GEMA week, and the average response rate for EMAs (53%), the expected probability of reporting alcohol drinking on any given EMA is

$$0.0007 * 5 * 7 * .53 = 0.013$$







# Rare Events Logit Results

