THE CAMPUS EFFECT

Campus Built Environment and Active Transportation & Physical Activity

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OUTLINE

- Thesis Project
  - Why this study? (Personal connection)
  - What do we need to know to understand this study? (Background)
  - What is this study about? (Introduction)
  - What is the reason for this study? (Purpose)
  - What did we do? (Methods)
  - What did we find? (Results)
  - Why are the findings important? (Discussion)
  - How does this contribute to the field of study? (Conclusion)
- Field Experience

Dr. Katie Heinrich (left), of Kinesiology, took me in as an student researcher (for class credit) and assigned me to a couple projects right away… and that jumpstarted my research "career" in Kinesiology. Going from Undergraduate Research Assistant to Graduate Research Assistant, Graduate Teaching Assistant and guest lecturer for undergraduate and graduate level courses.

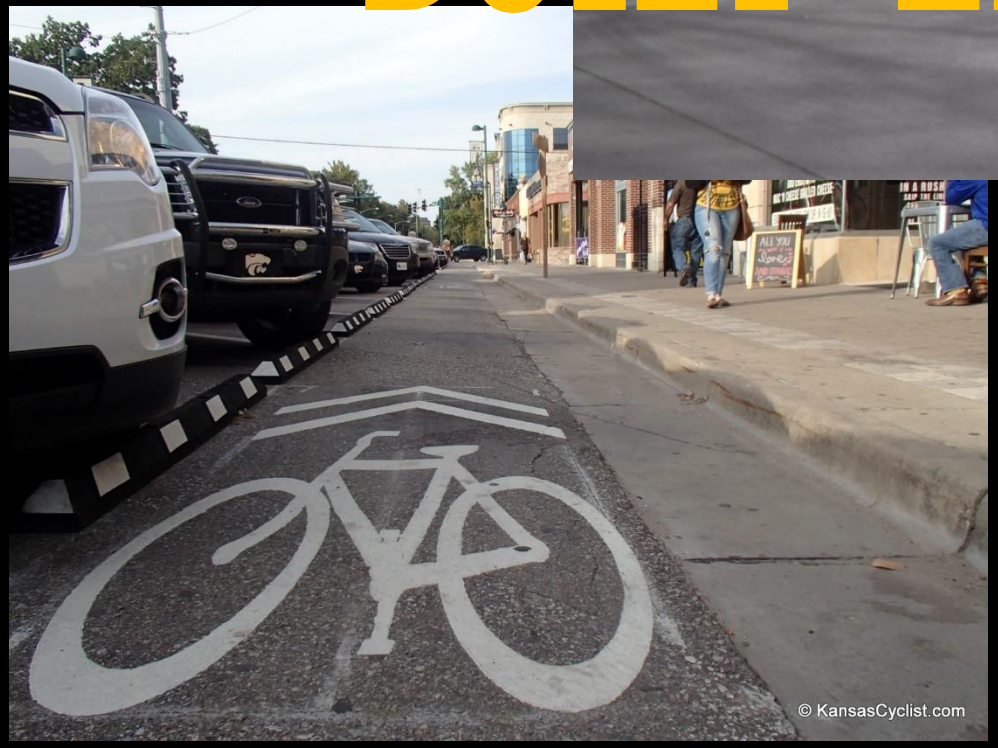
Dr. Tandalayo Kidd (right), of Human Nutrition, hired me as a research assistant and I became a part of the family "Dr. Kidd's Kids". The merriment of nutrition, physical activity, and the environment in the scope of the projects in this lab made me realize my true passion for all three of the subject areas.

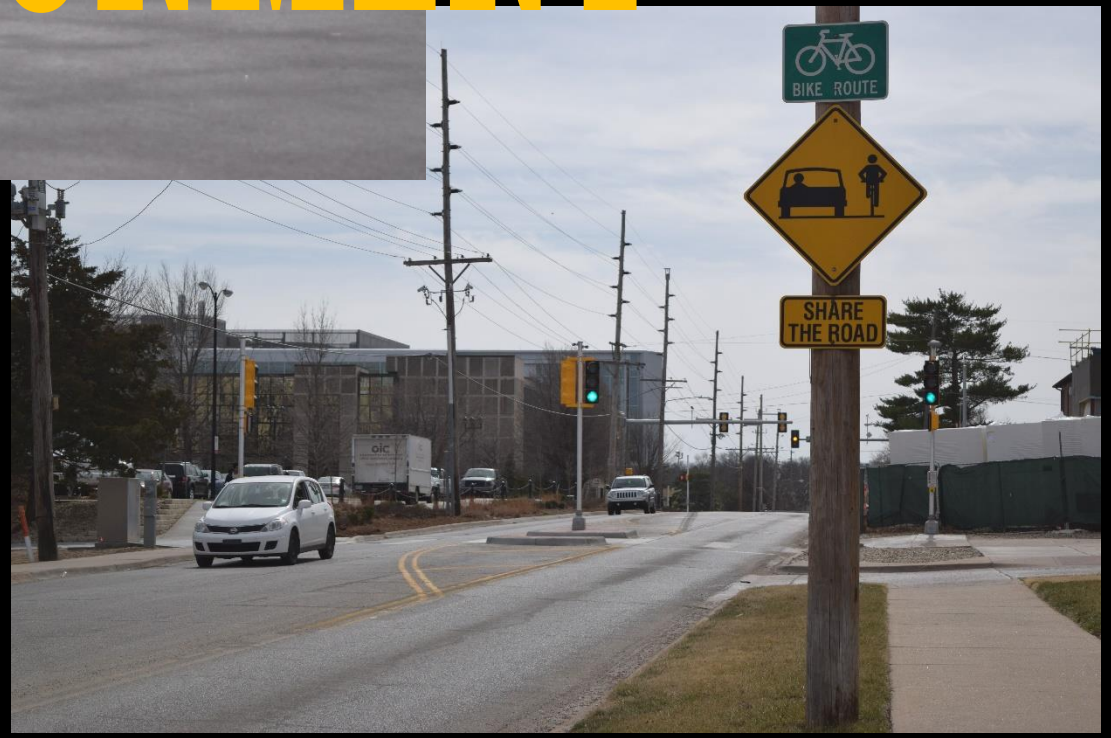
Dr. Hyung Jin Kim (bottom), of Landscape Architecture and Regional & Community Planning, first introduced me to research pertaining to built environment and physical activity. He passed on his passion for studying how community environment influences physical activity, especially through the Safe Routes to School study here in Manhattan.

PHYSICAL ACTIVITY

- Physical Activity Guidelines
  - Weekly: 150 mins of moderate, 75 mins of vigorous, or combination of both (USDHHS, 2008)
  - Bouts of 10 mins or more count toward meeting guidelines and often as helpful in regard to health benefits as longer bouts of exercise (USDHHS, 2008)
    - Active transportation and incorporating walking or biking throughout the day can help meet the aerobic physical activity recommendations
- 4 domains of physical activity
  - Transportation, occupational, recreational, and residential
- Currently 1 in 5 adults meet the aerobic physical activity recommendations on a regular basis (CDC, 2013).
- Many university students do not meet physical activity recommendations on a regular basis and it is not common for activity levels to increase as their years at the university increase (Judge, Bellar, et al. 2014).

BUILT ENVIRONMENT





TERMS

- Built Environment
  - Infrastructure that dictates use of the area such as trails, roads, buildings, parks, etc.
- Streel-Level infrastructure and amenities
- Lane features, parking, lighting, street connectivity, intersections, bike lanes, and road density (Bushell, Poole, Zegeer, & Rodriguez, 2013)
- Pedestrian-Level infrastructure and amenities
  - Sidewalks, crosswalks, benches, the proximity of buildings to the street, lighting, and aesthetics (Bushell, Poole, Zegeer, & Rodriguez, 2013)
- Active transportation
  - Non-motorized transportation - walking, biking, skateboarding, use of public transportation, etc.
- Green Apple Bikes
  - Bike share program in MHK – free to use, easy to spot, and grown in popularity
- aTa Bus services
  - Public transit with 4 main routes around MHK – 2 specifically when KSU in session
- K-State 2025
  - Campus visionary plan to make significant changes on campus to meet goals by 2025

INTRODUCTION

- Among a variety of changes on campus, the built environment has changed from street-oriented to pedestrian-oriented (especially in the past few years).
- Community response to the changes has been both positive and negative
- A prior study of active commuting behaviors at Kansas State University (KSU) became the foundation for my study
- Is there a connection between changes of campus built environment to physical activity and commuting behaviors?
- A cross-sectional study of the KSU population at 2 points in time, the Spring semesters of 2008 and 2016, could study differences between populations.

Active commuting patterns at a large, midwestern college campus. Bopp et. al 2011

- OBJECTIVE:
  - To understand patterns and influences on active commuting (AC) behavior.
- PARTICIPANTS:
  - Students and faculty/staff at Kansas State University (Manhattan campus) during Spring 2008 semester
- METHODS:
  - In April-May 2008, respondents answered an online survey about mode of travel to campus and influences on commuting decisions. Hierarchical regression analyses predicted variance in walking and biking using sets of demographic, psychological, and environmental variables.
- RESULTS:
  - Of 898 respondents, 55.7% were female, 457 were students (50.4%). Students reported more AC than faculty/staff (likely due to proximity to campus). For students, the models explained 36.2% and 29.1% of the variance in walking and biking, respectively. Among faculty/staff, the models explained 45% and 25.8% of the variance in walking and biking. For all models, the psychological set explained the greatest amount of variance (self-efficacy and individual barriers).
- CONCLUSIONS:
  - With current economic and ecological concerns, AC should be considered a behavior to target for campus health promotion.

PURPOSE & HYPOTHESIS

(1) Examine differences in the overall physical activity and active transportation (AT) behaviors of KSU students, faculty and staff between 2008 and 2016

Hypothesis: The overall rates of active transportation and physical activity are greater for students and faculty/ staff in 2016 than they were in 2008.

(2) Explore influential factors for transportation choice and perceptions of the campus built environment in 2016.

METHODS

DESIGN/ PROCEDURES

- Online electronic survey (Qualtrics)
- 43 questions; including all 29 from 2008 survey
- Question topics: Demographics, PA levels, transportation modes (TM), weekly commuting and parking habits, usage of built environment features and written feedback regarding influential BE and AT changes to campus
- Available for 4 weeks in April – May 2016
- Flyers, email listservs, word-of-mouth, ads, and gift cards were used to promote survey participation

MEASURES

- Demographics such as sex, age, role at KSU, student status, years at KSU, and college(s) within the University.
- Modified IPAQ (minutes and days per week per type of physical activity)
- Frequency and distance of trips to campus made by walking, biking, driving, and other modes per week
- A 5-point Likert scale was used to determine influential factors for choice of transportation mode(s)
- Additional questions asking about parking compared to previous years, location of parking, and usage of built environment features based on features added to campus since 2008.
- Open-ended questions on built environment and active transportation and suggestions for improvements

ANALYSIS

- Qualtrics for descriptive data and crosstabs; SPSS 25 for further analyses
- To determine differences between 2008 and 2016 survey responses, independent samples t-tests were conducted for each role (students or faculty/staff) with weekly minutes of moderate and vigorous physical activity, and average days for each type of transportation to campus as the dependent variables.
- To assess if there were significant relationships between physical activity and mode of transportation for each year, bi-variate correlation analysis was conducted for each role (students or faculty/staff) and year (2008 or 2016).
- Most influential factors for mode of transport were identified for the 2016 participants and compared by and role using independent samples t-tests
- Linear regression was used to predict the variance for each transportation mode with influential factors as the independent variables.
- Word clouds were created from the thematic analysis of the open-ended questions based on quantity of responses for each theme.

RESULTS

SURVEY POPULATION DEMOGRAPHICS

Characteristic	2008		2016	
	N (%)	Mean (SD)	N (%)	Mean (SD)
Sex				
Male	397 (44.3)		354 (35.3)	
Female	501 (55.7)		649 (64.7)	
Age in years	898	32.9 (14.0)	1003	26.7 (10.8)
	Range = 18-70		Range = 18-77	
Length of time on Campus				
Less than a year	--		107 (10.7)	
1 year	--		97 (9.7)	
2 years	--		180 (17.9)	
3 years	--		182 (18.1)	
4 years	--		124 (12.3)	
5 or more years	--		315 (31.3)	
Role				
Student	457 (50.9)		810 (80.8)	
Faculty	266 (29.6)		78 (7.8)	
Staff*	175 (19.5)		115 (11.4)	
Year in School (students only)				
Freshman	37 (8.2)		98 (12.1)	
Sophomore	65 (14.4)		132 (16.3)	
Junior	109 (23.9)		188 (23.2)	
Senior	190 (41.7)		249 (30.7)	
Graduate Student	54 (11.8)		144 (17.8)	

PHYSICAL ACTIVITY BEHAVIORS

Self-Reported Physical Activity from Both Survey Years

Characteristic	2008		2016	
	N	Mean (SD)	N	Mean (SD)
Weekly Minutes of Moderate Physical Activity				
Students	422	271.0 (248.3)	761	*480.9 (388.8)
Faculty/Staff	376	215.3 (195.3)	175	*332.7 (287.4)
Weekly Minutes of Vigorous Physical Activity				
Students	335	225.8 (224.8)	547	241.6 (245.3)
Faculty/Staff	248	164.7 (151.0)	107	183.6 (154.4)

*Significantly greater in 2016 than 2008 ($p < .001$)

TRANSPORTATION BEHAVIORS

Weekly Frequency of Each Travel Mode from Both Survey Years		2008		2016
Travel Mode to Campus (days per week)	**N**	**Mean (SD)**	**N**	**Mean (SD)**
Automobile				
Students	436	2.2 (2.3)	555	***3.3 (2.1)
Faculty/Staff	393	4.2 (2.0)	162	*4.5 (1.5)
Walking				
Students	436	3.7 (2.7)	574	3.8 (2.3)
Faculty/Staff	392	0.8 (1.7)	62	***2.0 (2.3)
Biking				
Students	436	0.8 (1.8)	253	***1.4 (2.1)
Faculty/Staff	393	0.4 (1.3)	47	**1.4 (1.9)
Other (e.g., skateboard)				
Students	434	0.0 (0.2)	169	**0.2 (0.9)
Faculty/Staff	390	0.0 (0.1)	33	0.1 (0.5)

Significantly greater than 2016 *($p < 0.05$), **($p < 0.01$), ***($p < .001$)

PHYSICAL ACTIVITY AND TRANSPORTATION

Students

2008

- No significant relationship between moderate or vigorous physical activity and any modes of transportation.

2016

- Moderate physical activity was negatively correlated with driving ($r = -0.13$, $p = 0.003$) but positively correlated with other transportation to campus ($r = 0.15$, $p < 0.05$).
- There was no relationship between vigorous physical activity and any modes of transportation.

Faculty/ Staff

2008

- Moderate physical activity was positively correlated with other transportation to campus ($r = 0.17$, $p = 0.001$), while vigorous physical activity was negatively correlated with driving ($r = -0.14$, $p = 0.033$) but positively correlated with other transportation to campus ($r = 0.29$, $p < 0.001$).

2016

- Moderate physical activity was positively correlated with walking to campus ($r = 0.46$, $p < 0.001$) and other transportation to campus ($t = 0.42$, $p = 0.02$). There was no relationship between vigorous physical activity and any modes of transportation.

Table 5. Key Factors Influencing Transportation Mode Choice in 2016.

Factor	Overall (N=922)	Students (N=749)	Faculty/Staff (N=173)	% Rating factor as most influential (5)
Time Constraints	4.16 (1.21)	4.11 (1.23)	4.39 (1.12)	56.6
Weather	3.67 (1.31)	3.67 (1.27)	3.66 (1.46)	34
Traveling to other points	3.58 (1.39)	3.55 (1.38)	3.70 (1.45)	33.6
Parking availability	3.49 (1.49)	3.57 (1.46)*	3.15 (1.59)	35.3
Parking cost	3.38 (1.53)	3.42 (1.54)	3.18 (1.49)	34.4
Health benefits	2.99 (1.42)	3.00 (1.41)	2.94 (1.45)	17.2
Traffic Congestion	2.89 (1.45)	2.91 (1.42)	2.82 (1.56)	17.9
Safety concerns (traffic)	2.47 (1.47)	2.34 (1.39)	3.04 (1.65)**	14.3
Availability of sidewalks	2.45 (1.48)	2.43 (1.47)	2.56 (1.52)	13.4
Terrain (e.g. hills)	2.41 (1.36)	2.37 (1.32)	2.61 (1.50)	10.1
Access to a bike	2.38 (1.50)	2.44 (1.51)	2.12 (1.43)	14.4
Economic concerns	2.28 (1.35)	2.28 (1.36)	2.31 (1.35)	8.7
Traveling with others	2.27(1.42)	2.24 (1.39)	2.40 (1.55)	10.7
Environmental concerns	2.26 (1.33)	2.19 (1.31)	2.58 (1.36)	8.8
Access to a vehicle	2.22 (1.52)	2.22 (1.51)	2.25 (1.57)	15.3
Safety concerns (crime)	2.19 (1.47)	2.21 (1.37)	2.08 (1.34)	9.1
Health problems	1.93 (1.28)	1.90 (1.25)	2.04 (1.37)	7.1

Ratings were based on a 5-point scale (from 1 "it is not an important factor" to 5 "it is a very important factor")

*Significantly higher than faculty/staff ($p < 0.01$)

**Significantly higher than students ($p < 0.001$)

Regression Model Predicting Transportation Choice – Driving days/week

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.95	0.24		8.10	.000
	Role (student or faculty/staff)	1.29	0.19	0.26	6.93	.000
2	(Constant)	1.21	0.39		3.09	.002
	Role (student or faculty/staff)	0.97	0.17	0.19	5.57	.000
	Time constraints	0.44	0.07	0.23	6.67	.000
	Traffic congestion	-0.18	0.06	-0.12	-3.17	.002
	Terrain (e.g. hills)	0.25	0.06	0.17	4.26	.000
	Safety concerns (for traffic)	0.15	0.06	0.11	2.59	.010
	Parking cost	-0.10	0.05	-0.07	-1.98	.048
	Access to a vehicle	0.11	0.05	0.08	2.34	.020
	Health benefits	-0.42	0.05	-0.28	-7.67	.000

*Participant role was entered in step 1 of the model and accounted for **6.6% of the variance**, $f(1,683) = 48.05$, $p < 0.001$.
*The remaining factors, along with role, accounted for **24.8% of the variance**, $f(8,683) = 27.89$, $p < 0.001$.

Strongest Predictors:
health benefits ($\beta = -0.28$) and time constraints ($\beta = 0.23$)

Regression Model Predicting Transportation Choice – Walking days/week

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	5.64	0.35		16.06	.000
	Role (student or faculty/staff)	-1.80	0.31	-0.23	-5.87	.000
2	(Constant)	5.93	0.53		11.24	.000
	Role (student or faculty/staff)	-1.59	0.29	-0.21	-5.42	.000
	Time constraints	-0.31	0.07	-0.17	-4.28	.000
	Traffic congestion	0.30	0.07	0.18	4.40	.000
	Weather	-0.28	0.08	-0.14	-3.50	.000
	Safety concerns (for traffic)	-0.26	0.07	-0.15	-3.51	.000
	Parking cost	0.19	0.06	0.12	3.10	.002
	Health benefits	0.25	0.07	0.15	3.85	.000

*Participant role was entered in step 1 of the model and accounted for **5.4% of the variance**, $f(1, 605) = 34.49$, $p < 0.001$.
*The remaining factors, along with role, accounted for **17.8% of the variance**, $f(7, 605) = 18.44$, $p < 0.001$.

Strongest Predictors: role (β =-.21) and traffic congestion (β = 0.18)

Regression Model Predicting Transportation Choice
Biking days/week

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	.87	.34		2.569	.011
	Safety concerns (for crime)	-.40	.09	-.26	-4.321	.000
	Economic concerns (e.g. cost of maintaining a car)	.26	.09	.183	2.959	.003
	Health benefits	.24	.09	.160	2.661	.008

*Participant role was not significant.
*The remaining factors accounted for **9.9% of the variance,**
$f(3, 287) = 10.46$, $p < 0.001$

Strongest Predictor:
Safety concerns for crime
($\beta = -0.26$)

Q: INDICATE WHAT OTHER CHANGES WERE NOTICED AROUND CAMPUS THAT INFLUENCED CHOICE OF TRANSPORTATION

- **436 responses**
- 174 addressed construction
- 128 addressed parking
- 99 addressed walking
- 64 addressed biking

Q: WHAT ADDITIONAL CHANGES WOULD YOU SUGGEST TO IMPROVE WALKING AND BIKING ON OR DURING THE TRIP TO/FROM CAMPUS

- **403 responses**
- 207 addressed walking
- 181 addressed biking
- 56 addressed parking
- 27 K-State Master Plan

MAIN FINDINGS

(1) Hypothesis: The overall rates of active transportation and physical activity (PA) are greater for students and faculty/ staff in 2016 than they were in 2008. **Mostly correct!**

- Moderate PA sig. higher for both students and faculty/staff in 2016 but not vigorous PA
- Driving and biking sig. higher for both populations, walking sig. higher for faculty/staff and other transportation is sig. higher for students

(2) Significant findings in factors influencing mode of transportation:

- Time constraints, weather, and traveling to other destinations were rated most influential by students and faculty/staff. Even with the tendency to assume differences between populations, the top factors were the same for both populations.
- Stepwise backward elimination linear regression was able to predict some amount of variance in 3 modes of transport based on the significance of role/factors. This helps to understand which factors are deemed to play a significant role in whether or not someone drives, walks, or bikes.

Main themes in feedback addressing changes to campus built environment and AT behaviors

-Changes to parking, walking, and biking infrastructure via construction were most likely to impact active transportation behaviors

-Suggestions to improve active transportation focused on walking, biking, parking and understanding the future improvements expected from the K-State 2025 Master Plan.

LIMITATIONS/ FUTURE RESEARCH

- Limitations:
  - Did not use the survey questions about usage of built environment features, address information to track distance of commute and groupings of students versus faculty/ staff on a map with GIS, and did not use affiliated colleges or frequented buildings to assess if proximity and area of study play a role in physical activity and transportation behaviors.
    - These paired with current data findings will be addressed in future manuscripts
  - Some questions were not worded correctly on the survey to match the response type necessary for certain analysis – this will come with experience of creating surveys.
  - Having a higher response rate of students in 2016 and faculty/staff in 2008 (need to find a way to market to a more representative sample of the University population).
- Future Research:
  - Taking this project a step forward would be to study the amount of physical activity from active transportation alone and note the differences in health and wellness – maybe with a smaller sample size? Tradeoff of power in order to gain insight into individual factors
  - Understanding the factors that significantly influence physical activity and transportation behaviors in this population can be useful when trying to effectively promote healthier behaviors. *Evidence-based solutions are most effective in lasting behavior change.

WHAT ARE THE HEALTH BENEFITS OF ACTIVE TRAVEL? A SYSTEMATIC REVIEW OF TRIALS AND COHORT STUDIES. SAUNDERS ET AL. 2013

- Does active travel reduce obesity rates? Positive influence on Other health outcomes? **"maybe"**
- Systematic review of non-randomized, & randomized control trials and observational studies
  - Looking for studies that had purposeful intent of studying active transportation and its influence on obesity and other health outcomes (diabetes, heart disease, cancer, fitness, bp, vo2, etc.)
- 12 countries, 24 studies, 6 involving children

Adults:
- Slight dose/response for diabetes
- No difference in risk for breast cancer
- Chinese showed more benefit from higher MET expenditure than US adults in various amounts of minutes of PA
- Cyclists had lower risk for all risk mortality

Children:
- No intervention studies
  - *SRTS*
- No statistical difference in bone density, BMI and skinfolds, sustained active travel & relative weight
- Children who cycled to school had a better fitness level than those that did not

EVIDENCE IS NOT CONCLUSIVE! But it is suggested to frequently use AC and longer trips = better benefits

HEALTH PROMOTION AT ALL LEVELS

- National
  - Health People 2020 (Office of Disease Prevention and Health Promotion)
  - Healthiest Nation 2030 (EPA and American Public Health Association)
  - Let's Move! Campaign for physical activity
  - Physical Activity Guidelines
- State
  - Walk Kansas – Promotion of walking and biking and community involvement
  - KDHE – Division of Public Health – Health promotion, PA, worksite wellness
- Local
  - Master Bike Plan, City Park renovations
  - Green Week
    - This week on campus – Monday was Bike to Campus Day

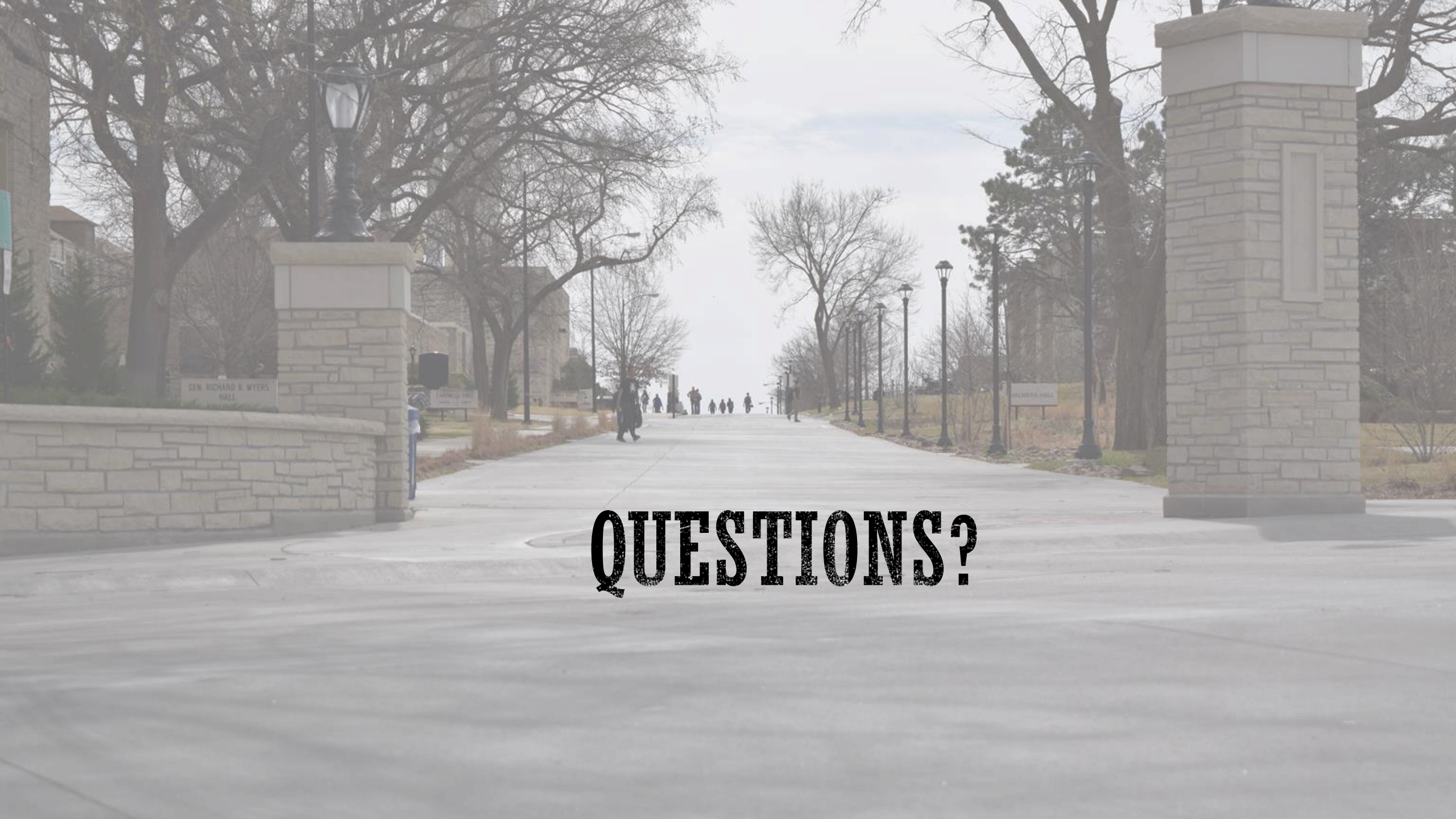
CALL TO ACTION

- "Many lifestyles in the United States are built around car travel and provide few opportunities for physical activity. Measuring and tracking the number of trips that require physical activity reveals individual physical activity levels. It also reflects how much support is needed to achieve more active transportation. To increase physical activity, it is important to reduce car dependency and provide increased opportunities for walking and bicycling. This indicator can be useful for decision makers wanting to create and implement policies to support alternate modes of transportation and direct investments to supportive infrastructure such as bicycle lanes, greenways, and sidewalks."

- U.S. Department of Transportation

FIELD EXPERIENCE

- Fort Riley Army Post
- Summer 2015
- Contact Hours: 180
- Department of Public Health
  - Army Nursing
  - Army Hearing Program
  - Environmental Health
  - Occupational Health
  - Veterinary Services
  - Army Wellness Centers
  - Administrative
  - Army Wellness Officer/ General's Office
- Objective sheets signed off by mentor, streamlined process due to popularity of site



QUESTIONS?

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