Combinations of Perceived Built Environmental Factors Differentiating Physically Active vs. Non-Active Adults – A Decision Tree Classification Approach

Yue Liao, MPH
Genevieve Dunton, PhD, MPH
Chih-Ping Chou, PhD
Arif Ansari, PhD
Casey Durand, MPH
Donna Spruijt-Metz, PhD
Mary Ann Pentz, PhD

Built Environmental Factors & Physical Activity

- Some characteristics of built environment are associated with people's physical activity level
  - Mixed land use (i.e., retail/commercial density)
  - Accessibility (i.e., distance to destinations)
  - Infrastructure (i.e., sidewalks, crosswalks)
  - Perceptual characteristics (i.e., safety, aesthetics)

Handy et al., 2002; Humpel et al., 2002; Li et al., 2005; Forsyth et al., 2008.

Combination & Interaction Effects of Environmental Factors?

- Previous studies typically examine the main (bivariate or independent) effects
- Information is lacking on the complex and multifaceted ways environmental factors may combine and interact with each other

The Hierarchy of Walking Needs
(Alfonzo, 2005)

- Five levels of needs that people consider when deciding to walk
  i. Feasibility (i.e., age, physical mobility)
  ii. Accessibility (i.e., presence of sidewalk, distance to destination)
  iii. Safety (i.e., fear of crime, presence of litter, pawnshops)
  iv. Comfort (i.e., street trees, sidewalk buffers)
  v. Pleasurability (i.e., aesthetic appeal)
- A higher order need would not be considered if a more basic need was not satisfied

Current Study

- How do different environmental factors interact with each other to predict people's total physical activity level?
- Which factors (combination of factors) are more important ("basic needs")?

Participants

- Adults from Healthy PLACES project with valid accelerometer data
  - at least 4 valid days out of 7 monitoring days
    - a valid day = at least 10 valid hours
- N=494
  - ages 23-62 (*M*=39.4) years
  - 82.6% female, 52.4% Hispanic
  - 22.7% annual household income <$30,000

Built Environmental Factors

- Self-reported items from Neighborhood Environment Walkability Scale (NEWS) including measures about
  - distance to park, gym
  - presence of sidewalks, pedestrian trails
  - accessibility to stores, transit stops
  - shades, litter, interesting things to look at in the neighborhood
  - traffic volume along the street, crosswalks
  - safety from crime

Saelens et al., 2003

Total Physical Activity Level

- Whether people met the recommended 30-minute average daily moderate-to-vigorous physical activity (MVPA)

- 33.0% participants were defined as “active”

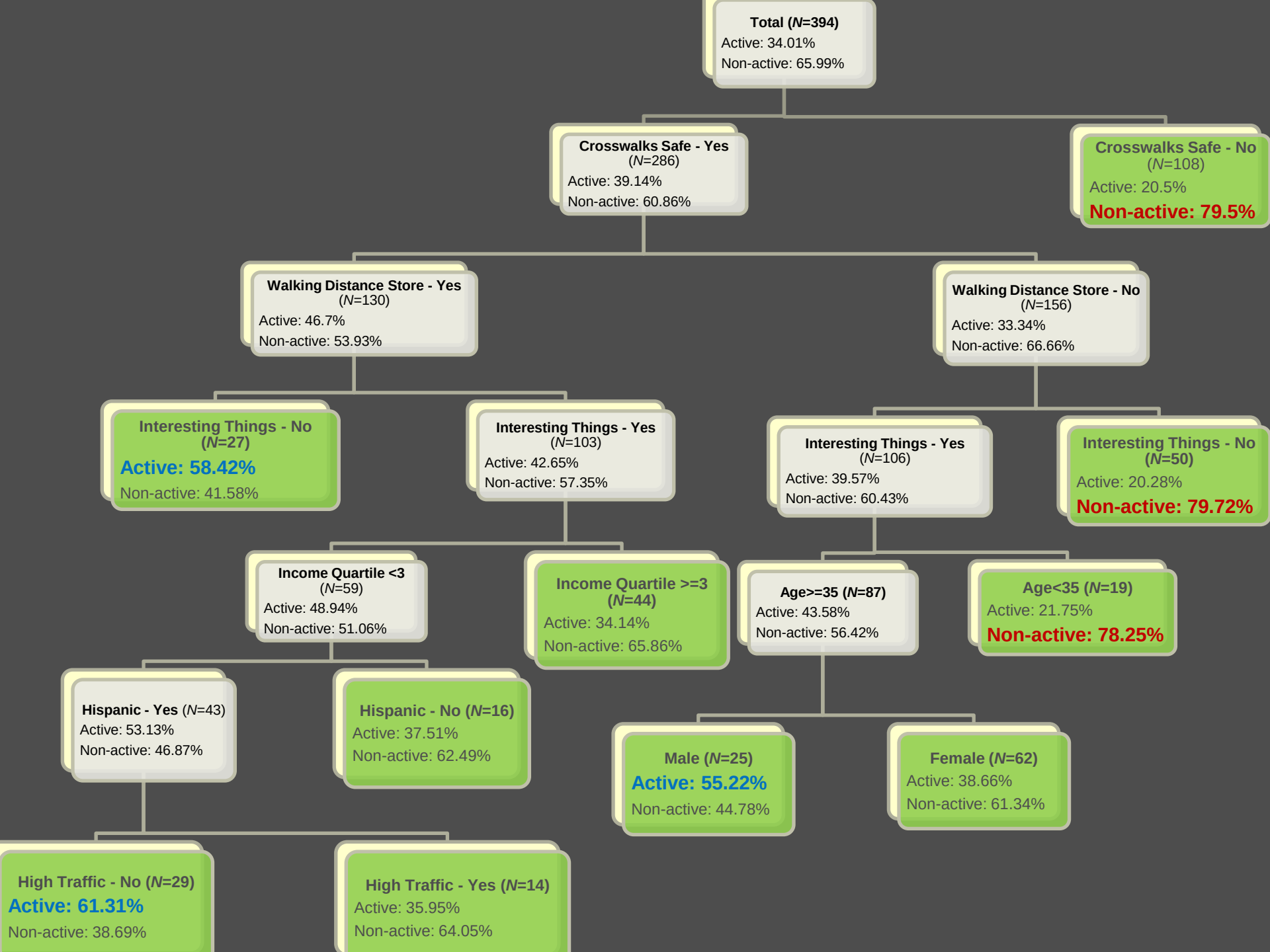
Statistical Methods

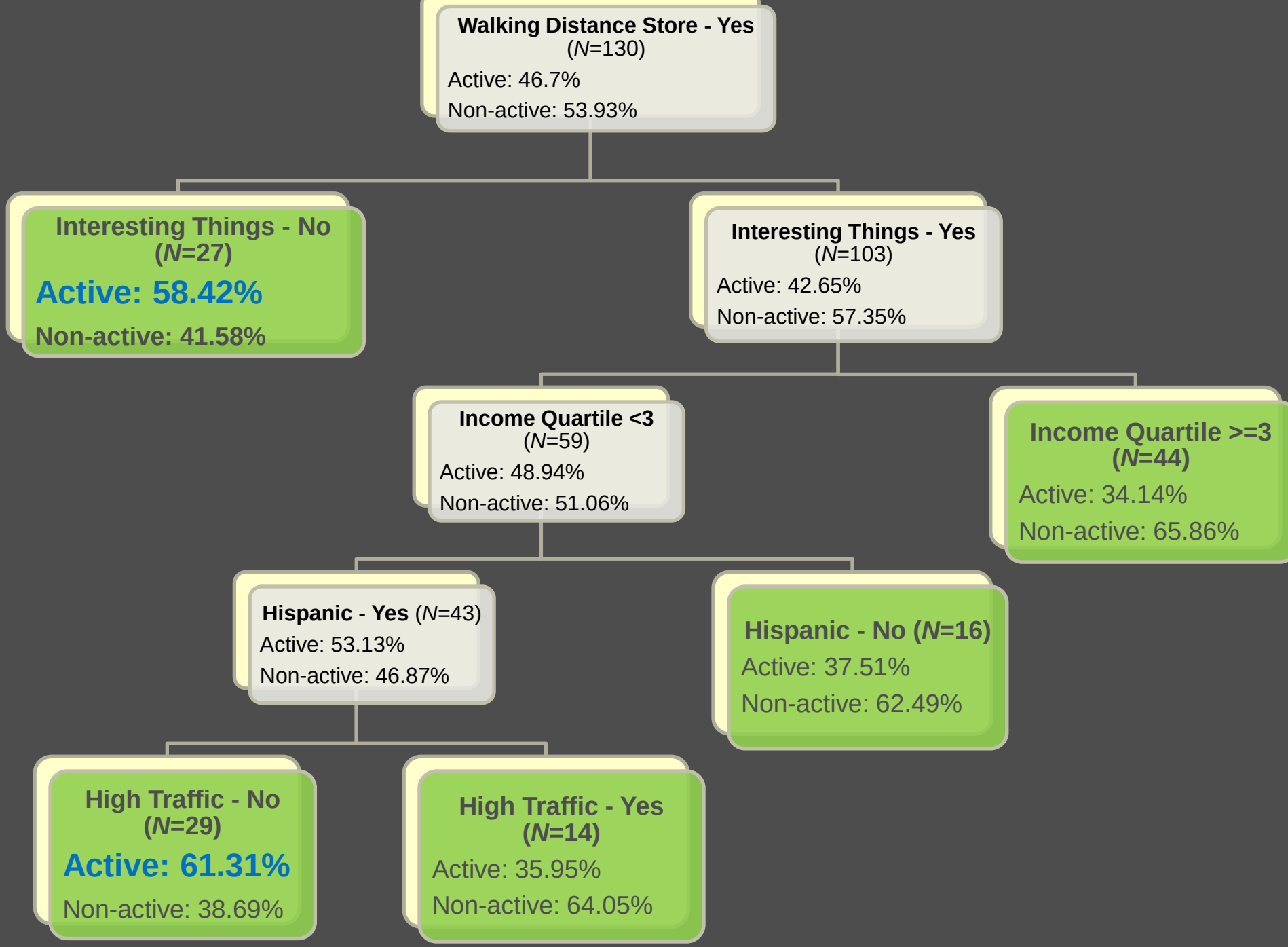
- Recursive partitioning (decision tree) was used to classify membership (active vs. non-active) based on environmental factors & demographic variables
  - a binary classification method
  - can examine the effects of combination of multiple predictors
    - if a person has x, y, and z, what is the probability of having condition q

- Order of the predictors was selected based on conditional probability that can minimize the entropy (randomness) in the model
  - the first predictor to be partitioned = the most important predictor to distinguish between membership (active vs. non-active)
- Analysis was performed using JMP 9.0.0

Results

- 10 groups with different combinations of environmental factors and demographic variables that distinguish between active vs. non-active adults were identified
- Accuracy rate of predicting active vs. non-active adults was 70%


Total (N=394)
Active: 34.01%
Non-active: 65.99%
Crosswalks Safe - Yes (N=286)
Active: 39.14%
Non-active: 60.86%
Crosswalks Safe - No (N=108)
Active: 20.5%
Non-active: 79.5%
Walking Distance Store - Yes (N=130)
Active: 46.7%
Non-active: 53.93%
Walking Distance Store - No (N=156)
Active: 33.34%
Non-active: 66.66%
Interesting Things - No (N=27)
Active: 58.42%
Non-active: 41.58%
Interesting Things - Yes (N=103)
Active: 42.65%
Non-active: 57.35%
Interesting Things - Yes (N=106)
Active: 39.57%
Non-active: 60.43%
Interesting Things - No (N=50)
Active: 20.28%
Non-active: 79.72%
Income Quartile <3 (N=59)
Active: 48.94%
Non-active: 51.06%
Income Quartile >=3 (N=44)
Active: 34.14%
Non-active: 65.86%
Age>=35 (N=87)
Active: 43.58%
Non-active: 56.42%
Age<35 (N=19)
Active: 21.75%
Non-active: 78.25%
Hispanic - Yes (N=43)
Active: 53.13%
Non-active: 46.87%
Hispanic - No (N=16)
Active: 37.51%
Non-active: 62.49%
Male (N=25)
Active: 55.22%
Non-active: 44.78%
Female (N=62)
Active: 38.66%
Non-active: 61.34%
High Traffic - No (N=29)
Active: 61.31%
Non-active: 38.69%
High Traffic - Yes (N=14)
Active: 35.95%
Non-active: 64.05%


Walking Distance Store - Yes (N=130)
Active: 46.7%
Non-active: 53.93%
Interesting Things - No (N=27)
Active: 58.42%
Non-active: 41.58%
Interesting Things - Yes (N=103)
Active: 42.65%
Non-active: 57.35%
Income Quartile <3 (N=59)
Active: 48.94%
Non-active: 51.06%
Income Quartile >=3 (N=44)
Active: 34.14%
Non-active: 65.86%
Hispanic - Yes (N=43)
Active: 53.13%
Non-active: 46.87%
Hispanic - No (N=16)
Active: 37.51%
Non-active: 62.49%
High Traffic - No (N=29)
Active: 61.31%
Non-active: 38.69%
High Traffic - Yes (N=14)
Active: 35.95%
Non-active: 64.05%

Combinations of factors that predict active adults	Probability
1. Crosswalks (Yes) + Store (Yes) + Interesting (Yes) + Income Quartile (<3) + Hispanic (Yes) + Traffic (No)	61.31%
2. Crosswalks (Yes)	58.42%
3. Crosswalks (Yes) + Store (No) + Interesting (Yes) + Age (>=35) + Male	55.22%
Combinations of factors that predict non-active adults	
1. Crosswalks (Yes) + Store (No) + Interesting (No)	79.72%
2. Crosswalks (No)	79.50%
3. Crosswalks (Yes) + Store (No) + Interesting (Yes) + Age (<35)	78.25%

Conclusions

- “Active” participants were more likely to live in a neighborhood where there are combined presence of
  - safety (crosswalks which help walkers feel safe crossing streets, low traffic along the home street)
  - accessibility (stores are within walking distance from home)
- even when pleasurability (interesting things to look at) is absent

- However, presence of pleasurability (combined with safety and accessibility) are important for lower income Hispanic adults
- Presence of safety and pleasurability are important for older (>=35 years) males
  - when accessibility is absent

- “Non-active” participants were more likely to live in a neighborhood where safety is absent, or
  - safety is present, but accessibility and pleasurability were absent
  - safety and pleasurability were present, but accessibility was absent for
    - younger adults (<35 years old)

Summary

- Presence of safety is a salient predictor for active adults
- Absence of accessibility is a salient predictor for non-active adults
- Pleasurability matters for certain demographic sub-groups

- Hierarchy of needs?

Limitations

- Choices of environmental factors
- Use of single items from NEWS
- Relatively small sample size for decision tree classification method
- Unclear about types and locations of physical activities
  - recreational vs. transportation activity
  - within or outside of neighborhood

Future Direction

- More comprehensive measures of environmental factors
  - Combined use perceived, audit, and GIS data
- Use of GPS data
  - Only look at the activities that occurred within the neighborhood

Acknowledgements

- National Cancer Institute #R01-CA-123243 (Pentz, PI)
- American Cancer Society Mentored Research Scholar Grant 118283-MRSGT-10-012-01-CPPB (Dunton, PI)
- ALR Accelerometer Loan Program
- Robert Gomez, B.A., and Keito Kawabata, B.A. (University of Southern California)