

Washington University in St. Louis
Washington University Open Scholarship

Brown School Faculty Publications

Brown School

1-1-2013

Emerging Technologies: Webcams and Crowd-Sourcing to Identify Active Transportation

J. Aaron Hipp

Washington University in St. Louis, Brown School, ahipp@wustl.edu

Deepti Adlakha

Washington University in St. Louis, Brown School, deeptia@wustl.edu

Bill Chang

Washington University in St. Louis, Computer Science and Engineering, billchang@wustl.edu

Amy A. Eyler

Washington University in St. Louis, Brown School, aeyler@wustl.edu

Robert B. Pless

Washington University in St. Louis, Computer Science and Engineering, pless@wustl.edu

Follow this and additional works at: http://openscholarship.wustl.edu/brown_facpubs

 Part of the [Community Health and Preventive Medicine Commons](#), and the [Environmental Public Health Commons](#)

Recommended Citation

Hipp, J. Aaron; Adlakha, Deepti; Chang, Bill; Eyler, Amy A.; and Pless, Robert B., "Emerging Technologies: Webcams and Crowd-Sourcing to Identify Active Transportation" (2013). *Brown School Faculty Publications*. Paper 3.
http://openscholarship.wustl.edu/brown_facpubs/3

This Article is brought to you for free and open access by the Brown School at Washington University Open Scholarship. It has been accepted for inclusion in Brown School Faculty Publications by an authorized administrator of Washington University Open Scholarship.

**Emerging Technologies:
Webcams and Crowd-Sourcing to Identify Active Transportation**

J. Aaron Hipp, PhD^{1,2*} Deepti Adlakha, MUD¹ Bill Chang, BS³ Amy A. Eyler, PhD^{1,2}
Robert Pless, PhD³

Washington University in St. Louis: ¹Brown School of Social Work, ²Prevention
Research Center, and ³Computer Science and Engineering

*One Brookings Drive, Washington University in St. Louis, Campus Box 1196
Saint Louis, Missouri 63130

[o] 314.935.3868 [f] 314.935.8511 [e] ahipp@wustl.edu

Introduction

Over 25% of adults in the US are obese,¹ contributing to 300,000 deaths and costing the US healthcare system \$147 billion annually.² Federal governments to local non-profit agencies have instituted policy and built environment (BE) changes in effort to reduce obesity and increase physical activity (PA). A challenge in evaluating the success of policy and BE change is the capacity to capture *a priori* PA behaviors and the ability to eliminate researcher and respondent bias in assessing post-change environments. A novel transdisciplinary collaboration between public health and computer science is presented here with the goal of automatically analyzing existing public data feeds in innovative ways to quantify BE intervention effectiveness.

Methods

The Archive of Many Outdoor Scenes (AMOS) has collected over 225 million images of outdoor environments from more than 12,000 public webcams since 2006.³ AMOS uses publicly available webcams and a custom web crawler (similar to web search engine or Google) to capture webcam images with a time stamp, capturing one photographic image per camera each half hour.⁴ Many of these environments have experienced BE improvements or policy change (e.g., complete street policies, bike shares, and walking school bus programs). AMOS provides a unique opportunity to measure BE change and associated behavioral modification.

Available webcams were spatially matched with policy and BE changes, identifying pilot areas in the US that have instituted BE change since 2006. One example is the addition of protected bike lanes and a bike share program in Washington, DC, during 2009/2010.

An AMOS webcam captured example BE change (addition of cycle paths; Figure 1) at the intersection of Pennsylvania Avenue NW and 9th Street NW. Using the AMOS dataset, all 120 webcam photographs were captured between 7:00am and 7:00pm during the first work week of June 2009 and the 120 photographs were captured from the same week of June 2010. The use of this captured webcam data allowed for a pre-cycle path and post-cycle path travel mode analysis.

The Amazon Mechanical Turk (MTurk) website was used to crowd-source the image annotation.⁵ MTurks are simple tasks that have not yet been automated by computers. MTurk workers were paid US\$0.01 in March 2012, to mark each pedestrian, cyclist, and vehicle in a photograph. Each image was counted 5 unique times (n=1200), a process completed in under eight hours. Counts per transportation mode were downloaded to SPSSv.19 for analysis in April 2012. The odds of observing each transportation mode in year two compared to year one was examined and a MANOVA conducted to establish overall mode variance between the years. With five unique workers, the range and variance of counts differed per photo. A test for difference in variation between the two years was not significantly different for any one travel mode. Recent research has revealed MTurk workers to be reliable.^{6,7}

Results

The odds of the webcam at Pennsylvania and 9th capturing a cyclist present in the scene in 2010 increased 3.5 times, compared to 2009 (OR=3.57, $p<0.001$). The number of cyclists per scene increased four-fold between 2009 (mean=0.03; SD=0.20) and 2010 (0.14; 0.90; $F=36.72$, 1198; $p=0.002$), associated with the addition of a new cycle path in the captured webcam scene. There was not a significant increase in pedestrians between years, but there was a significant increase in number of vehicles ($F=16.81$, 1198, $p<0.001$; see Figure 1). Overall, the MANOVA test revealed a statistically significant difference in transportation mode share between the two years ($F(3, 1196) = 11.265$, $p<0.001$).

Discussion

Findings suggest publicly available web data feeds and crowd-sourcing have great potential for capturing behavioral change associated with BEs. The addition of cycle paths at Pennsylvania and 9th was associated with a significant four-fold increase in the number of cyclists captured per scene.

This initial, novel research presents an unobtrusive surveillance of the effectiveness of a PA policy and BE intervention. The use of public webcam scenes and MTurks offer an inexpensive (US\$12.00) means for public health, urban design, and governments to evaluate effectiveness of BE policy change and interventions. Future research includes testing with additional bike lane scenes in Washington, DC and expanding to include

parks and safe routes to schools. Current efforts are also focused on the utilization of computer algorithms to automate the counting of transportation modes per scene.

Acknowledgements

The authors would like to acknowledge the Washington University in St. Louis University Research Strategic Alliance for providing the funding for this cross-university research.

References

1. CDC. Division of Nutrition, Physical Activity and Obesity. 2009 14 April 2009]; Available from: <http://www.cdc.gov/nccdphp/dnpa/index.htm>
2. Finkelstein E, Trogdon J, Cohen J, Dietz W. Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Affairs* 2009;28(5):822-831.
3. Pless R, Jacobs N. The Archive of Many Outdoor Scenes 2006; Available from: <http://amosweb.cse.wustl.edu/>
4. Jacobs N, Burgin W, Fridrich N, Abrams A, Miskell K, Braswell BH, et al. The Global Network of Outdoor Webcams: Properties and Applications. *ACM International Conference on Advances in Geographic Information Systems (SIGSPATIAL GIS)* 2009:111-120.
5. Bohannon J. Social science for pennies. *Science* 2011(334):307.
6. Mason W, Suri S. Conducting behavioral research on Amazon's Mechanical Turk. *Behavior Research Methods* 2012;44(1):1-23.
7. Buhrmester M, Kwang T, Gosling SD. Amazon's Mechanical Turk. *Perspectives on Psychological Science* 2011;6(1):3-5.

Figure. 1: Images of (A) pre-cycle path (2009), and (B) post-cycle path (2010) built environment improvement in Washington, DC, from AMOS; (C) Graph showing significant increase in cycling ($p < .001$).



A.

B.

