Technical Background Document on Impacts of Bicycle Strategies Based on a Review of the Empirical Literature

Susan Handy and Gil Tal, University of California, Davis
Marlon Boarnet, University of California, Irvine

Study Selection

Drawing on the extensive review by Pucher, et al. (2010), this review focused on studies from North America over the last 20 years that measure the impact of strategies on bicycling levels while controlling for socio-demographic characteristics. The search identified a small number of studies after excluding those that do not provide a quantitative measure of bicycle use and that do not differentiate between utilitarian trips (i.e. as a mode of travel) and recreational trips. The review considered both cross-sectional studies that compare bicycling in areas with different levels of infrastructure and before-and-after studies that measure changes in bicycling resulting from strategy implementation, whether an infrastructure investment, promotional program, or other policy. Studies that focus on the use of a new facility without accounting for potential shifts from other facilities were excluded. Only studies that provided enough information to enable the calculation of an effect size were included. No studies provided evidence of the effect of bicycle strategies on VMT, though Noland and Kunreuther (1995) give insights into the effect on the probability of driving.

Effect Size, Methodology and Applicability Issues

Effect sizes were calculated from the information presented in the papers as outlined in Tables 1 and 2. Each study uses a different methodology and different measures of bicycling, so that it is not possible to compare results. While controlling for socio-demographic characteristics, most studies do not account for weather, topography, and other factors that might moderate the effect of the strategy. They also do not control for self-selection, that is, the possibility that bicycling-inclined individuals choose residential locations with better bicycle infrastructure, or for the possibility that programs are more likely to be adopted in areas with greater potential for increased bicycling.

Other evidence suggests upper bounds for the total effect that could be expected from bicycle strategies. Pucher, et al. (2010) examined trends in cities world-wide that have adopted comprehensive programs involving infrastructure improvements and promotional programs and reported increases in bicycling share as shown in Table 3.

Note that the recent report published by the California Air Pollution Control Officers Association (CAPCOA), “Quantifying Greenhouse Gas Mitigation Measures,” assessed similar literature and, on the whole, found similar effects. The report does identify an effect size as large as 830 percent, but this is for an increase in bicycle lanes from 0.34 miles per square mile to 8.0 miles per square mile, nearly a 24-fold increase. This effect is thus equivalent to the effect reported here of a 0.3 percent increase in share of

bicycle commuters for a 1 percent increase in bicycle lanes per square mile (derived from Dill and Carr (2003) in the "Moving Cooler" report (Cambridge Systematics 2009)).

Table 1: Calculation of Effect Sizes for Studies of Infrastructure Projects

Study	Infrastructure measure	Bicycling measure	Results		
			Elasticities	*Calculation of effect size*	*Notes*
Dill and Carr (2003)	1. Miles of bike lanes per sq. mile	% commuting by bicycle	0.323 for impact of miles of bike lanes per sq. mile on percent commuting by bicycle per	Elasticity calculated based on regression coefficients (β) in Model 4 (see Table 3 in cited paper), average measure of infrastructure (x_o) and average % commuting by bicycle (y_o): $\beta * x_o / y_o$	Based on aggregate data for 33 of the largest U.S. cities, excluding New York City
	2. Average state spending of federal funds per capita on bicycle and pedestrian facilities (1990-99)		0.321 for impact of average state spending of federal funds per capita on bicycle and pedestrian facilities on percent commuting by bicycle	1. β=0.998, x_o=0.34, y_o=0.01055, elasticity = 0.323 2. β=1.021, x_o=$0.33 y_o=0.0105, elasticity = 0.321	

Study	Infrastructure measure	Bicycling measure	Results		
			Elasticities	*Calculation of effect size*	*Notes*
Noland and Kunreuther (1995)	1. Perceived bicycle parking available	Probability of bicycling; probability of driving	0.83 for impact of perceived bicycle parking on probability of bicycling -0.01 for impact of perceived bicycle parking on probability of using automobile	Effects on probability of bicycling are taken from direct short-run elasticities reported in Table 6 of cited paper. Effects on probability of using automobile are taken from short-run cross-elasticities reported in Table 7 of cited paper. Aggregate effects on mode share, as summarized in the brief, are reported in Table 8 of cited paper.	Short-run elasticities reflect the actual availability of different modes at the time of the study. Effect of bicycle comfort on probability of auto use is insignificant.
	2. Perceived bicycle convenience		3.16 for impact of perceived bicycle convenience on probability of bicycling -0.02 for impact of perceived bicycle convenience on probability of using automobile		
	3. Perceived bicycle comfort		0.97 for impact of perceived bicycle comfort on probability of bicycling		

Table 2: Calculation of Effect Sizes for Studies of Promotional Programs

Study	Promotional program	Bicycling measures	Calculation of effect size	Notes
Cooper (2007)	Promotion of transit and non-motorized modes to individuals who commit to reduce driving for 10 weeks	Bicycle trips that replace drive-alone trips	263 bicycling trips replaced driving trips (see Table 5 in cited paper), for 667 households that pledged to participate (see Table 4 in cited paper)	
League of American Bicyclists (2008)	Bike to Work Day promotion	Bicycle counts at central street intersection	Counts at Market Street and Van Ness from 8-9 am: One week before: 406 bikes Bike to Work Day: 813 bikes Four weeks later: 509 bikes	Counts may reflect seasonal effect

Study	Promotional program	Bicycling measures	Calculation of effect size	Notes
Staunton et al. (2003)	Safe Routes to School program	Number of children bicycling to school	As reported in paper, 114% increase in number of children bicycling from before to after implementation of program	Study did not include control schools

Table 3: Long-Term Increases in Bicycling Share for Comprehensive Programs

City	Number of Years	Increase in Bicycling Share
Barcelona	2	135%
Paris	6	150%
Bogota	8	300%
Portland	18	445%
Boulder	26	132%

Source: Pucher, et al. 2010

References

California Air Pollution Control Officers Association (2010). *Emission Reductions from Greenhouse Gas Mitigation Measures*. Sacramento, CA, August. Available: http://www.capcoa.org/wp-content/uploads/downloads/2010/09/CAPCOA-Quantification-Report-9-14-Final.pdf

Cambridge Systematics (2009). *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions*. Technical Appendices. Prepared for the Urban Land Institute. Available: http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

Cooper, C. (2007). Successfully changing individual travel behavior: Applying community- based social marketing to travel choice. *Transportation Research Record* 2021: 89-99.

Dill, J., Carr, T. (2003). Bicycle commuting and facilities in major U.S. cities: If you build them, commuters will use them. *Transportation Research Record* 1828, 116–123.

League of American Bicyclists (2008). Bike to Work events in selected US Cities. Unpublished memo. Washington, DC.

Noland, R. and Kunreuther, H. (1995). Short-run and long-run policies for increasing bicycle transportation for daily commuter trips. *Transportation Policy* 2(1): 67–79.

Pucher, J., Dill, J. and Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine* 50: 106–125

Staunton, C.E., Hubsmith, D., and Kallins, W., (2003). Promoting safe walking and biking to school: The Marin County success story. *American Journal of Public Health* 93: 1431–1434.

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