Quantifying the Air Quality, Congestion, and Health Benefits of Bicycle Facilities: A Cost-Benefit Analysis of Albuquerque’s Bicycle Network

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Extended Abstract

An increasingly popular strategy for reducing GHG emissions, improving air quality and minimizing congestion in urban areas is encouraging a greater share of bicycling though provision of cycling facilities (Krizek et al., 2007; Pucher et al., 2010). There are many studies that describe the benefits of cycling (Handy et al., 2014; Sælensminde, 2004) and an abundance of evidence associating the amount bicycle infrastructure with increased levels of cycling; however, there has been little to no research measuring the congestion and air quality benefits from the actual provision of bicycle infrastructure or a cost-benefit analysis of actual bicycle infrastructure investments. Our study aims to fill these gaps.

Background

Many studies have focused on identifying factors associated with increasing levels of cycling. Revealed preference and cyclists intercept studies generally find that people prefer bike paths and lanes (Broach et al., 2012; Howard and Burns, 2001; Shafizadeh and Niemeier, 1997). Cross sectional studies also indicate that bicycle infrastructure is associated with increased levels of cycling. For example, Buehler and Pucher (2012) find that off-street paths and on-street bike lanes are associated with higher bike mode share in a cross-sectional study of 90 large U.S. cities. Dill and Carr (2003) find that a higher density of bicycle lanes is associated with about a 1 percent increase in bike commuting in a study of 43 U.S. cities with a population greater than 250,000. Stated preference studies that have asked respondents about their likelihood of cycling under different conditions also indicate that providing bicycle infrastructure may increase the amount of cycling (Akar and Clifton, 2009; Wardman et al., 2007). Two recent quasi case-control studies that measure how subjects changed their travel behavior after the introduction of new bicycle facilities find that bicycle infrastructure increased bicycling (Goodman et al., 2014; K. Krizek et al., 2009), although a third study did not (Goodman et al., 2013).

While prior research suggests that providing bicycle infrastructure may increase the amount of cycling and therefore reduce vehicle trips, providing public health and air quality benefits, these studies suffer from several limitations. Many studies find an association between the provision of bicycle infrastructure and level of cycling but their design cannot determine the direction of causation (Buehler and Pucher, 2012; K. J. Krizek et al., 2009). Additionally, prior revealed preference and intercept studies have not provided information about what cyclists would do in the absence of the bicycle infrastructure they are observed using. Furthermore, stated preference studies face uncertainty from posing hypothetical questions to respondents about infrastructure they may have no familiarity with or to respondents who have no cycling experience to inform their opinion.
Furthermore, most prior studies that have evaluated the potential benefits of measures to increase cycling make simplistic assumptions about the level of cycling (Krizec, 2007). Many of these studies are best described as scenario analysis or “what if” studies. Two approaches are common. One approach estimates the congestion, air quality or health benefits that could occur if a fixed proportion of vehicle trips were replaced by bicycle trips (Rojas-Rueda et al., 2012). The other approach estimates the benefits that would occur if vehicle trips under a certain distance threshold were replaced by bicycle trips (Grabow et al., 2012; Lindsay et al., 2011). In either case, these studies are useful at demonstrating the potential benefits of increased rates of cycling; however, they say nothing about the effectiveness of particular interventions aimed at increasing the share of bicycle trips.

**Current Study and Previous Results**

Our current study addresses the limitations identified in prior studies and demonstrates a robust approach for estimating the congestion and air quality benefits of bicycle infrastructure investments that are consistent with methods used to evaluate highway projects aimed at vehicle traffic. We use data collected from a cyclist intercept survey that indicates how many vehicle trips have been replaced by cycling trips from the provision of bicycle paths in Albuquerque, New Mexico (Rowangould and Tayarani, n.d.). The survey data allows us to discriminate between cycling trips that have replaced vehicle trips and those that have been shifted from other routes. By focusing on current cyclists and infrastructure, the survey minimizes the causal uncertainty present in many previous studies.

We previously used these survey data to adjust the region’s travel demand model which allows us to estimate the change in traffic volumes and speed on each network link in the Albuquerque metropolitan area due to the provision of bicycle paths (Tayarani and Rowangould, 2015). The change in traffic volume and speed are then used to estimate the change in vehicle emissions using US EPA’s MOVES model. We estimated that had Albuquerque’s bicycle paths not been built that air pollution emissions during the morning peak hour would increase by about 0.7 to 1.2 percent, traffic congestion by 1.3 percent, and vehicle travel by 0.4 percent which would add up to $3.8 million in additional costs per year for the Albuquerque metropolitan area. We focused on these specific measures because much of Albuquerque’s bicycle path network has been built with federal Congestion Mitigation and Air Quality Improvement (CMAQ) funds. The aim was to measure the performance of these investments.

In this phase of our ongoing bicycle research project in Albuquerque, being completed over the next several months, we will update and expand upon our prior analysis in several important ways. First, due to limited existing data on bicycle volumes on Albuquerque’s bicycle path network we previously made several assumptions about what portion of the region’s cyclists may be using the network. In this research we replace these estimates with actual bicycle facility counts that are currently being completed. Second, we expand our enumeration of benefits to include health benefits associated with active transportation. Third, we replace our emission inventory of criteria air pollutants with an air quality and exposure analysis using an air dispersion modeling method that we have previously developed and demonstrated (Rowangould, 2015; Tayarani et al., 2016). Finally, we also include an evaluation of infrastructure costs to construct a cost-benefit analysis of Albuquerque’s bicycle path infrastructure that has been built to date. We will present, for the first time, our updated and expanded results at the 2016 Transportation Planning and Air Quality Conference.

**References**


