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Is traffic congestion overrated? Examining the highly variable effects of congestion on travel and accessibility

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ABSTRACT

Congestion is universally unpopular, but is it always a problem? Are some places more "congestion-adapted" than others? Using data for Los Angeles, we examine whether the geographies of congestion and accessibility are distinct by mapping and describing them across neighborhoods. We then estimate a series of regression models of trip-making to test the net effects of traffic delays on behavior. We find that there are places where people make many trips and engage in many activities despite lots of congestion, which tend to be more central, built-up areas that host many short trips; in other places, high congestion and low activity coincide. Why the variance? While congestion can constrain mobility and reduce accessibility, traffic is also associated with agglomerations of activity and is thus a byproduct of proximity-based accessibility. Whether agglomeration and congestion have net positive or negative impacts on activity participation thus varies substantially over space. Controlling for factors such as income and working at home, we find that the effects of congestion on access depend on whether congestion-adaptive travel choices (such as walking and making shorter trips to nearby destinations) are viable. Because "congestion-adapted" places tend to host more trip-making, planners may be justified in creating more such places in order to increase accessibility, even if doing so makes absolute levels of congestion worse in the process.

1. Introduction

Traffic congestion is widely perceived as among the most vexing of urban ills – one that exacts high social, economic, and environmental costs on residents and firms alike. But is congestion really all it's cracked down to be? Perhaps not.

Many urban and transportation planners assume that better land use and transportation integration will reduce congestion by promoting both compact development and alternatives to private vehicle travel. These efforts to increase walk- and transit-friendly environments include increasing development densities, mixing land uses, and devoting more street space to support other than motor vehicle movements (Bogert et al., 2011; Ewing, 2008; Talen and Koschinsky, 2013; US Environmental Protection Agency, 2016). But while such urbanizing policies may increase travel choices, they typically *increase* traffic delays as well, and in many communities have occasioned visceral pushback from residents and the officials they elect over rising congestion levels (Downs, 2005; Obrinsky and Stein, 2007). But if these policies are successful at increasing the number and variety of nearby destinations accessible by foot, bike, bus, and car, trip-making and utility may well increase in spite of worsening congestion.

To examine this issue, we assess the accessibility/congestion relationship using data for Los Angeles, one of the largest and most congested U.S. metropolitan areas. We find that some neighborhoods are more "congestion-adapted" than others by facilitating high levels of personal and economic activity across shorter distances and via non-auto modes, often in spite of high levels of congestion. In contrast, accessibility in other, less congestion-adapted areas may be strongly inversely related to congestion levels, which square with both intuition and the traditional tenets of transportation engineering practice. So while bumper-to-bumper traffic may be similarly frustrating to drivers everywhere, its social and economic effects likely vary substantially from place to place.

While the concept of accessibility has gained considerable traction among urban and transportation scholars as a more meaningful measure of how transportation systems enable social and economic activity, such measures are only beginning to trickle into professional transportation engineering and planning practice. This article examines how measures of accessibility may produce very different results than measures of delay. The common use of congestion measures that

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privilege speed over accessibility may lead to policy and planning outcomes (such as discouraging further development in built-up, congested areas) that inadvertently reduce rather than increase access. When and under what circumstances worsening traffic congestion should be viewed as irritating but relatively benign versus serious and costly is a pressing question for planners seeking to improve accessibility amidst skeptical residents and elected officials worried about traffic.

2. Thinking about accessibility and congestion

Traffic congestion has grown, albeit unevenly over the past half-century. According to the Texas Transportation Institute (TTI), the absolute levels of traffic delays and their rates of growth are highest in the largest metropolitan areas, but comparatively modest in smaller metros. The TTI also estimates the costs of congestion delays (relative to free-flow speeds) at $160 billion in wasted time and fuel across U.S. urban areas in 2015 (Schrank et al., 2015). Though certainly aggravating for drivers and passengers, congestion levels are not a direct measure of access, whether to jobs, shopping or other activities. As such, widely cited measures of the economic costs of congestion are problematic.

Nearly all congestion measures reflect aggregate traffic flows and potential mobility, but do not take into account other factors that determine accessibility, such as destination proximity or individual and household circumstances. As such, the emergent consensus among transportation planning researchers – that access matters more to travelers than mobility – is likely undermined by a continued emphasis on traffic congestion among public officials, and congestion metrics commonly used by traffic engineers and planners (Handy, 2002; Levine and Garb, 2002; Wachs and Kumagai, 1973).

Still, we expect that traffic congestion does play a role in accessibility. Slow speeds increase the amount of time needed to reach an activity, yet places of concentrated activity will generate the traffic that leads to slowdowns. Thus, we observe the worst traffic congestion in some of the most economically and socially vibrant places in the nation, from Manhattan to downtown San Francisco. Agglomeration theory suggests that activities cluster, whether in cities, districts, or even a single street, because of benefits to productivity fostered by such concentration (Anas et al., 1998; Fujita and Thisse, 1996; Glaeser and Kahn, 2004; Vernon, 1972). However, along with the benefits arise costs, most notably in the form of congestion delays. Furthermore, congestion is an experienced phenomenon, and human perceptions and responses to traffic will depend on a host of factors including trip purposes, timing, and habits (Salomon and Mokhtarian, 1997; Wener et al., 2005). Thus, traffic congestion and accessibility are not likely to have a simple relationship, such as where more delay always results in reduced access.

Empirically, accessibility measurement is different from measuring traffic congestion in two ways. First, access is usually measured in terms of individuals, households, firms, or places, while congestion is measured in terms of features of the transportation network, such as vehicles, roads, or the system as a whole. Second, access is conceptually broad and a wide range of measures can be applied depending on a particular conceptualization (Levinson and Krizek, 2005). Traffic congestion, though, tends to emphasize a consistent set of established metrics, typically capturing either the velocity or volume of vehicles on roadways or the network as a whole (Papacostas and Prevedouros, 2000). Volume and speed metrics make the road network the object of analysis, rather than as simply a means to other ends. Ultimately, the definitional and empirical contradictions between accessibility and congestion result in two largely incompatible approaches to evaluating transportation system functionality (Levine and Garb, 2002).

2.1. Conceptualizing accessibility

Accessibility can be understood in terms of individuals, households, or firms, or it can apply to society broadly. Hansen (1959) introduced accessibility as a phenomenon of travel and land use, underscoring that transportation systems provide opportunities for interaction. Kevin Lynch (1981) assigned social implications to accessibility such as diversity, equity, and self-determination. Potential variations in access among groups or places can guide decision-makers seeking to identify beneficiaries and possible losers from a proposed project, information that congestion or mobility metrics cannot directly transmit.

Because of its conceptual nature, perspectives on accessibility hinge on how it is defined and measured. For example, changes to access, such as by increasing densities, have been posited as a potential approach to reducing vehicle miles traveled (Handy, 2002). However, empirical findings have not consistently borne this supposition out (Ewing and Cervero, 2010) because, among other things, observable changes in population or activity density usually occur at the scale of an individual development or, at most, district. But decisions about vehicle ownership and use are based both on individual characteristics as well as the larger spatial context within which people travel. The population density of these larger spatial contexts, such as a city or region, change very slowly even if some districts within them change substantially.

Researchers have taken diverse approaches to measuring accessibility (Levinson and Krizek, 2005). One key difference is that measures may operate at the level of individuals/households or at the level of places (Kwan et al., 2003). Place-based accessibility measures, including gravity and cumulative opportunity metrics, capture the distribution of activities or opportunities around a location, primarily accounting for the impedances between the location and the set of activity destinations (Handy and Niemeier, 1997; Hansen, 1959). Impedances often are characterized in terms of travel times over a transportation network, and thus may be applied to specific modes, such as driving or public transit (Handy, 2002).

Person-based accessibility is a function of space and time impedances, as well as the individual and household characteristics of travelers. Income, for example, is a significant modifier of accessibility, shaping both activity and travel options (Redmond and Mokhtarian, 2001). Additionally, immigration status, gender, age, race and ethnicity, and other factors can modify accessibility (Kwan and Weber, 2003). Thus, access will vary from person to person at a single location, even when holding impedances to a set of opportunities along a network constant. For example, El-Geneidy and Levinson (2006) present a model of person-based access, where utility is determined by the set of choices applicable to a given individual, recognizing variations in the value of access across individuals.

2.2. Bridging congestion and accessibility

Surprisingly little research explores the relationship between congestion and accessibility. Extant research generally frames congestion as a drag on accessibility. Salomon and Mokhtarian (1997) proposed a framework for understanding human responses to congestion as “coping;” they offer numerous behavioral responses to congestion including shifting destinations, time of travel, and mode choice, underscoring that the effects of congestion on individuals' accessibility are likely modified by a wide range of factors from nearby destinations to job flexibility to available modes of travel.

Building on this behavioral approach, Weber and Kwan (2002) find that congestion's diurnal variability significantly affects accessibility from hour to hour as well, with a negative relationship between times of congestion and access. In the case of firms, Sweet (2014) finds that while regional congestion may be a diseconomy to firms, localized congestion may act as a proxy for amenities valued by a wide range of firms. Hou (2016) confirms that local and regional congestion have differential effects on firm location, depending on sector, with office-