



## Traffic and crime<sup>☆</sup>

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### ABSTRACT

We study the link between crime and extreme traffic congestion to estimate the psychological costs of traffic. Our empirical analysis combines police incident reports with observations of local traffic data in Los Angeles from 2011 to 2015. This rich dataset allows us to link traffic with criminal activity at a fine spatial and temporal dimension. Our identification relies on deviations from normal traffic to isolate the impact of abnormally high traffic on crime. We find that extreme traffic increases the incidence of domestic violence, a crime shown to be affected by emotional cues, but not other crimes. The result is robust to a variety of specifications and falsification tests. The results represent a lower bound of the psychological costs of traffic congestion, since most drivers stuck in traffic do not commit domestic violence but still bear some emotional costs.

### 1. Introduction

Traffic congestion is a severe problem in many cities that imposes substantial costs on the economy due to lost time, pollution, and increased gasoline expenditure. In metropolitan areas, road congestion led consumers to purchase 2.9 *additional* billion gallons of fuel and spend 5.5 billion hours sitting in traffic (Schrank et al., 2012). According to the Texas A&M Transportation Institute, an average commuter wastes 42 h a year stuck in traffic - more than an entire week of full time work.<sup>1</sup> Given that most roads in the U.S. are unpriced, the externalities associated with traffic represent an enormous welfare cost to urban residents.

While the primary costs of traffic are due to lost time and reliability, sitting in traffic is an extremely unpleasant use of time for most people.<sup>2</sup> Kahneman et al. (2004) find that commuting is one of the least enjoyable daily activities. Research using survey data links traffic to negative mental health outcomes, including stress and aggression (Parkinson, 2001; Hennessy and Wiesenthal, 1999; Gee and Takeuchi, 2004; Gottholmseder et al., 2009; Roberts et al., 2011; Künn-Nelen, 2016).<sup>3</sup> Using subjective well being data, recent research by Anderson et al. (2016) shows that the estimated costs of congestion greatly exceed typical estimates that account for lost time and reliability. This discrepancy is consistent with large psychological costs of traffic congestion, although this is not tested directly.

In this paper, we extend the literature on the costs of traffic congestion. In particular, we focus on the effect of traffic on domestic violence, which has been shown to be sensitive to emotional cues from local football teams' unexpected losses (Card and Dahl, 2011). We estimate the impact of emotional cues due to high traffic on the incidence of domestic violence in Los Angeles County. Los Angeles is a candidate for the worst traffic in the U.S.; six of the country's 10 most congested stretches of highway are in the Los Angeles metropolitan area.<sup>4</sup> Our primary contribution is to quantify a specific outcome of the emotional costs of traffic congestion using observational data. We also build on the literature of the economic consequences of emotional cues. Traffic will not induce most people to commit crimes but will still impose a psychological burden; therefore we consider our estimates a lower bound on the psychological cost of traffic.

Our empirical analysis combines police incident reports with observations of local traffic data in Los Angeles from 2011 to 2015. This rich dataset allows us to link traffic with criminal activity at a fine spatial and temporal resolution. Our empirical strategy relies on traffic shocks to estimate the effect of traffic on domestic violence. We find that extreme traffic (above the 95th percentile) significantly increases the incidence of domestic violence by approximately 9%. Since our primary outcome of interest, domestic violence, typically occurs in the home, we are confident that the offender faced the traffic that is typical of the commute at the location of the crime. We control for unobserved

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<sup>1</sup> See the Annual Urban Mobility Scorecard report from Texas A&M Transportation Institute available at: <http://mobility.tamu.edu/ums/>.

<sup>2</sup> For estimates of the value of time and reliability see among others Small et al. (2005).

<sup>3</sup> Traffic can also cause the late arrival and/or missing of business meetings, flights, court appearances or family responsibilities, which serve as additional sources of stress.

<sup>4</sup> See the INRIX 2015 Traffic Scoreboard, available at: <http://inrix.com/scorecard/>.

effects across space and time with fixed effects, and time-varying measures of traffic in the most recent week and month to control for changes in traffic expectations. Our results are robust to multiple specifications and falsification tests. There is no effect of traffic on lagged domestic violence incidents, no effect of evening traffic on morning domestic violence incidents, no effect of traffic in other areas of the city on domestic violence, and no effect of traffic on other categories of crime such as property crime and homicides. To alleviate concerns of endogeneity, we show that our results are similar when instrumenting for traffic conditions with the number and duration of severe accidents. We also investigate the differential impact of expected vs. unexpected traffic on domestic violence. We find suggestive evidence that unexpected severe traffic leads to larger effects than expected severe traffic.<sup>5</sup> The results are robust to including daily and lagged internet search volume for traffic in the region as an alternative control for traffic expectations.

The effects are also economically important. Using published estimates of the costs of different crimes indicates that extreme traffic is responsible for approximately \$5–22 million in annual damages due to increased incidence of domestic violence.<sup>6</sup> While these additional costs are small relative to the cost of lost time and pollution, we consider them to be extreme lower bounds. Most drivers who experience acute congestion will not commit crimes but still suffer some welfare loss due to stress, thereby greatly increasing the psychological costs of traffic.

The rest of the paper is organized as follows: Section 2 discusses the related literature; Section 3 provides a description of the data and presents descriptive statistics; Section 4 presents the empirical strategy; Section 5 is devoted to the main results, heterogeneity of the impacts, a series of robustness checks and investigation into the role of expectations and habituation; and Section 6 concludes with policy implications.

## 2. Literature review

Our paper is related to the literature on externalities associated with traffic congestion, emotional cues and the determinants of crime. Several papers find a negative impact of traffic on psychological health, anger and stress. In the psychology literature, traffic is shown to be associated with increased anger and aggression (Parkinson, 2001; Hennessy and Wiesenthal, 1999). Gee and Takeuchi (2004) is one of the first papers to establish a link between self-reported traffic stress and perceived physical and psychological health conditions. Gottholmseder et al. (2009) advance the statistical methodology and find a relationship between commuting features, including travel predictability, and self-reported stress. More recent work by Künn-Nelen (2016) shows that while self-reported commute times have an impact on self-reported health outcomes and doctor visits, there is little effect of commute time on objective health outcomes. Both Roberts et al. (2011) and Künn-Nelen (2016) find that the effect of commuting on health predominantly manifests itself in women as opposed to men. Stutzer and Frey (2008) show that panel respondents in Germany who have longer daily commutes report lower levels of subjective well-being. Incorporating observed traffic data with subjective well-being data in China, Anderson et al. (2016) show that the estimated costs of congestion greatly exceed typical estimates that account for lost time and reliability.

We build on this literature in several ways. First, we link observed traffic data with an observed stress-related outcome. Most of the traffic data in the existing literature relies on survey data that only capture a self-reported snapshot of traffic conditions. This mutes most of the time series variation in actual traffic conditions. Our traffic data are built on

a rich panel of hourly data from different roads and directions that enables us to provide a representative depiction of actual traffic conditions. Similarly, most of the physical and psychological health effects are also based on self reported data. Conversely, our measure of the psychological costs of traffic relies on observed crimes from police incident reports. Therefore, we significantly advance the literature on the psychological costs of traffic congestion.

This article also fits into a broad literature investigating negative externalities of traffic. The largest traffic externality is likely the value of time and fuel expenditures associated with congestion. Schrank et al. (2012) estimates these two categories cost U.S. commuters \$121 billion in 2011. The economics literature has also quantified several other externalities of traffic. For example, Gibson and Carnovale (2015) show that tolling not only reduces traffic but also leads to lower levels of air pollution. Currie and Walker (2011) show that traffic reductions due to the introduction of electronic toll collection (E-ZPass) reduce vehicle emissions near highway toll plazas, which subsequently reduces prematurity and low birth weight among mothers near a toll plaza. In addition to negatively affecting infant health, Anderson (2015) uses quasi-random variation in wind direction to show that traffic has a long run effect of increasing mortality within the elderly population. Ossokina and Verweij (2015) exploits a quasi-experiment that reduced traffic congestion on certain streets in the Netherlands and find that the decrease in traffic led to an increase in housing prices. Another strand of the literature focuses on policies to reduce externalities to traffic such as congestion pricing through dynamic tolling (e.g. De Borger and Proost, 2013; Brent and Gross, 2017; Bento et al., 2017).

Our paper is also related to the literature on emotional cues and their impact on economic outcomes. Card and Dahl (2011) study the link between family violence and the emotional cues associated with wins and losses by professional football teams. They use police reports of violent incidents on Sundays during the professional football season in the United States. They find that upset losses (defeats when the home team was predicted to win by four or more points) lead to a 10% increase in the rate of at-home violence and the impact is larger for important games. While Card and Dahl (2011) establish an important finding, there are potentially fewer policy levers to address unexpected football losses compared to managing traffic congestion. Additionally, there are a limited number of football games whereas traffic is a daily concern for many urban residents. There are several related studies on emotional cues and economic outcomes. Eren and Mocan (2017) find that criminal sentences set by Louisiana judges for juvenile crimes are harsher following an unexpected loss by the local university's football team. Duncan et al. (2016) shows that emotional cues due to Super Bowl exposure is associated with a small, but precisely estimated, increase in the probability of low birth weight.<sup>7</sup> This is relevant for consumers' experience with traffic because research on dynamically priced toll lanes shows that drivers have a larger valuation for increased reliability (Brent and Gross, 2017) and on-time arrival (Bento et al., 2017).

The existing literature has shown that many stressors have been associated with crime. For example, Schneider et al. (2016) find that domestic violence is affected by negative labor market conditions. Cui and Walsh (2015) show that following a vacant home foreclosure, there is an increase in violent crime and a smaller increase in property crime. Ranson (2014) finds that weather and climate change affect crime; temperature has a strong positive effect on criminal behavior, with little evidence of lagged impacts. Herrnstadt et al. (2016) estimate the causal

<sup>5</sup> However, some of the differential effects are not statistically significant. A challenge in separating the role of expectations is that we do not perfectly know how drivers form their traffic expectations.

<sup>6</sup> Direct and indirect cost to assaults are valued at \$121,825 in 2017 dollars according to McCollister et al. (2010).

<sup>7</sup> There is a related literature documenting the changes in stress and behavior following a dramatic event. For example, the emotions associated with tragic events have been shown to affect birth outcomes and student performance. For birth outcomes, see Eskenazi et al. (2007) following the September 11th terrorist attacks, and Currie and Rossin-Slater (2013) following Hurricane Katrina. For student performance, see Beland and Kim (2016) after a shooting in a high school and Imberman et al. (2012) after a hurricane.

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