Speed Limit Enforcement and Road Safety*

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Abstract

We study the impact on road safety of one-day massive speed limit monitoring operations (SLMO) accompanied by media campaigns that announce the SLMO and provide information on the dangers of speeding. Using register data on the universe of police reported accidents in a generalized difference-in-differences approach, we find that SLMO reduce traffic accidents and casualties by eight percent. Yet, immediately after the SLMO day, all effects vanish. Further evidence suggests that people drive more slowly and responsibly on SLMO days to avoid fines; providing information on the dangers of speeding does not alter driving behavior in a sustainable way.

Keywords: traffic, law enforcement, safety, accidents
JEL Classification: H76, K42, R41

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1 Introduction

Traffic accidents are the world's leading cause of death for young people aged 5 to 29. Overall, more than 1.3 million people die in a road traffic accident and up to 50 million people are injured every year (WHO, 2018). While a large share of these traffic fatalities occur in middle- and low-income countries, traffic accidents continue to constitute a major health risk in high-income countries. The OECD (2018) estimates that the socio-economic cost of road traffic accidents in the European Union amount to 500 billion euros (or 3 percent of its GDP). Blincoe et al. (2015) argue that in the U.S., the economic cost of accidents amounted to 242 billion dollars (or 1.6 percent of its GDP) in 2010; this figure increases to 836 billion dollars if quality-of-life valuations are considered.

The main contributing factor to traffic accidents is inappropriate behavior of road users and, more specifically, excessive or inappropriate speed. In high-income countries, speeding accounts for around 30 percent of all fatal accidents; in middle- and low-income countries, this figure is even higher (WHO, 2004). The death rate of accidents due to speeding is considerably higher than the death rate for any other accident cause (Statistisches Bundesamt, 2018). Both the OECD (2018) and the WHO (2018) stress that even though most countries have enacted speed limits, the enforcement of these laws is often inadequate. However, while we have seen rising interest in the effect of speed limits and other traffic regulations on road safety in recent years, research on the impact of traffic law enforcement is still scarce.

This paper studies repeated speed limit enforcement campaigns enacted by German states. The campaigns build on one-day lasting massive speed limit monitoring operations (SLMO) accompanied by a temporary media campaign that announces the timing, extent, and purpose of the SLMO, and informs the public about the dangers of speeding. To evaluate the impact of the speed limit enforcement campaigns on the number of traffic accidents and casualties, we use a generalized difference-in-differences approach that exploits variation in the treatment over time and across states. Our analysis draws on rich register data on the universe of police reported accidents in combination with self-collected data on speed limit enforcement. Data on news media coverage, Google Trends' search volume data, and Twitter statistics allow us to assess the public awareness of the campaigns. To identify the effect mechanisms, we additionally rely on administrative data on hourly traffic volume and hourly driving speed from automated traffic monitors.

We find a highly significant reduction in the number of traffic accidents and road casualties on SLMO days as compared to regular days. The number of traffic accidents falls by 7.5 percent; the number of slightly injured by 8.5 percent. For the number of severely and fatally injured, we find quantitatively similar yet statistically insignificant effects. These findings suggest that people react to an increased detection probability of speed limit violations. The expected detection probability increases via two channels, which we cannot disentangle, namely via the information on speed enforcement spilled through the media and via the visibility of enforcement points installed in the streets. Our second finding is that the effect is not persistent but disappears immediately after the end of the SLMO day. It seems that providing information on the dangers of speeding in the accompanying media campaign does not alter driving behavior in a sustainable way. This interpretation is confirmed by further empirical evidence. In particular, we exploit the German peculiarity that there are no speed limits (and therefore no SLMO) on many freeways. If drivers reacted to information on the dangers of speeding, we should expect a decrease in accidents even on roads without any increased risk of detection. Yet, on freeways without any speed limits (and therefore without SLMO), the number of accidents does not decline on SLMO days. Moreover, in Bavaria, where the massive SLMO last for one week (and speed enforcement points are installed for one week), we do find negative effects on accidents for one week.

A battery of validity checks and robustness tests support the interpretation of our findings. In particular, placebo treatment tests in the pre-treatment weeks corroborate the common time trends assumption of the difference-in-differences approach. Further estimates show that drivers do not avoid fines by systematically switching to other modes of transport not targeted by the speed limit enforcement campaigns, e.g., public transport. Rather, we observe a decline in average driving speed on roads. Detailed data about the causes of accidents suggest that accidents decrease not only because of less speeding but also because people drive in general more responsibly on SLMO days.

Our paper relates to three strands of the economics literature. The first related literature studies the effect of traffic regulations on accidents. Ashenfelter and Greenstone (2004) and van Benthem (2015) find that raising the speed limit by 10 mph on U.S. highways increased traffic fatalities by 35 to 44 percent. The introduction of stricter traffic regulations is generally effective in reducing traffic fatalities. These regulations include mobile phone texting bans (Abouk and Adams, 2013) and the use of safety devices such as helmets, seat belts, airbags, and child restraints (Cohen and Einav, 2003; Dee, 2009; Doyle and Levitt, 2010; Levitt, 2008; Levitt and Porter, 2001; Markowitz and Chatterji, 2015). However, whether the police can primarily enforce traffic laws, i.e., stop and fine drivers for any violation, is important for the effect of these laws to materialize (Abouk and Adams, 2013; Cohen and Einav, 2003). Luca (2015) studies two one-week lasting periods of the "Click-it-or-ticket" campaign in Massachusetts. The campaign targets seat belt use but induces police officers to prosecute other offenses as well. Using the campaign as an instrument for the number of issued traffic tickets, she finds that traffic tickets significantly reduce the number of accidents and injuries. Deangelo and Hansen (2014) show that a layoff of roadway troopers due to budget cuts in Oregon substantially reduced traffic citations and increased traffic injuries and fatalities. Using budgetary shortfalls as an instrument for traffic citations, Makowsky and Stratmann (2011) find that issuing more traffic tickets reduces the number and the severity of motor vehicle accidents. Eeckhout et al. (2010) show theoretically that random crackdowns, i.e., arbitrary and publicized interdiction/surveillance, can be an optimal policing strategy. Using data on radar controls from the Belgian province of Eastern Flanders for the years 2000–2003, they find empirical evidence in line with this theory. Banerjee et al. (2019) run a randomized control trial in India to show that rotating anti-drunk driving checkpoints reduce accidents and fatalities, while fixed checkpoints are less effective; in a structural model, they also show that pre-announcing crackdowns can be an optimal strategy. Dusek and Traxler (2021) document that drivers punished for speed limit violations reduce their driving speed in the following two years. Similarly, Gehrsitz (2017) demonstrates that punishing drivers by temporarily suspending their driver's license lowers the probability of recidivating within the following year.

We also relate to the literature that analyzes the effect of the presence of the police on crime rates. Increasing the presence of the police is equivalent to increasing the (subjective) dectection probability for an offense. Theoretically, an increase in the probability of detection reduces the number of offenses (Becker, 1968). The earlier theoretical and empirical literature on the impact of policing on crime is nicely summarized by Cameron (1988). Levitt (1997) gave rise to a quasi-experimental literature that exploits exogenous increases in the presence of the police to find negative effects on violent crimes (e.g., murder, assault, and robbery) as well as property crimes (e.g., burglary and motor vehicle thefts) (Chalfin and McCrary, 2018; Di Tella and Schargrodsky, 2004; Draca et al., 2011; Evans and Owens, 2007; Klick and Tabarrok, 2005; Machin and Marie, 2011). Chalfin and McCrary (2017) provide a recent review of the literature on criminal deterrence in general, in which they also capture the effect of police on crime. The massively increased presence of the police in the streets on SLMO days (and the explicit announcement of the SLMO in the media) should increase the (subjective) detection probability of traffic offences and thus reduce accidents on SLMO days.

Finally, we speak to the literature presenting field evidence on the impact of information nudges. It has been shown that these comparatively cheap interventions can indeed affect behavior in many areas (see, e.g., Jensen (2010) for educational choices, Allcott and Rogers (2014) for energy consumption, Bott et al. (2019) for tax compliance, Dolls et al. (2018) and Duflo and Saez (2003) for retirement savings, or Dupas (2011) and Wisdom et al. (2010) for risky health behavior). Other studies fail to find significant behavioral impacts of information nudges in particular in the form of moral appeals (see, e.g., Blumenthal et al. (2001) and Fellner et al. (2013)). Typically, information nudges are particularly effective if they provide information that results in an update of prior beliefs. Our findings are compatible with a story in which even speeders are perfectly aware of the dangers of speeding in general, which is why information nudges on the dangers of speeding do not result in an update of beliefs, and consequently, do not sustainably change driving behavior in the aftermath of the SLMO day. In this respect, our results are in line with recent findings by Hall and Madsen (2021) who show that a highway safety campaign displaying information on traffic fatality counts did not have any persistent effects on road safety.

The German speed limit enforcement campaigns that we analyze differ from other traffic law enforcement campaigns in particular by combining the scheduled one-day massive SLMO with an extensive media campaign that not only documents the locations of the temporary speed enforcement points but also explicitly informs the public about the dangers of speeding. The underlying idea is that these information nudges should increase drivers' awareness about the dangers of speeding and thus sustainably alter their driving behavior. This setting allows us to study in a narrow time frame whether any effects on road safety can still be found after the one-day SLMO, which could then be traced back to effective information nudges. While this campaign started out in Germany, it became a pan-European effort in 2015. Ireland has run this campaign as the 'national slow down day' since 2015. In the German public, the usefulness of the speed limit enforcement campaigns to sustainably affect road safety is highly disputed. Not only drivers but also politicians and interest groups of the police have doubted any positive effects for road safety. As a consequence, several federal sates in Germany have recently opted out of the campaigns, also because of the high planning effort and excessive use of police resources.[1] However, so far, empirical evidence on the speed limit enforcement campaigns' effectiveness in reducing the occurrence and the severity of traffic accidents is missing. Given the general relevance of traffic law enforcement strategies, our results have implications for policy makers in designing adequate interventions beyond the German and European context.

The remainder of the paper is organized as follows. Section 2 provides background information about the speed limit enforcement campaigns. Section 3 describes the data. Section 4 outlines our empirical strategy. In Section 5, we present our main results and perform validity and robustness checks, while we discuss the underlying mechanisms in Section 6. We conclude in Section 7.

2 Background

On February 10, 2012, the German state of North Rhine-Westphalia initiated the first massive state-wide speed limit enforcement campaign to reduce traffic accidents and casualties, and coined it "Blitzmarathon". Key features were (1) one-day lasting massive SLMO by the police using temporary speed enforcement points, and (2) a media campaign

[1] See, e.g., https://www.faz.net/aktuell/gesellschaft/kriminalitaet/blitz-marathon-am-donnerstag-in-vielen-bundeslaendern-14182239.html, 2019/04/09

that informed the public in advance about the locations of the speed enforcement points, the purpose of the SLMO, and in particular also about the dangers of speeding. After North Rhine-Westphalia had conducted its second Blitzmarathon on July 3, 2012, the state Lower Saxony joined for the third campaign on October 24, 2012. One year later, on October 10, 2013, 15 German federal states, all states except Saxony, participated in a Blitzmarathon.[2] Bavaria prolonged the one–day lasting SLMO by an additional week. By the end of our period of observation in December 2014, seven one–day Blitzmarathons and two Blitzmarathon extension periods had occurred with varying participation of the German federal states. Table 1 provides a detailed overview of the Blitzmarathon dates and the respective participating states. It illustrates that apart from regional variation across participating states, we can use variation in the occurance of Blitzmarathon across day of the week, months of the year, and years. At the county level, we can draw on 1,194 treatment days for the one–day Blitzmarathons and 1,344 treatment days for the two Blitzmarathon extension periods.

Table 1

Overview of the Blitzmarathons in Germany, 2012 to 2014

Date	Day of the week	Federal State	Duration
February 10, 2012	Friday	North Rhine-Westphalia	one day
July 3, 2012	Tuesday	North Rhine-Westphalia	one day
October 24, 2012	Wednesday	North Rhine-Westphalia & Lower Saxony	one day
June 4, 2013	Tuesday	North Rhine-Westphalia & Lower Saxony	one day
October 10, 2013	Thursday	nation-wide (excl. Saxony)	one day
October 11 to 17, 2013	Friday to Thursday	Bavaria (extension)	seven days
April 8, 2014	Tuesday	North Rhine-Westphalia & Lower Saxony	one day
September 18, 2014	Thursday	nation-wide	one day
September 19 to 25, 2014	Friday to Thursday	Bavaria (extension)	seven days

Notes: The table shows the dates, the participating federal states, and the duration of the Blitzmarathons between 2012 and 2014.

Detected speed limit violations may result in a warning, be treated as a regulatory offense or as a criminal offense. Monetary fines start at 10 euro (for driving 10 km/h above the speed limit outside built-up areas) and may go up to 700 euro (for driving more than 70 km/h above the inner city speed limit). Apart from monetary fines, drivers might get punished with malus points for traffic law violations. The more severe the violation, the more malus points a driver receives. Each driver has an account that stores all malus points from past traffic violations. If a driver crosses a certain threshold of points, he or she will (at least temporarily) lose his or her driver's license. As a result of a severe speed limit violation, a driver's license may be immediately suspended for up to three months. Repeated speeding may result in an unlimited suspension of the driver's license. In this

[2] Saxony conducted a traffic safety campaign targeting schools and kindergartens from October 7 to 18, 2013. The Blitzmarathon on October 10, 2013, overlaps with this period. We treat the campaign in Saxony and the Blitzmarathon on October 10, 2013, as two separate campaigns.

case, a driver's licence can only be regained after passing a special medical-psychological test.[3] While the police officially target speed limit violations during a Blitzmarathon, they can fine drivers for any offenses. Press releases after the Blitzmarathons reveal that the police also prosecute law violations such as not using a seat belt, talking on the phone while driving, driving under the influence of drugs and alcohol, or possessing no driver's license.

The German public has witnessed heated debates about the usefulness of these Blitzmarathons. The initiators of the campaign emphasize that their ultimate goal is to increase the awareness of the dangers of speeding and thereby sustainably reduce the number of traffic accidents and casualties.[4] However, many people hold the view that the true motivation for setting up the Blitzmarathons is to boost state revenues through traffic fines. A poll conducted by the German newspaper magazine *Spiegel Online* right before the nation-wide Blitzmarathon on April 19, 2017, showed that more than 25 percent of all participants held the view that the Blitzmarathon was a 'pure rip–off'; another 42 percent argued that the campaign was 'useless because most notorious speeders would continue violating speed limits the day after'; less than 33 percent believed that the campaign was 'good because it highlights the dangers of speeding'.[5]

2.1 Speed Limit Monitoring on a Blitzmarathon Day and on a Regular Day

Speed limit enforcement in Germany is a combination of automated permanent (stationary) speed enforcement points and temporary speed enforcement points, i.e., mobile radar or laser speed measurement systems that allow for an easy, temporarily and geographically flexible speed monitoring. Mobile temporary speed enforcement points are either unmanned or operated by policemen. In order not to impede traffic flow, drivers are usually not stopped; rather, their number plate is registered and a few weeks later, they receive a letter informing them about the speed limit offense and the fine. If policemen do indeed stop speeders, they typically do so a few hundred meters behind the enforcement point, at a place, where drivers can easily be stopped without impeding traffic flow.

To get an idea about the usual speed limit enforcement in German counties, we have collected data on permanent speed enforcement points and temporary speed enforcement points on a regular non-Blitzmarathon day. The information about permanent speed

[3] The point system changed on May 1, 2014. While monetary fines remained unchanged, drivers might lose their driver's license after committing fewer traffic violations than in the old system. In our empirical strategy, we account for this change by including time fixed effects.

[4] To underline the awareness-concept, school children sometimes help the police during a Blitzmarathon by rewarding commendable drivers with sweets. For instance, the "Westfalen Blatt" reports on September 17, 2014: "Those drivers who follow traffic regulations get sweets [from the children]. Those who drive too fast receive a lemon with an unhappy looking smiley."

[5] The poll can be found at http://www.spiegel.de/auto/aktuell/blitzermarathon-2017-standorte-wichtige-infos-das-sollten-autofahrer-wissen-a-1143852.html, 2019/04/04.

enforcement points stems from '*blitzer.de*', a for-profit organization offering speed enforcement points warnings through their homepage and mobile app. *blitzer.de*'s editorial staff collects information about permanent speed enforcement points through screening of radio news, websites, and social media posts. Moreover, the company sends cars on a tour to check on permanent speed enforcement points several times a year and validate that they are activated. In 2011, before the first Blitzmarathon, we observe on average 9.0 permanent speed enforcement points per county. Analyzing data from 2014, we see a modest increase of on average 1.2 permanent speed enforcement points over our study period. This increase is mostly driven by the state of Hesse, where the number of permanent speed enforcement points increased on average by 8.8 per county. To control for these changes in the empirical analysis, we introduce county-specific time effects.[6] *blitzer.de* also provides us with county-level data about temporary speed enforcement points on non-Blitzmarathon days. This data comes from *blitzer.de*'s four million active users, who report speed enforcement points through the company's homepage or mobile app. *blitzer.de* provides us with a list of all reported temporary speed enforcement points in October 2015.[7] According to the editorial staff, October is a representative month for speed limit enforcement with on average 5.8 temporary speed enforcement points per day and county. Note that even if the number of temporary speed enforcement points is not exhaustive (because *blitzer.de* is not aware of all temporary speed enforcement points every day), the numbers reflect the expectations of the population about the level of speed limit enforcement on a regular day.

To measure the intensified speed limit enforcement during a Blitzmarathon day, we take advantage of the fact that the police announce the locations of the Blitzmarathon speed enforcement points a few days before a Blitzmarathon through the local media.[8] Reviewing all announcements, we count the number of temporary speed enforcement points in each county during each Blitzmarathon and relate this number to speed limit enforcement on any other day. For counties where the information could not be collected anymore through the media, we contacted the local police departments to send us the lists

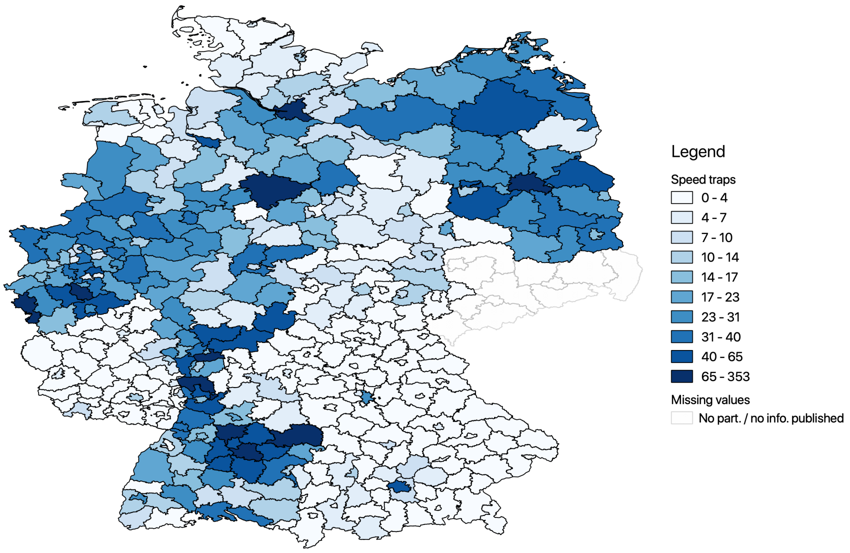
[6] Note that the effect of permanent speed enforcement points on driving behavior might differ from the effect of temporary speed enforcement points. The police can relocate temporary speed enforcement points at different places every time they are set up, while permanent speed enforcement points remain fixed to a location. Hence, a county with a high number of temporary speed enforcement points induces much more uncertainty to drivers with respect to the detection probability of speed limit violations than a county with the same number of permanent speed enforcement points.

[7] Unfortunately, there is no data from earlier years. Therefore, if temporary speed enforcement points increased over the years, we underestimate the increase in speed limit enforcement on a Blitzmarathon day as compared to a regular day.

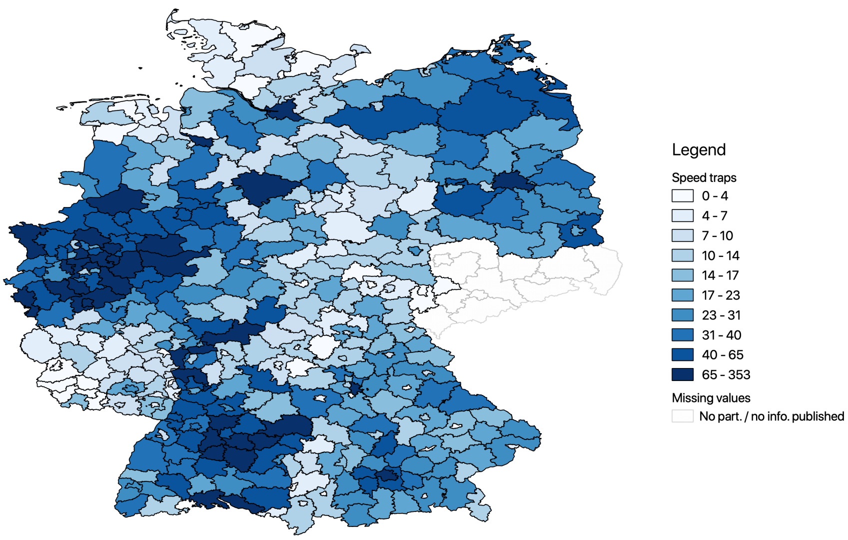
[8] The public can suggest locations where temporary speed enforcement points should be installed on a Blitzmarathon day. For example, for the second Blitzmarathon in North-Rhine Westphalia on July 3, 2012, more than 15,000 people nominated locations. The police implemented around 2,700 of these suggestions.

Figure 1

Speed Limit Enforcement on a Regular Day and on a Blitzmarathon Day



(a) Speed enforcement points on a regular day



(b) Speed enforcement points on a Blitzmarathon day

Notes: The figure shows the total number of speed enforcement points per county during a regular day [Panel (a)] and during a Blitzmarathon day [Panel (b)]. The total number of speed enforcement points is the sum of temporary and permanent speed enforcement points. In Panel (b), temporary speed enforcement points are the average number of speed enforcement points per county over all Blitzmarathons in which the respective county participated in the operations. The federal state of Saxony participated in one Blitzmarathon, but did not publicly announce speed enforcement points in advance.

of speed enforcement points they published.[9] The average number of temporary speed enforcement points on a Blitzmarathon day is 24.3 per county.

The two maps presented in Figure 1 contrast SLMO on Blitzmarathon days and non-Blitzmarathon days. To this end, we have added the number of permanent speed enforcement points to the number of temporary speed enforcement points for both a regular day and a Blitzmarathon day. The figure highlights both the more intense enforcement on Blitzmarathon days as compared to regular days and the geographical variation in the intensity of the Blitzmarathon across counties even within federal states.

Table 2 exemplifies the intensity of the SLMO for the state of North-Rhine Westphalia, which participated in all Blitzmarathons. Taking the length of the road network in North-Rhine Westphalia and dividing it by the total number of speed enforcement points, we obtain the average distance in km at which a driver should expect a speed enforcement point. We compute this distance for a Blitzmarathon day and for a regular day. Using an average driving distance of 24 km per day (Lenz et al., 2010), an average driver in North-Rhine Westphalia should expect at most one speed enforcement point on the road on a regular day. This number increases almost by a factor of three on a Blitzmarathon day. Comparing temporary speed enforcement points only, drivers should expect five times more speed enforcement points on a Blitzmarathon day than on a regular day.

Table 2

Speed Limit Enforcement in North-Rhine Westphalia

	Regular day (1)	Blitzmarathon–day (2)
Temporary speed traps	475	2,379
Permanent speed traps	944	944
Total speed traps	1,419	3,323
Speed trap every x-th km	21	9
Expected number of speed traps per day	1.1	2.7
Temporary speed trap every x-th km	62	12
Expected number of temporary speed traps per day	0.4	2.0

Notes: The table shows speed limit enforcement in the federal state of North-Rhine Westphalia for a regular day (column (1)) and a Blitzmarathon day (column (2)). Total length of all roads is 29,582 km; average distance by car per day is 24 km (Lenz et al., 2010).

2.2 Media Campaign and Public Awareness

The details of the massive SLMO on a Blitzmarathon day are explicitly announced in a media campaign. The police disclose the exact date of a Blitzmarathon one to one and a half weeks in advance. In addition, they reveal the locations of the speed enforce-

[9] For North Rhine-Westphalia, information is missing for one county during three Blitzmarathons as the county did not announce the locations of the speed enforcement points. Similarly, the states of Baden-Wuerttemberg and Saxony did not announce the loctions of the speed enforcement points for the fifth and seventh Blitzmarathon, respectively.

ment points a few days before a Blitzmarathon. Starting around three days before a Blitzmarathon, supra-regional media inform about the date of a Blitzmarathon but do typically not announce all speed enforcement points. Local media, however, would also announce the locations of the local speed enforcement points as forwarded by the police. The nationwide Blitzmarathons are regularly covered in the large national newspapers, radio and TV programs. The information provided in the media campaigns allows the public to form expectations about the SLMO on Blitzmarathon days and should increase the subjective detection probability of a speed limit offense. Those drivers who consume local media could even be informed about the exact locations of the speed enforcement points.

Announcing the Blitzmarathons, the media also extensively report about the dangers of speeding, cite the county's current accident statistics, illustrate the vulnerability of pedestrians and bicyclists, or quote police officers and politicians explaining the purpose of the Blitzmarathon. By providing this information, the initiators try to nudge drivers to behave more responsibly and comply with speed limits. The following quotes provide examples of information nudges in the local media in advance of a Blitzmarathon:

- With a car driving speed of 50 km/h, eight out of ten pedestrians survive in case of an accident. With a car driving speed above 65 km/h, it is the other way around: eight out of ten pedestrians die in case of an accident. (Westdeutsche Zeitung, 02-07-2012)
- Last year, we counted 6,000 road accidents in Freiburg, in which almost 1,200 people were slightly injured and 140 were severely injured. 6 people died. (Badische Zeitung, 09-10-2013)
- With this initiative [the Blitzmarathon] we want to increase the awareness that speeding constitutes the highest risk [for traffic casualties] on German roads. With the Blitzmarathons, we want to promote a considerate driving culture on our roads. (Minister of the Interior of Lower Saxony in Bersenbrücker Kreisblatt, 04-07-2014)

To provide quantitative evidence that the public was well aware of the Blitzmarathons, we have gathered data from Google Trends' weekly search volume index for the word 'Blitzmarathon'. Google Trends counts the weekly number of searches for a specific term and relates this number to the global maximum of weekly searches for that term within the specified period. Hence, the week with the maximum number of searches for a specific term scores 100 in the weekly search volume index. To better assess the magnitude of the search activity for 'Blitzmarathon', we compare the weekly search volume index for the term 'Blitzmarathon' to the terms 'Fukushima' (Japanese city linked to a nuclear catastrophe on 11th March 2011, which resulted in the political decision to rapidly phase-out nuclear power in Germany), 'Snowden' (U.S. whistleblower whose publications caused the NSA scandal in summer 2013), ‘Papst Benedikt’ (German Pope Benedict XVI who resigned on 28th February 2013), ‘Obama’ (U.S. president who was relected in November 2012 and visited Germany on 18th/19th June 2013) and ‘DAX’ (German stock exchange that experienced a historic crash in August 2011). In Figure 2, we plot the search activity for these terms from 2011 to 2014 separately for two states, namely for North Rhine-Westphalia, which participated in all seven Blitzmarathons (Panel (a)), and for Bavaria, which only participated in the two nation-wide Blitzmarathons (Panel (b)). The grey bars mark three week periods consisting of the week of a Blitzmarathon, the week before, and the week after. Filled bars indicate that North Rhine-Westphalia (Panel (a)) or Bavaria (Panel (b)) participated in the respective Blitzmarathon.

Figure 2 yields four key results: (1) There are more Google searches using the term ‘Blitzmarathon’ around a Blitzmarathon day than usual. (2) The increase in search activity in a state is conditional on the participation of this state in the respective Blitzmarathon campaign. (3) The first Blitzmarathon received less attention compared to subsequent ones; the two nation-wide Blitzmarathons gained the most attention. (4) The nation-wide Blitzmarathons created more search activity than Barack Obama’s visit to Germany, Edward Snowden’s whistleblowing and the resignment of pope Benedict XVI, but less search activity than the Fukushima nuclear catastrophe, the historic DAX crash, and Barack Obama’s re-election.[10]

To obtain a more complete and fine-grained picture, we have also collected the number of daily news media articles including the term ‘Blitzmarathon’ from the WiSo database and the daily number of Twitter tweets including the term ‘Blitzmarathon’. The WiSo database provides full text access to 60 million press articles from more than 150 regional and national newspapers in Germany, which allows a comprehensive media monitoring. Regarding Twitter, we extracted about 13,000 Blitzmarathon tweets that may belong to accounts of the media, private persons, or government institutions (including the police).[11] Panel (a) of Figure 3 shows that media coverage starts to increase on average about three days before a Blitzmarathon; three days after a Blitzmarathon, the media rarely covers the topic. The former observation supports our argument that the public knows beforehand about the intervention. A very similar pattern appears if we look at the number of Twitter tweets in Panel (b) of Figure 3. The number of Twitter tweets starts to increase around two days before a Blitzmarathon; two days after the Blitzmarathon, the campaign rarely receives attention on Twitter. Complementing this quantitative analysis, media sources reported that Twitter listed the hashtag ‘#Blitzmarathon’ as the number one hashtag during the seventh Blitzmarathon (Handelsblatt, September 19, 2014).

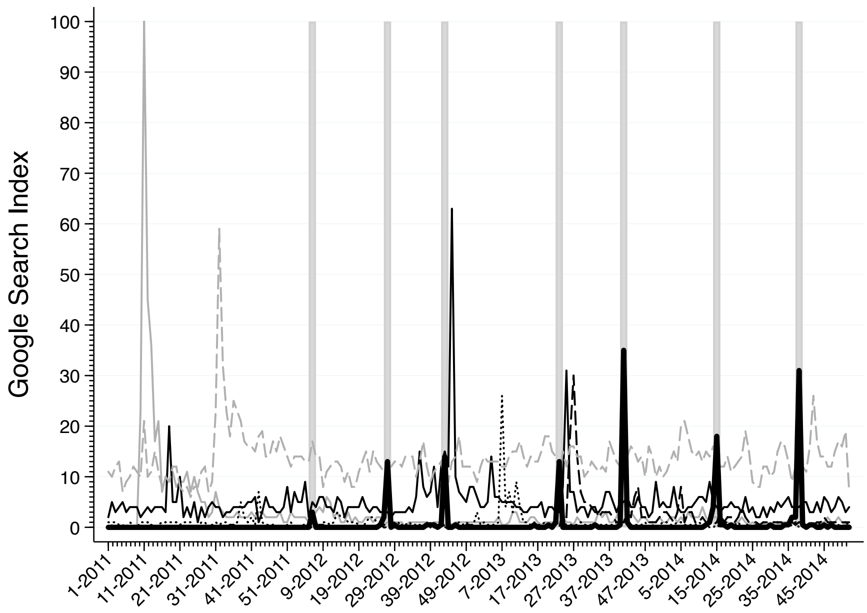
[10] Additional analyses for the other German federal states support the finding that the search volume highly correlates with a state’s participation in a Blitzmarathon. Moreover, comparing search volumes for the term ‘Blitzmarathon’ to the search volumes for more general expressions for speed limit enforcement such as ‘Radarkontrolle’ or ‘Blitzer’ yields very similar patterns.

[11] We extracted the tweets using Twitter’s advanced search module.

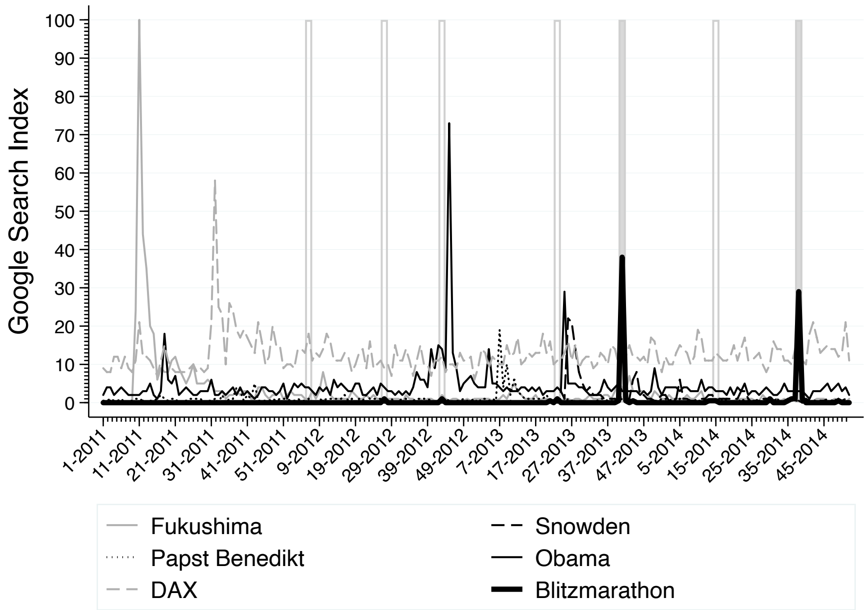
Figure 2

Google Trends' Weekly Search Volume Index for "Blitzmarathon", 2011 to 2014

(a) North Rhine-Westphalia



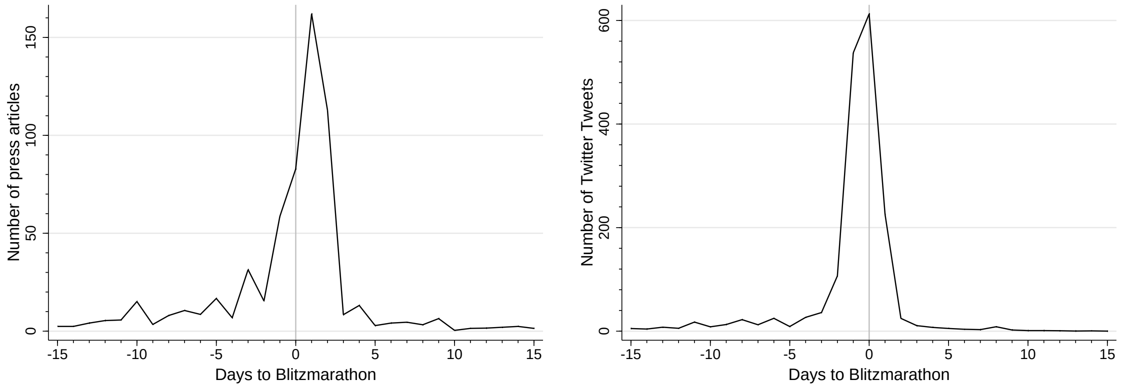
(b) Bavaria



Notes: The graphs compare Google Trends' weekly search volume index for the word 'Blitzmarathon' to the terms 'Fukushima' (nuclear catastrophe, grey solid line), 'Snowden' (U.S. whistleblower, grey dashed line), 'Papst Benedikt' (German Pope Benedict XVI, grey dotted line), 'Obama' (U.S. president, dark grey dashed line), and 'DAX' (German stock market, dark grey dashed line) from 2011 to 2014. Google assigns a value of 100 to the maximum number of searches within the specified period. Panel (a) documents search behavior in North Rhine-Westphalia, while panel (b) documents search behavior in Bavaria. Each bar marks a three week period: the week of a Blitzmarathon, the week before, and the week after. Filled bars mark Blitzmarathons in which the respective state did participate, unfilled bars bars mark Blitzmarathons in which the respecitve state did not participate.

Figure 3

Daily Press Articles and Twitter Tweets about the 'Blitzmarathon'



(a) Average number of press articles

(b) Average number of Twitter Tweets

Notes: The figure shows the average daily number of press articles including the word 'Blitzmarathon' according to the WiSo database (Panel (a)) and the daily number of Twitter tweets including the word 'Blitzmarathon' (Panel(b)) 15 days before and a after a Blitzmarathon.

Our analysis in this section has shown that the public is aware of the Blitzmarathon campaigns, in which SLMO are massively increased as compared to regular days. Roughly three days before the operation, Blitzmarathons start to get intense press and online media attention. To investigate whether drivers respond to the increased detection probability of speed limit violations in the very short run and whether the campaigns have a more sustainable effect on driving behavior, we exploit the quasi-experimental nature of the Blitzmarathons using rich register data.

3 Data

3.1 Register Data on Police Reported Accidents

Our primary data source is the accident statistic maintained by the Research Data Center of the German Federal Statistical Office and Statistical Offices of the Federal States (Statistische Ämter des Bundes und der Länder). This register data set covers the universe of police reported traffic accidents in Germany. The police report all accidents with slightly, severely, or fatally injured to the Statistical Offices. In addition, the police report accidents with material damage if at least one vehicle is non-roadworthy and the accident involves a traffic offense, e.g., speeding or ignoring the right of way. Accidents on which the involved parties reach a private agreement without giving notice to the police do not appear in the data. Each accident record contains information on the number of slightly, severely, and fatally injured as well as on characteristics of the people involved, the scene and the causes of the accident. For our sample period from 2011 to 2014, we have detailed information about 1.5 million police reported accidents.

We apply some restrictions to the accident data set to construct the sample for the main analysis. First, we exclude accidents where the person who caused the accident was conducting a train or omnibus, as these follow different traffic regulations and/or are not targeted by the Blitzmarathons.[12] Moreover, we exclude accidents where the person who caused the accident was a bicyclist or a pedestrian. As we can see from the media quotes in section 2, the police motivate the Blitzmarathons also with the vulnerability of bicyclists or pedestrians in motor vehicle accidents. Feeling more protected during the Blitzmarathons, bicyclists or pedestrians might change their behavior and act in a more risky way.[13] Because the Blitzmarathons focus on regular working days and weekends, we drop all days with a public holiday in any state. Since public holidays are often used for short getaways, we also drop long weekends and the day before a long weekend, which span the days from Wednesday (Thursday) to Sunday when the public holiday is a Thursday (Friday); or the days from Friday to Monday (Tuesday) when the public holiday is a Monday (Tuesday). Finally, for each county, we aggregate accidents at the day level.

Our sample includes the number of accidents, slightly injured, severely injured, and fatally injured for each of the 402 counties in Germany on a daily basis from January 1st, 2011 to December 31, 2014. Panel (a) in Table 3 provides summary statistics for these accident variables. The police register on average 2.4 accidents per day and county, summing up to around 950 accidents per day in Germany. In these 950 accidents, 770 people are slightly injured, 150 severely injured, and 8 fatally injured. In supplementary analyses, we use additional information on specific characteristics of the person who caused the accident (gender, age, probation period) and of the accident scene (type of road, speed limit, cause of accident).

3.2 Traffic Volume and Driving Speed Data

In addition to the police reported accident statistic, we draw on hourly data on traffic volume provided by the Federal Highway Research Institute (Bundesanstalt für Straßenwesen, BASt). Inductive loops embedded in the road pavement measure the hourly number of passenger vehicles (cars and motorbikes) and trucks passing a monitoring station. In total, we use traffic volume information from 1,408 automated monitoring stations installed on non-freeway roads covering 273 out of 402 counties and spanning the period from 2011 to 2014. Appendix Figure B1 provides an overview of the spatial distribution of the monitoring stations. Panel (b) in Table 3 summarizes the traffic volume data. On average, 250 passenger vehicles and 20 trucks pass a monitoring station every hour.

[12] The share of police-reported accidents that are caused by trams/trains is 0.27 percent, and it is 0.85 percent for omnibuses. Since single tram or omnibus accidents can result in a high number of injured individuals, excluding these rare events also reduces the probability that outliers affect our results.

[13] In robustness checks, we will show that our results are not affected by these restrictions.

Table 3
Summary Statistics

Variable	N	Mean	S.D.	Min	Max
(a) Accidents					
Number of accidents	493,518	2.362	3.132	0	75
Slightly injured persons	493,518	1.916	3.061	0	73
Severely injured persons	493,518	0.367	0.774	0	32
Fatally injured persons	493,518	0.021	0.157	0	8
(b) Traffic volume on non-freeway roads [1,000 vehicles/h]					
Passenger vehicles	40,898,880	0.252	0.335	0	6.320
Trucks	40,898,880	0.023	0.034	0	0.513
Passenger vehicles [q/v–data]	20,462,014	0.265	0.265	0	6.821
Trucks [q/v–data]	20,433,158	0.021	0.036	0	3.135
(c) Driving speed on non-freeway roads [km/h]					
Passenger vehicles [q/v–data]	20,244,303	70.748	17.674	1	254
Trucks [q/v–data]	17,501,447	64.273	13.670	1	153
(d) Weather control variables					
Mean temperature ($^{\circ}C$)	493,518	9.712	7.321	-19.1	30.6
Precipitation (mm)	493,518	1.980	4.558	0.0	111.4
Snow cover	493,518	0.070	0.254	0	1
Missing mean temperature	493,518	0.008	0.089	0	1
Missing precipitation (mm)	493,518	0.009	0.097	0	1
Missing snow cover	493,518	0.117	0.322	0	1
(e) Vacation control variables					
Last school day before a school vacation	493,518	0.011	0.106	0	1
School vacation	493,518	0.229	0.420	0	1
Last day of a school vacation	493,518	0.010	0.099	0	1

Notes: The table shows the number of observations, mean, standard deviation, minimum, and maximum for the variables in the data. Panels (a), (d), and (e) are based on county-day observations; Panels (b) and (c) are based on monitor-hour observations.

Although no public organization systematically collects data on driving speed throughout Germany, we were able to receive hourly driving speed data from the state of Hesse (Hessen Mobil) as well as from the state of North Rhine-Westphalia (Landesbetrieb Straßenbau NRW) for the Ruhr area, a large region in this state. Driving speed is recorded using inductive monitoring loops or infrared detectors. We obtained the average hourly driving speed in km/h separately for passenger vehicles and trucks passing a monitoring station. Importantly, the police do not use the inductive loops or infrared detectors for speed limit enforcement. Moreover, because the loops are embedded in the road pavement and infrared detectors are rather small, the monitoring is not readily visible in contrast to the speed cameras used for enforcement. This ensures that the monitors measure driving speed which is unbiased by drivers' short-run reactions to visible speed limit monitoring. In total, we have information from 1,017 monitoring stations installed on non-freeway roads spanning the period from 2012 to 2014 and covering 39 counties. Appendix Figure B2 provides an overview of the spatial distribution of the monitoring stations. Panel (c) in Table 3 summarizes the driving speed data. Passenger vehicles pass a monitoring station with on average 71 km/h; trucks with 64 km/h. Note that the maximum speed limit on non-freeway roads is 100 km/h for passenger cars and 80 km/h for trucks.[14]

As the driving speed data also contains information about traffic volume, we can compare this traffic volume data covering only 10 percent of all German counties to the more extensive traffic volume data introduced in the previous subsection. This gives us an idea about how representative the driving speed data are for the general traffic situation in Germany. And indeed, the means for traffic volume are very similar across these two data sets. In the driving speed data, 265 passenger vehicles and 21 trucks pass a monitoring station every hour as compared to 252 passenger vehicles and 23 trucks in the data provided by the Federal Highway Research Institute (see Panel (b) in Table 3). We label this data set that provides information on both traffic volume q and traffic speed v 'q/v–data'.

3.3 Weather and Vacation Data

Finally, we have collected county level data about weather conditions and school vacations on a daily basis for the period from 2011 to 2014. Weather data comes from the National Meteorological Service of Germany (Deutscher Wetterdienst, DWD) and contains information about the daily temperature in $°C$, the amount of precipitation in mm, and snow cover for 523 weather stations. For each county, we use the weather station that is closest to the center of the county. We impute missing values in the weather data with the daily mean value in the data. In the empirical analysis, we include indicators for missing values. Information on school vacations is provided by the Standing Conference of the Ministers of Education and Cultural Affairs of the German states (Ständige Konferenz der

[14] We do neither have information on the speed limit nor on the speed distribution at the monitor level.

Kultusminister). Using this data, we generate a dummy variable equal to one for school vacation days. Moreover, we generate a dummy variable for the last school day before a school vacation and a dummy variable for the last day of a school vacation.

4 Empirical Strategy

To identify the causal effect of the Blitzmarathons on road safety, we apply a generalized difference-in-differences approach which exploits state and day variation in the occurrance of Blitzmarathons. In its standard specification, the estimation equation takes the following form:

$$Y_{ct} = \beta_1(Blitzmarathon_{st}) + \beta_2 X_{ct} + \mu_y + \pi_m + \rho_d + \theta_c + \epsilon_{ct} \quad (1)$$

where Y_{ct} refers to the number of accidents or the number of road casualties on date t in county c. $Blitzmarathon_{st}$ denotes our variable of interest and equals one for every county of state s in which a Blitzmarathon, i.e., massive announced SLMO, is in force on date t, and is zero otherwise. We control for year (μ_y), month-of-year (π_m), and day-of-week (ρ_d) fixed effects, which absorb any changes in traffic volume and accidents over the years, any seasonal patterns and any patterns over the course of a week that are common to all counties.[15] X_{ct} includes controls for weather conditions and school vacations in county c at date t. Variables for weather conditions include the daily temperature in $°C$, the amount of precipitation in mm, a dummy for snow cover, and three dummies indicating missing values for daily temperature, precipitation, and snow cover, respectively. The variables for school vacation include a dummy for school vacation days, a dummy for the last school day before a school vacation, and a dummy for the last day of a school vacation. The inclusion of county fixed effects (θ_c) absorbs any time-invariant heterogeneity across counties. ϵ_{ct} is an idiosyncratic error. We cluster standard errors at the state level since treatment is assigned at the state level. Our findings hold when employing wild cluster bootstrapping procedures, using two-way clustering at the state and calendar date level, and clustering standard errors at the county level.

In the most extensive specifications, we interact the full set of time fixed effects as well as all weather and vacation controls with county dummies. The resulting county-specific time effects control not only for county-specific changes in traffic volume but also, for instance, for county-specific changes in automated permanent enforcement points. County-specific weather and vacation effects capture the possibility that specific weather

[15] Using calendar date fixed effects instead yields imprecise estimates whose confidence intervals include our preferred estimates. The variation we can exploit in this alternative specification shrinks considerably. Since the calendar date fixed effects are perfectly multicollinear with the nationwide Blitzmarathon editions, we can only identify the effect of the state-specific Blitzmarathons in two out of 16 states.

conditions or vacations might cause traffic volume and, thus, accidents to decrease or increase more in a specific county than in other counties.

The key identifying assumption for β_1 to yield the unbiased causal effect of massive announced SLMO on road safety is that treated and untreated counties would follow a common time trend in accidents in absence of the Blitzmarathon. Hence, we assume that conditional on county fixed effects as well as the full set of time fixed effects, weather and vacations controls (and all their interactions with county fixed effects), the occurance of a Blitzmarathon is uncorrelated with unobservable factors that affect road safety. To check the validity of this assumption, we perform placebo treatment tests in the pre-treatment period. Moreover, we examine whether the Blitzmarathon has any effects beyond the SLMO day itself. This analysis reveals whether drivers' behavior is altered even if the detection probability for speed limit violations has returned to its pre-treatment level. This could be the case if the information on the dangers of speeding provided in the media campaigns makes drivers reconsider and sustainably change their driving style.

In specifications in which we estimate the effect of the Blitzmarathons on traffic volume and driving speed, we replace the county fixed effects with monitoring station fixed effects. Because traffic volume and driving speed data is hourly data, we additionally include hour-of-day and hour-of-day$\times$day-of-week fixed effects (as well as their interactions with monitor dummies). To account for the varying number of monitoring stations across counties, we weight observations with the inverse of the number of stations within each county.

5 Main Results

5.1 The Immediate Effect of Blitzmarathons on Traffic Accidents

Table 4 reports the main results for the immediate effects of the Blitzmarathons, i.e., days with massive announced SLMO, on road safety. Panel (a) shows the effects on the number of traffic accidents. In column (1), we start with a basic specification in which we only control for county fixed effects and the set of time fixed effects (day-of-week, month-of-year, and year fixed effects). We find a highly significant negative effect of Blitzmarathons on the number of traffic accidents. Adding weather controls (column (2)) and vacation controls (column (3)) slightly increases the point estimate. In column (4), we introduce interactions between the county fixed effects and the full set of time fixed effects, which leaves the point estimate virtually unaffected. Moreover, the estimate is unchanged when we allow for county-specific weather effects (column (5)) and county-specific vacation effects (column (6)). The significant point estimate from the most extensive specification suggests that on the day of a Blitzmarathon, traffic accidents decline by 7.5 percent as compared to regular days. Panel (b) depicts the effects of Blitzmarathons on the number of slightly injured individuals. Again, the point estimates are stable across the different specifications and statistically significant. In our preferred specification shown in column (6), we find that the number of slightly injured individuals decreases by 8.5 percent on Blitzmarathon days. The effects of Blitzmarathons on the number of severely injured (Panel (c)) and the number of fatally injured (Panel (d)) do not reach conventional significance levels. Still, the point estimates suggest a non-negligible decline of 9.0 percent in the number of severely injured, and of 4.8 percent in the number of fatalities.

Table 4

The Effect of the Blitzmarathons on Traffic Accidents

	(1)	(2)	(3)	(4)	(5)	(6)
(a) Number of accidents						
[Mean: 2.362; N: 493,518]						
Blitzmarathon	-0.121***	-0.146***	-0.171***	-0.174***	-0.161***	-0.178**
	(0.041)	(0.039)	(0.051)	(0.051)	(0.051)	(0.061)
R^2	0.669	0.671	0.672	0.706	0.709	0.710
(b) Number of slightly injured						
[Mean: 1.916; N: 493,518]						
Blitzmarathon	-0.126*	-0.132*	-0.154**	-0.165***	-0.155***	-0.163***
	(0.065)	(0.075)	(0.058)	(0.051)	(0.049)	(0.040)
R^2	0.582	0.583	0.584	0.620	0.623	0.624
(c) Number of severely injured						
[Mean: 0.367; N: 493,518]						
Blitzmarathon	-0.036	-0.032	-0.035	-0.031	-0.029	-0.033
	(0.021)	(0.020)	(0.022)	(0.022)	(0.022)	(0.023)
R^2	0.123	0.124	0.124	0.130	0.130	0.128
(d) Number of fatally injured						
[Mean: 0.021; N: 493,518]						
Blitzmarathon	-0.002	-0.001	-0.002	-0.001	-0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
R^2	0.122	0.123	0.124	0.129	0.129	0.128
County FE	×	×	×	×	×	×
Time FE	×	×	×	×	×	×
Weather		×	×	×	×	×
Vacation			×	×	×	×
County × Time FE				×	×	×
County × Weather					×	×
County × Vacation						×

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Panel (a)], slightly injured [Panel (b)], severely injured [Panel (c)], and fatally injured [Panel (d)]. Each column in each row presents a separate regression. All regressions are run at the county-day level. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. County × Time, County × Weather, and County × Vacation are interaction of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The findings are robust to alternative procedures of testing for statistical significance. Since the number of states and thus the number of clusters is not larger than 16, we additionally compute p-values using wild cluster bootstrapping techniques (Cameron et al., 2008). In particular, we create pseudo-samples applying cluster-specific Rademacher weights to the residuals of the original regression under the null hypothesis of no Blitzmarathon effect. Then, we estimate the Blitzmarathon effect on the pseudo-samples holding the vector of controls constant. The resulting distribution of t-values is used for statistical inference. Table B1 in the Appendix shows that the findings are not affected.[16] Moreover, we obtain virtually identical results clustering the standard errors two-way at the state and the calendar date level (see Table B2 in the Appendix). Likewise, clustering the standard errors at the county level confirms the results (see Table B3 in the Appendix). Thus, we conclude that all four ways of deriving statistical inference yield remarkably similar results.

Since the outcome variables are count variables, we check that the results are robust to using Pseudo Poisson Maximum Likelihood regressions. One nice feature of this alternative specification is that the estimated coefficients can be interpreted as percent effects. Thus, the coefficients allow us to directly identify relative effects instead of estimating absolute effects and relating them to the sample mean. Table B4 in the Appendix shows that all our findings are confirmed using Pseudo Poisson Maximum Likelihood regressions. The negative effect on the number of severely injured is now even marginally significant in the most extensive specifcation.

In another check, we compare the Blitzmarathon effects to the effects of other smaller scale traffic law enforcement campaigns. In particular, the Traffic Information System Police (TISPOL) is a network of traffic police forces within the European Union and carries out pan-European traffic law enforcement operations with a focus on speed, seat belt use, and driving under the influence of alcohol and drugs.[17] TISPOL operations usually last for one week without prior announcement of the geographical concentration of the police enforcement effort and receive much less media attention than the Blitzmarathons. For instance, while the news articles search using the term 'Blitzmarathon' yields 5,027 articles for seven Blitzmarathons, the term 'TISPOL' yields only 123 hits for 23 TISPOL operations in the same period. This also corresponds with a low Google search activity for the term 'TISPOL'. Moreover, the scope of SLMO is much smaller in the TISPOL campaigns than the scope of SLMO in the Blitzmarathon campaigns. While during a TISPOL operation from April 18 to 24, 2011, 300 police officers monitored driving speed throughout Germany, more than 13,000 did so during the nation-wide Blitzmarathon in

[16] Wild cluster bootstrapping does not work in the most extensive specifications due to a too high dimension of fixed effects. Yet, note that the estimates hardly change from specification (3) to the most extensive specification (6) in Table 4.

[17] TISPOL also carries out operations focusing on trucks and buses; in this analysis, we focus on TISPOL operations targeting passenger vehicles.

2014. We create a dummy variable which is unity if a TISPOL operation is in force on a particular day and zero otherwise and add this variable to our preferred specification. Even though the point estimates for the TISPOL operations have the expected signs, they are small and insignificant. In contrast, the Blitzmarathons estimates remain large and significant also when controlling for TISPOL operations (see Appendix Table B5).

To rule out that a specific Blitzmarathon or the participation of a specific state drives the Blitzmarathon effect, we drop one-by-one a Blitzmarathon date (Appendix Figure B3) or a state (Appendix Figure B4) from the estimation sample and re-run the analyses. The Blitzmarathons effects are stable across these estimations rebutting concerns that our results just reflect the effect from a particular state or a specific Blitzmarathon date.

We obtain consistent results if we use the number of temporary speed enforcement points during a Blitzmarathon instead of a Blitzmarathon dummy as the treatment variable. While the Blitzmarathon dummy relies on daily variation in speed limit enforcement across states, this alternative treatment variable allows us to additionally exploit variation in treatment intensity across counties. Table 5 shows the results of the most extensive specification. In column (1), we see that each additional temporary speed enforcement point reduces the number of traffic accidents on a Blitzmarathon day by 0.006. Multiplying this point estimate by the mean number of temporary speed enforcement points in a county during a Blitzmarathon yields a reduction in the number of accidents by $0.006 \times 24.3 = 0.146$; the magnitude of this mean effect is similar to the respective effect we obtained using the Blitzmarathon dummy as the treatment variable (see column (6) in panel (a) of Table 4). The same is true for the number of slightly injured in column (2) ($0.006 \times 24.3 = 0.146$) and the number of severly injured in column (3) ($0.001 \times 24.3 = 0.024$). The latter effect now even turns significant. We do not find any negative effects for the number of fatally injured (column (4)). In sum, the results show that the announced SLMO on Blitzmarathon days cause an immediate, economically meaningful and statistically significant reduction in the number of traffic accidents and casualties.

5.2 The Effect of Blitzmarathons on Traffic Accidents over Time

In a next step, we investigate the validity of the common trend assumption and analyze how persistent the effect of the Blitzmarathons is over time. To this end, we add a set of dummy variables for the time spanning 15 days before and 15 days after a Blitzmarathon day to the most extensive specification of equation 1. We group the days before and after a Blitzmarathon in intervals of three so that we add five pre-treatment and five post-treatment indicators to our preferred specification.[18] The coefficients of

[18]The resulting pattern remains very similar if we group the days in intervals of two. The pattern becomes somewhat noiser if we use single days since the sample restriction to weekdays lowers the number of observations for days around a Blitzmarathon.

Table 5
The Effect of the Blitzmarathons on Traffic Accidents: Number of Speed Traps

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)	Number of fatally injured (4)
No. of temporary speed traps	-0.006***	-0.006*	-0.001**	0.000
	(0.002)	(0.003)	(0.001)	(0.000)
Mean	2.362	1.916	0.367	0.021
N	493,458	493,458	493,458	493,458

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents, slightly injured, severely injured, and fatally injured. The variable "No. of speed traps" counts the number of temporary speed traps in a county on a Blitzmarathon day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

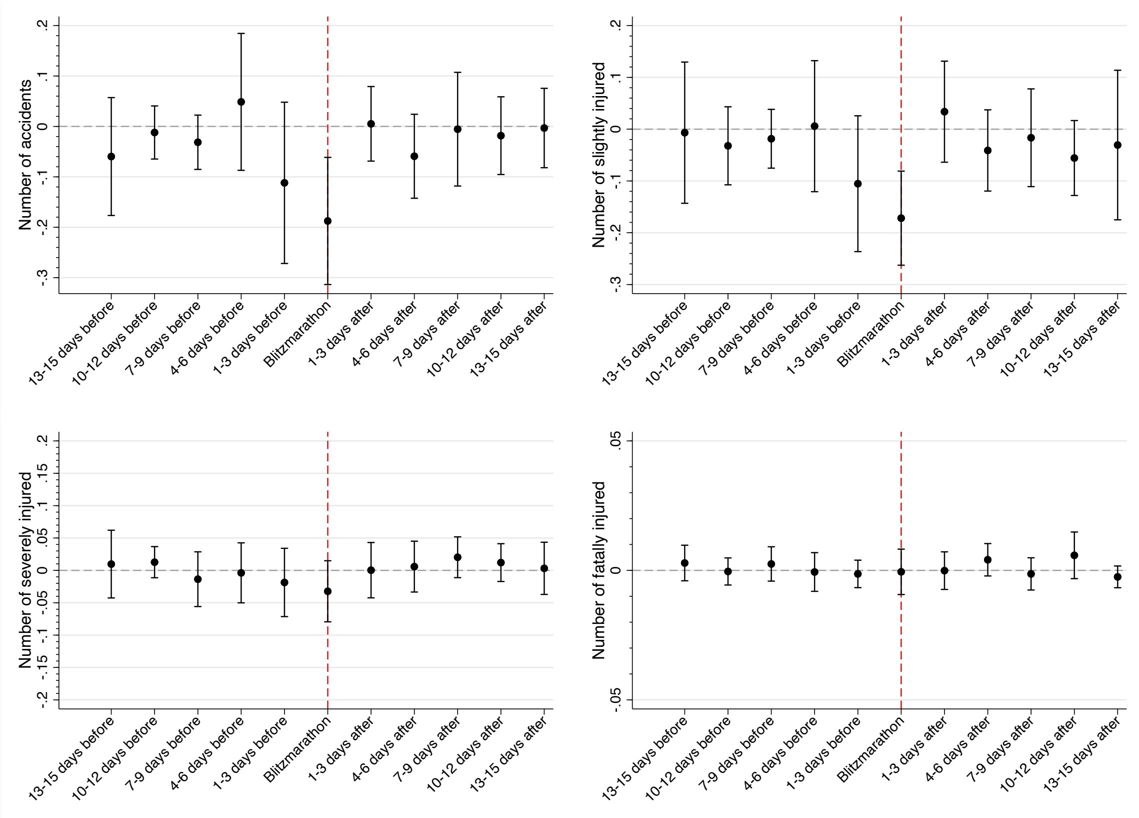
these dummy variables show how the accidents in the treated units evolve before and after a Blitzmarathon relative to the untreated units. Consequently, this specification allows us to run placebo treatment tests in the pre-treatment period to assess the validity of the common trend assumption underlying the difference-in-differences approach. Moreover, this specification allows us to inspect the existence of any more sustainable effects of Blitzmarathons on road safety in the days after the massive announced SLMO. We would expect such effects if the media campaigns' information nudges on the dangers of speeding are effective. Figure 4 depicts the results of this analysis, from which we draw three conclusions.

First, the results from Figure 4 provide evidence for the validity of the key identifying assumption, namely that treatment and control units follow the same trend in accidents in absence of the treatment. The coefficients of the indicator variables covering days 4 to 15 before a Blitzmarathon are small and insignificant for all four outcome variables. Even when looking at the size and signs of the pre-treatment coefficients in more detail, we do not detect any conspicuous pattern which would suggest a systematic deviation from the common trend in the pre-treatment period. The fact that accidents in treated units do not evolve differently from accidents in untreated units in the period of 4 and 15 days before the Blitzmarathon corroborates the validity of the key identifying assumption of the generalized difference-in-differences approach.

Secondly, we find a conspicuous though not significant reduction of 4.7 percent in the number of accidents (upper left panel; p-value 0.157) and 5.4 percent in the number of slightly injured (upper right panel; p-value 0.108) one to three days before a Blitzmarathon. The timing of these reductions coincides with the onset of the media coverage

Figure 4

The Effect of the Blitzmarathons on Traffic Accidents over Time



Notes: The figure shows point estimates and 95 percent confidence intervals for the effect of the Blitzmarathons +/− 15 days on the number of traffic accidents [upper left panel], slightly injured [upper right panel], severely injured [lower left panel], and fatally injured [lower right panel]. We group the 15 days before and after a Blitzmarathon in three-day intervals. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors are clustered at the state level.

and Twitter tweets before a Blitzmarathon (see Figure 3). The effects observed shortly before the Blitzmarathon are roughly 60 percent of the treatment effect on the Blitzmarathon day itself. There are two possible explanations for this finding. It might be that the Blitzmarathon media campaign makes people aware of the dangers of speeding, which in turn induces them to drive more slowly and responsibly. Alternatively, people might have heard about the upcoming Blitzmarathon in the news but are not sure anymore about the exact date, which is why they take precautions and drive more slowly to avoid fines. Note that we would not observe these announcement effects if drivers were not informed about the Blitzmarathon but just reacted to police on the streets.

Thirdly, and probably most interestingly, the effects of the Blitzmarathons on traffic accidents and casualties disappear immediately after the termination of the one-day lasting massive SLMO. As can be seen from Figure 4, the post-Blitzmarathon coefficients are small and insignificant for all four outcome variables. This finding suggests that the Blitzmarathons do not have any persistent effect on road safety. Particularly note that we do not find any evidence for Blitzmarathon effects one to three days after the massive SLMO despite the fact that the Blitzmarathons still receive considerable media coverage (Figure 3). Thus, in contrast to the initiators' intention, drivers do not seem to react to the media campaigns highlighting the dangers of speeding by sustainably altering their driving behavior. Rather, it seems that the reason why accidents decline (shortly before and) on Blitzmarathon days is that people try to avoid fines by driving more slowly and responsibly. Once they understand that the massive SLMO are over and the detection probability of violating speed limits has returned to its usual level, they continue driving as they used to.

The results of this dynamic specification are confirmed in Pseudo Poisson Maximum Likelihood regressions (see Table B6 in the Appendix). These regressions also reveal that the percent changes in fatalities over time fluctuate a lot; this is not least due to the fact that fatalities are a very rare event as we also document in Table 3. The problem would become even more severe if we further disaggregated fatalities. Therefore, and because the effect on fatalities has been zero so far in all regressions, we do not use fatalities as outcomes in the following analyses that look at heterogeneities across subgroups.[19]

6 Discussing the Mechanisms

Blitzmarathons reduce traffic accidents, arguably because they increase the (objective and subjective) probability of detection of speed limit offences, which makes drivers drive more slowly and responsibly to avoid fines. The expected detection probability increases via two

[19] In unreported regressions, we observe implausibly large coefficients on fatalities with changing signs and large variance over subgroups in the OLS models, while the Pseudo Poisson Maximum Likelihood models cannot be computed for specific subgroups at all.

channels, which we cannot disentangle, namely via the information on speed enforcement spilled through the media and via the possible visibility of enforcement points installed in the streets. The fact that we do observe some decrease in accidents one to three days ahead of the Blitzmarathon day, where the media has started to inform about the speed limit enforcement campaign but the speed limit enforcement points are not set up yet, suggests that the Blitzmarathon effects are at least to some degree also driven by the media informing people about the SLMO. Our second main finding is that accidents return to the pre-Blitzmarathon level immediately after the SLMO end and the speed enforcement points are removed. We argue that this result suggests that providing information on the dangers of speeding via the media campaign does not alter driving behavior in a way that would translate into a long-run or at least medium-run decline of accidents. We now provide further evidence for this interpretation.

6.1 Evidence from Heterogeneity Analyses

If informing people about the dangers of speeding had any effects in our setting, we should expect a decline in accidents on Blitzmarathon days even on roads where people know there would not be any SLMO for sure. The German particularity that there is no speed limit (and therefore also no SLMO) on most freeways allows for a nice test of this hypothesis. We distinguish between accidents and casualties on non-freeway roads and on freeways without any speed limits and re-run the estimations. Table 6 presents the results of this analysis. On non-freeway roads, we find large and statistically significant reductions of accidents and injuries on Blitzmarathon days. The estimates are similar to the estimates on the overall sample. By contrast, the estimated effects for accidents and injuries on freeways without speed limits are all close to zero and far away from any conventional significance levels. This result provides further evidence that informing about the dangers of speeding as such does not improve road safety in general. Rather, people only drive more slowly and carefully if they expect a higher detection probability of speed limit offenses due to an expansion of SLMO.

To analyze whether the Blitzmarathon effect would last for more than one day if the massive SLMO lasted for more than one day, we exploit the fact that the state of Bavaria extended each Blitzmarathon by an additional seven days. There is no difference in the implementation of the Blitzmarathon extensions compared to the one-day Blitzmarathons. Although treatment exposure during the extension periods is similar to the one-day Blitzmarathons, drivers may become more familiar with the locations of the speed enforcement points during the extension period, leading to responsible driving only at the exact location of the speed enforcement points (Ahlfeldt and Keat Tang, 2020). We first estimate the effect of the first day of the Blitzmarathons for Bavaria only. We do so by dropping all Blitzmarathon days outside the state of Bavaria as well as all days of the Blitzmarathon extension period in Bavaria. As Bavaria participated only in two

Table 6
Effect Heterogeneity by Type of Road

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
(a) Non-Freeway Road			
Blitzmarathon	-0.172***	-0.149***	-0.030
	(0.053)	(0.043)	(0.022)
Mean	2.162	1.759	0.332
N	493,518	493,518	493,518
(b) Freeway without speed limits			
Blitzmarathon	-0.001	-0.006	0.005
	(0.014)	(0.010)	(0.007)
Mean	0.132	0.099	0.025
N	493,518	493,518	493,518

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)] for non-freeway roads and for freeways without any speed limit. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Blitzmarathon campaigns, this reduces the number of treatment days at the county level substantially to $2 \times 96 = 192$. Then, to estimate the effect of the Blitzmarathon extensions in Bavaria, we drop all one–day Blitzmarathons and add the observations for the two extension periods. The number of treatment days at the county level sums to $14 \times 96 = 1,344$ in this estimation.[20]

Panel (a) of Table 7 depicts the effects of the first day of the Blitzmarathons in Bavaria while Panel (b) presents the effects for the extension periods. The point estimates in Panel (a) are somewhat smaller than our main estimates presented in column (6) of Table 4. Due to the low number of treatment units in this specification, it is not surprising that the effects are rather imprecisely estimated. However, the estimates in Panel (b) clearly show that continuing the publicly announced SLMO for another seven days keeps reducing the number of traffic accidents and slightly injured. In particular, the highly significant point estimates for the extension period are very similar to the point estimates of the first day of the Blitzmarathon in Bavaria.[21] This finding further supports the interpretation that drivers drive more slowly and responsibly to avoid fines as long as the probability of detecting speed limit offenses is increased.

[20] Since standard errors become implausibly small when clustering at the state level (see Appendix Table B7), we use county level clustering, which turns out to be more conservative for these estimations.

[21] Unfortunately, we lack the statistical power to show how the effect evolves within these seven days of the extension period.

Table 7

The Effect of the Blitzmarathon–Extensions on Traffic Accidents

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
(a) Blitzmarathon in Bavaria			
Blitzmarathon (Bavaria)	-0.106	-0.159*	0.036
	(0.084)	(0.087)	(0.046)
Mean	2.361	1.915	0.367
N	492,516	492,516	492,516
(b) Blitzmarathon Extension in Bavaria			
Extension Blitzmarathon	-0.104***	-0.139***	0.002
	(0.031)	(0.034)	(0.015)
Mean	2.360	1.914	0.367
N	493,668	493,668	493,668

Notes: The table shows the effect of the first day of the Blitzmarathon and the effect of the Blitzmarathon extension days in Bavaria on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)]. Each column presents a separate regression. All regressions are run at the county-day level. The sample in Panel (a) drops all one-day Blitzmarathons outside of Bavaria; the sample in Panel (b) drops all one-day Blitzmarathons and adds the observations for the two extension periods. "Blitzmarathon (Bavaria)" is as a dummy variable indicating the first day of the Blitzmarathon in Bavaria. "Extension Blitzmarathon " is a dummy variable indicating the Blitzmarathon extension days in Bavaria. All regressions include county and time fixed effects, weather controls, vacation controls, and interaction of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In further heterogeneity analyses, we estimate the effect of Blitzmarathons separately for urban and rural counties[22] and for various speed limit segments (see Appendix Table B8), for male and female drivers and for drivers in probation period and drivers out of probation period (see Appendix Table B9)[23], and for drivers of different ages (see Appendix Table B10). We add accidents caused by bicylists and pedestrians to our sample and show that Blitzmarathons do significantly reduce the number of accidents of car drivers but have no significant effects on accidents of motorbike drivers, truck drivers, bicylists, or pedestrians. Finally, we use an encompassing outcome variable including accidents caused by car, motorbike and truck drivers, bicylists, pedestrians, bus as well as tram and train drivers, and other road users; regression results confirm that Blitzmarathons do reduce the total number of traffic accidents and casualties on SLMO days (see Appendix Table B11).

6.2 Evidence from Hourly Traffic Volume Data

An alternative mechanism for the negative effect of Blitzmarathons on accidents might be that drivers leave their car at home and instead use public transport, ride a bicycle, or walk to avoid fines. We analyze the relevance of this argument by regressing the hourly number of vehicles passing traffic volume monitors on a Blitzmarathon dummy in a model along the lines of equation 1. Table 8 presents the results separately for passenger vehicles (cars and motorbikes) and trucks. We start with a basic specification controlling for monitoring station fixed effects and hour-of-day, day-of-week, month-of-year, hour-of-day x day-of-week as well as year fixed effects (column (1)). Then, we add weather controls (column (2)), vacation controls (column (3)), and interactions of monitor fixed effects and the set of time fixed effects (column (4)), interactions of monitor fixed effects and weather controls (column (5)), and interactions of monitor fixed effects and vacation controls (column (6)). The results are stable across these six specifications. The number of passenger vehicles on non-freeway roads decreases by between 0.4 and 1.2 percent on a Blitzmarathon day. For the number of trucks, we do not find any statistical significant effects. Thus, the magnitude of these effects seems too small to plausibly explain the negative effects of Blitzmarathons on accidents. Still, we rigorously check that this small decline in traffic volume does not explain our findings. Table B12 in the Appendix first depicts the basic estimates on the subsample of counties for which we observe traffic volume; then, we add the traffic volume control. As expected, traffic volume is positively correlated with traffic

[22] It might be that drivers are less likely to speed in urban areas due to congestion; as a reaction, urban counties might also be treated less intensely during the Blitzmarathon. Indeed, treatment intensity is clearly higher in rural counties, where the number of speed enforcement points increases by a factor of 4.2 on Blitzmarathon days, while it increases by a factor of 2.1 in urban counties.

[23] After gaining a driver's licence, drivers are on probation for two years. During this period, they are sanctioned more fiercely for traffic offenses. The strict rules for drivers on probation already may already largely elimit deliberate misbehavior on streets such as speeding. Therefore, the Blitzmarathons might not have any extra effect on this group. An alternative explanation for the zero effect might be that these drivers do not pay attention to news in the (traditional) media or do not care about being fined.

accidents and casualties. However, most importantly, the Blitzmarathon estimates hardly change when controlling for traffic volume. The same result emerges if we use Pseudo Poisson Maximum Likelihood regressions and control for the logarithm of traffic volume. Thus, these results provide evidence against the argument that the reason why we observe a decline of accidents on Blitzmarathon days is that the Blitzmarathons induce drivers to switch to other means of transport.

Table 8

The Effect of the Blitzmarathons on Hourly Traffic Volume

	(1)	(2)	(3)	(4)	(5)	(6)
(a) Number of passenger vehicles / 1,000						
[Mean: 0.252; N: 40,898,880]						
Blitzmarathon	-0.002	-0.001	-0.001	-0.002	-0.002	-0.003***
	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)
R^2	0.707	0.707	0.708	0.981	0.982	0.982
(b) Number of trucks / 1,000						
[Mean: 0.023; N: 40,898,880]						
Blitzmarathon	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.693	0.693	0.693	0.962	0.962	0.962
Monitor FE	×	×	×	×	×	×
Time FE	×	×	×	×	×	×
Weather		×	×	×	×	×
Vacations			×	×	×	×
Monitor × Time FE				×	×	×
Monitor × Weather					×	×
Monitor × Vacation						×

Notes: The table shows the effect of the Blitzmarathons on the number of passenger vehicles on non-freeway roads [Panel (a)], and the number of trucks on non-freeway roads [Panel (b)]. The sample includes 1,408 monitoring stations. An overview of the stations is given in Appendix Figure B1. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include monitor station and time fixed effects. Time fixed effects include hour-of-day, day-of-week, month-of-year, hour-of-day×day-of-week, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Monitor × Time, Monitor × Weather, and Monitor × Vacation are interactions of monitor station indicators with all time fixed effects, weather controls, and vacation controls, respectively. We weight observations with probability weights of the inverse of the number of stations within each county. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.3 Evidence from Hourly Driving Speed Data

To more directly measure the impact of the Blitzmarathons on drivers' risky behavior, we now use complementary hourly data on driving speed. Our driving speed data does not cover all counties in Germany but our analyses suggest it is still representative.[24] We estimate a generalized difference-in-differences model along the lines of equation 1, start

[24] Appendix Table B13 depicts the effect of the Blitzmarathons on traffic volume as measured in the driving speed data (q/v–data) separately for passenger vehicles and trucks. The results for passenger vehicles are similar to those from Table 8. For trucks, we now even find a small increase in traffic volume during a Blitzmarathon.

with a basic specification and then gradually move on to the most extensive specification which controls for monitor fixed effects, hour-of-day, day-of-week, month-of-year, hour-of-day x day-of-week as well as year fixed effects, interactions of monitor fixed effects with the full set of time fixed effects, weather controls and their interactions with monitor fixed effects as well as vacation controls and their interactions with monitor fixed effects.[25]

Table 9

The Effect of the Blitzmarathons on Hourly Driving Speed

	(1)	(2)	(3)	(4)	(5)	(6)
(a) Passenger vehicle driving speed [km/h]						
[Mean: 70.748; N: 20,244,303]						
Blitzmarathon	-1.816***	-1.737***	-1.586***	-1.642***	-1.730***	-1.717***
	(0.155)	(0.150)	(0.152)	(0.158)	(0.172)	(0.170)
R^2	0.872	0.873	0.873	0.921	0.922	0.922
(b) Truck driving speed [km/h]						
[Mean: 64.273; N: 17,501,447]						
Blitzmarathon	-0.945***	-0.933***	-0.812***	-1.062***	-1.117***	-1.082***
	(0.122)	(0.111)	(0.112)	(0.117)	(0.133)	(0.131)
R^2	0.716	0.717	0.717	0.787	0.788	0.791
Monitor FE	×	×	×	×	×	×
Time FE	×	×	×	×	×	×
Weather		×	×	×	×	×
Vacations			×	×	×	×
Monitor × Time FE				×	×	×
Monitor × Weather					×	×
Monitor × Vacation						×

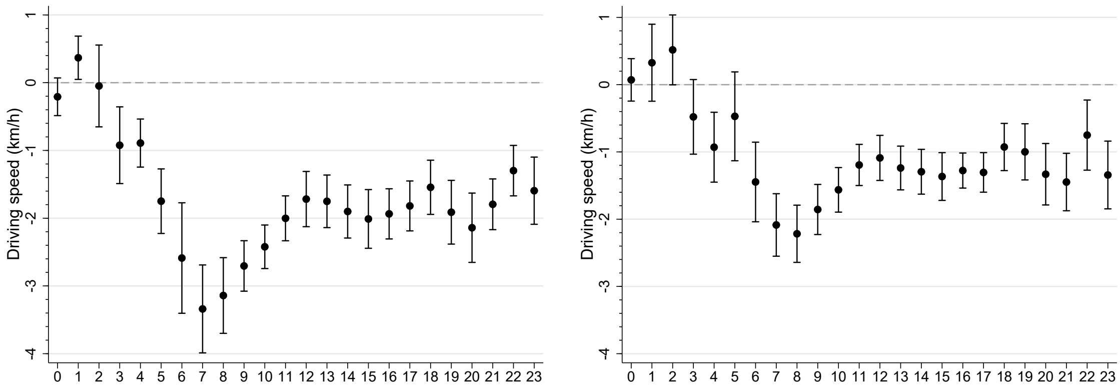
Notes: The table shows the effect of the Blitzmarathons on driving speed for passenger vehicles [Panel (a)] and trucks [Panel (b)]. The sample includes 1,017 monitoring stations on federal roads. An overview is given in Appendix Figure B2. All regressions are run at the monitor-hour level. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include monitor station and time fixed effects. Time fixed effects include hour-of-day, day-of-week, month-of-year, hour-of-day×day-of-week, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Monitor × Time, Monitor × Weather, and Monitor × Vacation are interactions of monitor station indicators with all time fixed effects, weather controls, and vacation controls, respectively. We weight observations with probability weights of the inverse of the number of stations within each county. The reported R-squared is the adjusted R-squared. Standard errors (in parentheses) are clustered at the county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9 presents the Blitzmarathon effect on hourly driving speed for the six different specifications and separately for passenger vehicles (cars and motorbikes) and trucks. Again, the estimates are robust across the specifications. The results from the most extensive specification show a reduction in average passenger vehicle driving speed of 1.717 km/h measured over the whole Blitzmarathon day compared to a regular day. This effect is economically meaningful if we consider the results of Ashenfelter and Greenstone (2004) who found that an increase of speed by two mph increased fatality rates by roughly 35 percent in the U.S.

[25] Since the speed data is only available for two states, we do not cluster the standard errors at the state but at the county level in these regressions.

Figure 5

The Effect of the Blitzmarathons on Hourly Driving Speed by Hour of the Day



(a) Passenger vehicles **(b)** Trucks

Notes: The figure shows the effect of the Blitzmarathons on driving speed by hour of the day for passenger vehicles [Panel (a)] and trucks [Panel (b)]. The point markers indicate the point estimates of the variable Blitzmarathon interacted with dummies for hour of the day; the whiskers represent the 95 percent confidence intervals. All regressions include hour-of-day, day-of-week, month-of-year, hour-of-day×day-of-week, and year fixed effects; weather and vacation controls; and interactions of monitor station indicators with all time fixed effects, weather controls, and vacation controls, respectively. Standard errors are clustered at the county level.

To get more detailed insights, Figure 5 shows the effect on driving speed over the course of a Blitzmarathon day. In this exercise, we interact the Blitzmarathon dummy with each hour of the day. The resulting estimates depict the effect of the Blitzmarathon at a given hour compared to a regular day at the same hour. Figure 5 (a) shows that passenger vehicle driving speed is about two to three km/h lower from 5:00 in the morning until 21:00 at night, which corresponds to a decline of around 2.8 to 4.2 percent relative to the mean. Note that these effects are similar to those identified by Dusek and Traxler (2021) as a reaction to receiving a speeding ticket. The effect on truck driving speed is slightly smaller but the pattern over the course of the day is similar to passenger vehicles.

Thus, these findings substantiate the claims of police officials who report an overall lower driving speed during a Blitzmarathon.[26] The findings are also in line with a descriptive study by Oeser et al. (2015) who show that driving speed in the city of Cologne was two to three km/h lower during the Blitzmarathon in April 2015 compared to the five weeks around the Blitzmarathon.

To further interpret the magnitude of the Blitzmarathon effects on driving speed, we should keep in mind that only a fraction of drivers usually violates speed limits and should therefore react to the Blitzmarathon campaigns. In a representative poll conducted by *Forsa* for the insurer *Cosmos Direkt* in 2014, 15 percent of all respondents admitted that they 'often' violated speed limits.[27] If we take this number and argue that only this group

[26]See Appendix A for selected quotes of police officers.

[27]For the official press release, see https://www.presseportal.de/pm/63229/2882373, 2019/04/04.

reacts to Blitzmarathons by slowing down, an average speed reduction of two to three km/h would translate into a 13 to 20 km/h speed reduction for those risky drivers who often violate speed limits. Finally, note that the locations of the speed monitors do not coincide with the locations of the speed enforcement points. Since drivers who consumed local media could be informed about the exact locations of speed enforcement points, they might only slow down in the proximity of the speed enforcement points (see, e.g., Ahlfeldt and Keat Tang (2020)). Thus, the speed reducing effects might be stronger if we measured the effect closer to the speed enforcement points.

If people drive more slowly, they can more easily react to street signs and other drivers, which should make them less likely to break traffic rules in general. Moreover, while the police are targeting speed limit violations during a Blitzmarathon, they can and do stop and fine drivers for other offenses as well, for instance, for using no seat belt, talking on the phone, driving under the influence of drugs and alcohol, or possessing no driver's license.[28] Therefore, we expect the Blitzmarathon to reduce accidents of various behavior related causes. Exploiting data on the causes of accidents, we find negative point estimates for almost all causes (see Appendix Table B14). These estimates provide evidence that people do not only drive more slowly but also in general more responsibly during a Blitzmarathon.[29]

7 Conclusion

We evaluate the impact on road safety of extensive speed limit enforcement campaigns in Germany. These campagins, coined Blitzmarathons, are characterized by one day massive speed limit monitoring operations (SLMO), accompanied by a temporary media campaign which informs the public about the date of the Blitzmarathon, the location of speed enforcement points, and in particular about the dangers of speeding. Using rich register data on the universe of police reported accidents, we estimate a generalized difference-in-differences model exploiting regional and time variation in the occurance of Blitzmarathons.

We find that traffic accidents and casualties decline by roughly 8 percent on Blitzmartahon days. Interestingly, accidents return to the pre-Blitzmarathon level right after the massive one day SLMO end. Moreover, we do not find any effects on freeways without speed limits and thus without SLMO on Blitzmarathon days. If the SLMO are extended

[28] According to the Peltzman-effect (Peltzman, 1976), a regulation induces drivers to become more risky in non-regulated domains of driving behavior. Given that the police can stop and fine drivers for all types of offenses, we find it unlikely that this type of offsetting behavior occurs for Blitzmarathons.

[29] Since reporting of causes reflects police officers' subjective evaluations, we should be cautious when interpreting causes of accident data. Measurement error in reporting reduces the precision of estimates. Moreover, if reporting is different on Blitzmarathon days than on regular days, estimates are biased. For example, if the police systematically report more speeding related causes on Blitzmarathons days because they pay more attention to speeding, estimates would be upward biased.

for another seven days, we keep on finding negative effects on accidents over this period. These pieces of evidence suggest that people expect higher detection probabilities of speed limit offenses during Blitzmarathon days and thus drive more slowly and responsibly to avoid fines. The Blizmarathon media campaigns are intended to make drivers more aware of the dangers of speeding, leading to long-term improvements in driving behavior; we do not find any evidence that this is successful. A battery of validity checks and robustness tests confirm the findings and our interpretation.

In a back-of-the-envelope calculation, we try to monetize the benefits of the speed limit enforcement campaigns. Besides material damage, accidents raise medical care costs and reduce productivity, household production, and life satisfaction for casualties, where the size of the effect depends on the severity of the accident. We use the point estimates of the most extensive specifications from panels (b), (c) and (d) of Table 4 to compute how many casualities are prevented by Blitzmarathons. To compute the prevented material damage, we run additional regressions, where we slightly modify the outcome variables. In particular, we use the number of accidents with material damage only, the number of accidents with slighlty injured, the number of accidents with severely injured, and the number of accidents with fatally injured (see Appendix Table B15). Using monetized values of all these different types of accident costs, we find that the seven Blitzmarathon days between 2012 and 2014 saved economic costs in the order of 9.5 to 11.0 million euro (see Appendix Table B16).

In contrast to the benefits, the costs of the Blitzmarathons are much more difficult to assess. From media reports, we calculate that around 47,000 police officers must have enforced speed limits during the seven Blitzmarathon days, but we do not know exactly into how many working hours this effort translates. From the state of Lower Saxony, we gained information that each counted police officer in a Blitzmarathon spent around four hours with speed limit monitoring. Generalizing this to Germany, this results in $47,000 \times 4$ hours $= 188,000$ hours and expenditures of roughly 9.6 million euro.[30] The upper limit in terms of hours spent monitoring speed during a Blitzmarathon is eight hours, i.e., the length of a regular working day, summing to $47,000 \times 8$ hours $= 376,000$ hours and expenditures of 19.2 million euro.

In addition to these direct costs and benefits of Blitzmarathons, there may be indirect costs or benefits from an increased focus of police officers on enforcing speed limits. On the one hand, the deployment of police officers for the prosecution of speed limit violations might cause non-traffic related crime rates to increase. On the other hand, from a range of economics studies we know that an increased presence of the police in the streets (for whatever reason) causes violent and property crime rates to fall (see, for instance, Di Tella

[30] For the average cost of a police officer we take the value of 51 euro per hour from Krems (2016), which includes wages, social security contributions, and future pensions.

and Schargrodsky, 2004; Draca et al., 2011; Machin and Marie, 2011). These potential crime effects could be explored in future research.

The policy implications we can finally draw from our findings are thus twofold. First, increasing the detection probability of speed limit offenses increases road safety; drivers react to (expected) fines. Second, just providing information on the dangers of speeding in media campaigns does not change driving behavior and thus does not sustainably improve road safety. One possible reason why the information policy is not more effective might be that the information about the dangers of speeding that is provided in the campaign is not new to speeders. Alternatively, the information might indeed be new but speeders are overconfident with respect to their own risk. Via both mechanisms, information campaigns might leave speeders unimpressed.

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This Web Appendix provides additional material discussed in the manuscript "Speed Limit Enforcement and Road Safety" by Stefan Bauernschuster and Ramona Rekers.

A Media Quotes of Police Officers

Blitzmarathon February 10, 2012

- "Almost all were driving very responsibly." (WAZ Hattingen, 10-02-2012)
- "Because of the media reports, the drivers are especially attentive." (WAT Lethmathe, 10-02-2012)
- "Those who were on the road in Oberberg could see that many drivers were driving with less speed than on regular days, sometimes they were even going slower than what the maximum speed limit allows." (RP Hueckeswagen, 13-02-2012)

Blitzmarathon July 3, 2012

- He [chief inspector] knows that many drivers were driving especially careful because of the Blitzmarathon. "But that is the whole point of it". (RP Grevenbroich, 03-07-2012)
- "Many drivers were clearly much more disciplined than on other days which is not unexpected but a desirable effect, given the numerous announcements in advance." (Aachener Zeitung, 05-07-2012)
- "The announcements were effective: most drivers were going with less speed and more discipline." (General Anzeiger Bonn, 05-07-2012)

Blitzmarathon October 24, 2012

- "We noticed that many drivers adjusted to the announced police controls and followed traffic regulations." (Ruhr Nachrichten Luenen, 25-10-2012)
- The police confirm that drivers were behaving "pronouncedly disciplined." (Westfaelische Nachrichten Muenster, 25-10-2012)
- "Drivers were obviously warned and comply with the speed limits." (HNA Goettingen, 24-10-2012)

Blitzmarathon June 4, 2013

- On June 4, 2013, four percent of the controlled vehicles violated the speed limit. "Considering that on normal days eight percent of all [controlled] drivers are caught for driving too fast, the drivers obviously complied more with the speed limits.(...) Most drivers behaved very responsibly and complied with the traffic regulations." (DerWesten Siegen, 05-06-2013)
- "People adjust and drive more slowly." (Aachener Zeitung Heinsberg, 04-06-2013)

- Drivers were “altogether exceptionally disciplined.” (Ruhr Nachrichten Steinfurt, 05-06-2013)

Blitzmarathon October 10, 2013

- “People are driving especially careful today. We notice that our campaign is successful.(...) That there is no result [referring to the low detection rate] is a result for us, a good one.” (Suedwest Presse Ulm, 10-10-2013)
- “We observe a strikingly calm driving style. (...) In total, we observe a very careful driving.” The detection rate is much higher during announced speed controls, says the police spokeswoman. (Hamburger Abendblatt, 11-10-2013)
- ”We achieved the goals we had. (...) Most cars were forewarned and were driving considerably more slowly.” (Potsdamer Neueste Nachrichten, 11-10-2013)

Blitzmarathon April 8, 2014

- “Even if the number of detected traffic offenders is relatively low given the large number of controls, the police and the county are very satisfied with the result. It shows that the drivers complied with speed limits at least in the last 24 hours.” (Hamburger Abendblatt Winsen/Stade, 10-04-2014)
- “We notice that the behavior has changed. The driving speed has already clearly declined.” (RP Dinslaken, 09-04-2014)
- “When we usually conduct speed controls here, we have relatively many hits [offenders]. (...) Usually, only one percent of all trucks are driving at 60km/h [speed limit], most trucks are usually driving at 70 to 80 km/h.”(Allgmeine Zeitung Uelzen, 09-04-2014)

Blitzmarathon September 18, 2014

- “They were clearly driving with less speed than usually.” (NWZ Duesseldorf, 19-09-2014)
- The police note an “essentially more relaxed and responsible behavior” on Berlin’s roads. (Berliner Morgenpost, 19-09-2014)
- “The drivers were warned. This leads to slower driving. This is exactly our goal.” (Mitteldeutsche Zeitung Aschersleben, 18-09-2014)

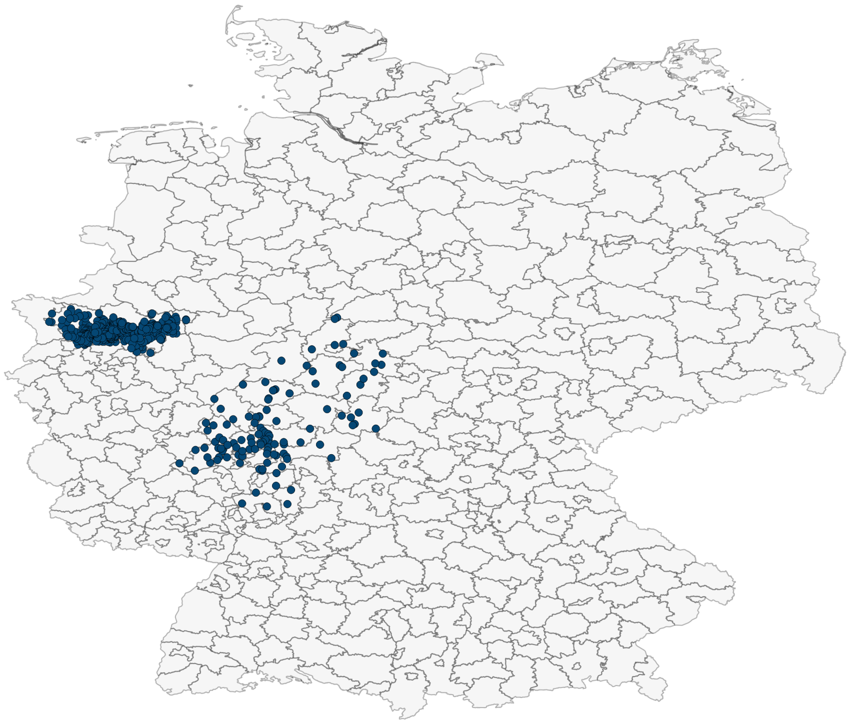
(All quotes are translated from German)

B Supplementary Figures and Tables

Figure B1
Locations of Traffic Volume Monitoring Stations

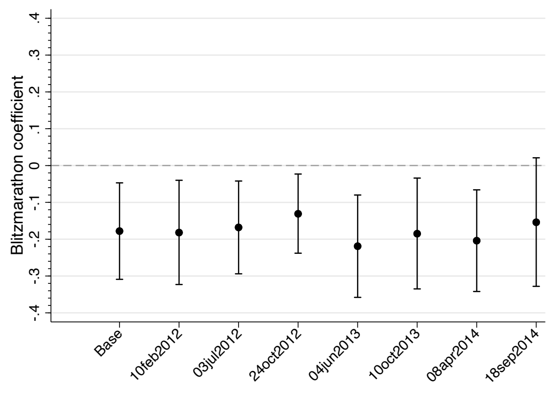
Notes: The figure shows the locations of the monitoring stations for the data on the number of passenger vehicles and trucks per hour. The sample includes 1,408 monitoring stations on non-freeway roads, measuring the hourly number of vehicles on the road. Source: Federal Highway Research Institute (Bundesanstalt für Straßenwesen, BASt).

Figure B2
Locations of Driving Speed Monitoring Stations

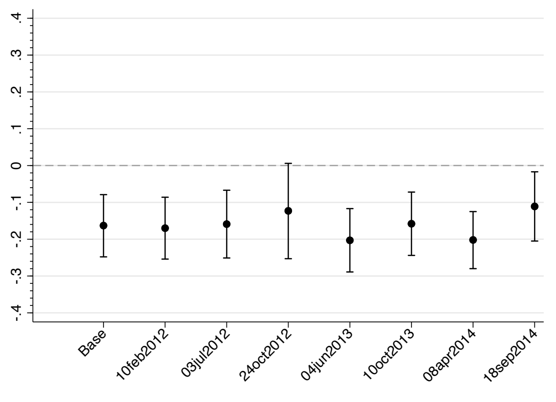


Notes: The figure shows the locations of the monitoring stations for the data on hourly driving speed for passenger vehicles and trucks. The sample includes 1,017 monitoring stations on non-freeway roads, measuring the hourly number of vehicles on the road and their average driving speed. Source: Federal State of Hesse (Hessen Mobil) and North Rhine-Westphalia (Landesbetrieb Straßenbau NRW).

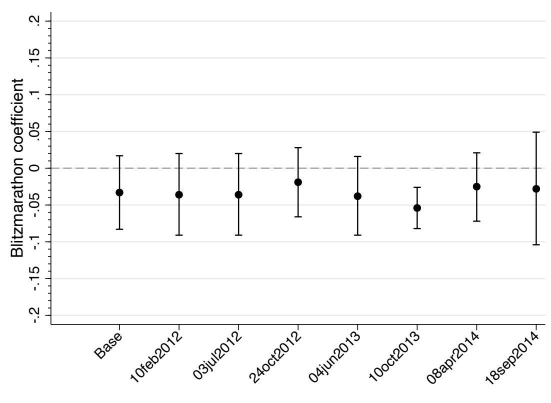
Figure B3
Dropping Blitzmarathon Dates One-by-One



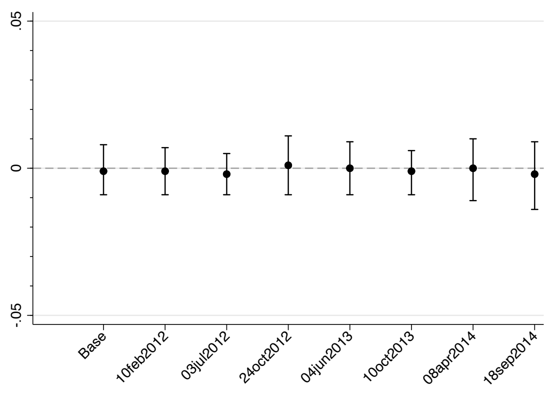
(a) Number of accidents



(b) Number of slightly injured



(c) Number of severely injured

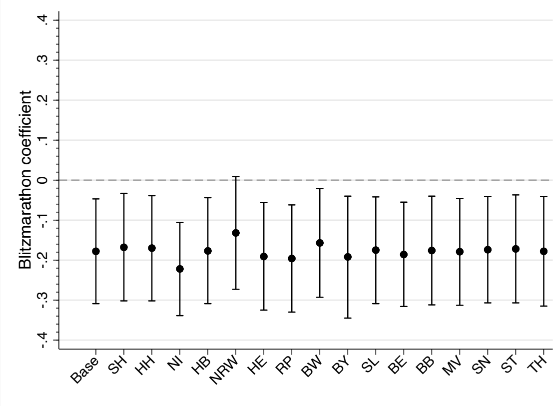


(d) Number of fatally injured

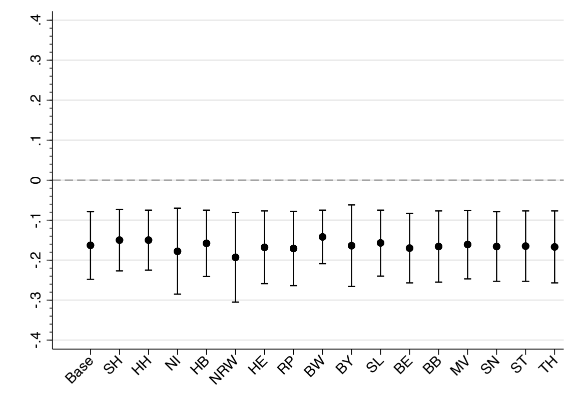
Notes: The figure shows the effect of the Blitzmarathons on the number of traffic accidents [Panel (a)], slightly injured [Panel (b)], severely injured [Panel (c)], and fatally injured [Panel (d)], sequentially dropping a particular Blitzmarathon date one by one. The point markers denote the point estimates of the variable Blitzmarathon, using a sample that deviates from Table 3 by dropping a particular Blitzmarathon date; the exception is "Base" which denotes the effect of the Blitzmarathons when all dates are included and corresponds to the estimates in Column (6) in Table 4. The whiskers represent the 95 percent confidence intervals. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a snow cover dummy. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include a dummy for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors are clustered at the state level.

Figure B4

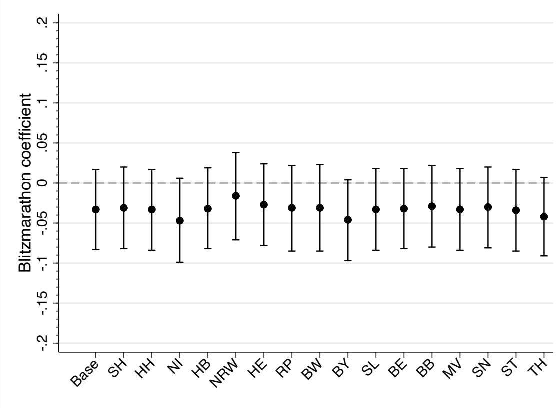
Dropping Federal States One-by-One



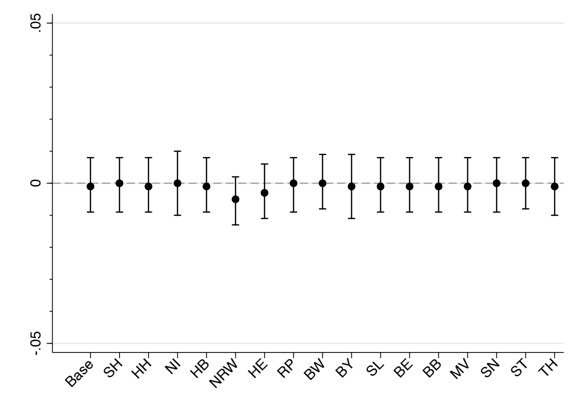
(a) Number of accidents



(b) Number of slightly injured



(c) Number of severely injured



(d) Number of fatally injured

Notes: The figure shows the effect of the Blitzmarathon on the number of traffic accidents [Panel (a)], slightly injured [Panel (b)], severely injured [Panel (c)], and fatally injured [Panel d)], sequentially dropping a particular federal state one by one. The point markers denote the point estimates of the variable Blitzmarathon, using a sample that deviates from Table 3 by dropping all observations from a particular state; the exception is "Base" which denotes the effect of the Blitzmarathons when all states are included and corresponds to the estimates in Column (6) in Table B3. The whiskers represent the 95 percent confidence intervals. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a snow cover dummy. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include a dummy for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors are clustered at the state level.

Table B1

The Effect of the Blitzmarathons on Traffic Accidents (Wild cluster boostrap inference)

	(1)	(2)	(3)
(a) Number of accidents			
[Mean: 2.362; N: 493,518]			
Blitzmarathon	-0.121**	-0.146**	-0.171**
Wild bootstrap-t	-2.971	-3.706	-3.357
Prob $> \|t\|$	0.049	0.013	0.012
R^2	0.669	0.671	0.672
(b) Number of slightly injured			
[Mean: 1.916; N: 493,518]			
Blitzmarathon	-0.126*	-0.132	-0.154***
Wild bootstrap-t	-1.939	-1.759	-2.645
Prob $> \|t\|$	0.065	0.134	0.003
R^2	0.582	0.583	0.584
(c) Number of severely injured			
[Mean: 0.367; N: 493,518]			
Blitzmarathon	-0.036	-0.032	-0.035
Wild bootstrap-t	-1.698	-1.612	-1.573
Prob $> \|t\|$	0.218	0.228	0.238
R^2	0.123	0.124	0.124
(d) Number of fatally injured			
[Mean: 0.021; N: 493,518]			
Blitzmarathon	-0.002	-0.001	-0.002
Wild bootstrap-t	-0.469	-0.365	-0.393
Prob $> \|t\|$	0.660	0.736	0.715
R^2	0.122	0.123	0.124
County FE	×	×	×
Time FE	×	×	×
Weather		×	×
Vacation			×

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Panel (a)], slightly injured [Panel (b)], severely injured [Panel (c)], and fatally injured [Panel (d)]. Each column in each row presents a separate regression. All regressions are run at the county-day level. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. We provide t-statistics and p-values using wild cluster bootstrapping methods, where the clusters are states. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B2

The Effect of the Blitzmarathons on Traffic Accidents (two-way clustering at state and date level)

	(1)	(2)	(3)	(4)	(5)	(6)
(a) Number of accidents						
[Mean: 2.362; N: 493,518]						
Blitzmarathon	-0.121**	-0.146***	-0.171***	-0.174***	-0.161**	-0.178**
	(0.045)	(0.045)	(0.047)	(0.053)	(0.059)	(0.065)
R^2	0.669	0.671	0.672	0.706	0.709	0.710
(b) Number of slightly injured						
[Mean: 1.916; N: 493,518]						
Blitzmarathon	-0.126**	-0.132*	-0.154**	-0.165**	-0.155**	-0.163***
	(0.057)	(0.074)	(0.061)	(0.059)	(0.064)	(0.055)
R^2	0.582	0.583	0.584	0.620	0.623	0.624
(c) Number of severely injured						
[Mean: 0.367; N: 493,518]						
Blitzmarathon	-0.036*	-0.032*	-0.035	-0.031	-0.029	-0.033
	(0.018)	(0.018)	(0.020)	(0.019)	(0.020)	(0.022)
R^2	0.123	0.124	0.124	0.130	0.130	0.128
(d) Number of fatally injured						
[Mean: 0.021; N: 493,518]						
Blitzmarathon	-0.002	-0.001	-0.002	-0.001	-0.001	-0.001
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
R^2	0.122	0.123	0.124	0.129	0.129	0.128
County FE	×	×	×	×	×	×
Time FE	×	×	×	×	×	×
Weather		×	×	×	×	×
Vacation			×	×	×	×
County × Time FE				×	×	×
County × Weather					×	×
County × Vacation						×

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Panel (a)], slightly injured [Panel (b)], severely injured [Panel (c)], and fatally injured [Panel (d)]. Each column in each row presents a separate regression. All regressions are run at the county-day level. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. County × Time, County × Weather, and County × Vacation are interaction of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Standard errors (in parentheses) are two-way clustered at the state and calendar date level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B3

The Effect of the Blitzmarathons on Traffic Accidents (county level clustering)

	(1)	(2)	(3)	(4)	(5)	(6)
(a) Number of accidents						
[Mean: 2.362; N: 493,518]						
Blitzmarathon	-0.121***	-0.146***	-0.171***	-0.174***	-0.161***	-0.178***
	(0.044)	(0.045)	(0.045)	(0.046)	(0.046)	(0.047)
R^2	0.669	0.671	0.672	0.706	0.709	0.710
(b) Number of slightly injured						
[Mean: 1.916; N: 493,518]						
Blitzmarathon	-0.126**	-0.132**	-0.154***	-0.165***	-0.155***	-0.163***
	(0.052)	(0.052)	(0.052)	(0.052)	(0.051)	(0.052)
R^2	0.582	0.583	0.584	0.620	0.623	0.624
(c) Number of severely injured						
[Mean: 0.367; N: 493,518]						
Blitzmarathon	-0.036*	-0.032	-0.035*	-0.031	-0.029	-0.033
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
R^2	0.123	0.124	0.124	0.130	0.130	0.128
(d) Number of fatally injured						
[Mean: 0.021; N: 493,518]						
Blitzmarathon	-0.002	-0.001	-0.002	-0.001	-0.001	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
R^2	0.122	0.123	0.124	0.129	0.129	0.128
County FE	×	×	×	×	×	×
Time FE	×	×	×	×	×	×
Weather		×	×	×	×	×
Vacation			×	×	×	×
County × Time FE				×	×	×
County × Weather					×	×
County × Vacation						×

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Panel (a)], slightly injured [Panel (b)], severely injured [Panel (c)], and fatally injured [Panel (d)]. Each column in each row presents a separate regression. All regressions are run at the county-day level. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. County × Time, County × Weather, and County × Vacation are interaction of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Standard errors (in parentheses) are clustered at the county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B4

The Effect of the Blitzmarathons on Traffic Accidents (Pseudo Poisson ML)

	(1)	(2)	(3)	(4)	(5)	(6)
(a) Number of accidents						
Blitzmarathon	-0.048***	-0.055***	-0.070***	-0.067***	-0.065***	-0.067**
	(0.013)	(0.016)	(0.016)	(0.016)	(0.016)	(0.018)
N	493,518	493,518	493,518	493,518	493,518	493,518
$PseudoR^2$	0.292	0.294	0.295	0.302	0.303	0.304
(b) Number of slightly injured						
Blitzmarathon	-0.062*	-0.063	-0.077***	-0.075***	-0.074***	-0.075***
	(0.032)	(0.038)	(0.028)	(0.028)	(0.024)	(0.023)
N	493,518	493,518	493,518	493,518	493,514	493,506
$PseudoR^2$	0.276	0.277	0.278	0.287	0.289	0.290
(c) Number of severely injured						
Blitzmarathon	-0.089*	-0.076*	-0.087*	-0.078	-0.078	-0.085*
	(0.046)	(0.044)	(0.049)	(0.049)	(0.051)	(0.051)
N	493,518	493,518	493,518	493,419	493,264	492,443
$PseudoR^2$	0.089	0.090	0.091	0.106	0.109	0.110
(d) Number of fatally injured						
Blitzmarathon	-0.080	-0.068	-0.072	-0.090	-0.051	-0.038
	(0.196)	(0.206)	(0.201)	(0.208)	(0.201)	(0.195)
N	488,650	488,650	488,650	342,703	338,328	332,542
$PseudoR^2$	0.045	0.045	0.046	0.078	0.091	0.100
County FE	×	×	×	×	×	×
Time FE	×	×	×	×	×	×
Weather		×	×	×	×	×
Vacation			×	×	×	×
County × Time FE				×	×	×
County × Weather					×	×
County × Vacation						×

Notes: The table shows Pseudo Poisson Maximum Likelihood estimates of the effect of the Blitzmarathons on the number of traffic accidents [Panel (a)], slightly injured [Panel (b)], severely injured [Panel (c)], and fatally injured [Panel (d)]. Each column in each row presents a separate pseudo poisson maximum likelihood regression. All regressions are run at the county-day level. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. County × Time, County × Weather, and County × Vacation are interaction of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B5

The Effect of the Blitzmarathons and TISPOL Operations on Traffic Accidents

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)	Number of fatally injured (4)
Blitzmarathon	-0.178**	-0.164***	-0.033	-0.001
	(0.062)	(0.040)	(0.023)	(0.004)
TISPOL Operation	-0.007	-0.013	-0.005	-0.000
	(0.010)	(0.011)	(0.004)	(0.001)
Mean	2.362	1.916	0.367	0.021
N	493,518	493,518	493,518	493,518

Notes: The table shows the effect of the Blitzmarathons and TISPOL operations on the number of traffic accidents [Column (1)], slightly injured [Column (2)], severely injured [Column (3)], and fatally injured [Column (4)]. Each column presents a separate regression. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. The reported R-squared is the adjusted R-squared. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B6

The Effect of the Blitzmarathons on Traffic Accidents over Time (Pseudo Poisson ML)

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)	Number of fatally injured (4)
13–15 days before	-0.021	-0.003	0.026	0.138
	(0.022)	(0.028)	(0.058)	(0.125)
10–12 days before	-0.001	-0.009	0.030	0.002
	(0.010)	(0.017)	(0.028)	(0.120)
7–9 days before	-0.008	-0.005	-0.032	0.140
	(0.009)	(0.011)	(0.052)	(0.142)
4–6 days before	0.016	-0.004	-0.016	-0.033
	(0.025)	(0.030)	(0.046)	(0.151)
1–3 days before	-0.044	-0.052	-0.050	-0.071
	(0.033)	(0.032)	(0.062)	(0.112)
Blitzmarathon	-0.070***	-0.079***	-0.083*	-0.022
	(0.017)	(0.024)	(0.049)	(0.202)
1–3 days after	0.004	0.014	-0.003	0.007
	(0.011)	(0.021)	(0.044)	(0.136)
4–6 days after	-0.023	-0.018	0.020	0.198
	(0.014)	(0.018)	(0.042)	(0.128)
7–9 days after	-0.002	-0.008	0.049	-0.056
	(0.020)	(0.020)	(0.032)	(0.140)
10–12 days after	-0.005	-0.024	0.029	0.236
	(0.015)	(0.018)	(0.032)	(0.171)
13–15 days after	-0.004	-0.018	0.009	-0.115
	(0.011)	(0.025)	(0.044)	(0.118)
N	493,518	493,506	492,443	332,542

Notes: The table reports Pseudo Poisson Maximum Likelihood estimates of the effect of the Blitzmarathons +/− 15 days on the number of traffic accidents [Column (1)], slightly injured [Column (2)], severely injured [Column (3)], and fatally injured [Column (4)]. We group the 15 days before and after a Blitzmarathon in three-day intervals. "Blitzmarathon" is a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B7

The Effect of the Blitzmarathon–Extensions on Traffic Accidents

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
(a) Blitzmarathon in Bavaria			
Blitzmarathon (Bavaria)	-0.106***	-0.159***	0.036***
	(0.001)	(0.001)	(0.000)
Mean	2.361	1.915	0.367
N	492,516	492,516	492,516
(b) Blitzmarathon Extension in Bavaria			
Extension Blitzmarathon	-0.104***	-0.139***	0.002***
	(0.001)	(0.001)	(0.000)
Mean	2.360	1.914	0.367
N	493,668	493,668	493,668

Notes: The table shows the effect of the first day of the Blitzmarathon and the effect of the Blitzmarathon extension days in Bavaria on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)]. Each column presents a separate regression. All regressions are run at the county-day level. The sample in Panel (a) drops all one-day Blitzmarathons outside of Bavaria; the sample in Panel (b) drops all one-day Blitzmarathons and adds the observations for the two extension periods. "Blitzmarathon (Bavaria)" is as a dummy variable indicating the first day of the Blitzmarathon in Bavaria. "Extension Blitzmarathon " is a dummy variable indicating the Blitzmarathon extension days in Bavaria. All regressions include county and time fixed effects, weather controls, vacation controls, and interaction of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B8

Effect Heterogeneity by Urban vs Rural County and Speed Limit

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
(a) Urban County			
Blitzmarathon	-0.064	-0.088	-0.021
	(0.143)	(0.085)	(0.033)
Mean	2.878	2.461	0.294
N	131,367	131,367	131,367
(b) Rural County			
Blitzmarathon	-0.224***	-0.193***	-0.037
	(0.068)	(0.058)	(0.025)
Mean	2.175	1.719	0.393
N	362,151	362,151	362,151
(a) Speed Limit 30 km/h			
Blitzmarathon	0.030**	0.019	0.003
	(0.013)	(0.017)	(0.004)
Mean	0.211	0.146	0.022
N	493,518	493,518	493,518
(b) Speed Limit 50 km/h			
Blitzmarathon	-0.118**	-0.098***	-0.014
	(0.051)	(0.032)	(0.014)
Mean	1.342	1.102	0.154
N	493,518	493,518	493,518
(c) Speed Limit 70 km/h			
Blitzmarathon	-0.042***	-0.032**	-0.011**
	(0.012)	(0.011)	(0.004)
Mean	0.197	0.180	0.044
N	493,518	493,518	493,518
(d) Speed Limit 100 km/h			
Blitzmarathon	-0.043***	-0.040*	-0.013
	(0.010)	(0.020)	(0.011)
Mean	0.454	0.366	0.118
N	493,518	493,518	493,518
(e) Speed Limit 130 km/h			
Blitzmarathon	-0.004	-0.006	-0.002
	(0.004)	(0.006)	(0.002)
Mean	0.028	0.023	0.005
N	493,518	493,518	493,518

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)] for roads in urban and rural counties as well as for different speed limit segments. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B9

Effect Heterogeneity by Driver Characteristics

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
(a) Female			
Blitzmarathon	-0.048**	-0.043*	-0.015***
	(0.022)	(0.020)	(0.005)
Mean	0.727	0.644	0.106
N	493,518	493,518	493,518
(b) Male			
Blitzmarathon	-0.129**	-0.124***	-0.016
	(0.054)	(0.037)	(0.022)
Mean	1.562	1.224	0.255
N	493,518	493,518	493,518
(c) Probation period			
Blitzmarathon	-0.010	-0.013	-0.003
	(0.012)	(0.027)	(0.005)
Mean	0.337	0.286	0.060
N	493,518	493,518	493,518
(d) No Probation period			
Blitzmarathon	-0.145**	-0.147***	-0.023
	(0.054)	(0.030)	(0.019)
Mean	1.841	1.510	0.284
N	493,518	493,518	493,518

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)] for different driver characteristics. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B10

Effect Heterogeneity by Driver's Age

		Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
Age < 21	Blitzmarathon	-0.024	-0.031	-0.015***
		(0.015)	(0.024)	(0.005)
	Mean	0.267	0.236	0.049
Age 21–25	Blitzmarathon	-0.033**	-0.037**	0.005
		(0.015)	(0.014)	(0.007)
	Mean	0.304	0.253	0.049
Age 26–30	Blitzmarathon	0.015	0.023	0.006
		(0.009)	(0.014)	(0.004)
	Mean	0.223	0.180	0.033
Age 31–35	Blitzmarathon	-0.016	-0.011	-0.005
		(0.017)	(0.011)	(0.008)
	Mean	0.190	0.155	0.027
Age 36–40	Blitzmarathon	-0.020*	-0.015	0.001
		(0.011)	(0.012)	(0.003)
	Mean	0.171	0.142	0.024
Age 41–45	Blitzmarathon	-0.021*	-0.018	-0.012***
		(0.007)	(0.012)	(0.003)
	Mean	0.202	0.165	0.029
Age 46–50	Blitzmarathon	0.003	-0.013	-0.003
		(0.014)	(0.016)	(0.005)
	Mean	0.216	0.171	0.033
Age 51–55	Blitzmarathon	-0.047***	-0.041***	-0.000
		(0.008)	(0.011)	(0.008)
	Mean	0.183	0.143	0.029
Age 56-60	Blitzmarathon	-0.007	-0.008	0.001
		(0.012)	(0.010)	(0.005)
	Mean	0.142	0.111	0.023
Age 61–65	Blitzmarathon	0.013	0.016*	0.002
		(0.010)	(0.008)	(0.004)
	Mean	0.101	0.079	0.016
Age 66–70	Blitzmarathon	-0.003	-0.005	-0.000
		(0.004)	(0.005)	(0.003)
	Mean	0.075	0.060	0.012
Age > 70	Blitzmarathon	-0.035*	-0.023	-0.009***
		(0.019)	(0.020)	(0.003)
	Mean	0.193	0.157	0.037

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)] for drivers of different age. The number of observations is 493,518 for every regression. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B11

The Effect of the Blitzmarathons on Traffic Accidents by Traffic Participation

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
(a) Car			
Blitzmarathon	-0.193**	-0.173***	-0.030
	(0.067)	(0.026)	(0.018)
Mean	1.989	1.634	0.283
N	493,518	493,518	493,518
(b) Motorbike			
Blitzmarathon	0.001	0.007	-0.008
	(0.017)	(0.017)	(0.006)
Mean	0.160	0.118	0.052
N	493,518	493,518	493,518
(c) Truck			
Blitzmarathon	0.011	0.001	0.005
	(0.009)	(0.012)	(0.005)
Mean	0.211	0.163	0.032
N	493,518	493,518	493,518
(d) Bicycle			
Blitzmarathon	0.036	0.035	0.011
	(0.026)	(0.025)	(0.007)
Mean	0.243	0.197	0.060
N	493,518	493,518	493,518
(e) Pedestrian			
Blitzmarathon	0.000	0.002	-0.000
	(0.005)	(0.005)	(0.003)
Mean	0.067	0.050	0.022
N	493,518	493,518	493,518
All accidents			
Blitzmarathon	-0.136**	-0.127*	-0.020
	(0.048)	(0.064)	(0.018)
Mean	2.743	2.219	0.458
N	493,518	493,518	493,518

Notes: The table shows the effect of the Blitzmarathon on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)] for different types of road users. In the lower panel, we use an encompassing outcome variable that includes accidents where the person who caused the accident was a car driver, motorbike driver, truck driver, bicyclist, pedestrian, bus driver, tram or train driver, or any other road user. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B12

The Effect of the Blitzmarathon After Controlling for Traffic Volume

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
(a) OLS model not controlling for traffic volume			
Blitzmarathon	-0.222***	-0.173***	-0.035
	(0.071)	(0.048)	(0.025)
Mean	2.330	1.865	0.397
N	335,076	335,076	335,076
(b) OLS model controlling for traffic volume			
Blitzmarathon	-0.210***	-0.159***	-0.031
	(0.070)	(0.047)	(0.024)
Traffic volume	0.034 ***	0.042***	0.011***
	(0.010)	(0.010)	(0.002)
Mean	2.330	1.865	0.397
N	335,076	335,076	335,076
(c) Pseudo Poisson Maximum Likelihood model not controlling for traffic volume			
Blitzmarathon	-0.085***	-0.081***	-0.084
	(0.025)	(0.028)	(0.057)
Mean	2.330	1.865	0.397
N	335,076	335,074	334,664
(d) Pseudo Poisson Maximum Likelihood model controlling for log(traffic volume)			
Blitzmarathon	-0.082***	-0.074***	-0.074
	(0.024)	(0.027)	(0.057)
Log(Traffic volume)	0.315 ***	0.663***	0.805***
	(0.078)	(0.075)	(0.147)
Mean	2.330	1.865	0.397
N	335,076	335,074	334,664

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)]. The sample is restricted to counties with traffic volume information. Panel (a) and (b) show results from an OLS model, whereas panel (c) and (d) show results from a Pseudo Poisson Maximum Likelihood model. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. The sample is restricted to all counties for which we have data on daily traffic volume. All regressions include county and time fixed effects, weather controls, vacation controls, and interaction of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. In panel (b), we additionally control for daily traffic volume, i.e., the number of cars and trucks passing the traffic volume monitors in a county. In panel (d), we control for the log of daily traffic volume instead. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B13

The Effect of the Blitzmarathons on Hourly Traffic Volume (q/v–data)

	(1)	(2)	(3)	(4)	(5)	(6)
(a) Number of passenger vehicles / 1,000 (q/v–data)						
[Mean: 0.265; N: 20,462,014]						
Blitzmarathon	0.002**	0.003*	-0.003	-0.003**	-0.003**	-0.004***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
R^2	0.718	0.718	0.719	0.955	0.955	0.956
(b) Number of trucks / 1,000 (q/v–data)						
[Mean: 0.021; N: 20,433,158]						
Blitzmarathon	0.0001	0.001	0.001	0.001**	0.001**	0.001**
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
R^2	0.57	0.57	0.57	0.81	0.81	0.81
Monitor FE	×	×	×	×	×	×
Time FE	×	×	×	×	×	×
Weather		×	×	×	×	×
Vacations			×	×	×	×
Monitor × Time FE				×	×	×
Monitor × Weather					×	×
Monitor × Vacation						×

Notes: The table shows the effect of the Blitzmarathons on the number of cars [Panel (a)] the number of trucks [Panel (b)] on federal roads in the q/v–data. The sample includes 1,017 monitoring stations on federal roads. An overview of the stations is given in Appendix Figure B2. All regressions are run at the monitor-hour level. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include monitor station and time fixed effects. Time fixed effects include hour-of-day, day-of-week, month-of-year, hour-of-day×day-of-week, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Monitor × Time, Monitor × Weather, and Monitor × Vacation are interaction of monitor station indicators with all time fixed effects, weather controls, and vacation controls, respectively. We weight observations with probability weights of the inverse of the number of stations within each county. The reported R-squared is the adjusted R-squared. Standard errors (in parentheses) are clustered at the county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B14

The Effect of the Blitzmarathons on Different Causes of Accidents

	Number of accidents (1)	Number of slightly injured (2)	Number of severely injured (3)
(a) Alcohol or drugs			
Blitzmarathon	-0.017	-0.006	0.002
	(0.011)	(0.010)	(0.006)
Mean	0.246	0.089	0.037
(b) Wrong lane			
Blitzmarathon	-0.009	-0.005	-0.014***
	(0.009)	(0.014)	(0.005)
Mean	0.089	0.071	0.024
(c) Speed			
Blitzmarathon	-0.028	-0.025	-0.004
	(0.028)	(0.017)	(0.005)
Mean	0.332	0.238	0.072
(d) Distance to next driver			
Blitzmarathon	0.018	-0.002	0.013**
	(0.015)	(0.023)	(0.005)
Mean	0.268	0.339	0.021
(e) Overtaking			
Blitzmarathon	-0.017*	-0.018**	-0.004
	(0.009)	(0.008)	(0.003)
Mean	0.126	0.105	0.022
(f) Right of way			
Blitzmarathon	-0.055**	-0.055**	0.002
	(0.027)	(0.023)	(0.013)
Mean	0.489	0.375	0.061
(g) Turn			
Blitzmarathon	-0.035*	-0.031	-0.014**
	(0.019)	(0.022)	(0.006)
Mean	0.407	0.348	0.055
(h) Loading/ technical issues			
Blitzmarathon	-0.015***	-0.014**	-0.003*
	(0.005)	(0.006)	(0.002)
Mean	0.044	0.033	0.006
(i) Other			
Blitzmarathon	-0.003	-0.000	-0.003
	(0.022)	(0.021)	(0.005)
Mean	0.265	0.241	0.048

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents [Column (1)], slightly injured [Column (2)], and severely injured [Column (3)] for different reported accident causes. The number of observations is 493,518 for every regression. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects, weather controls, vacation controls, and interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B15

The Effect of the Blitzmarathons on Traffic Accidents by Accident Category

	(1)	(2)	(3)	(4)	(5)	(6)
(a) Number of accidents with material damage						
[Mean: 0.618; N: 493,518]						
Blitzmarathon	-0.034	-0.062*	-0.065*	-0.060*	-0.058	-0.064
	(0.031)	(0.031)	(0.036)	(0.033)	(0.035)	(0.037)
R^2	0.292	0.300	0.300	0.311	0.316	0.315
(b) Number of accidents with slightly injured						
[Mean: 1.414; N: 493,518]						
Blitzmarathon	-0.049	-0.052	-0.070*	-0.082**	-0.073**	-0.080***
	(0.045)	(0.052)	(0.038)	(0.032)	(0.030)	(0.026)
R^2	0.645	0.646	0.648	0.700	0.703	0.704
(c) Number of accidents with severely injured						
[Mean: 0.312; N: 493,518]						
Blitzmarathon	-0.034	-0.030	-0.032	-0.029	-0.028	-0.031
	(0.020)	(0.018)	(0.021)	(0.021)	(0.021)	(0.023)
R^2	0.153	0.154	0.155	0.164	0.163	0.162
(d) Number of accidents with fatally injured						
[Mean: 0.019; N: 493,518]						
Blitzmarathon	-0.003	-0.003	-0.003	-0.003	-0.003	-0.002
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)
R^2	0.008	0.008	0.008	0.006	0.005	0.003
County FE	×	×	×	×	×	×
Time FE	×	×	×	×	×	×
Weather		×	×	×	×	×
Vacation			×	×	×	×
County × Time FE				×	×	×
County × Weather					×	×
County × Vacation						×

Notes: The table shows the effect of the Blitzmarathons on the number of traffic accidents with material damage [Panel (a)], with slightly injured [Panel (b)], with severely injured [Panel (c)], and with fatally injured [Panel (d)]. Each column in each panel presents a separate regression. All regressions are run at the county-day level. "Blitzmarathon" is as a dummy variable indicating the Blitzmarathon is in force in a specific county on a specific day. All regressions include county and time fixed effects. Time fixed effects include day-of-week, month-of-year, and year fixed effects. Weather controls include atmospheric temperature, amount of precipitation, and a dummy for snow cover. Additionally, we include dummies indicating missing atmospheric temperature, missing amount of precipitation, and missing snow cover. Vacation controls include dummies for school vacation, the last school day before a school vacation, and the last day of a school vacation. County × Time, County × Weather, and County × Vacation are interactions of county indicators with all time fixed effects, weather controls, and vacation controls, respectively. The reported R-squared is the adjusted R-squared. Standard errors (in parentheses) are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B16

Benefits of the Reduction in Accidents

Variable		Point estimate (1)	Prevented cases (2)	Unit costs in 2014 prices (3)	Total (4)
Costs per casualty					
Number	of slightly injured	0.163	195	5,014€	977,730€
	of severely injured	0.033^{+}	39	120,921€	4,715,919€
	fatally injured	0.001^{+}	1	1,191,397€	1,191,397€
Material damage					
Accidents	with material damage	0.064^{+}	76	21,484€	1,632,784€
	with slightly injured	0.080	96	14,190€	1,632,240€
	with severely injured	0.031^{+}	37	21,883€	809,671€
	with fatalities	0.002^{+}	2	48,003€	96,006€
Total (lower bound)					9,498,344€
Total (upper bound)					10,785,747€

Notes: The table shows the number of prevented accidents and the corresponding cost reduction for the seven one-day Blitzmarathons between 2012 and 2014. In Column (2), we multiply the coefficient of the variable Blitzmarathon (Column (1)) with the 1,194 Blitzmarathon-county-days to get the prevented accident cases. Column (3) lists the unit costs for each accident case. Unit costs stem from calculations from the German Federal Highway Research Institute (BASt, 2010) with updates for the year 2014. Column (4) returns the total costs for each accident case given the prevented cases in Column (2). The upper bound for the reduction in costs includes the number of fatally injured and material damage for accidents with fatalities. $^{+}$ indicates not statistically significant at the ten percent level.