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Headlight glare in police-reported crash data: prevalence, contributing factors, and potential effects

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Contents

ABSTRACT

Introduction: This study investigates the prevalence and contributing factors of headlight glare in police-reported crash data across 11 U.S. states from 2015 to 2024. The purpose was to evaluate the degree to which glare is reported as a contributing factor in nighttime crashes and to identify conditions and populations most commonly associated with glare.

Method: Analyses utilized crash data combined across multiple states, matched-pair comparisons of crashes within the same states, and narrative reviews of officer reports.

Results: Glare was reported in only 0.1%–0.2% of nighttime crashes, with little variation over time despite the widespread improvement in headlight visibility that took place during the study years. Overall, most glare-related crashes occurred during daylight hours when the sun was close to the horizon. Nighttime glare crashes were disproportionately associated with older drivers, older vehicles, and undivided low-speed roads. Narrative analysis revealed that lane departures were the most common driver response to headlight glare, accounting for over half of cases.

Conclusions: While already at a low reported level, the results suggest the effect of headlight glare on crash risk could be further reduced by targeted countermeasures such as adaptive lighting systems, improved lane markings, and more advanced lane departure technologies. Additionally, future research should explore whether increased visibility illumination reduces drivers' susceptibility to glare from other vehicles.

Previous research has demonstrated that improved headlight visibility reduces the risk of single-vehicle nighttime crashes. This study found no indication that such improvements have led to an increase in glare-related crashes.

Keywords: nighttime driving, driver visual impairment, vehicle forward lighting

1. INTRODUCTION

Vehicle headlight design must balance two conflicting safety goals: ensuring sufficient illumination for the driver while minimizing glare for other road users. Although headlights also serve purposes like conspicuity and aesthetic styling, visibility and glare remain the key indicators of their functional performance. Since at least 1915, a combination of government regulations, industry guidelines, and independent testing has aimed to strike this balance (Moore, 1998). Today, multiple design standards exist globally, but two are most influential in the U.S. market: the Federal Motor Vehicle Safety Standard (FMVSS) 108, which sets regulatory requirements, and the Insurance Institute for Highway Safety (IIHS) headlight evaluation program, which has provided consumer-focused assessments since 2016.

Although the IIHS headlight test program was established using baseline criteria from FMVSS 108 (IIHS, 2015), it likely has influenced a shift in headlight designs in the U.S. fleet. One key reason is the testing approach: IIHS evaluates headlights on actual vehicles driving on a test track, while in FMVSS 108 tests, individual headlamps are mounted on a laboratory fixture. The IIHS method requires manufacturers to consider real-world variables such as vertical and horizontal aim, mounting height, vehicle power supply, and heat dissipation—factors that can affect headlight performance during actual driving. Furthermore, FMVSS 108 allows for a range of acceptable values at certain test points, permits some re-aiming to meet specific criteria, and only requires that headlamps be "designed to comply," not necessarily perform to standard in practice. By testing complete production vehicles, the IIHS program has pushed manufacturers to adopt a systems-level approach to headlight optimization. This impact is evident in the growing share of headlight systems receiving the highest IIHS rating of "good," which rose from 7% in 2017 to 51% in 2025.

Performance in the IIHS test or any other headlight assessment is only meaningful if it correlates to improved real-world outcomes. While a vehicle must perform well in both the visibility and glare components of the IIHS test to achieve a good overall rating, visibility and glare are likely related to different types of crashes. The field data associated with the visibility portion of the test are more straightforward to collect because a vehicle's performance affects its own crash risk. A 2022 study found that vehicles with good visibility ratings had 19% fewer single-vehicle nighttime crashes per mile than vehicles with the lowest rating of poor (Brumbelow, 2022).

The effects of glare performance differences on other road users cannot be directly tracked in the same way because the glare-producing vehicle will only be identified if it is physically involved in the resulting collision. Many U.S. states include fields on police crash reports to indicate whether glare contributed to a crash, but these likely rely on drivers' subjective assessments. Several studies have demonstrated a difference between discomfort glare, which describes an observer's perception of glare, and disability glare, which describes measurable impairments in visual performance caused by glare (Bullough et al., 2002; Mainster & Turner, 2012).

Despite these limitations, analyzing available glare-related crash records could still yield valuable insights. For example, the overall frequency of reported glare in crashes, even with some uncertainty, can help contextualize glare relative to other contributing factors. Trends over time may reflect changes in headlight technology or performance. Comparing cases with and without reported glare could also help identify driver characteristics or environmental conditions that increase the likelihood of glare-related crashes. Finally, crash narratives written by investigating officers may reveal common driver responses to glare that lead to crashes. This study is designed to explore these issues while also identifying the most promising countermeasures to reduce glare-related crash risks.

2. METHODS

Individual U.S. state crash databases were inspected to identify those with glare-related codes or with searchable crash narratives for any combination of the 2016–2024 calendar years. In addition to glare, required data elements were crash date, time, and location, recorded either as geospatial coordinates (latitude and longitude) or as the county where the crash occurred. The sun altitude (in degrees above or below the horizon) was calculated using the crash date, time, and coordinates. When geospatial coordinates were missing, the median values for other crashes in the same county were used where available. For states without any coordinate data, population-weighted county centroids from the U.S. Census Bureau (2021) were substituted. The role of glare in contributing to vehicle crashes was evaluated in three separate sets of analyses: glare prevalence, factors associated with glare in nighttime crashes, and glare source and driver response. Each is described below.

2.1 Glare prevalence

This analysis included 11 states with crash-, vehicle-, or driver-level glare codes (Table 1). Only two states distinguished between headlight and sun glare. To enable combined analyses using all states glare from any source was treated similarly, with the sun altitude used to distinguish between glare at night and during the day. For states with vehicle- or driver-level glare codes, a crash-level code was generated indicating glare for any involved vehicle or driver.

The glare rate was defined as the proportion of crashes involving glare. The glare rate was calculated for four different sun altitude categories: high sun (above 20°), low sun (0° to 20°), twilight (−6° to 0°), and nighttime (below −6°). Nighttime glare rates were calculated annually and normalized to each state's rate in 2017, the earliest year with data available in all states. A weighted average across states was then computed using the number of nighttime crashes as weights.

2.2 Factors associated with glare in nighttime crashes

To identify factors linked to glare-related crashes at night, three states with the highest number of nighttime crashes and vehicle- or driver-level glare codes were selected. A nearest-neighbor matching method was used to pair each driver in a glare-related crash with a similar driver in a nonglare crash. To limit the effect of potential reporting differences between police jurisdictions, all matches occurred within the same county.

Two sets of matched pairs were created. The first set matched on crash environment to compare driver demographics (age and sex). The second set matched on driver demographics to compare vehicle and environmental factors. Matching variables varied by state and are listed in Table 2. Matches between two drivers involved in the same crash were not allowed and crashes with codes indicating alcohol involvement, drug involvement, sleep, or medical episodes were excluded. A bootstrapping procedure with 1,000 resamples was used to estimate the sampling distribution and assess the statistical significance of differences between the glare and no-glare groups at the $\alpha = 0.05$ level.

2.3 Glare source and driver response

This analysis used crash data from Ohio, which include full-text officer reports. Nighttime crashes (sun altitude $< -6°$) were searched for glare-related terms (Table 3). Each matching narrative was reviewed to confirm whether headlight glare was cited, identify the glare source (e.g., oncoming or trailing vehicles), and determine how glare contributed to the crash.

3. RESULTS

3.1 Glare prevalence

There were 23.8 million total reported crashes in all 11 states for the years studied. Of these, 146,799 crashes (0.6%) had glare coded as a contributing factor. Figure 1 shows the rate of coded glare by sun altitude in 5° increments. Within the four sun altitude categories, the rate of coded glare was 0.4% for high sun, 2.3% for low sun, 0.2% during twilight, and 0.1% during nighttime. Of all reported glare-related crashes, 55% occurred with the sun at low altitude, 38% at high altitude, 6% at nighttime, and 1% during twilight.

There were 6.4 million total nighttime crashes. Figure 2 shows the annual proportion by state, while Figure 3 shows the glare rate in each state. With only a few exceptions, the annual rate in each state was between 0.1% and 0.2%. After normalizing the rate in each state to its 2017 rate, an annual weighted average was calculated using all states with available data from 2015 to 2023 (Figure 4). Over this time period, the glare rate was highest in 2015 (11% higher than the 2017 rate) and lowest in 2020 (9% lower than in 2017). The rate in 2023 was 5% higher than in 2017.

3.2 Factors associated with glare in nighttime crashes

The nearest-neighbor matching technique yielded two sets of driver pairs involved in nighttime crashes in three states. There were 1,137 driver pairs in Florida, 971 in Illinois, and 1,260 in New York. The first set of pairs was formed by matching a driver with coded glare to another driver without coded glare but with similar crash environment variables, facilitating comparisons of driver age and sex. These are shown in Table 4 and Figure 5. In all three states, the mean driver age in glare-reported crashes was significantly higher than in crashes without glare. None of the differences in driver sex distribution between glare and no-glare crashes were statistically significant.

The second set of driver pairs was formed by matching on driver sex and age. Comparisons of crash environment and vehicle model year for these drivers are shown in Table 5. Many of the differences were statistically significant. Relative to drivers without reported glare, crashes for drivers with glare were more often single-vehicle crashes (in all three states) and more often occurred in rain or when the road surface was wet (in NY). They also more often occurred on local (FL and IL), undivided (IL), two-lane (FL) roads with lower speed limits (FL). Crash-involved drivers with reported glare tended to be in older vehicles (FL and NY). Results for environmental lighting differed by state; drivers with reported glare were more often in crashes without environmental lighting in Florida and Illinois, while the reverse was true in New York.

3.3 Glare source and driver response

There were 220 nighttime crashes from the 2017–2024 Ohio data with a narrative that contained a matching search term and described headlight glare. In 88% of these cases, oncoming traffic was cited as the source of glare, with the remainder being caused by the headlights of trailing vehicles (8%) or other locations (e.g., lateral or vehicles parked against traffic; 4%).

Table 6 shows the distribution of driver actions that were attributed to headlight glare in all 220 cases. A lane departure to the right was the most common action, accounting for 45% of all cases. The crash types for all cases are shown in Figure 6 along with the driver action. Over two thirds were either single-vehicle crashes with an object (53%) or parked vehicle (18%).

4. DISCUSSION

The overall rate of reported glare in nighttime crashes was relatively consistent from 2015 to 2023. This period of time corresponds to the introduction of the IIHS headlight rating program in 2016 and its subsequent expansion. For each model year beginning with 2017, IIHS has carried ratings for between 150 and 190 vehicles. For the states evaluated in this study, over 40% of crashed vehicles in 2023 were 2017 or newer models. Overall, the data do not indicate that improvements in headlight visibility linked to the IIHS program have led to an increase in glare-related nighttime crashes.

The four states with the highest number of nighttime crashes all had reported glare involvement rates between 0.10% and 0.17% for all years studied. The remaining seven states fell between 0.07% and 0.27%, but these rates were based on as few as 20 crashes with reported glare in some years. The relative consistency between the figures based on the most data, despite the variety of coding, reporting, and other differences between states, suggests the true rate of glare involvement may be close to this range. However, this cannot be stated conclusively. Overreporting could occur if drivers attribute crashes to glare to avoid admitting fault due to another cause, or if their visual performance was not actually affected to the degree they believed (Balk & Tyrrell, 2011; Sewall et al., 2016). Underreporting might result from incomplete or inconsistent documentation in multiple stages of the crash reporting process.

There is some limited existing research to compare the rates of crashes involving glare measured in this study. For the National Motor Vehicle Crash Causation Survey (NMVCCS), NHTSA collected data for 5,470 crashes from 2005 to 2007. Glare from headlights or the sun was coded as a factor in 0.2% and 1.3% of all crashes, respectively (Singh, 2008). Between 2014 and 2023, the U.K. Department for Transport (2024) recorded contributory factors for nearly 850,000 road collisions in Great Britain. During that period, "dazzling headlights" were identified in 0.31% of collisions with at least one coded factor, while "dazzling sun" was cited in 2.7%. These rates are broadly consistent with those observed in U.S. state-level data, though they do not account for sun altitude or time of day. Additionally, both the

NMVCCS and U.K. datasets are based on far fewer crashes than the nearly 24 million analyzed in this study.

A recently cited statistic about nighttime glare appears inaccurate. In 2022, Hu et al. claimed that "the number of [U.S.] traffic accidents caused by glare from the high-beam headlights of oncoming traffic at night accounts for 12% to 15% of all traffic accidents." However, this figure was attributed to a study (Janoff, 1993) that contains no such finding or any analysis of field crash data. None of the other sources cited by Hu et al. appear to support this statistic either. Since then, the 12%–15% figure has been repeated in a 2023 publication by a U.K. charity (LightAware, 2023), which in turn may have influenced a similar claim made during a U.K. Parliament debate (2024).

As more vehicles with IIHS good-rated headlights penetrate the U.S. vehicle fleet, it is possible that future years of data could show a change in the rate of reported glare. While a good rating implies limited glare exposure in real-world scenarios that resemble the test conditions, different road geometry, vehicle loading, or inconsistent aim can affect the results. However, the glare rates measured in this study, supported by the NMVCCS and U.K. data cited above, suggest that any realistic increase will be too small to outweigh the benefits of improved headlight visibility. It was previously estimated that inadequate headlight visibility contributes to at least 19% of single-vehicle nighttime crashes based on the difference in crash risk between vehicles rated as having poor versus good visibility (Brumbelow, 2022). This is conservative because even the best headlights offer significantly less visibility than daylight. But even using this figure, the true glare involvement rate would need to be around 100 times higher than measured in order to align with the effect of inadequate visibility. This would also imply that every daytime crash occurring within an hour of sunrise or sunset is caused by sun glare. It is virtually impossible that underreporting is currently occurring on such a scale, or that future nighttime glare rates will rise to that extent.

The sun’s dual role as a source of both visibility and glare offers valuable context for understanding headlight performance. While discomfort glare from headlights is a frequent source of public complaints directed at government regulators (Singh & Perel, 2004; U.K. Parliament, 2024), over 90% of crashes involving reported glare occur during daylight. The special attention given to headlight glare may partly be one of perspective: the sun affects all road users equally, whereas any specific vehicle's headlights enhance visibility for only one driver while increasing perceived glare for everyone else. Additionally, research indicates that drivers routinely overdrive their own headlights, underestimating the amount of illumination they need to detect and avoid obstacles at a given speed (Leibowitz et al., 1998; Owens & Tyrrell, 1999), while also overestimating the degree to which their visual performance is affected by glare (Balk & Tyrrell, 2011; Sewall et al., 2016). This misjudgment may lead them to perceive other vehicles' headlights as excessively bright and unnecessarily glaring, even when those lights provide improved visibility and reduced crash risk.

While excessive headlight glare may contribute to far fewer crashes than insufficient visibility, this does not mean that efforts to reduce its effects are unimportant. The analysis of nighttime crash data in this study offers several insights that could inform such efforts. For instance, while experimental research has shown that older drivers are more susceptible to glare (e.g., Skinner & Bullough, 2009), the crash data (Figure 5) illustrate how this vulnerability translates into real-world outcomes. Drivers aged 55–60 appear in similar proportions in both glare-related and nonglare-related crashes, but 70- and 80-year-olds are overrepresented by factors of approximately 2 and 4, respectively.

The matched crash cases also reveal that glare-related incidents are more likely to occur on lower-speed, two-lane roads. Several factors may contribute to this pattern, including the increased visual separation from glare sources provided by medians, the use of glare screens on divided highways (Johnson & McDonald, 2019), and the possibility that lower speeds result in a higher cumulative glare exposure. This exposure ("glare dosage") may be more relevant to disability glare than peak brightness alone (Skinner & Bullough, 2009). Additional countermeasures such as headlight systems that adapt to speed or increased environmental lighting could provide benefits of reducing glare in certain scenarios where the requirements for visibility illumination are reduced.

The Ohio crash narratives suggest that preventing lane departures for glared drivers could reduce the number of glare-related crashes by over half. This indicates potential benefits for improved lane markings, both in wet and dry conditions (Carlson, 2015), and for lane departure warning and lane departure prevention systems (Cicchino, 2018). Data on the presence or condition of lane markings for glare- and no-glare cases were not available for this study but could be a topic of future research. Current lane departure systems may have reduced effectiveness under glare conditions (Pike et al., 2019, 2024). If technological advances enable improvements, future systems could use incoming light levels to predict when a driver may be experiencing glare and adjust warning or intervention thresholds accordingly.

In addition to driver and crash environment factors, differences between vehicles may affect the likelihood of glare-related crashes. The nearest-neighbor matching analyses showed that drivers who reported experiencing glare were more likely to be operating older vehicles compared with those who did not. While multiple explanations are possible, one hypothesis is that newer vehicles offer better visibility illumination, either due to improved headlight design or less degradation from weathering (American Automobile Association, 2018), and that this makes drivers less susceptible to glare. In a 2008 report, Bullough et al. stated: "more consistently correct headlamp aim should improve driver visibility. Whether improving one's headlamp aim might actually help in increasing the resistance of a driver to discomfort glare is not well understood" (Bullough et al., 2008). Other research has found that disability glare decreases as visibility illumination increases (Flannagan et al., 2000; Johansson et al., 1963). Future research should evaluate whether improving the overall visibility performance of the fleet has the additional benefit of increasing discomfort glare tolerance for drivers.

Adaptive driving beam (ADB) headlights represent one of the most promising advancements for minimizing glare without compromising visibility. These systems dynamically adjust the headlight beam pattern to dim only the portions directed at oncoming or preceding vehicles, while maintaining full high-beam illumination elsewhere. ADB-equipped vehicles have been available in many countries since the early 2010s, and numerous studies have confirmed their effectiveness (Bullough, 2014; Reagan &

Brumbelow, 2015; Stolte et al., 2021). However, regulatory hurdles have delayed their adoption in the U.S., and as of the end of 2024, no vehicles in the U.S. market were equipped with ADB technology. While this study finds that glare contributes to only a small fraction of nighttime crashes, discomfort glare remains a widespread concern among drivers. Accelerating the deployment of ADB headlights in the U.S. is a key step toward reducing both discomfort glare and crash rates due to the dual benefits of reduced glare and enhanced visibility in a variety of driving conditions.

5. CONCLUSION

This study provides a comprehensive analysis of headlight glare in police-reported crash data, highlighting its prevalence, contributing factors, and potential countermeasures. Glare is reported in a small fraction of nighttime crashes, both as a raw percentage and relative to the incidence of reported sun glare. Rates were relatively similar among states with the most data and showed little change from 2015 to 2023—a period during which many headlights were redesigned to improve visibility, a factor previously linked to reduced crash risk (Brumbelow, 2022). Nevertheless, the findings underscore the disproportionate impact of headlight glare on older drivers and its association with specific roadway and environmental conditions. Targeted interventions such as improved lane markings, enhanced lane departure systems, and adaptive lighting technologies could reduce glare-related crashes. These efforts would benefit from additional research to clarify how the visibility provided by a vehicle's headlights influences the driver's perception of glare from other sources.

As headlight technology continues to change, maintaining a balance between adequate visibility illumination and minimizing glare remains essential. When considered alongside earlier research showing visibility improvements, this study indicates that manufacturers are largely succeeding in achieving that balance.

6. FUNDING

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7. TABLES

Table 1. State crash databases with glare-related codes.

State	Years	Table	Field	Choices allowed	Glare-related codes
CT	2016–2023	Crash	Environmental contributing circumstances	3	Glare
FL	2014–2023	Crash	Environmental contributing circumstances	3	Glare
FL	2014–2023	Driver	Vision obstructions	1	Glare
IA	2015–2022	Vehicle	Vision obstructions	1	Blinded by sun or headlights
IL	2015–2023	Driver	Vision obstructions	1	Blinded by sun; Blinded by headlights
MA	2013–2023	Vehicle	Driver contributing circumstances	2	Glare
MI	2016–2023	Crash	Environmental contributing circumstances	2	Glare
MO	2014–2023	Vehicle	Vision obstructions	5	Glare from sun or other source
NY	2013–2023	Vehicle	Contributing circumstances	2	Glare
TX	2015–2024	Crash	Other crash factor	1	Vision obstructed by headlight or sun glare
WA	2013–2019 2021–2023	Crash	Miscellaneous action	3	Blinded by sun; Blinded by headlights
WI	2017–2022	Crash	Environmental contributing circumstances	3	Glare

Table 2. Crash variables used for generating matched pairs.

Matching criteria for generating groups used for comparing driver demographics		
Variable	**Match type**	**States**
County	Exact	FL, NY, IL
Rural/urban	Exact	FL, IL
Road classification	Exact	FL, IL
Road type	Exact	IL
Speed limit	Exact	FL
Environmental lighting	Exact	FL, NY, IL
Crash year	Nearest	FL, NY, IL
Crash time since noon	Nearest	FL, NY, IL
Sun altitude	Nearest	FL, NY, IL
Matching criteria for generating groups used for comparing vehicles or crash environments		
Variable	**Match type**	**States**
County	Exact	FL, NY, IL
Driver sex	Exact	FL, NY, IL
Crash year	Nearest	FL, NY, IL
Crash time since noon	Nearest	FL, NY, IL
Sun altitude	Nearest	FL, NY, IL
Driver age	Nearest	FL, NY, IL

Table 3. Search terms used to identify crashes potentially related to glare in Ohio narratives.

Blinded
Blinding
Bright light
Glare
Head lights
Headlights
High beam
Vision * obstructed
Vision obstruction

Note. The * wildcard allows matches with intervening characters.

Table 4. Differences in driver age and sex for pairs of glare and no-glare drivers matched on crash environment variables.

	Mean driver age			
	Glare	No glare	Difference	95% CI
Florida	45.0	39.4	**5.6**	(4.1, 7.0)
Illinois	45.2	38.4	**6.8**	(4.9, 8.5)
New York	47.6	40.0	**7.6**	(6.3, 9.0)
	Proportion of drivers that are female			
	Glare	No glare	Difference	95% CI
Florida	0.399	0.404	−0.005	(−0.043, 0.036)
Illinois	0.403	0.385	0.018	(−0.024, 0.061)
New York	0.387	0.369	0.017	(−0.019, 0.056)

Note. CI = confidence interval. Statistically significant differences are shown in **bold**.

Table 5. Differences in crash environment and vehicle variables for pairs of glare and no-glare drivers matched on sex and age.

	Florida				Illinois				New York			
	Glare	No glare	Difference	95% CI	Glare	No glare	Difference	95% CI	Glare	No glare	Difference	95% CI
Number of vehicles												
1	0.419	0.194	**0.224**	(0.186, 0.260)	0.455	0.338	**0.117**	(0.075, 0.160)	0.494	0.338	**0.156**	(0.114, 0.193)
≥2	0.581	0.806	**−0.224**	(−0.260, −0.186)	0.545	0.662	**−0.117**	(−0.160, −0.075)	0.506	0.662	**−0.156**	(−0.193, −0.114)
Environmental lighting												
Dark, lit	0.479	0.610	**−0.131**	(−0.172, −0.092)	0.386	0.507	**−0.120**	(−0.162, −0.079)	0.617	0.581	**0.037**	(0.002, 0.072)
Dark, unlit	0.350	0.252	**0.098**	(0.062, 0.135)	0.563	0.444	**0.119**	(0.076, 0.160)	0.267	0.279	−0.012	(−0.048, 0.020)
Other/unknown	0.171	0.137	**0.033**	(0.004, 0.065)	0.050	0.049	0.001	(−0.016, 0.019)	0.116	0.140	−0.025	(−0.050, 0.002)
Weather												
Clear/cloudy	0.881	0.900	−0.018	(−0.044, 0.007)	0.795	0.786	0.009	(−0.027, 0.047)	0.582	0.762	**−0.180**	(−0.216, −0.144)
Rain	0.109	0.089	0.020	(−0.004, 0.046)	0.137	0.116	0.021	(−0.008, 0.048)	0.377	0.107	**0.270**	(0.240, 0.303)
Other/unknown	0.010	0.011	−0.001	(−0.010, 0.007)	0.068	0.098	**−0.030**	(−0.055, −0.005)	0.041	0.131	**−0.090**	(−0.113, −0.068)
Road surface												
Dry	0.825	0.848	−0.023	(−0.056, 0.007)	0.738	0.717	0.022	(−0.018, 0.060)	0.501	0.676	**−0.175**	(−0.214, −0.139)
Wet	0.164	0.148	0.017	(−0.012, 0.048)	0.208	0.176	0.032	(−0.004, 0.065)	0.461	0.187	**0.274**	(0.240, 0.308)
Other/unknown	0.011	0.004	0.006	(−0.001, 0.013)	0.054	0.107	**−0.054**	(−0.077, −0.029)	0.038	0.137	**−0.098**	(−0.119, −0.076)
Road type												
Parking lot	0.071	0.042	**0.029**	(0.011, 0.047)								
County/local	0.631	0.456	**0.174**	(0.133, 0.214)								
State/U.S. highway	0.255	0.355	**−0.100**	(−0.138, −0.062)								
Interstate/toll	0.018	0.134	**−0.116**	(−0.136, −0.096)								
Other/unknown	0.026	0.012	**0.013**	(0.002, 0.025)								
Road class												
Local					0.227	0.154	**0.072**	(0.037, 0.108)				
Collector					0.219	0.157	**0.063**	(0.028, 0.096)				
Minor arterial					0.249	0.206	**0.043**	(0.006, 0.080)				
Other principal arterial					0.181	0.256	**−0.075**	(−0.112, −0.038)				
Interstate/expressway					0.026	0.138	**−0.112**	(−0.136, −0.090)				
Other/unknown					0.098	0.089	0.009	(−0.015, 0.036)				

Table 5 (continued). Differences in crash environment and vehicle variables for pairs of glare and no-glare drivers matched on sex and age.

	Florida				Illinois				New York			
	Glare	No glare	Difference	95% CI	Glare	No glare	Difference	95% CI	Glare	No glare	Difference	95% CI
Road description												
Not divided					0.578	0.403	**0.175**	(0.129, 0.216)				
Divided, no barrier					0.234	0.250	−0.016	(−0.054, 0.021)				
Divided, with barrier					0.067	0.193	**−0.126**	(−0.156, −0.096)				
Intersection					0.060	0.063	−0.003	(−0.024, 0.020)				
Other/unknown					0.062	0.092	**−0.030**	(−0.054, −0.007)				
Number of lanes												
0	0.016	0.015	0.001	(−0.010, 0.011)								
1	0.032	0.031	0.001	(−0.014, 0.015)								
2	0.615	0.351	**0.264**	(0.222, 0.303)								
3	0.047	0.079	**−0.032**	(−0.052, −0.012)								
≥4	0.290	0.524	**−0.234**	(−0.272, −0.195)								
Speed limit												
≤20 mph	0.097	0.064	**0.033**	(0.011, 0.055)								
25–35 mph	0.415	0.274	**0.141**	(0.101, 0.179)								
40–50 mph	0.361	0.412	**−0.052**	(−0.088, −0.011)								
≥55 mph	0.091	0.229	**−0.138**	(−0.168, −0.110)								
Unknown	0.037	0.020	**0.017**	(0.004, 0.031)								
Rural / urban												
Rural	0.465	0.511	**−0.046**	(−0.087, −0.005)								
Urban	0.535	0.489	**0.046**	(0.005, 0.087)								
Area population												
Unincorporated					0.366	0.327	0.038	(−0.003, 0.076)				
0 to 10,000					0.152	0.132	0.021	(−0.009, 0.055)				
10,000 to 25, 000					0.146	0.131	0.015	(−0.014, 0.048)				
25,000 to 50,000					0.095	0.102	−0.007	(−0.035, 0.021)				
50,000 and higher					0.150	0.153	−0.003	(−0.035, 0.029)				
Chicago					0.091	0.154	**−0.064**	(−0.094, −0.033)				
Vehicle model year												
≤2006	0.380	0.323	**0.057**	(0.019, 0.095)	0.302	0.268	0.034	(−0.005, 0.071)	0.229	0.188	**0.041**	(0.008, 0.073)
2007–2012	0.253	0.257	−0.004	(−0.038, 0.030)	0.269	0.282	−0.013	(−0.054, 0.024)	0.274	0.264	0.010	(−0.025, 0.050)
≥2013	0.319	0.371	**−0.052**	(−0.088, −0.015)	0.366	0.368	−0.002	(−0.044, 0.043)	0.375	0.413	**−0.039**	(−0.076, −0.003)
Unknown	0.047	0.049	−0.002	(−0.019, 0.017)	0.064	0.082	−0.019	(−0.040, 0.004)	0.122	0.134	−0.012	(−0.037, 0.015)

Note. CI = confidence interval. Statistically significant differences are shown in **bold.**

Table 6. Driver actions attributed to headlight glare in Ohio crash narratives.

Driver action	Percent
Lane departure to right	45%
Failed to detect object in lane	23%
Misjudged turn	15%
Lane departure to left	12%
Other	4%

8. FIGURES

Figure 1

Percentage of crashes with coded glare by sun position and direction

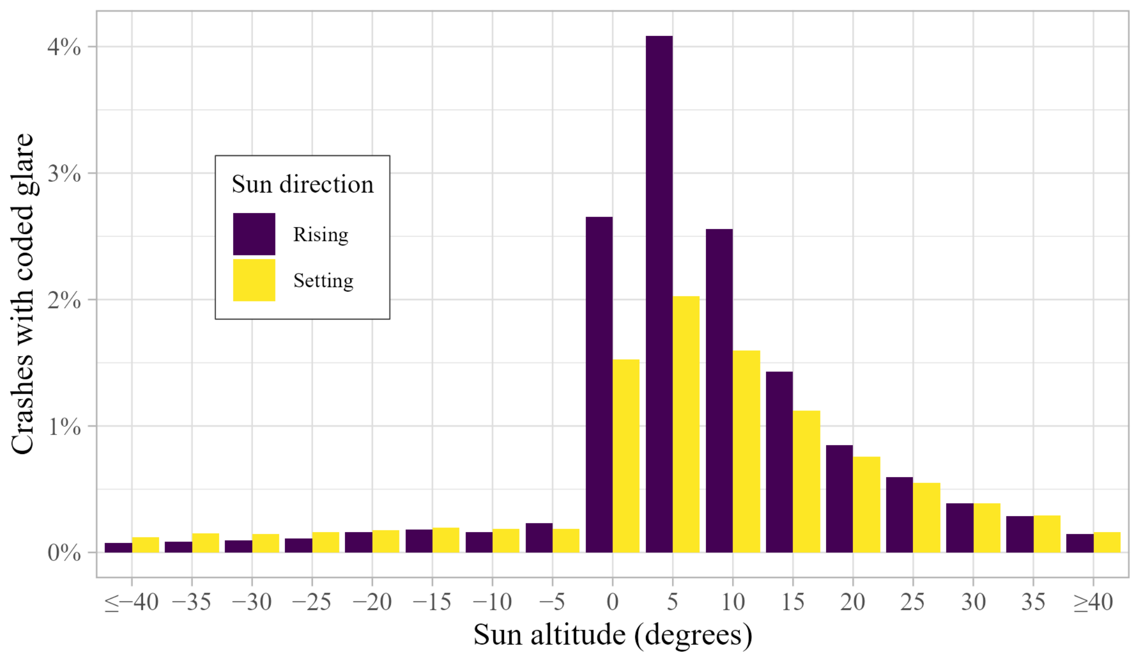


Figure 2

Contribution of each study state by year to the total number of nighttime crashes

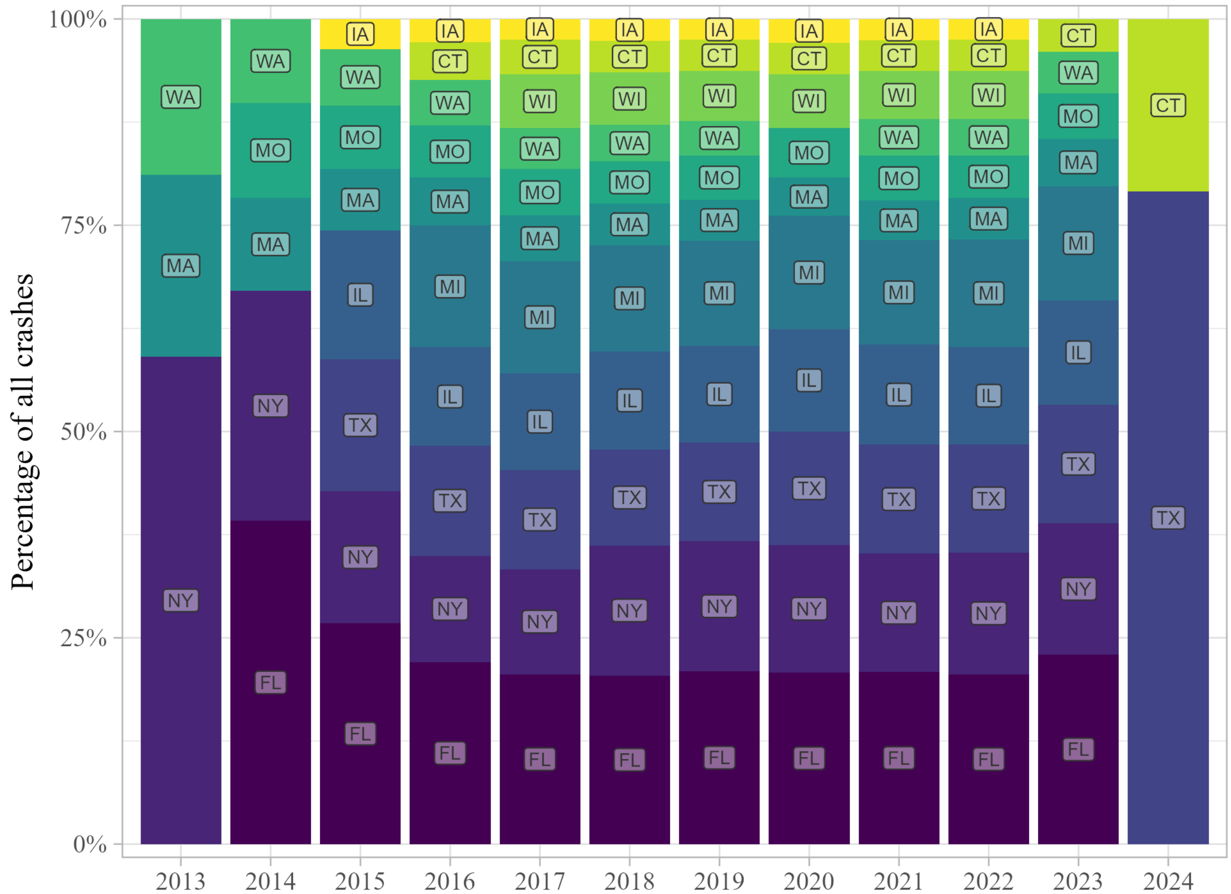
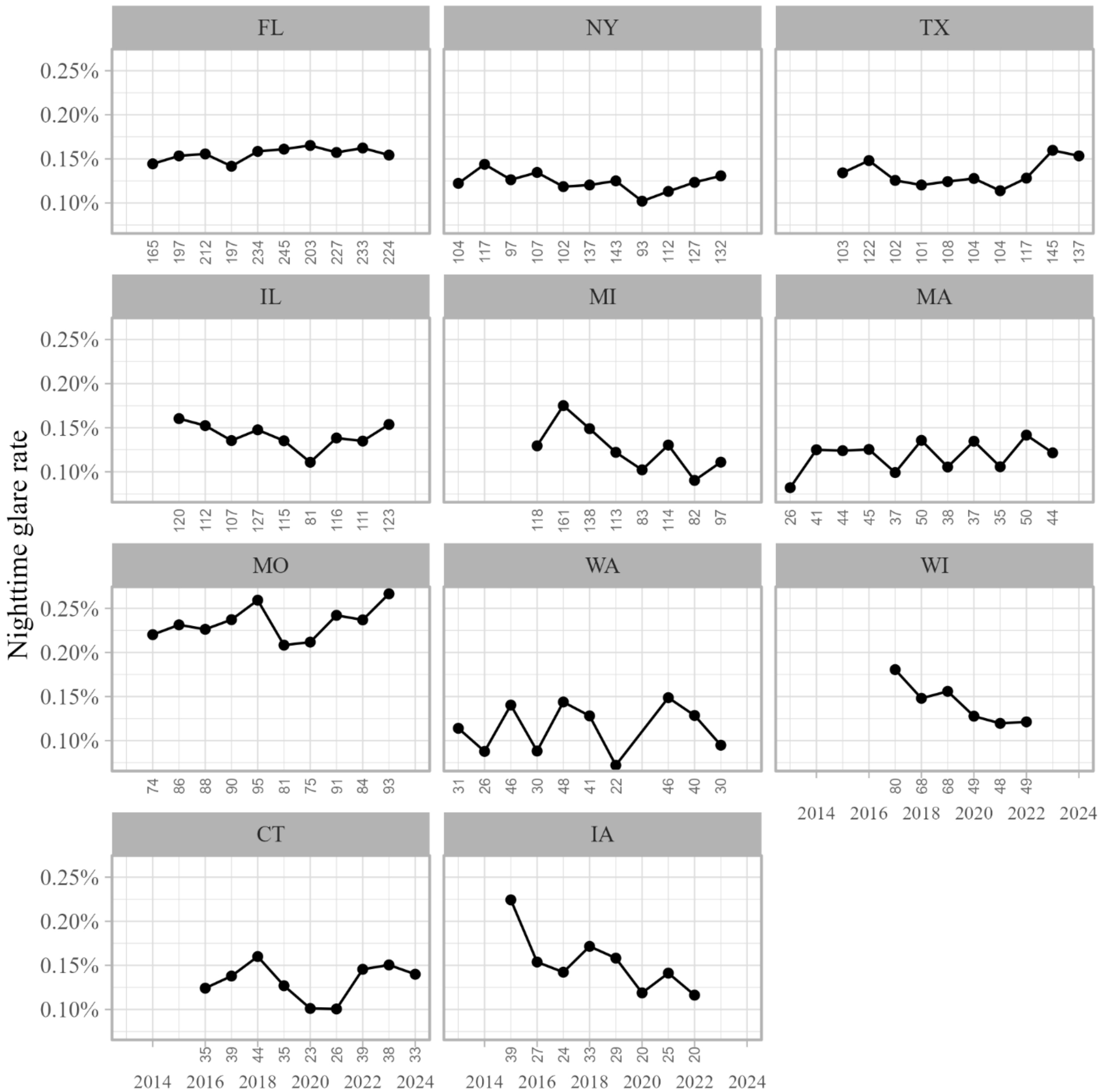


Figure 3

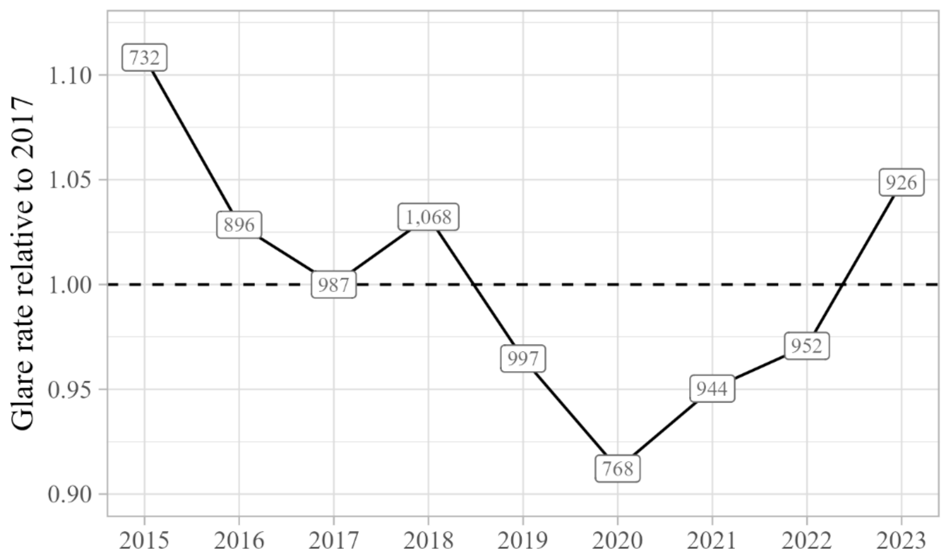
Nighttime glare rate by state and year.



Note. States are presented in descending order of total nighttime crashes. Labels show the number of glare-reported crashes per year.

Figure 4

Glare rate in nighttime crashes relative to 2017 (all states combined and weighted)



Note. Labels show the total number of glare-reported crashes for each study year.

Figure 5

Driver age distribution for nighttime crashes with and without coded glare (driver pairs matched on crash environment variables)

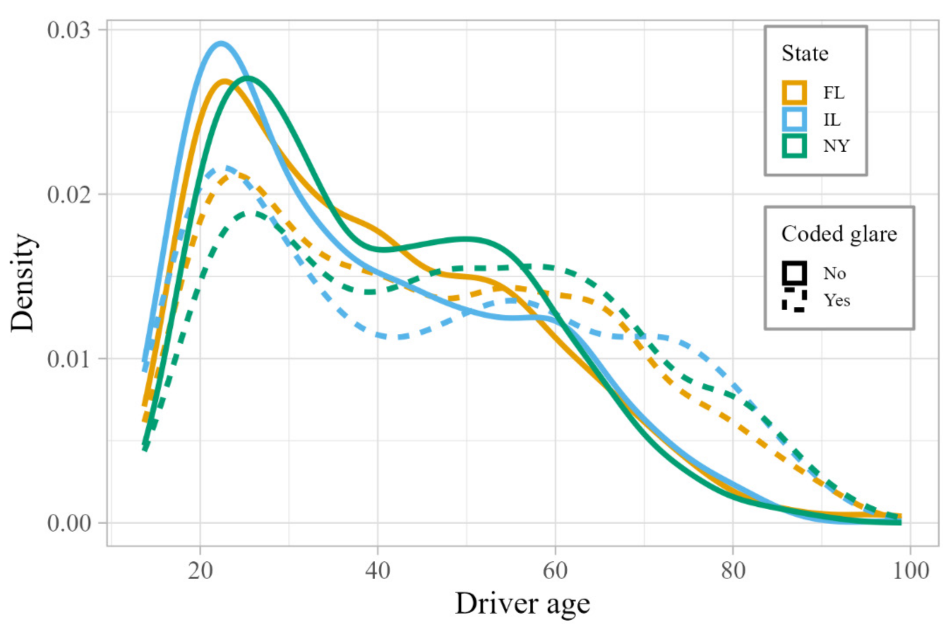
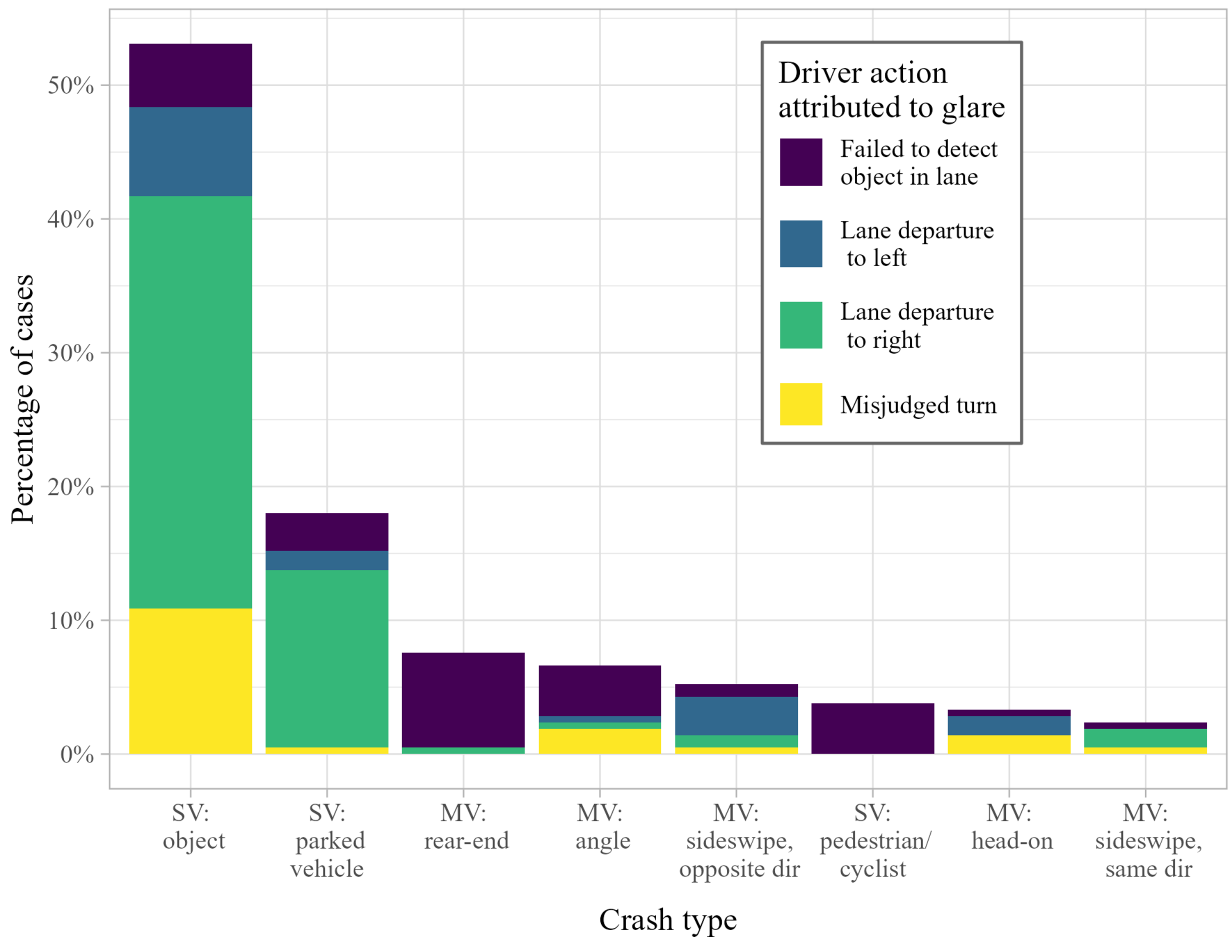


Figure 6

Crash types for Ohio cases with narratives describing headlight glare contributing to the crash



Note. SV stands for single vehicle and MV for multiple vehicle.

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