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SMARTPHONES, ONLINE MUSIC STREAMING, AND TRAFFIC FATALITIES

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ABSTRACT

Modern smartphones present new threats to road safety beyond talking and texting, but the real-world effects are difficult to study. One way to causally assess the impact of smartphones on road safety is to identify arbitrarily timed events during which smartphone-related distraction may exogenously increase – i.e., a situation that relies not on plausibly random variation in who uses smartphones while driving, but when smartphones are used. We investigated the impact of smartphones on road safety by examining traffic fatalities on days when smartphone use likely surges: the release of major music albums. Using event study analysis, we show that music streaming – an indicator for smartphone use, where streaming most often occurs – sharply increases, by nearly 40%, on dates of major music album releases, while U.S. traffic fatalities increase by nearly 15% on those same days. Mobile device use while driving is a known safety issue, but today's smartphones present new and greater opportunities for driver distraction. Our study indicates how features of these phones may have important impacts on distracted driving and traffic fatalities.

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1. Introduction

Each year, more than 1 million people around the world are killed on roads, and traffic fatalities are the leading cause of death globally among children and young adults.[1] The global burden of road injuries has been estimated to cost the global economy over 1 trillion U.S. dollars from 2015-2030.[2] In the U.S., motor vehicle collisions remain a leading cause of death, with approximately one death occurring every 13 minutes in 2021.[3] While many developed nations have experienced reductions in traffic collisions and fatalities over the past decade, the U.S. is one of the few where they have increased despite advances in automobile safety technology.[4] Distraction is thought to play an important role in traffic collisions. The National Highway Traffic Safety Administration reported that in 2022, 8% of fatal crashes and 11% of all police-reported crashes were classified as "distraction-affected."[5]

Making calls and texting have long been primary concerns related to distracted driving, as these activities may draw attention away from the cognitive and physical tasks required for safe driving.[6-9] Smartphone telematics data suggest that mobile device use occurs in up to 52% of car trips that result in a collision.[10] Simulations, surveys, and observational studies suggest a strong link between driving distractions, unsafe driving, and collisions.[11] Texting-while-driving and related laws are estimated to have been effective in reducing traffic fatalities and injuries.[12-14] However, advancements in smartphone capabilities, dramatic increases in access to high-speed internet on these devices,[15] and the proliferation of touchscreen-based in-car infotainment systems[16] have created a new landscape of sources of driver distraction, outpacing development of traffic safety laws.

Real-world empirical evidence of the impact on traffic fatalities of new distractions created by smartphones—such as for streaming media—is lacking, at least in part due to the ethical barriers of randomized experiments that would involve intentionally distracting drivers on roads in the community. Moreover, real-world observational studies linking smartphone use to distracted driving are challenging to implement because smartphone use is not randomly

allocated across drivers, precluding causal interpretations. However, previous research has suggested that exogenous events that distract drivers may offer an opportunity to quasi-experimentally study the impact of distraction using observational data. For example, one study showed that the introduction of messages on the highway intended to promote safe driving ultimately led to an increase in collisions, likely due to distraction caused by such signs.[17]

One way to assess the impact of smartphone-enabled distractions on traffic fatalities would to be to identify naturally occurring periods during which distraction increases for reasons otherwise unrelated to traffic fatality risk – i.e., a situation that relies not on plausibly exogenous variation in *who* uses smartphones while driving, but *when* smartphones are used. A popular of use of smartphones today is to stream music, with services like Spotify and Apple Music offering consumers the ability to listen to almost any song at any time.[18] A 2024 industry survey of listeners estimated that 55% of U.S. adults who were drivers or passengers of a car in the past month streamed online audio, with 16% using Apple CarPlay and 10% using Android Auto infotainment platforms to connect their phone to their car's display.[18] At the same time, while managing music in the car is an activity drivers perceive as less risky in surveys, simply *listening* to music has been shown to create significant distraction in simulations.[19-21]

One event which may lead to large increases in smartphone use is the release of new albums by popular music artists. For example, Taylor Swift's *The Tortured Poets Department* had over 300 million streams worldwide on its release day, setting a record for the most-streamed album in a single day.[22] While album releases are likely timed to maximize exposure, album releases are *not* timed to influence the incidence of traffic fatalities. This makes the timing of album releases as good as random *with respect to the outcome of traffic fatalities*, permitting a quasi-experimental evaluation that can adjust for certain factors (e.g., the day of the week an album is released) that may be related to both driving behaviors and album release timing.

Using national population-based data, we conducted a quasi-experimental event study analysis of the time periods surrounding the release of the ten most streamed albums between

2017 and 2022 in the U.S., hypothesizing that the release of popular new music would be temporally associated with an increase in fatalities from motor vehicle collisions because of the smartphone-enabled distraction it may cause.

2. Data and Methods

Data Sources

We used the Fatality Analysis Reporting System[23] (FARS) to obtain population-based data on all fatal crashes occurring on public roads in the U.S.. FARS is the official governmental registry of fatal crashes in the U.S. and contains characteristics of crashes, vehicles, and drivers for fatal crashes occurring between 1975 to 2022. FARS has been used and linked to other datasets for decades to study traffic fatalities.[24-26]

Music streaming data were obtained from Spotify Charts, which provides the daily number of streams for the top 200 most streamed songs each day in the U.S. on the Spotify platform from 2017 onwards.[27] Spotify is the most popular music streaming service in the U.S., with approximately 29% of Americans aged 12 and over streaming music on Spotify in a given week.[18,28]

Exposure, Outcome, and Variables

The exposure of interest was the release of a popular music album, intended to identify a discrete period when smartphone use might surge. Using Spotify data, we identified the 10 albums with the highest number of streams within a single day between 2017 and 2022 (**Table 1**). The number of daily streams was used not only to identify those albums that were the most popular but to examine whether total streaming volume, and therefore use of smartphones, increased on days of major album releases. Increases in total streaming volume on days of popular music album releases would suggest an increased use of smartphones on those days.

The primary outcome was the number of nationwide traffic fatalities on album release days and on each of the 10 days before and after each album release day.

Variables obtained from the FARS database included decedent demographic characteristics, including age (<40, 40-64, or ≥65 years), sex , race or ethnicity (Non-Hispanic Asian, Non-Hispanic Black, Non-Hispanic White, Hispanic, and other or multiple races); crash characteristics including the date of the crash, number of vehicle occupants (single occupant or multiple occupants), vehicle make, model, and year, lighting conditions (daylight or nighttime), driver alcohol involvement, and weather conditions (clear, cloudy, rain, or other). Driver alcohol involvement was determined as having either a positive blood alcohol level or police-reported involvement. Crashes were characterized as occurring in urban (1-3) or rural (4-9) regions using the 2013 Rural-Urban Continuum Codes. The presence of Apple CarPlay capability was ascertained by cross-referencing the vehicle make, model, and year with Apple's list of supported vehicles.[29]

Statistical Analyses

Although album releases are intentionally scheduled, it is safe to assume they are not timed with short-term changes in risk of traffic fatalities in mind, making the specific release date likely arbitrary with respect to traffic fatality risk, so long as the day of week of an album release is adequately adjusted for. This generates exogenous variation in *when*, rather than *by whom*, smartphones are used, creating a natural experiment of whether streaming-related increases smartphone use impact traffic fatalities. Importantly, this study design permits adjustment for potential confounding factors that could be related to both album release timing and traffic fatality risk (e.g., albums tend to be released on Fridays) while still taking advantage of the otherwise exogenous variation in album release timing.

We examined the number of traffic fatalities during the dates of album releases compared with the 10 days before and after the releases using a quasi-experimental event study design. This study design combines the period surrounding multiple similar events into a single analysis, with the advantage of accounting for unmeasured contemporaneous factors that may have impacted fatalities in the days surrounding any individual album release. The 10-day window

was selected because it includes the *same* weekday one week before and after the release, as well as the weekends immediately before and after – thus providing control days that account for weekday, seasonal, and annual trends. Therefore, if albums tend to be released on Fridays, traffic fatalities on album release Fridays and the adjacent weekend can be compared to surrounding Fridays/weekends. This directly addresses the concern that observed increases in traffic fatalities on album release days are because albums may tend to be released on specific days of the week.

We used multivariable linear regression at the album-day level to estimate national daily counts of traffic fatalities in each of the ±10 days surrounding album releases (indicator variables for each day relative to album release, defined as day zero), adjusting for fixed effects (i.e., indicators) of federal holidays, day-of-week (Monday through Sunday), week-of-year (weeks 1 through 52), and calendar-year. This model adjusts for potential confounding by day-of-week in two ways. First, because we include the 10 days before and after each album release, the model compares the release day to the closest *same day* of the week one week before and one week after. Second, including day-of-week fixed effects draws from all days in 2017-2022 to adjust for broad differences in driving behaviors on a given day of the week. To facilitate interpretation of effect sizes associated with the album releases, we repeated this analysis instead using an indicator variable for album release days versus the ±10 days surrounding album release day.

Finally, we repeated the analyses across subgroups of crash and driver characteristics, including by driver age (to evaluate whether album-related fatality increases, if present, were greater among younger drivers who are more likely to stream music[18]); by driver alcohol involvement (defined as the driver being reported to be under the influence of alcohol), to assess whether album-related fatality increases may be mediated by alcohol use following an album release rather than by online streaming itself; and by vehicle occupancy (i.e., single vs. multiple occupants), to assess whether album-related fatality increases were larger in single-occupancy vehicles since drivers may be less likely to directly interact with the music streaming platforms themselves when accompanied by other passengers who might be able to do so instead. We also

evaluated whether album-related fatality increases varied by the model year of cars, as safety features present in newer cars may mitigate distraction related to online music streaming. Finally, we evaluated whether any changes in album-related fatalities varied for cars with and without large infotainment screens that are equipped with Apple CarPlay. While such infotainment systems might be considered safer since they allow drivers to interact with a smartphone model-specific interface that may distract less than the system included in the car,[16] that same interface might also lower the barrier for drivers to interact with online music streaming platforms, thereby increasing overall distraction. Because Apple CarPlay is a more common feature in newer cars, this analysis was restricted to vehicles manufactured in 2016 or later, which is when many new cars began to come pre-installed with Apple CarPlay. For all subgroup analyses, we added an interaction term between each crash or driver characteristic and an indicator variable for album release day to determine whether there were significant differences across subpopulations in effect sizes associated with album releases.

Sensitivity analyses

In two related falsification tests, we repeated the primary analysis using 10 randomly selected Fridays and, separately, 10 randomly selected dates ("placebo album release dates") from 2017-2022 instead of actual album release dates to assess the probability of obtaining similar effect sizes due to chance alone. We repeated the analysis with these placebo album release dates (i.e., compared traffic fatalities on these placebo dates to the 10 surrounding days) for 1000 iterations and compared our observed effect size with the distribution of effect sizes obtained from the simulation. Importantly, the falsification test that assigned placebo album release dates using randomly selected Fridays during 2017-2022 also directly addresses the concern that traffic fatalities may be higher on album release days simply because they disproportionately occur on Fridays.

As a third falsification test, we conducted a same-date-different-year analysis to assess whether major albums tend to be released on holiday-adjacent or heavy travel periods that could

otherwise explain our findings. For each album, we identified the same calendar date in each other study year, selecting the date falling closest to the same weekday as the original release in each year. These dates would replicate the holiday and seasonal context of the actual release date but are not tied to the album event itself (since the album was not released on those dates in other years), providing a control condition in which no increase in fatalities would be expected.

Finally, to further address potential confounding arising from the fact that most major albums are released on specific weekdays—particularly Fridays—we conducted an adjacent-weekday sensitivity analysis restricted to Friday releases alone. For each Friday release, we compared fatalities on the release day with fatalities occurring exactly 7 days before and after, providing a strictly day-of-week–matched comparison within the same season and year. We then estimated the relative risk of fatalities on release Fridays versus the pooled adjacent Friday controls using exact binomial methods consistent with prior FARS analyses.[30-32]

Analyses were performed using Stata version 18.0 (StataCorp) and MATLAB 2022b (MathWorks). The 95% confidence intervals reflect an alpha level of 0.025 in each tail. This secondary analysis of previously collected publicly available data was deemed exempt from review by the Harvard Medical School Institutional Review Board.

3. Results

The aggregate Spotify streaming volume for the top 200 songs in the U.S. each day was significantly higher on the date of major album releases compared to surrounding days (**Figure 1; eFigure 1** in **Appendix**), with a mean 123.3 million streams [95% CI, 113.4-133.2] occurring on album release days compared to a mean 86.1 million streams (95% CI, 85.3-87.0) occurring on the ±10 days surrounding the release, corresponding to a relative increase of 43%. For each of the 10 albums, the date with the most streams was the album's release date, which occurred between May and November and usually occurred on Fridays.

In an event study analysis, traffic fatalities were highest on the dates of album releases (day 0) compared with all other days in the ±10 days surrounding album releases (**Figure 2A**). The adjusted number of U.S. traffic fatalities was 139.1 (95% CI 126.8-151.4) on album release days compared to 120.9 (95% CI 119.6-122.2) on the ±10 days surrounding the release, corresponding to an absolute increase of 18.2 fatalities (95% CI 4.8-31.7, p = 0.01) or a relative increase of 15.1% on album release days **(Figure 2B)**. This is equivalent to approximately 182 fatal crashes in the U.S. attributable to the release days of the ten included albums.

The observed increase in traffic fatalities that occurred on album release days varied in magnitude according to driver characteristics (**Figure 3**). For example, the increase in traffic fatalities on album release days was larger in absolute terms among younger drivers (7.8 additional fatalities among drivers aged <40 years versus 4.1 additional fatalities among drivers aged ≥65 years; p = 0.04 for interaction), male drivers (13.5 additional fatalities among male drivers versus 4.4 additional fatalities among female drivers; p = 0.01 for interaction), and among White and Asian drivers (9.2 additional fatalities among White drivers versus 7.3 additional fatalities among Asian drivers versus 1.1 fewer fatalities among Black drivers; p < 0.01 for interaction).

The observed increase in traffic fatalities on album release days also varied in magnitude according to characteristics of the crash (**Figure 4**). For instance, the increase in traffic fatalities on album release days was larger in absolute terms among cars with a single occupant, a sober driver, in cars with older model years, in cars with Apple CarPlay (after restricting to any car manufactured following the mass rollout of Apple CarPlay in 2016), and on days with clear weather. There were no meaningful differences for crashes occurring during the daytime versus nighttime and for crashes occurring in rural versus urban counties.

Sensitivity Analyses

In a simulation of effect sizes estimated using either 10 random Fridays or 10 random dates in lieu of actual album release dates, an estimated effect size greater than our observed

effect size was seen in only 14 out of 1,000 iterations for random dates and 20 out of 1,000 iterations for random Fridays, suggesting our primary findings were not due to chance alone (**eFigure 2**). In a same-date, different-year falsification test – applying each album's release date to all other study years matched to the nearest weekday – no increase in fatalities was observed, suggesting that holiday-adjacent or heavy-travel periods do not explain the primary findings (**eFigure 3**). Finally, in a sensitivity analysis restricted to Friday releases, fatalities remained elevated on album release Fridays compared with the Fridays before and after (odds ratio, 1.10 [95% CI, 1.04-1.18]), consistent with the primary event-study results (**eFigure 4**).

4. Discussion

Mobile device use while driving is a known safety issue.[6-9] However, today's smartphones present new and greater opportunities for driver distraction. Although the real-world effects of smartphone phone use on road safety are difficult to study, the popularity of in-car music streaming presents a novel opportunity to assess the potential impact of smartphone-enabled distracted driving by studying changes in traffic fatalities during a period when in-car smartphone use dramatically increases: the dates of major music album releases. In a national event study analysis, we observed an increase in fatal car crashes in the U.S. on days that major music albums were released and when streaming volumes surged on a large music streaming platform; multiple additional analyses suggested these findings were not explained by releases occurring on certain days of the week or on holiday weekends.

Although there are multiple mechanisms that could explain these findings, our results point to smartphone-enabled driver distraction as a likely contributor. Music is frequently streamed from online platforms and managing music in the car through smartphones is an activity that may lead to significant distraction,[19,20] particularly during periods when online streaming and therefore smartphone use are greater (e.g., when popular music albums are released). Because new album releases are plausibly exogenously timed with respect to the risk

of a fatal car crash, our analysis suggests that album releases are a potential cause of traffic fatalities, but the primary analysis alone does not imply a specific causal mechanism. While distraction seems the most plausible mechanism, there are multiple possible sources of distraction within the car: manipulation of the device, use of infotainment systems, noise, or human response to the music itself. Besides driver distraction, other plausible mechanisms include a contemporaneous increase in other events that increase the risk of traffic fatalities, such as parties and nighttime events where drivers may consume alcohol.[33] However, we found that the increase in traffic fatalities associated with album releases was more pronounced among sober drivers and not more pronounced during the nighttime, suggesting against these mechanisms.

With these possible mechanisms in mind, this study adds real-world evidence about smartphone media-based distraction to a literature that is largely comprised of controlled simulation and survey studies. Drivers simply listening to their preferred music, in addition to controlling music on various devices, can be a source of driver distraction.[20,34] Passengers can also be a source of distraction.[35] Our study found that the increase in traffic fatalities associated with surges in online streaming was significantly more pronounced among single-occupant vehicles, suggesting the possibility that a passenger may potentially *reduce* driver distraction related to streaming music use (e.g., by helping to manage streaming devices). The presence of other occupants may also reduce the likelihood of using a smartphone while driving if instead drivers are having conversations with passengers. In either scenario, the larger increase in album-related traffic fatalities among single-occupant vehicles is consistent with smartphone-enabled media streaming leading to driver distraction.

While fatal accident rates in general are higher at night and during adverse weather due to visibility and/or road conditions,[36,37] we found that traffic fatalities associated with surges in online streaming were larger during clear driving conditions. This may occur if drivers are more easily distracted by their smartphones (i.e., “let their guard down”) when road conditions are

better and perceived safety is higher.[38] Additionally, drivers may be more likely to listen to distracting high-energy, positive-emotion, danceable, and fast-tempo music when the weather is better.[39]

The presence of a larger increase in album-related traffic fatalities in cars with infotainment systems, after accounting for model year, suggests that while the smartphone-optimized platform includes several safety features such as hands-free voice control, it also might lower the barrier for drivers to interact with its features in general, and music streaming in particular, an offsetting effect that might contribute to *more* distracted driving behaviors in aggregate. Our study highlights how natural experiments – in this case, involving increases in smartphone demand brought about by popular music album releases – may be a useful tool to understand the real-world safety impacts of increasingly popular car infotainment systems.

There are several possible explanations for why the observed increase in traffic fatalities associated with surges in online music streaming varied by demographic subgroups. Younger drivers, for whom the effect was larger, are more likely to stream music than older drivers, with industry research studies estimating the incidence of streaming audio use in the past month to be 87% among Americans ages 12-34, 81% for those ages 35-54, and 52% for those ages 55 and above in 2022.[18] Differences in effect sizes between racial and ethnic groups may be explained by differences in music preferences between groups and/or differences in racial and ethnic composition across age groups in the U.S.[40-42]

Our analysis has several limitations. First, causal interpretation relies on the assumption that there are no other mechanisms besides distractions related to smartphone use that would increase traffic fatalities on the day an album is released and use of streaming platforms surges; residual confounding is possible despite the quasi-experimental study design. Importantly, our models included the weeks surrounding the release and accounted for day-of-week fixed effects, and we conducted sensitivity analyses comparing album days against the same weekday in adjacent weeks (addressing the possibility that traffic fatalities may be higher on Fridays, when

albums were more likely to be released) and with the same calendar date in adjacent years (addressing the possibility that album releases may coincide with holiday-adjacent or heavy-travel periods). These analyses yielded no evidence that weekday patterns or holiday-related travel explain the findings. Second, drivers do not only listen to music using Spotify, so although we used Spotify data to identify the most popular albums and demonstrated surges in streaming on album release days, our estimates represent the impact of album releases across all platforms and formats. Third, while various subgroup analyses suggest that the observed increase in traffic fatalities on online album release days may be due to driver distraction from smartphone use, our study design does not permit a direct investigation of this theory. Fourth, our data is restricted to fatal car crashes and therefore does not consider the potential impact of album releases and increased smartphone use on non-fatal crashes and other measures of distracted driving.

In conclusion, using an event study analysis, we found that music streaming – an indicator for smartphone use – sharply increases, by nearly 40%, on dates of major music album releases, while U.S. traffic fatalities increase by nearly 15% on those same days. Our study highlights how the potential impact of smartphone use on distracted driving can be assessed by studying changes in traffic fatalities during periods when smartphone use dramatically increases, leveraging plausibly exogenous variation in *when* rather than by *whom* smartphones are used. Further actions by smartphone and vehicle manufacturers, software developers, and policymakers to improve driver safety surrounding streaming media may be warranted to reduce traffic fatalities.

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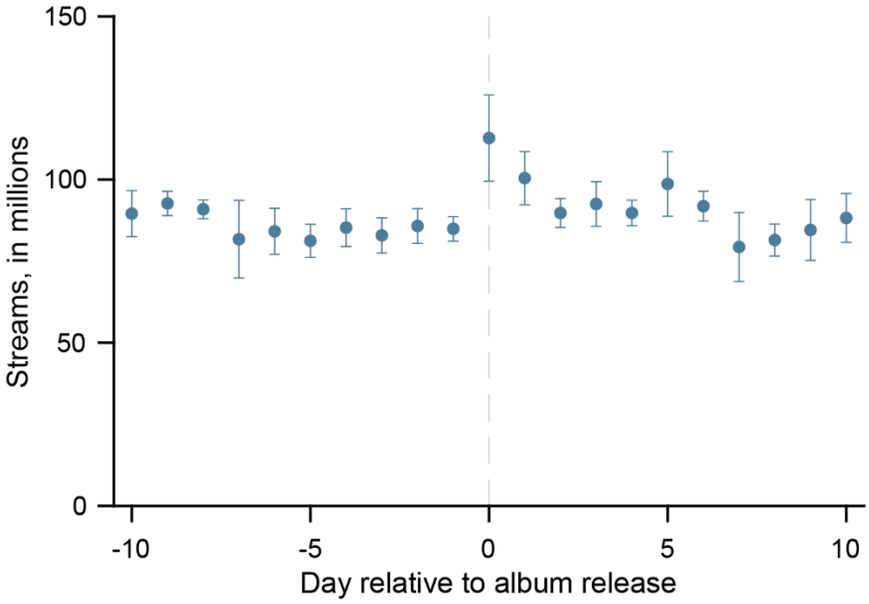
Table 1. Top 10 Most Streamed Albums in a Single Day from 2017 through 2022.

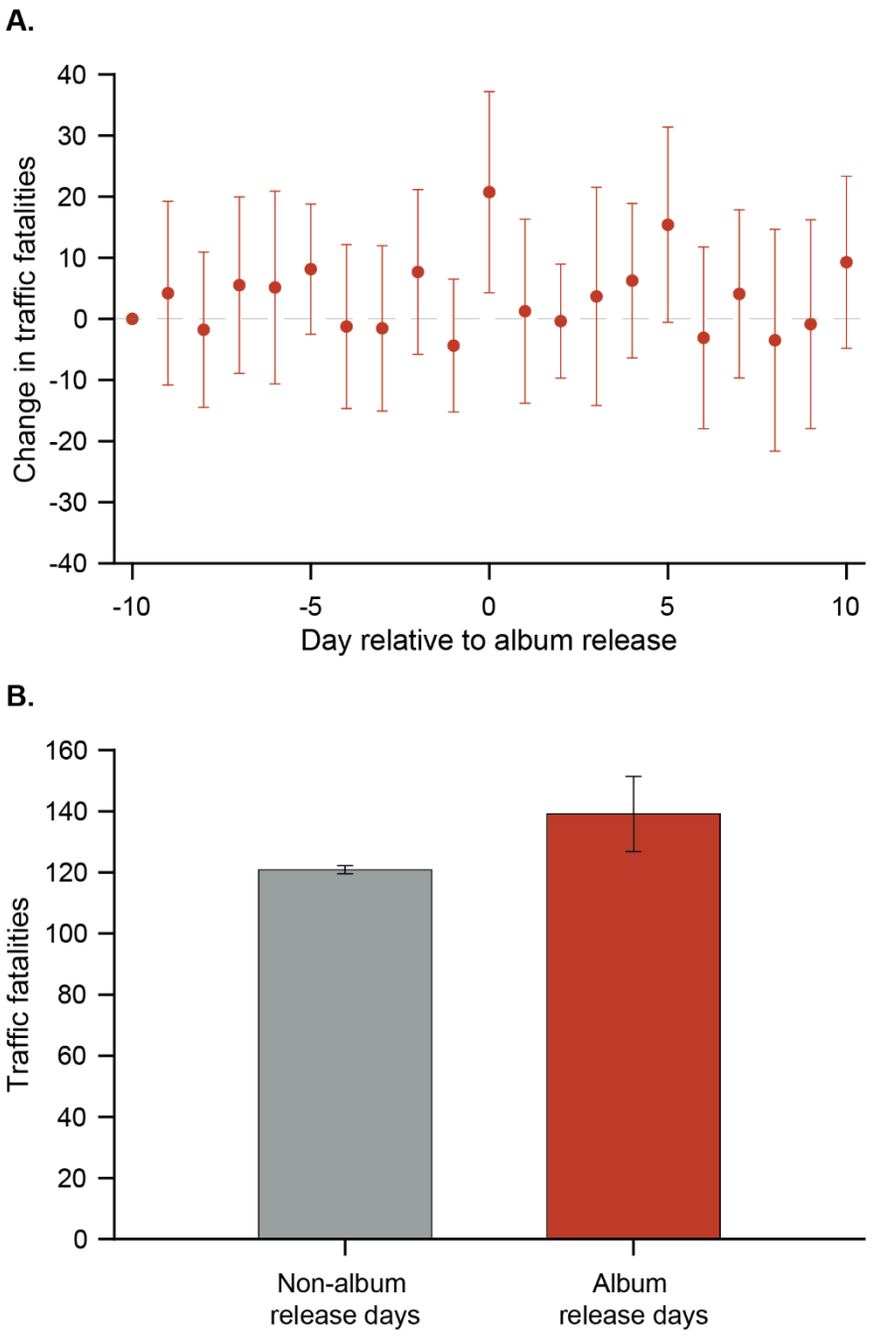
Date released	Album	Artist(s)	Tracks	First-day streams	Rank
October 21, 2022	Midnights	Taylor Swift	20	184,695,609	1
September 3, 2021	Certified Lover Boy	Drake	21	153,441,565	2
May 6, 2022	Un Verano Sin Ti	Bad Bunny	23	145,811,373	3
June 29, 2018	Scorpion	Drake	25	132,384,203	4
May 13, 2022	Mr. Morale & the Big Steppers	Kendrick Lamar	18	99,582,729	5
May 20, 2022	Harry's House	Harry Styles	13	97,621,794	6
November 4, 2022	Her Loss	Drake and 21 Savage	16	97,390,844	7
August 29, 2021	Donda	Kanye West	25	94,455,883	8
November 12, 2021	Red (Taylor's Version)	Taylor Swift	30	90,556,180	9
July 24, 2020	Folklore	Taylor Swift	16	79,443,136	10

Figure 1. Music Streaming Volume Around Major Album Release Days.



Notes: Figure shows online music streams, in millions, by day relative to album release. Streams reflect the total number of online music streams from the top 200 most streamed songs on Spotify each day, as available through Spotify Charts (www.charts.spotify.com/charts/view/regional-us-daily/latest). Estimates are from event study models which adjust for federal holidays, day of the week, week of the year, and year fixed effects. Day 0 indicates the day of an album release. Error bars indicate 95% CIs.

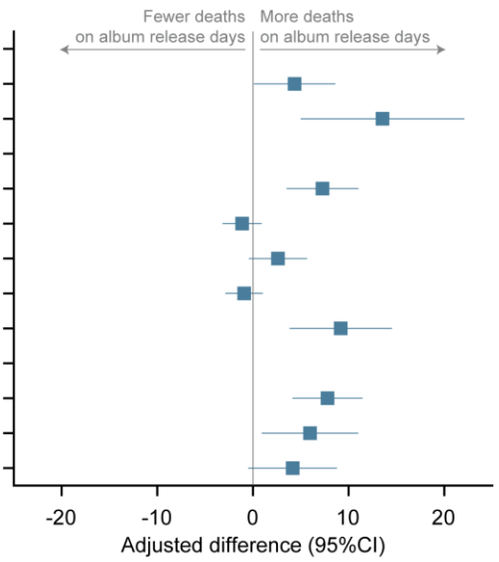
Figure 2. Changes in Traffic Fatalities Around Major Album Release Days.



Notes: Panel A shows the adjusted change in the number of traffic fatalities by day relative to album release days (day 0), where the baseline (dotted line) is the first day in the event study (10 days prior to the album release). Panel B shows the adjusted mean number of traffic fatalities on album release days and on non-album release days (the 10 days before and after each album release day). Estimates are from models which adjust for federal holidays, day of the week, week of the year, and year fixed effects. Error bars indicate 95% CIs.

Figure 3. Changes in Traffic Fatalities on Major Album Release Days by Driver Characteristics.

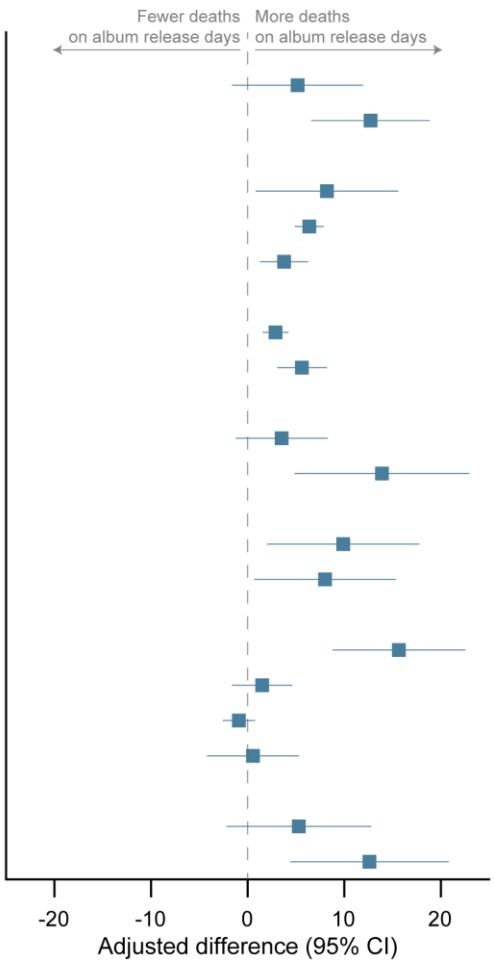
	Adjusted deaths, no.			
	Non-album days	Album days	Adjusted Difference (95%CI)	P value
Sex				
Female	27.0	31.4	4.4 (0.1 to 8.6)	0.05
Male	86.5	100.0	13.5 (5.0 to 22.1)	0.01
Race and ethnicity				
Asian	42.7	49.9	7.3 (3.5 to 11.0)	<0.01
Black	11.9	10.8	-1.1 (-3.2 to 0.9)	0.24
Hispanic	9.6	12.2	2.6 (-0.4 to 5.7)	0.08
Other	1.7	0.8	-0.9 (-2.9 to 1.0)	0.31
White	48.4	57.5	9.2 (3.8 to 14.5)	<0.01
Age				
<40 years	51.2	59.0	7.8 (4.1 to 11.5)	<0.01
40-64 years	40.3	46.3	6.0 (0.9 to 11.0)	0.03
≥65 years	22.0	26.1	4.1 (-0.5 to 8.8)	0.07



Notes: Estimates are from models that adjusted for federal holidays, day of the week, week of the year, and year fixed effects. Error bars indicate 95% CIs. The p-value for the interaction terms between album release day and each driver characteristic were as follows: sex (p=0.01), race and ethnicity (p <0.01), age (p=0.04).

Figure 4. Changes in Traffic Fatalities on Major Album Release Days by Vehicle and Environmental Characteristics.

	Adjusted deaths, no.			
	Non-album days	Album days	Adjusted Difference (95%CI)	P value
Vehicle occupants				
Multiple	36.0	41.2	5.2 (-1.6 to 12.0)	0.12
Single	77.5	90.2	12.7 (6.6 to 18.9)	<0.01
Model year				
≤2010	55.2	63.4	8.2 (0.8 to 15.6)	0.03
2011-2017	31.3	37.7	6.4 (4.9 to 7.9)	<0.01
≥2018	24.3	28.0	3.8 (1.3 to 6.3)	0.01
Apple CarPlay[a]				
Not included	16.3	19.2	2.9 (1.6 to 4.2)	<0.01
Included	12.7	18.4	5.6 (3.0 to 8.2)	<0.01
Driver drinking				
Drinking	26.0	29.5	3.5 (-1.2 to 8.3)	0.13
No drinking	84.7	98.6	13.9 (4.9 to 23.0)	0.01
Lighting condition				
Daylight	55.5	65.4	9.9 (2.0 to 17.8)	0.02
Nighttime	58.0	66.0	8.0 (0.7 to 15.3)	0.04
Weather condition				
Clear	91.2	106.9	15.7 (8.8 to 22.5)	<0.01
Cloudy	14.5	16.0	1.5 (-1.6 to 4.6)	0.31
Other	1.5	0.6	-0.9 (-2.6 to 0.8)	0.25
Rain	7.1	7.7	0.6 (-4.2 to 5.3)	0.80
Rurality				
Rural	30.5	35.8	5.3 (-2.2 to 12.8)	0.15
Urban	83.0	95.6	12.6 (4.4 to 20.8)	0.01



[a] The Apple CarPlay analysis was restricted to crashes involving vehicles manufactured in 2016 or later (following the mass rollout of Apple CarPlay).Vehicles manufactured with Apple CarPlay were identified by the vehicle make, model, and year (www.apple.com/ios/carplay/available-models/).

Notes: Estimates are from models that adjusted for federal holidays, day of the week, week of the year, and year fixed effects. Error bars indicate 95% CI. The p value for the interaction terms between album release day and each crash characteristic were as follows: vehicle occupants (p=0.02), model year (p <0.01), Apple CarPlay (p = 0.04), driver drinking (p=0.03), lighting condition (p=0.67), weather condition (p<0.01), rurality (p=0.15).

Appendix

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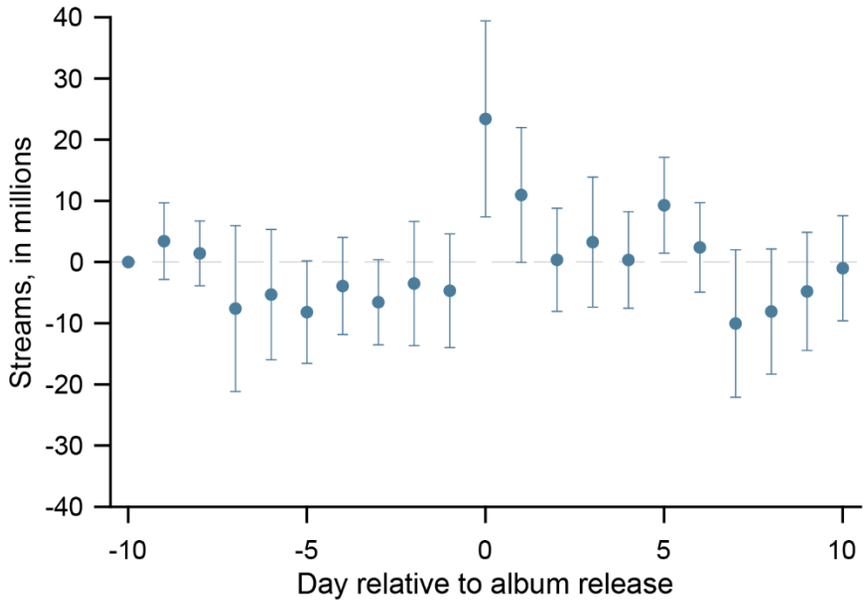
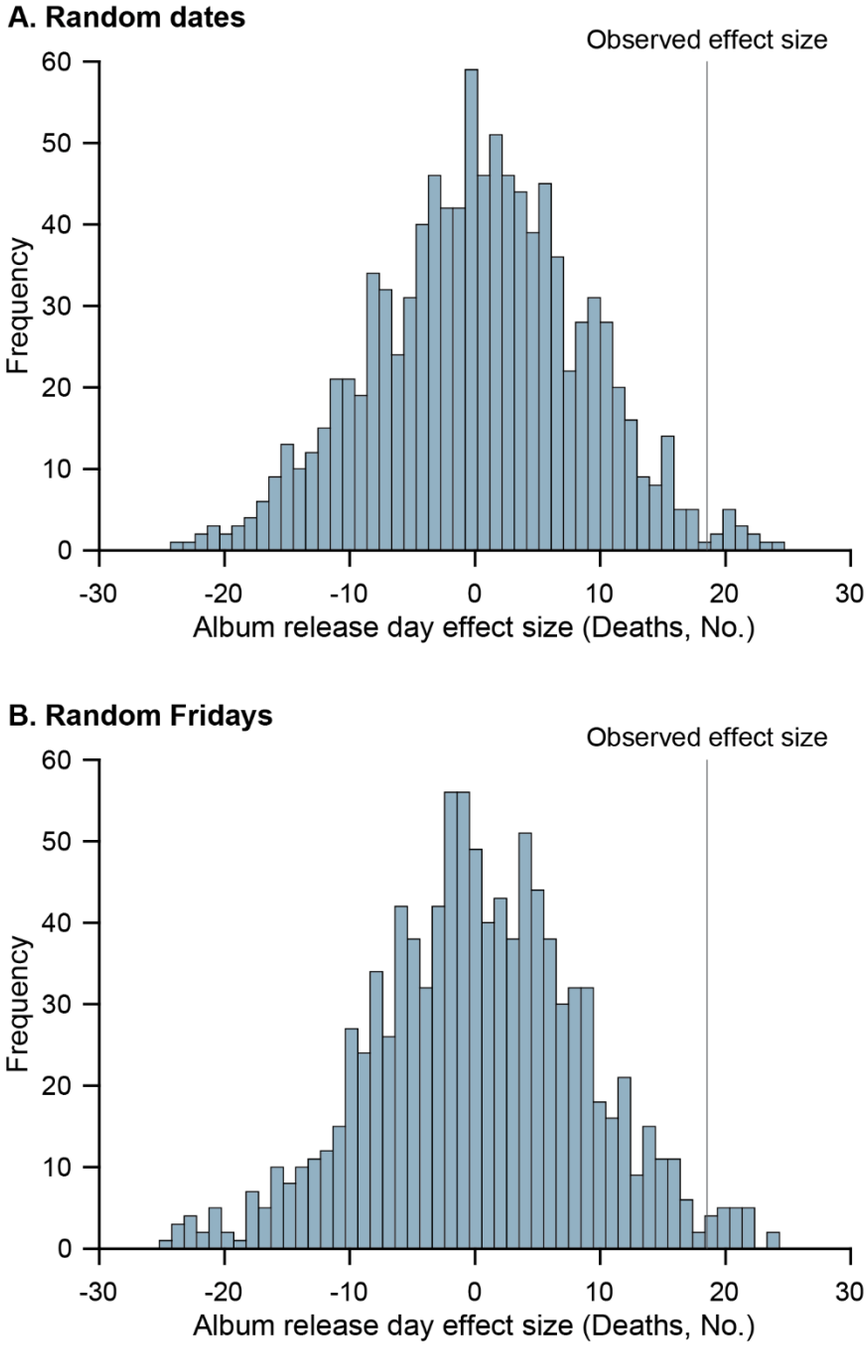
eFigure 1. Changes in Music Streaming Volume Around Major Album Release Days.



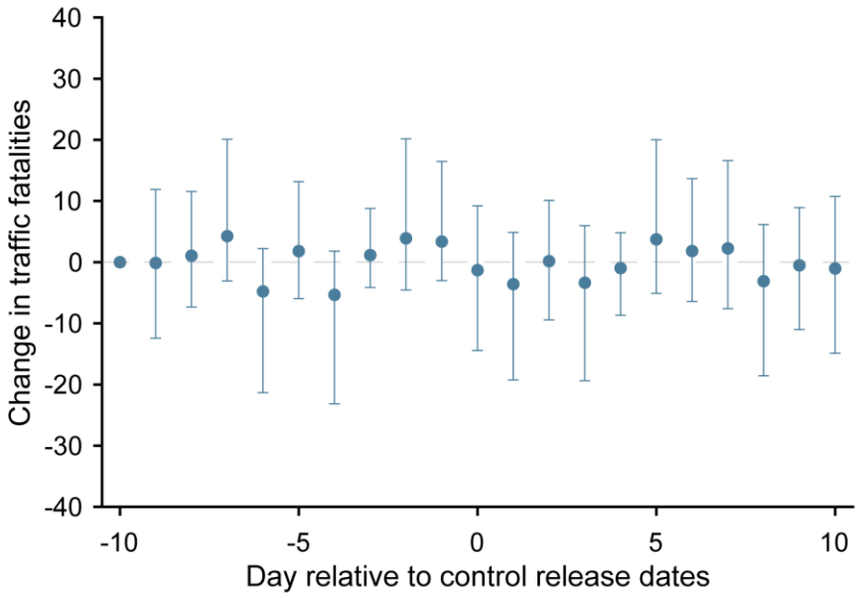
Notes: Figure shows the adjusted change in the number of Spotify streams by day relative to album release days (day 0), where the baseline (dotted line) is the first day in the event study (10 days prior to the album release). Estimates are from event study models which adjust for federal holidays, day of the week, week of the year, and year fixed effects. Day 0 indicates the day of the album release. Error bars indicate 95% CIs.

eFigure 2. Comparison of Observed Effect Sizes to Effect Sizes Obtained From a Permutation Analysis of Randomly Assigned "Placebo Album" Dates.



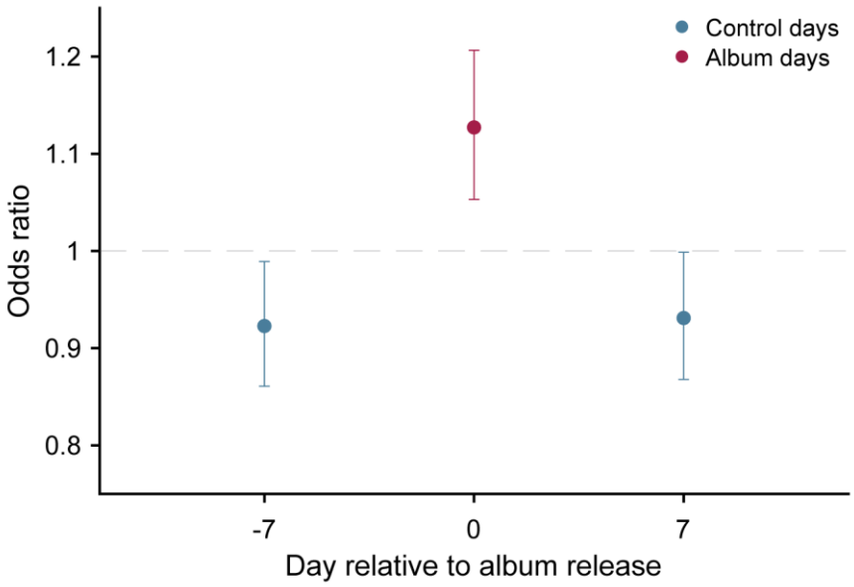
Notes: Figure shows the results of a permutation analysis in which we selected 10 random "placebo album release" days from 2017-2022 and estimated our baseline models (which adjust for federal holidays, day of the week, week of the year, and year fixed effects) to derive the effect size of album releases on the number of traffic-related deaths, repeated for 1,000 iterations. Panel A shows the distribution of effect sizes produced from this simulation for randomly selected dates (all days of week). Panel B shows the distribution of effect sizes produced from this simulation for randomly selected Fridays, given that most album releases were on Fridays. The vertical line in each figure shows our observed effect size for the increase in traffic fatalities on album release day. This simulation produced an effect size greater than our observed effect size in only 14 out of 1,000 iterations for random dates and 20 out of 1,000 iterations for random Fridays. Importantly, the falsification test that assigned placebo album release dates using randomly selected Fridays during 2017-2022 (Panel B) directly addresses the concern that traffic fatalities may be higher on album release days simply because they disproportionately occur on Fridays. If this were the case, we would expect to observe "Friday effects" from this analysis that are similar to the estimated album release effect on traffic fatalities.

eFigure 3. Traffic Fatalities on Dates Matching Each Album's Release Day in Other Study Years.



Notes: Figure shows the adjusted number of traffic fatalities on the same calendar date as each album's release date in all other study years (2018–2022), with each placebo album release date matched to the nearest weekday of the original release. This falsification analysis isolates any holiday-adjacent or seasonal travel patterns that may be tied to an album's calendar release date itself by reproducing the same temporal context of the release day, but in adjacent calendar years (without the album release event). Estimates are derived from the same event-study regression specification used in the primary analysis, adjusting for federal holidays, day of the week, week of the year, and year fixed effects. Error bars indicate 95% CIs.

eFigure 4. Traffic Fatalities on Album Release Fridays Compared with Fridays Before and After.



Notes: Shown is a weekday-matched sensitivity analysis restricted to albums released on Fridays, comparing fatalities on each release Friday with fatalities on the Fridays immediately before and after. Because there are two control Fridays and one release Friday, exact binomial methods accounting for differing exposure time (2 control days vs 1 release day) were used to estimate the relative risk. This strictly day-of-week–matched design within the same season and year assesses potential confounding arising when album releases occur on particular weekdays, most commonly Fridays. Error bars indicate 95% CIs.