Analysis of Colfax Road 2023 Traffic Studies Data / Breck Taylor

Author Note

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Author can be contacted at ColfaxStudies@gmail.com; messages can be left at 610 446 4 822.

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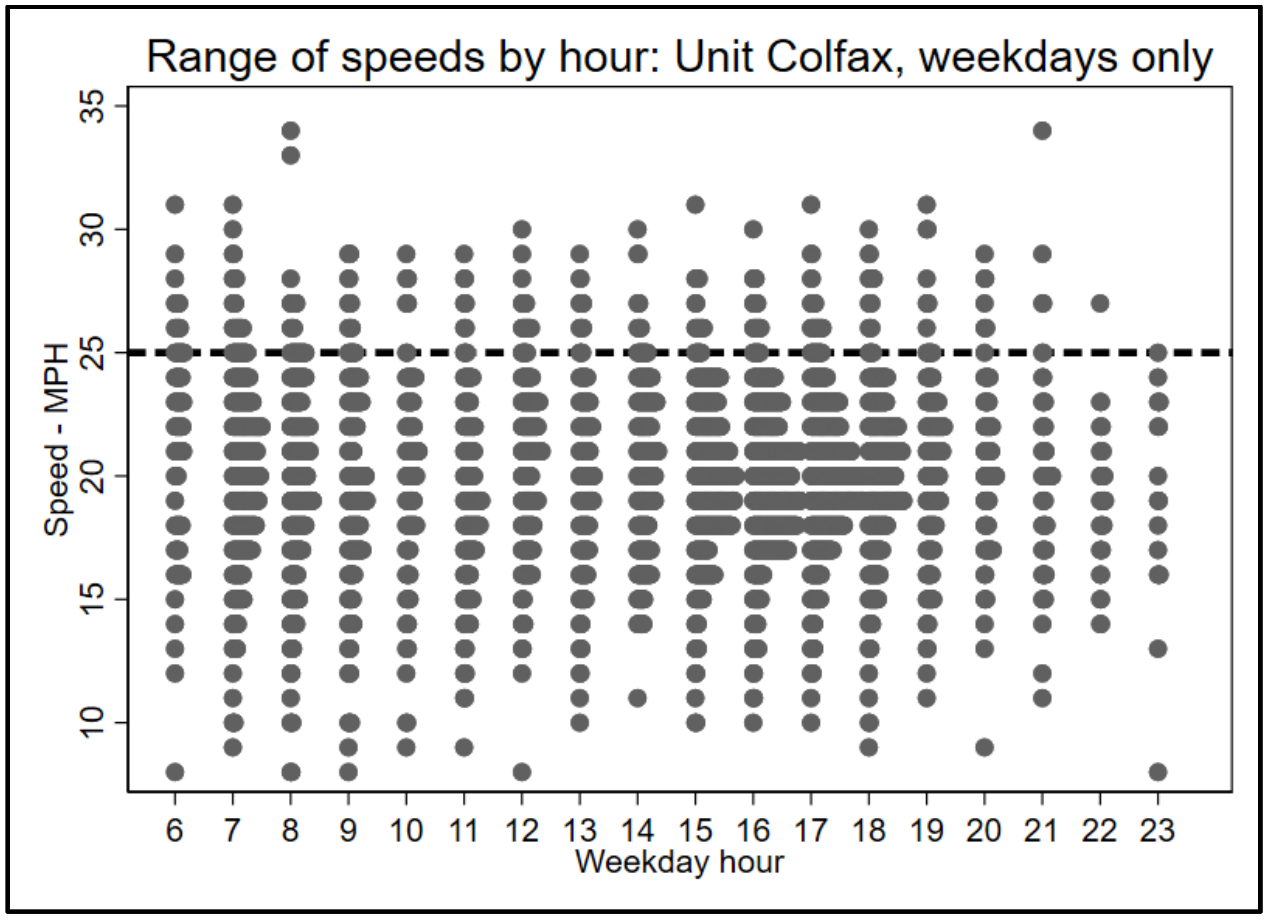

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Executive Summary

Background. To address residents' ongoing concerns about traffic on the unit block of Colfax Road in Haverford Township (PA), vehicle-level data from recent traffic studies were requested from and provided by the Haverford Township Police Department. This report examines data from two of the provided traffic studies: the 100 block of Colfax Road from May of 2023 (n=6,252 vehicle records), and the unit block (0-99) of Colfax Road from October of 2023 (n = 4,603 vehicles). Each study collected data for seven days.

Focus. One goal was simply to describe broad traffic patterns. (1) For each block what was the overall traffic volume, and how did patterns vary across different days, times, and blocks? (2) How frequent were speeding vehicles on each block? (3) How closely packed was traffic? The same questions were reconsidered with a specific focus on weekday afternoon rush hours, when pedestrian and vehicle traffic volumes on the unit block are higher. At these times, (4) what were traffic volumes, (5) speeding vehicle rates and (6) intervals between passing vehicles? Finally, (7) did the data support unit block residents' suspicions that the unit block of Colfax had a traffic-cutting-through-from-Darby Road problem during weekday afternoon rush hours?

Methods. Data were analyzed quantitatively using a well-known statistical program, Stata v. 18. Results using both individual vehicles and individual hours of traffic as the units of analyses were reported. Where appropriate, statistical tests were deployed to determine if key differences likely resulted from more than random noise in the data.

Key Findings. *Weekday Volume.* (1) On the unit (0-99) block, 722 vehicles passed on a typical weekday, translating to a vehicle passing every 2 minutes averaged over all hours of the day and night for all weekdays. (2) On the 100 block, over 987 vehicles passed on an average weekday, translating to a vehicle passing every 87 seconds averaged over all hours of the day and night

over all weekdays. (3) On both blocks, hourly volumes were highest during 4-6 PM on weekdays. (4) Weekday traffic is more heavily concentrated during afternoon rush hours for the unit block of Colfax. *Speeders.* Speeders going 27 mph or faster were more likely on the 100 block of Colfax. Further, on that block, during weekday rush hours, at least one out of every nine passing vehicles was a speeder. *Support for the cut through thesis.* Several findings support unit block residents' suspicions that their street was used as a cut through westbound by vehicles turning off of Darby Road. For example, (a) westbound weekday traffic on the unit block compared to the 100 block is more concentrated into this time frame, and a bigger share of the unit block's weekday traffic volume is funneled into afternoon rush hours.

Key conclusions: Specific. (1) Weekly vehicle volumes on both blocks are substantial. (2) Volumes during weekday afternoon rush hours are especially high on both blocks. (3) Data patterns support the cut-through hypothesis for the unit block of Colfax. (4) Weekday afternoon rush hour speeders are a concern on the 100 block of Colfax.

Key conclusion: General. **More broadly, there are foreseeable and sizable potential risks of serious injury posed to children and pedestrians on the unit block of Colfax Road given these weekday afternoon rush hour traffic patterns. These foreseeable risks might be substantially reduced through one or more policy interventions.**

Policy Implications. (1) Vehicle entry prohibition onto the unit block of Colfax from Darby Road is recommended for 4-6 PM on weekdays. This policy would likely (a) significantly reduce vehicle volumes on both blocks at these times, (b) reduce the fraction of that block's share of weekday traffic occurring during these times, and (c) reduce the prevalence of speeding vehicles on the 100 block. (2) A speed limit sign, preferably that either lights up or reflects passing vehicle speed, is recommended for the 100 block of Colfax to reduce speeding prevalence,

especially during weekday afternoon rush hours. (3) Resources permitting, a speed limit sign is also recommended for the unit block of Colfax which currently has no speed limit signage. Any of these policy recommendations could be implemented on a trial basis with effectiveness and potential adverse displacement impacts, either spatial or temporal, gauged through collection of and analysis of subsequent traffic studies data. (4) Township stakeholders engage in serious discussion about locating the resources for and finding common ground about redesigning the intersection at Eagle and Darby Roads to include a right turn lane southbound to reduce southbound afternoon congestion on Darby Road.

Background

Residents on the unit block (0-99) of Colfax Road, between Darby Road and Grasslyn Road in the Oakmont Estates / Paddock Park section of Haverford Township, Delaware County, PA, have become increasingly concerned about traffic volume and traffic speeds on their block over the past few years. Some residents on the 100 block of Colfax Road also have expressed concern about speeding vehicles. Both blocks are two lane, two-way residential streets.

Geographic context

See Figure 1 for a map of the lower portion of the Oakmont Estates section of Haverford Township in Delaware County, Pennsylvania. Numeral 1 centers on the unit block of Colfax. Numeral 2 centers on the 100 block of Colfax. Numeral 3 centers on the unit block of East Hillcrest.

West Darby Road, at the east end of the unit block of Colfax, is a major arterial road. On Darby, morning rush hour traffic volume is especially heavy northwest bound, and the traffic light at Darby and Ardmore Roads creates substantial lines of queued vehicles. Afternoon rush hour traffic on Darby is heavy southeast bound, with the traffic light (circled) at Eagle and Darby roads creating long lines of waiting vehicles, sometimes queuing back several blocks.

Eagle Road itself is a high volume arterial road, with eastward bound traffic predominating in the morning rush hours, and westward bound traffic predominating in the afternoon rush hours.

Current signage prohibits the following driver actions during weekday rush hours from 4 – 6 PM. (1) Westbound drivers cannot turn into the unit block of West Hillcrest, off of Darby, during afternoon rush hours. (2) Neither can they turn into the 100 block of West Hillcrest if

proceeding westbound. (3) Westbound drivers exiting the unit block of East Hillcrest cannot turn left onto Darby during afternoon rush hours.

Note the following driver adaptations to rush hour congestion and current restrictions. First, drivers southbound on Darby in afternoon rush hour traffic, if they want to proceed westbound on Eagle, can turn right on Colfax, and then left on either Grasslyn or Prescott, and avoid the long wait for the light (circled) at Eagle and Darby. Second, westbound drivers at these times favor Colfax since it runs all the way Golf Hills Road (intersection not shown on map), where drivers can access Lawrence Road if headed to West Chester Pike. Third, Decatur Road, one block northwest of Colfax, and West Clearfield, two blocks northwest of Colfax, both end in a T intersection at Prescott Road, deceasing their utility as shortcuts to westbound rush hour drivers. Finally, as noted above, westbound afternoon rush hour drivers at the intersection of the unit block of East Hillcrest and Darby Road are prohibited from turning left at these times. Many opt to turn right on Darby, then make an immediate left on Colfax to continue.

Note one key land use in the bottom left corner of the map: the Haverford Area YMCA just southwest of the intersection of West Hillcrest and Eagle roads, just to the left of the left pointing arrow. Opened in the 20tens on the site of the old “Bubble Gum Factory” on Eagle Road, it has proven enormously popular; so popular that the parking lot at times requires a parking lot manager (McCrystal, April 13, 2014). Commuters south bound on Darby and heading to the Y can cut through to their destination via Colfax Road.

Figure 1. Street network, Oakmont Estates and Surrounding

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Residents' Perceptions

In the past few years, as southbound weekday afternoon traffic volume on Darby Road has seemingly increased, and lines of vehicles queuing for the light at the Darby Road / Eagle Road intersection have seemingly lengthened, many residents on the unit block of Colfax have perceived that their street was being used increasingly by drivers as a cut through to Eagle Road westbound.

It is not the intent here to document historical or recent changes in traffic patterns on Darby Road or Eagle Road and their environs, but simply to share that (a) residents on the unit block of Colfax are increasingly concerned about vehicle traffic especially during weekday afternoon rush hours; (b) the opening of the Haverford Y has likely substantially increased vehicular traffic through the area; (c) and Colfax Road, for the reasons explained above, makes a better shortcut for afternoon westbound cars and trucks than adjoining blocks.

Deepening residents' concerns are the increased volume of preteen children living on the block. One resident has enumerated seventeen households on the unit block with preteens. High traffic volumes, and high vehicle speeds are potentially dangerous, or worse, potentially lethal on a residential block with many children. Some residents on both the unit and 100 block of Colfax have voiced concerns about child traffic safety.

Current conditions on the unit block of Colfax

Current setting conditions on the streetblock are as follows.

The township speed limit is 25 MPH. ***Currently, however, there is no speed limit sign anywhere on the unit block of Colfax Road.***

Parking is permitted only on the north side of the streetblock. One "No Parking" sign is located on the south side of the streetblock at the west end.

Stop signs at each end of the unit block, and at each end of the 100 block of Colfax.

The streetblock is approximately 880 feet in length, or about 1/6th of a mile. The street gently curves in the middle, impeding drivers' lookahead capabilities.

Traffic concerns shared among residents and voiced to Haverford Township Commissioners

Responding to current traffic concerns, one resident of the unit block of Colfax talked with residents of all households about the current situation. The resident was in favor of changing current parking regulations on the block to permit parking on both sides of the block, with the expectation that such a change would slow down the through traffic on the block. Ultimately, over 80 percent of households signed a petition in favor of such a change. Some residents contacted were not in favor of the change, and some other residents thought a better change would be to restrict weekday afternoon rush hour traffic from entering the block from Darby Road.

In short, although they may disagree on the most effective solution, a substantial majority of households on the unit block of Colfax agree that traffic is a concern on their block. Fueling the concern is worry about the welfare of children living on the block, as well as the inconvenience the traffic creates for residents entering and exiting their driveways, and just moving through the block.

Residents' traffic concerns were communicated publicly to the Board of Commissioners, Haverford Township, at both their November, 2023 and December, 2023 meetings. These discussions at the commissioners' meetings had been preceded by contacts between a concerned resident and Township Commissioner for the 3rd Ward Kevin McCloskey, as well as personnel of

both the Haverford Township Police Department (HTPD) and the Haverford Township Administration.

Township and HTPD personnel had been responsive to these concerns in the following ways. (1) The HTPD conducted two traffic studies, one on the 100 block of Colfax, and one on the unit block of Colfax. Details about these studies appear below in the data section. (2) Township personnel verified that emergency vehicles like fire engine and ambulance could proceed unimpeded down the unit block of Colfax if both sides of the street were parked with vehicles.

Signage or regulatory changes to date

That said, no signage or regulatory changes that might dampen traffic problems on the unit block of Colfax have yet taken place.

Analysis of traffic data patterns may help prioritize policy changes

The hope is that analyses of traffic data patterns might more fully inform township stakeholders, and residents, about features of their current traffic information. These details might guide the discussion among concerned parties about both the specific nature of the current problem, and about which policy changes might address those problems more effectively.

The RTK (right to know) request

At the rise of the December 11th Commissioner meeting, the author, subsequent to a brief conversation with HTPD Police Commissioner Joseph Viola, submitted a right to know (RTK) public records request for detailed data from recent traffic studies. The request was submitted on 20 December, 2023, to Haverford Township's Open Records Officer, Ms. Gloria Cugini, HTPD Deputy Commissioner Joseph Hagan, and HTPD Commissioner Joseph Viola.

The RTK request was framed as follows:

I respectfully request machine-readable files containing record-level data, from both these traffic studies completed on the unit block of Colfax Rd, with the data to be made available in an easily-readable electronic file format such as an Excel spreadsheet for windows, with individual records represented as individual rows in the spreadsheet data, and variables represented as columns, said spreadsheet file to include all available data fields produced by the recording device.

For example, if the Haverford Police Department was using a device comparable to JAMAR Technologies Black Cat II Plus Radar Recorder and accompanying StarneXt software for download, when a data file with a "Count type" of "Vehicle by Vehicle" is downloaded, a "Create Count" command generates a spreadsheet titled "Per Vehicle Records" (Page 4-4, "Black Cat II Plus Radar Recorder Manual 1.2.pdf available at https://www.jamartech.com/manuals). It is those per vehicle records that are of interest to current residents.

I respectfully request any available record-level traffic data records from any traffic studies completed by the Haverford Police Department, in either Calendar Year 2022 or 2023, using comparable data collection devices, on all blocks within a three block radius of the unit block of Colfax Rd. on the west side of Darby Road, those blocks including: a) Hillcrest between Darby and Grasslyn; b) Hillcrest between Grasslyn and Prescott; c) Prescott between Hillcrest and Colfax; d) Woodleigh between Colfax and Paddock; e) Colfax between Grasslyn

and Prescott; f) Colfax between Prescott and Woodleigh; g) Decatur between Darby and Grassslyn; h) Clearfield between Grasslyn and Prescott; i) Ellis between Darby and Grasslyn or between Darby and Prescott.

The 100 block of Colfax

Casual conversations with residents of the 100 block of Colfax suggests that traffic is of concern to at least some residents with children there as well. Although the exact number of households on that block with small children has not been documented, there are some. Further, informal conversations suggest that residents on that streetblock have had conversations about traffic with their township commissioner, Judy Trombetta, Fourth Ward Commissioner.

Purpose and Key Questions

Purpose

Stated simply, the current report uses HTPD-produced vehicle-level traffic studies data to better describe how traffic actually behaves on the unit and the 100 blocks of Colfax Road. This more precise framing would, ideally, better inform residents of both blocks, and township stakeholders as well, as they engage in discussions about potential remedies. The evidence may help ground these discussions.

Key questions

Traffic patterns

Several questions address traffic patterns on the unit and the 100 block of Colfax.

Volume over time

What is the number of vehicles moving through each of these blocks, and at different times of day? This question is about the *count* of vehicles in total, and at different times of day. Of particular interest are weekday afternoon rush hours and rush hour adjacent times.

Rates over time

A different but related question asks: what is the *hourly traffic rate*? This can be examined over different times or days of the week, and for different blocks. Whereas the previous question was about counts, this question is about the *hourly rates* of vehicles. Of particular interest are weekday afternoon rush hours and rush hour adjacent times.

Closely packed vehicle traffic flows

How closely packed is the vehicle traffic flow, especially during weekday afternoon rush hours? How much time does a child, or an adult, or an adult with child, have to safely cross the street? Further, more densely packed traffic flows make it more difficult for residents to exit and enter their driveways. So of concern here is the typical gap, in seconds, between passing vehicles.

Getting at the cutoff question using proportion westbound traffic

As mentioned above, many unit block Colfax residents perceive that their block suffers from extensive traffic cutting through to get to Eagle Road westbound during weekday afternoon rush hours. At least one resident living close to Darby has publicly expressed frustration at a Commissioners'' meeting about the wait times needed during weekday afternoon rush hours before he can safely exit his driveway, given the volume of traffic turning onto the unit block of Colfax from Darby.

What data patterns might support this cut through idea?

(1) If many drivers are using the unit block of Colfax as a weekday afternoon rush hour cut through, the proportion of westbound vehicles should be higher at these times compared to other times.

(2) Further, if, as suspected some sizable fraction of those cutting through are just cutting through for one block, and turning on Grasslyn, then the proportion of westbound vehicles, during weekday afternoon rush hours, should be higher on the unit block of Colfax compared to the hundred block of Colfax.

Speeding vehicles

Of concern for some residents on each of the blocks of Colfax are speeding vehicles. Counts of speeding vehicles, and how those differ by block and time of the week, are of interest. How many speeding vehicles are there in a week on each block? What is the hourly rate of speeding vehicles? Are the rates different between the two blocks?

For a given time frame, or on an hourly basis, especially at sensitive times such as weekday rush hours, what fraction of vehicles are speeding?

Note the likely relationship between speeding and congestion. If the unit block of Colfax has a more severe weekday afternoon rush hour congestion problem due to vehicles cutting through, speed may be less of a problem during these times. If the 100 block has less congestion due to cut throughs, speeding may be more of a problem there during these times.

Methods

This section describes the traffic study data sources provided to the author by the HTPD, including the specific fields or variables contained in those files. Further, how those data were processed by the author, including additional variables created, are noted as well. Readers not interested in such details should skip directly to the results section.

Provided reports and data files

Following the RTK request submission, a conversation with Deputy Commissioner Hagan, and emails, the author received from Deputy Commissioner Hagan on 22 December,

2023, three Excel files of vehicle-level data for three locations and times. Summary reports for each traffic study were provided as well.

The unit block of Colfax

The recording device was placed in proximity to 36 Colfax Road. Data from passing vehicles were recorded between Tuesday 10/17/2023 at 12:55:42 PM and Tuesday 10/24/2023 at 12:50:19 PM

The 100 block of Colfax

The recording device was placed in proximity to 106 Colfax Road. Data from passing vehicles were recorded between Tuesday 5/16/2023 at 12:23:47 PM and Tuesday 5/23/2023 at 12:28:05 PM.

Unit block of East Hillcrest

The exact location of the recording device was not available. Passing vehicles were recorded between Monday 4/5/2021 at 12:42:09 PM and Tuesday 4/13/2021 at 9:58:49 AM. Note the following features of this traffic study. (1) Data are from 2021, not 2023. (2) This block is *east* of Darby Road, between Darby Road and Hirst Terrace, whereas the two blocks of Colfax are *west* of Darby Road. (3) This block at the time of the traffic study had a vehicle entry exclusion. Vehicles are *not permitted* to turn into this street, from Darby Road, between 7 AM and 9 AM on weekdays. (4) Finally, note that this traffic study extended for almost eight days, so overall counts will naturally be higher in this traffic study. By contrast, in each of the other two traffic studies, data were collected for almost exactly seven days.

Given these above points, the analyses addressing the specific points outlined above relies only on the data from the two Colfax Road 2023 traffic studies.

Data Processing

All three vehicle level Excel files were brought into a standard scientific statistical analysis program, Stata, version 18, for quantitative analyses.

Available initial variables

Available fields in the spreadsheets included:

- Date
- Time at which the passing vehicle was recorded
- Date at which the passing vehicle was recorded
- Direction, called "channel,", either eastbound or westbound. The connection between direction and channel was inspected so that a consistent direction variable could be constructed across all three traffic studies.
- Speed, in miles per hour (mph)
- Length, in inches, of the recorded vehicle
- Gap: this records, for a registered vehicle, how many seconds have passed since the previous vehicle was registered going in the same direction

Constructing variables [1]

Dates and times

The following variables were constructed from the date and time variables: year, month, day of month, day of the week, elapsed time since 1/1/1960 in seconds, and interval in seconds between passing vehicles.

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[1] The data processing and analysis program is available at xxx

Using these variables as a foundation permitted constructing the following additional variables.

Weekday

Monday through Friday were coded 1, Saturday and Sunday were coded 0.

Afternoon rush hour

The observations from 4:00 PM (1600) through 5:59 PM (1759) were coded 1, all other hours coded 0.

Expanded afternoon rush hour

The hours from 3:00 PM (1500) through the 6:59 PM (1859) were coded 1, all other hours coded zero.

Weekday PM rush hour and expanded PM rush hour

Combining the weekday indicator with the rush hour indicators permits narrowing attention to the times and days of most concern to residents.

By selecting records where the weekday variable = 1 *and* the PM rush hour variable also = 1, analysis can focus only on weekday afternoon rush hour times.

Similarly, by selecting records where the weekday variable = 1 *and* the expanded PM rush hour variable also = 1, analysis can focus solely on weekday afternoon expanded rush hour times.

Block identification

An identification variable (0 = the unit block of Colfax, 1 = the 100 block of Colfax, 2 = unit East Hillcrest) permits analyses describing patterns separately by block.

Direction

For the current investigation, a direction variable gowest was coded to 1 if the vehicle was picked up by the westbound channel in the data recording device, and 0 for vehicles picked up by the eastbound channel. [2]

Analyzing only westbound traffic, and only during PM or expanded PM weekday rush hours, permits testing the cut through hypothesis for the unit block of Colfax Road.

Interval between passing vehicles going in the same direction

The gap variable generated by the JAMAR technology recording device is direction specific. That makes sense for traffic studies where flows in different directions might need to be analyzed separately to better understand traffic patterns.

In the case of both Colfax blocks, therefore, for a westbound vehicle record the gap only reflects how many seconds since the previous *westbound* vehicle. For example, if westbound vehicle W1 passed the recorder at 15:01:00 (hh:mm:ss) and westbound vehicle W2 passed the recorder at 15:02:00, the interval recorded would be 60 seconds between the two vehicles.

Interval between vehicles going by in either direction: Bidirectional time gap

But residents' concerns are about traffic in both directions. Regardless of direction, more traffic passing a residence makes for a busier street, a noisier street, and a street where more caution is required for both children and adults crossing streets during these busy times.

Continuing with the above scenario and vehicles W1 and W2, suppose vehicle E1 traveling eastbound passed the recorder at 15:01:40. The bidirectional gap between W1 and E1 is 40 seconds and the bidirectional gap between E1 and W2 is 20 seconds. The gap between

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[2] Connection between channel 1 versus 2 differed across the three traffic studies. In constructing the present file, this was taken into account.

vehicles going either direction more fully captures the traffic compression or traffic busyness experienced by residents on the block.

Therefore, it was necessary to construct a variable capturing the interval between passing vehicles going either direction. This variable, gap_eith – for gap in seconds for vehicles traveling in either direction – was constructed by using elapsed time in seconds since 1/1/1960 for each vehicle, copying the preceding vehicle's time onto the record for the current vehicle, and subtracting the difference. The first vehicle record on each block's traffic study has a missing value for this bidirectional gap because there was no preceding vehicle.

Distinguishing between vehicle-level file and hourly level file

Questions about vehicle counts require data files where each individual record corresponds to an individual vehicle. Questions about hourly rates require data files where each individual hour of the specific traffic study is an individual record. Both types of files were analyzed.

To construct files where individual records correspond to specific hours, data were collapsed by block, day within block, and hour within day.

Note that traffic study devices were not turned on and off precisely at the top of the hour. Consequently, to construct the hourly file for each traffic study, the vehicles during the initial partial hour recorded by the device, and the vehicles during the final partial hour recorded by the device, were dropped. Therefore in the hourly file each hour contains a full 60 minutes during which passing vehicles could be recorded.

Other adjustments

The 100 block of Colfax traffic study contained one duplicate record at the very beginning of the data file. The duplicate record was dropped from the vehicle file. The author did

not systematically inspect all the records in the vehicle-level data files for additional possible duplicate records.

In each vehicle-level traffic study data file, the initial record contained a value of zero for the gap between the first vehicle and the preceding vehicle. The gap value for this record for each traffic study vehicle file was changed to missing. Since the device was not recording when the previous value passed, a missing value is more appropriate than a zero value.

Findings

Entire week summary information and differences: Vehicle level file

Descriptive statistics for the vehicle file for the unit block of Colfax appear in Table 1. Table 2 contains the same information for the 100 block of Colfax Road, and Table 3 contains the information for both blocks combined.

Overall vehicle volume

Unit block of Colfax

The recorder counted 4,603 vehicles going by in one week. Just using straight division, and averaging across all hours of the day and night, and all days of the week, this translates to

- 657.57 Vehicles per day
- 27.40 Vehicles per hour
- 0.46 Vehicles per minute
- 2.19 Minutes between vehicles or 2 minutes and 11 seconds between vehicles

Table 1 Descriptive statistics, vehicle file, unit block of Colfax

BLOCK	The unit block of Colfax				
Variable	Counts (percentages)				
N vehicles recorded	4,603 (42.4%)				
Direction west					
0 = East	2,142 (46.5%)				
1 = West	2,461 (53.5%)				
PM Rush 4-6					
0 (non rush hour vehicles)	3,620 (78.6%)				
1 (rush hour vehicles)	983 (21.4%)				
Expanded PM Rush 3 - 7					
0 (non rush hour vehicles)	2,826 (61.4%)				
1 (rush hour vehicles)	1,777 (38.6%)				
Weekday indicator					
0 = weekend	991 (21.5%)				
1 = weekday	3,612 (78.5%)				
Speeders 27 mph or faster					
0 = non speeders	4,431 (96.3%)				
1 = speeders	172 (3.7%)				
	Statistics				
	N	Minimum	Maximum	Mean	Median (50th percentile)
Speed	4,603	7	34	20.0	20.0
Gap (seconds) since preceding vehicle	4,602	0	26,062	131.4	54.0

Table 2 Descriptive statistics, vehicle file, the 100 block of Colfax

BLOCK	100 block of Colfax
Variable	Counts (percentages)
N vehicles recorded	6,251 (57.6%)
Direction west	
0 = East	3,404 (54.5%)
1 = West	2,847 (45.5%)
PM Rush 4-6	
0 (non rush hour vehicles)	5,183 (82.9%)
1 (rush hour vehicles)	1,068 (17.1%)
Expanded PM Rush 3-7	
0 (non rush hour vehicles)	4,368 (69.9%)
1 (rush hour vehicles)	1,883 (30.1%)
Weekday indicator	
0 = weekend	1,313 (21.0%)
1 = weekday	4,938 (79.0%)
Speeders 27 mph or faster	
0 = non speeders	5,309 (84.9%)
1 = speeders	942 (15.1%)

	Statistics				
	N	Minimum	Maximum	Mean	Median (50th percentile)
Speed	6,251	7	61	22.5	23.0
Gap (seconds) since preceding vehicle	6,250	0	7,869	96.8	43.0

Table 3 Descriptive statistics, vehicle file, unit + the 100 block of Colfax

BLOCK	Total (unit block of Colfax + 100 block of Colfax)
Variable	Counts (percentages)
N vehicles recorded	10,854 (100.0%)
Direction west	
0 = East	5,546 (51.1%)
1 = West	5,308 (48.9%)
PM Rush 4-6	
0 (non rush hour vehicles)	8,803 (81.1%)
1 (rush hour vehicles)	2,051 (18.9%)
Expanded PM Rush 3 - 7	
0 (non rush hour vehicles)	7,194 (66.3%)
1 (rush hour vehicles)	3,660 (33.7%)
Weekday indicator	
0 = weekend	2,304 (21.2%)
1 = weekday	8,550 (78.8%)
Speeders 27 mph or faster	
0 = non speeders	9,740 (89.7%)
1 = speeders	1,114 (10.3%)

	Statistics				
	N	Minimum	Maximum	Mean	Median (50th percentile)
Speed	10,854	7	61	21.4	22.0
Gap (seconds) since preceding vehicle	10,852	0	26,062	111.5	47.0

100 block of Colfax

The recorder counted 6,251 vehicles in its week of recording. Just using straight division, and averaging across all hours of the day and night, and all days of the week, this translates to

- 893.0 Vehicles per day
- 37.21 Vehicles per hour
- 0.62 Vehicles per minute
- 1.61 Minutes between vehicles or 1 minute and 37 seconds between vehicles

The 100 block of Colfax has 35.8% *more* weekday vehicle traffic than the unit block of Colfax. Two interpretations are plausible. This could arise from long established differences in the traffic patterns on the two different blocks. Alternatively, it might represent a seasonal difference in traffic volumes with data recorded in May on the 100 block of Colfax and in October on the unit block of Colfax.

Weekday volume

What are weekday volumes considering the entire 24 hour period, from midnight to 11:59 PM, for each weekday?

Unit block of Colfax

On the unit block of Colfax, 3,612 or 78% of all vehicles passed during the five weekdays, at all times of the day and night.[3] Using just straight division, this translates to

- 722.40 Vehicles per weekday

[3] Because the unit block of Colfax and the 100 block of Colfax traffic studies each began and ended around noon on a Tuesday, beginning Tuesday and the ending Tuesday together make up just one weekday day, so weekday totals were divided by 5 to get daily rates.

- 30.10 Vehicles per weekday hour
- 0.50 Vehicles per weekday minute
- 1.99 Minutes between weekday vehicles or 1 minute and 59 seconds between these vehicles

100 block of Colfax

On this block, 4,938 vehicles, or 79% of the weekly total, were recorded during the five weekdays of the traffic study.

Using just straight division, this translates to

- 987.60 Vehicles per weekday
- 41.15 Vehicles per weekday hour
- 0.69 Vehicles per weekday minute
- 1.46 Minutes between weekday vehicles, or 1 minute and 27 seconds between weekday vehicles.

Weekend volume

Weekends, however, are not totally dead. The unit block saw almost 500 cars per weekend day and the 100 block saw over 600 vehicles per weekend day.

Unit block of Colfax

Including all weekend hours, 991 vehicles passed through the unit block of Colfax over the two weekend days of recording. This translates to

- 495.50 Vehicles per weekend day
- 20.65 Vehicles per weekend hour
- 0.34 Vehicles per weekend minute

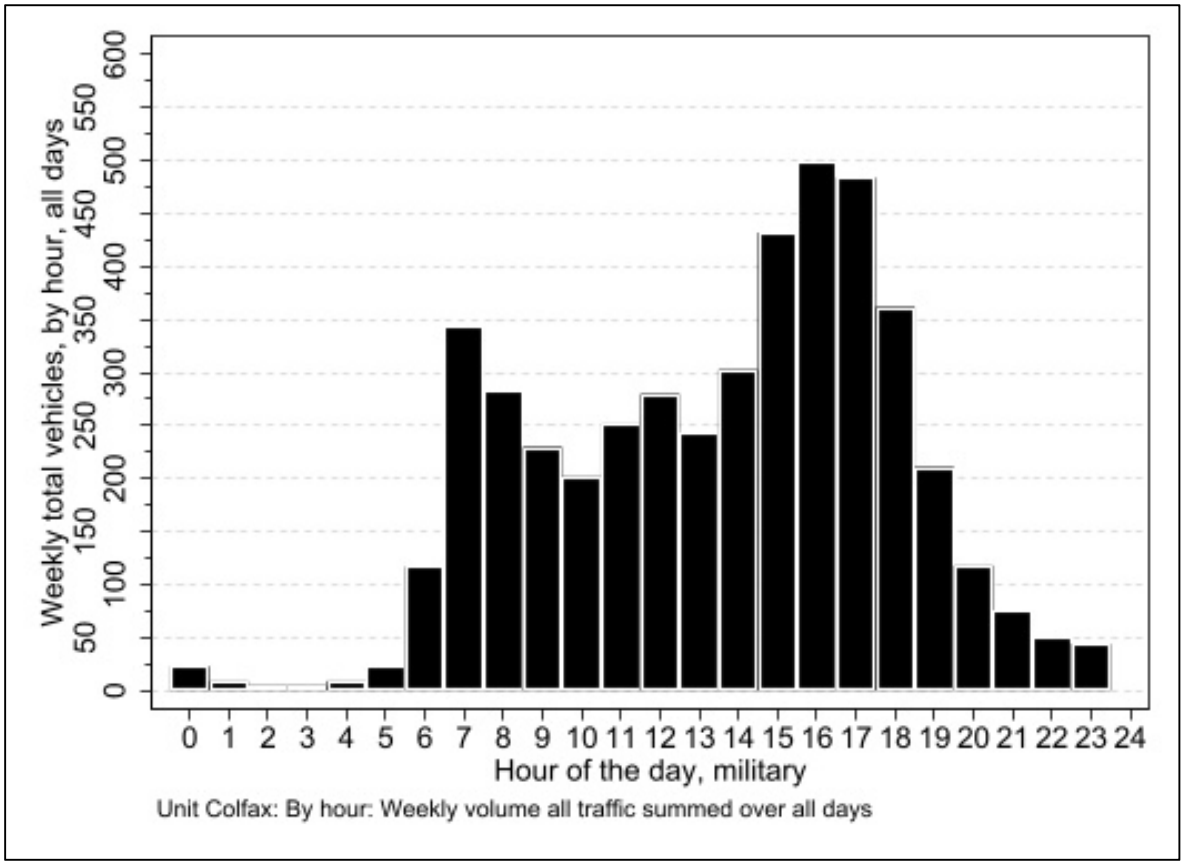
- 2.91 Minutes between weekend vehicles or 2 minutes and 55 seconds between weekend vehicles

100 block of Colfax

Including all weekend hours, 1,313 vehicles passed through the 100 block of Colfax over the two weekend days of recording. This translates to

- 656.50 Vehicles per weekend day
- 27.35 Vehicles per weekend hour
- 0.46 Vehicles per weekend minute
- 2.19 Minutes between weekend vehicles or 2 minutes and 11 seconds between weekend vehicles

Figure 2 Total weekly traffic volume by time of day: Unit block of Colfax



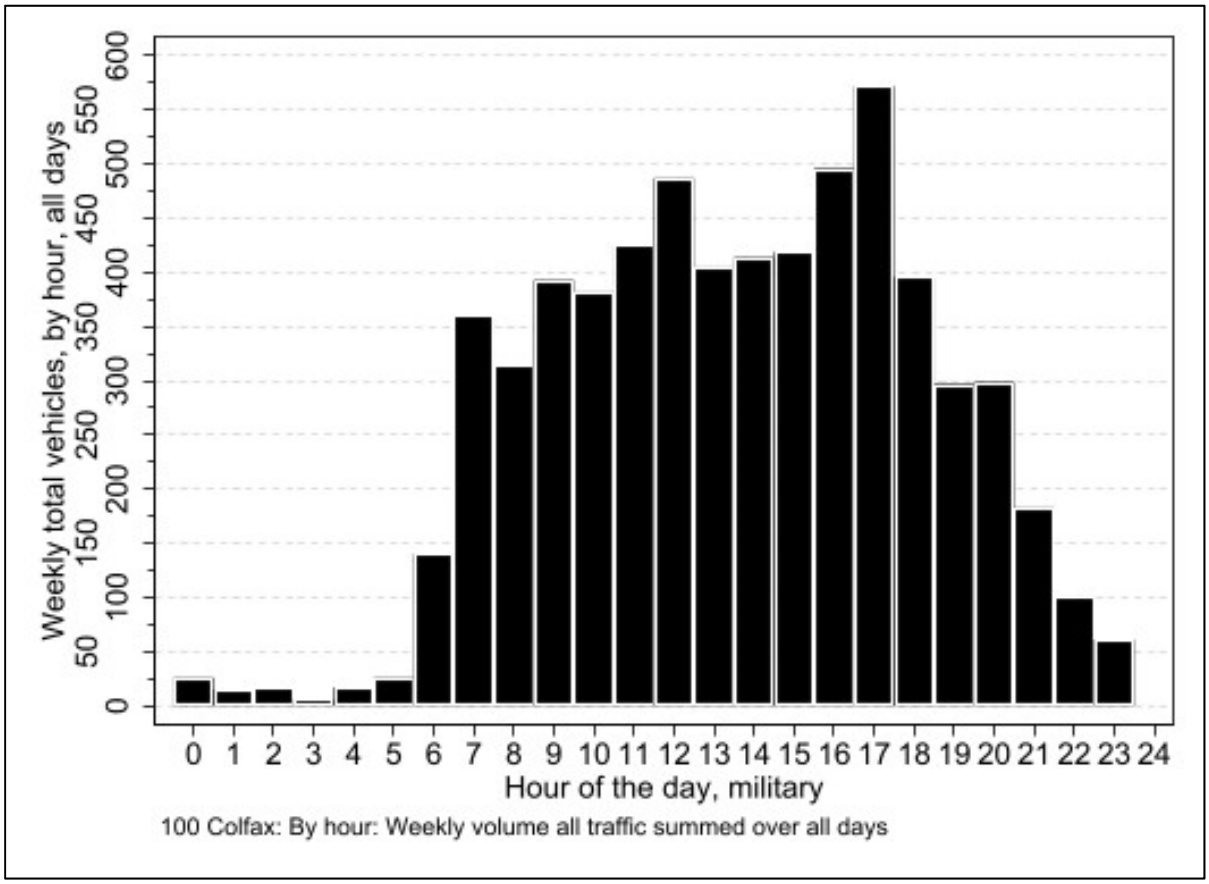
Weekly vehicle volumes by time of day

Considering all vehicles recorded over all days of each traffic study, Figure 2 shows vehicle counts by hour for the unit block of Colfax, and Figure 3 shows the corresponding figure for the 100 block of Colfax.

The Unit block of Colfax

During a week of afternoon rush hours, including weekend days and weekdays, from 4 to 6 PM (16:00 – 18:00), close to a thousand vehicles travel through the unit block of Colfax Road. Weekly volume is around 500 for each individual hour during this time frame.

Figure 3 Total weekly traffic volume by time of day: 100 block of Colfax



Over the entire week of the traffic study, the next highest volume hours are the "shoulders" of the afternoon rush hours, from 3:00 – 4:00 PM (15:00 – 16:00), with about 430 vehicles, and from 6:00 PM to 7:00 PM (18:00 – 19:00), with about 350 vehicles.

The 100 block of Colfax

During a week of afternoon rush hours, from 4 to 6 PM (16:00 – 18:00), including weekend days and weekdays, over a thousand vehicles travel through the 100 block of Colfax Road (Figure 3). The weekly volume is higher in the 5:00 PM as compared to the 4:00 PM hour.

Interestingly, and in contrast to the pattern on the unit block of Colfax, the next highest volume hours are not the "shoulder" hours of the afternoon rush hour, 3-4 PM and 6 – 7 PM, but rather the noon hour, with close to 500 vehicles moving through during a week of noontimes.

Gaps (in seconds) between passing vehicles

The gap between passing vehicles provides a sense of how closely packed or dense the vehicle traffic is. Obviously, higher vehicle counts imply shorter intervals between passing vehicles.

Unit block of Colfax

On the unit block of Colfax, typically, all week long, considering all times of night and day, ***a vehicle is typically preceded by another vehicle 54 seconds earlier.*** [4]

100 block of Colfax

On the 100 block of Colfax (Table 2) typically, all week long, considering all times of night and day, ***a vehicle is typically preceded by another vehicle 43 seconds earlier***. [5]

Distribution of vehicle speeds

The next to bottom row in Tables 1-3 provides descriptive information about the distribution of vehicle speeds. Vehicle speeds ranged from 7 to 61 mph. [6] The 50th percentile, which is the middlemost figure, was 20 mph on the unit block of Colfax, meaning half of the

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[4] Again, the median or 50th percentile is used rather than the average.
[5] Again, the median or 50th percentile is used rather than the average.
[6] Two vehicles were recorded going high rates of speed, 49 mph and 61 mph, on the 100 block of Colfax. To determine if these were emergency vehicles, like police or ambulance, the records with these speeds could be referenced with 911 call logs or officer dispatch data.

vehicles were going this fast or faster, and 23 mph on the 100 block of Colfax, meaning half the vehicles were going this fast or faster. [7]

Weekday afternoon rush hours, 4 – 6 PM: Volume by hour, day, and by block

As mentioned early, weekday afternoon rush hours are of particular interest to unit block residents. To obtain a more granular picture of what residents experience, Table 4 depicts what unit block residents experience on an hourly basis. Hourly vehicle volumes range from 74 to 93, with higher hourly counts later in the week. Over the entire week of weekday rush hours, **843 vehicles travel through the block.** Note that 75.5% of the volume is westbound, reflecting vehicles cutting into Colfax Road from Darby Road.

The bottom half of the table shows the weekly volume, **870,** for the 100 block of Colfax Road. Hourly counts range from 72 to 108. Note that here a lower portion of the traffic, 52.1%, is westbound.

[7] The distribution of the speed variable has positive "outlier" values. Therefore, the median or 50th percentile is a better indicator of a typical score than the average. In situations like this the average can be misleading as an indicator of typicality. There is the well-known problem of what happens when Bill Gates walks into a bar the average bar patron then becomes a multimillionaire.

Table 4 Weekdays only: Afternoon rush hour vehicle volumes by hour and block

Block	Day of Week	Hour	Vehicles/hour	West/hour	East/hour
Unit (0-99) Colfax Rd	Monday	4 - 5 PM	80	60	20
		5 - 6 PM	74	58	16
	Tuesday	4 - 5 PM	78	64	14
		5 - 6 PM	76	51	25
	Wednesday	4 - 5 PM	92	74	18
		5 - 6 PM	87	69	18
	Thursday	4 - 5 PM	82	55	27
		5 - 6 PM	91	70	21
	Friday	4 - 5 PM	93	72	21
		5 - 6 PM	90	64	26
WEEKLY TOTAL weekday afternoon rush hour vehicle volume			843	637	206
DAILY AVERAGE weekday afternoon rush hour vehicle volume			168.60		
PER MINUTE AVERAGE: vehicles per rush hour minute			1.41		
AVERAGE SECONDS between rush hour vehicles			42.70		
100 Colfax	Monday	4 - 5 PM	77	52	25
		5 - 6 PM	78	38	40
	Tuesday	4 - 5 PM	84	55	29
		5 - 6 PM	108	52	56
	Wednesday	4 - 5 PM	72	46	26
		5 - 6 PM	86	47	39
	Thursday	4 - 5 PM	86	54	32
		5 - 6 PM	78	42	36
	Friday	4 - 5 PM	97	57	40
		5 - 6 PM	104	62	42
WEEKLY TOTAL weekday afternoon rush hour vehicle volume			870	453	340
DAILY AVERAGE weekday afternoon rush hour vehicle volume			174.00		
PER MINUTE AVERAGE: vehicles per rush hour minute			1.45		
AVERAGE SECONDS between rush hour vehicles			41.38		

Speeder counts and prevalence rates.

Speeder counts, of course, depend on the threshold or cut point used to define a speeding vehicle. Tables 1-3 show a variable where a speeder is defined as going 27 mph or faster.

Across the two blocks of Colfax, 1,114 vehicles were recorded going 27 mph or faster. Overall, across the two blocks, the prevalence of speeders was 10%.

Looking at the speeding vehicle counts and the proportion of speeding vehicles separately by block shows marked differences across the two locations.

Unit block of Colfax

On the unit block of Colfax 172 vehicles going 27 mph or faster were recorded. On this block, the prevalence of speeders was 3.7%.

100 block of Colfax

On the 100 block of Colfax, 942 vehicles were recorded going 27 mph or faster. On this block the prevalence of speeders was 15%.

Differences in prevalence of speeders across the two blocks of Colfax

The proportion of vehicles going through the block at 27 mph or faster, is significantly higher on the 100 block of Colfax – 15% – than on the unit block of Colfax – 3.7%. [8] Stated another way:

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[8] The term "statistically significant" typically applies when the investigator seeks to learn whether the differences on a variable observed in his/her/their sample are likely to "really" exist in the population of observations from which the sample observations were drawn using a probability sampling procedure.

Here, records were not randomly sampled from larger populations. Rather we have a population of vehicle records, for one week each, from two different blocks. Tests of statistical significance can still be used, but the interpretation is different. Now, the interpretation is as follows. If the differences between blocks on the variable are statistically significant, it indicates that differences are unlikely to be arising *merely* from variation produced by random noise in the data; there is something more than noise going on that is driving the difference observed between the two blocks on this variable (Blalock, 1979: 241-243). This interpretation of statistical significance is applicable to all the statistical tests reported here.

- The odds that a recorded vehicle would be a speeding vehicle instead of a non-speeding vehicle were *three and a half times higher* on the 100 block as compared to the unit block of Colfax.

Again, as noted earlier, these block differences could reflect established between-block differences, or seasonal differences given the different data collection times of the two traffic studies, May versus October.

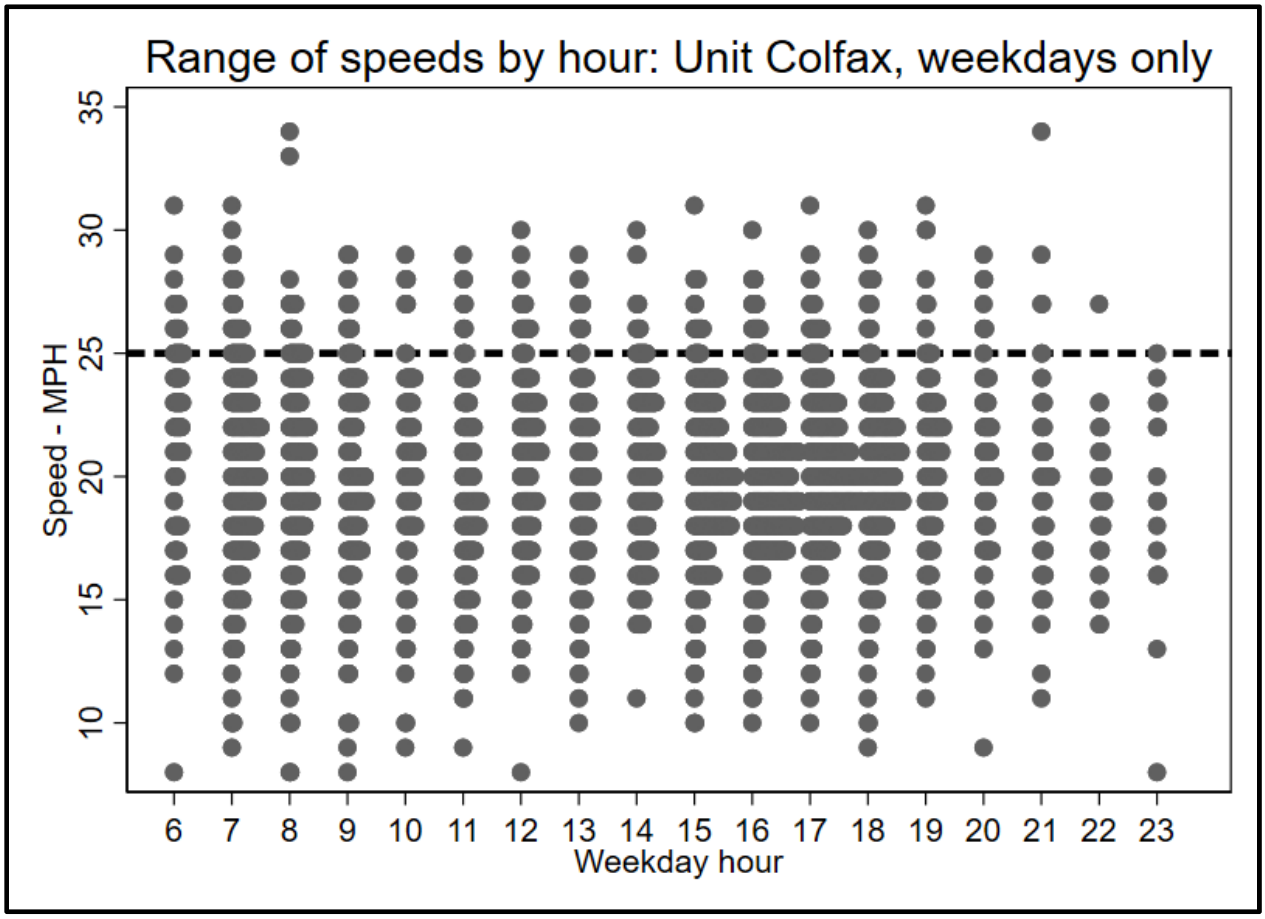
Distribution of speeds: Weekdays, by hour

The speeder variable is binary. A more detailed picture of what is happening if individual weekday vehicle speeds are portrayed. Figure 4 and On the 100 block, the volume of vehicles exceeding the speed limit is markedly higher. There are far more vehicles going over the speed limit. Of course, this is due in part to the 41% higher overall volume on this block. But, as will be shown below, analyses controlling for overall volume differences will indicate that excessive speed is more of a problem on this block compared to the unit block.

A logit model predicting the 27+ mph speeder variable (0 (not speeding) / 1 (speeding)) using a dummy variable for the 100 block of Colfax (=1) versus the unit block of Colfax (=0) showed that the odds of a vehicle [being a speeder versus not being a speeder] were three and a half *times* higher on the 100 block. The z test (z=17.8) of the odds ratio (OR=4.57) indicated a difference this large or larger between the two blocks was likely to occur *just* from random differences between the two blocks, less than one time in a thousand.

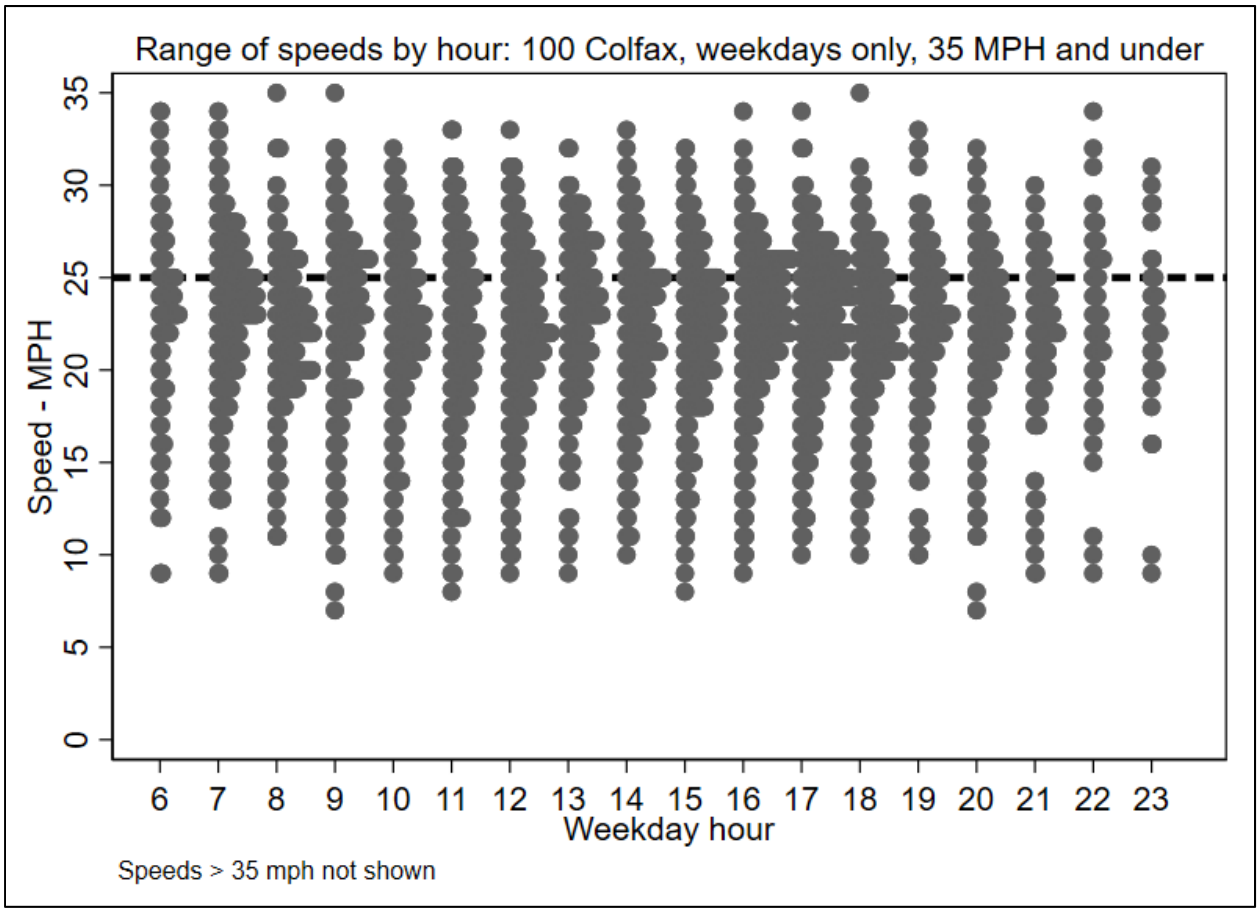
Figure 5 provide that information for, respectively the unit block and the 100 block of Colfax Road. Given extremely low volumes from midnight up until 5:59 AM, those hours are not shown. These are dotplots (Sasieni & Royston, 1996). Each dot may represent one vehicle, with multiple vehicles represented by multiple dots aligned side by side. The dot widens as more vehicles are represented. When horizontally elongated dots start running into one another, the 1:1 relationship between the count and horizontal width may break down. But the overall picture is clear. The dashed horizontal line reflects the speed limit, 25 mph.

Figure 4 Weekday distribution of speeds, by hour: Unit block of Colfax Road



On the unit block on weekdays numerous vehicles drive faster than the speed limit. During **every hour in a week of weekdays, from early morning until 9 PM, there are at least a handful of vehicles exceeding the speed limit.** On the 100 block, the volume of vehicles exceeding the speed limit is markedly higher. There are far more vehicles going over the speed limit. Of course, this is due in part to the 41% higher overall volume on this block. But, as will be shown below, analyses controlling for overall volume differences will indicate that excessive speed is more of a problem on this block compared to the unit block.

Figure 5 Weekday distribution of speeds, by hour: 100 block of Colfax Road



Vehicle travel direction

Across the two Colfax blocks, 48.9% of traffic was recorded westbound (Table 3). The prevalence of westbound on the unit block of Colfax, 53.5% (Table 1) was significantly higher than on the 100 block of Colfax, 45.5% (Table 2). [9]

[9] The likelihood ratio chi squared test of this difference in proportions westbound across the two blocks yielded a value of 66.6 with one degree of freedom. The chances that a difference on this variable this extreme or more extreme between the two blocks could have arisen just due to chance differences between the two blocks are less than one in a thousand.

Westbound traffic predominance gets reconsidered when the question of a potential cut through problem on the unit block of Colfax during weekday afternoon rush hours is considered.

Summary information and differences: Hourly level file

How and why

After removing vehicle records from the partial first and partial last hour of each traffic study, data were collapsed by hour within day within block. With this collapsed file, the hour is the individual record or unit of analysis, and every hour is a complete hour.

Such a data structure permits constructing hourly counts and rates, for both vehicles and speeders. [10] Here, typical indicators reference a count or a rate for a typical hour. For example, typical *hourly* vehicle speeds, and typical *hourly* patterns of vehicle packing can be described.

An Important limitation

An important limitation of the hourly file is that hours with no vehicle traffic were not registered by the device. And, as mentioned above, records from the partial hour at the beginning and end of traffic study were removed. So there were only 151 recorded hours for the unit block of Colfax (Table 5) and 162 for the hundred block of Colfax (Table 6). Inspection of the data file showed no records for some early morning hours.

Both hourly files, however, started and ended on the same day of the week, at roughly the same time of day, around noon time.

This recording feature has implications for how data patterns are interpreted. These data are about hourly rates or hourly counts *for hours when there is at least some traffic*. Hours with no vehicles generated no recorded data.

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[10] Technically, these are called incidence rates. They describe how many instances or incidents of something occurred per hour.

Descriptive statistics

Descriptive statistics for the unit block of Colfax appear in Table 5, for the 100 block of Colfax in Table 6, and for both blocks together in Table 7. Descriptive statistics include minimum and maximum values, averages, medians or 50th percentiles, and standard deviations. The latter indicate how dispersed the scores are for that variable. As with the vehicle file, 50th percentile scores or medians will be used to describe typical cases because the variables have outlying values that are not symmetrically distributed.

Hourly vehicle volume

Unit block of Colfax

Over an entire week, in a typical hour with recorded traffic,

- 28 vehicles per hour were recorded (Table 5). This translates to
- One vehicle every 2.14 minutes, or one every 2 minutes 23 seconds.

100 block of Colfax

Over an entire week, in a typical hour with recorded traffic,

- 41 vehicles per hour were recorded (Table 6). This translates to
- One vehicle every 1.45 minutes, or one every 86 seconds.

Difference between blocks

Over an entire week, for hours with traffic, typical hourly traffic volume (41 vs. 28) is significantly higher on the 100 block compared to the unit block of Colfax. [11]

[11] For the variable vehicles per hour, the difference between the two blocks was tested with a median test. "The median test examines whether it is likely that two or more samples came from populations with the same median. The null hypothesis is that the samples were drawn from populations with the same median. The alternative hypothesis is that at least one sample was drawn from a population with a different median" (StataCorp, 2023: ranksum-5). See also Snedecor & Cochran (1989).

Hourly number of speeding vehicles going 27 mph or higher

Over an entire week, in a typical hour with recorded traffic,

- 1 speeding vehicle passed through the unit block of Colfax (Table 5), and
- 4 speeding vehicles passed through the 100 block of Colfax (Table 6). [12]

Hourly proportion of vehicles speeding 27 mph or higher

Over an entire week, in a typical hour with recorded traffic,

- 1 out of every 40 vehicles were speeding (proportion = .025) on the unit block of Colfax (Table 5), and
- 1 out of every 7 vehicles were speeding (proportion = .14) on the 100 block of Colfax (Table 6).

Difference between blocks

Over an entire week, the proportion of hourly proportion of speeding vehicles was significantly higher on the 100 block of Colfax compared to the unit block of Colfax. [13] The difference was likely not due to just random noise in the data.

The median test produced a continuity-corrected Pearson chi squared value (df=1) of 4.87. A difference between the blocks this large or larger could have arisen solely from random differences between the blocks less than 3 times in a hundred.

[12] The difference in hourly speeding vehicle counts between the blocks is not tested because we already know that the 100 block has higher hourly traffic counts.

[13] For the variable hourly proportion of speeders, the difference between the two blocks was tested with a median test. The resulting Pearson continuity corrected chi squared value (df=1) was 80.91. A difference this large or larger between the two blocks on this variable, could have arisen solely from random differences less than 1 time in a thousand.

Note that testing the proportion of speeders rather than the speeder counts controls for different hourly vehicle volumes between the two blocks.

Typical hourly speeds

Over an entire week, n hours with recorded traffic, typical hourly speeds range from 14 mph to 32 mph on the unit block of Colfax (Table 5) and 17 mph to 36 mph on the 100 block of Colfax (Table 6). [14] The overall most typical hourly speed, that is the median of the hourly medians,

- was 20 mph on the unit block of Colfax (Table 5) and
- 23 mph on the 100 block of Colfax (Table 6).

Difference between blocks

Over an entire week, typical hourly vehicle speeds were significantly higher on the 100 block of Colfax compared to the unit block. [15]

Typical gap (in seconds) between vehicles

Over an entire week, for hours with recorded traffic,

- On the unit block of Colfax, in a typical hour with recorded traffic, one vehicle followed another every 91 seconds (Table 5). [16]
- On the 100 block of Colfax, in a typical hour with recorded traffic, one vehicle followed another every 58 seconds (Table 6). [17]

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[14] Even though these are medians, more extreme values are more likely when the hourly vehicle count is low. If Bill Gates walks into a bar and there is only one other patron, median income of bar patrons will be extremely high. If the bar has 99 patrons before he walks in, median patron income after he walks in will be higher than it was before he walked in, but the jump in median income will be much more modest.

[15] For the variable median hourly speed, the difference between the two blocks was tested with a median test. The resulting Pearson continuity corrected chi squared value (df=1) was 101.66. A difference this large or larger between the two blocks on this variable, could have arisen solely from random differences less than 1 time in a thousand. In short, the higher typical hourly speeds on the 100 block compared to the unit block, over an entire week, do not arise solely from noise in the data.

[16] This is the median of hourly medians.

[17] This is the median of hourly medians.

Difference between blocks

Over an entire week, typical gaps between passing vehicles were significantly shorter on the 100 block of Colfax compared to the unit block of Colfax. [18] Considering the entire week, and using an hourly basis, traffic was more densely packed on the 100 compared to the unit block of Colfax.

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[18] For the variable median hourly gap between vehicles, the difference between the two blocks was tested with a median test. The resulting Pearson continuity corrected chi squared value (df=1) was 6.47. A difference this large or larger between the two blocks on this variable, could have arisen solely from random differences less than 2 times in a hundred.

Table 5 Descriptive statistics, hourly file: Unit block Colfax

Block	Variable	Descriptive statistics				
The unit block of Colfax						
	Number of hours recorded	151 (48.2%)				
		Minimum	Maximum	Average	Median (50th percentile)	(Standard Deviation)
	Hourly vehicle volume	1	93	30.2	28	(24.927)
	Hourly number of speeders 27 mph or faster	0	5	1.1	1	(1.310)
	Hourly proportion speeding vehicles 27 mph or faster	0	1	0.1	0.025	(0.128)
	Median (50th percentile) hourly speed	14	32	20.2	20	(2.221)
	Median (50th percentile) hourly gap between vehicles in seconds	21	14,413	682.0	91	(2,049.806)

Table 6 Descriptive statistics, hourly file: 100 block Colfax

Block	Variable	Descriptive statistics				
the 100 block of Colfax						
	Number of hours recorded	162 (51.8%)				
		Minimum	Maximum	Average	Median (50th percentile)	(Standard Deviation)
	Hourly vehicle volume	1	113	38.1	41.5	(28.815)
	Hourly number of speeders 27 mph or faster	0	24	5.8	4	(5.502)
	Hourly proportion speeding vehicles 27 mph or faster	0	1	0.2	0.14	(0.170)
	Median (50th percentile) hourly speed	17	36.5	23.0	23	(2.155)
	Median (50th percentile) hourly gap between vehicles in seconds	20	6,247	512.6	58.25	(1,092.220)

Table 7 Descriptive statistics, hourly file, total both blocks

Block	Variable	Descriptive statistics				
Total						
	Number of hours recorded	313 (100.0%)				
		Minimum	Maximum	Average	Median (50th percentile)	(Standard Deviation)
	Hourly vehicle volume	1	113	34.3	32	(27.258)
	Hourly number of speeders 27 mph or faster	0	24	3.5	2	(4.669)
	Hourly proportion speeding vehicles 27 mph or faster	0	1	0.1	0.057	(0.160)
	Median (50th percentile) hourly speed	14	36.5	21.6	22	(2.586)
	Median (50th percentile) hourly gap between vehicles in seconds	20	14,413	594.3	79	(1,625.679)

Weekday afternoon rush hour volumes: Regular and expanded rush hours

The next set of findings focus on patterns during weekday afternoon rush hour times. Both "regular" (4:00 – 6:00 PM) rush hour periods, and expanded afternoon rush hour periods (3:00 – 7:00 PM) were examined. As seen above (Figure 2), on the unit block of Colfax the "shoulders" of the afternoon rush hour are the next highest volume times after the regular rush hours.

Figure 6 Proportion of weekday vehicles passing during expanded afternoon rush hours, by block. From vehicle-level file.

The following pattern features merit attention: weekday afternoon rush hour traffic volume, traffic direction, traffic packing, and speeding. Differences by block are noted. Traffic direction was relevant to the potential cut through problem noted earlier for the unit block of Colfax. Some of these findings use the vehicle record file, and some use the hourly record file. Which is used is mentioned in each case.

Size of the weekday rush hour burden on unit block and the 100 block of Colfax

Considering all weekday traffic, for each block, what is the relative burden created by weekday afternoon rush hour traffic? Stated differently, how concentrated into the weekday afternoon rush hours was each block's total weekday traffic? Further, if there were between-block differences, were they significant, that is, were they arising from more than random noise in the data?

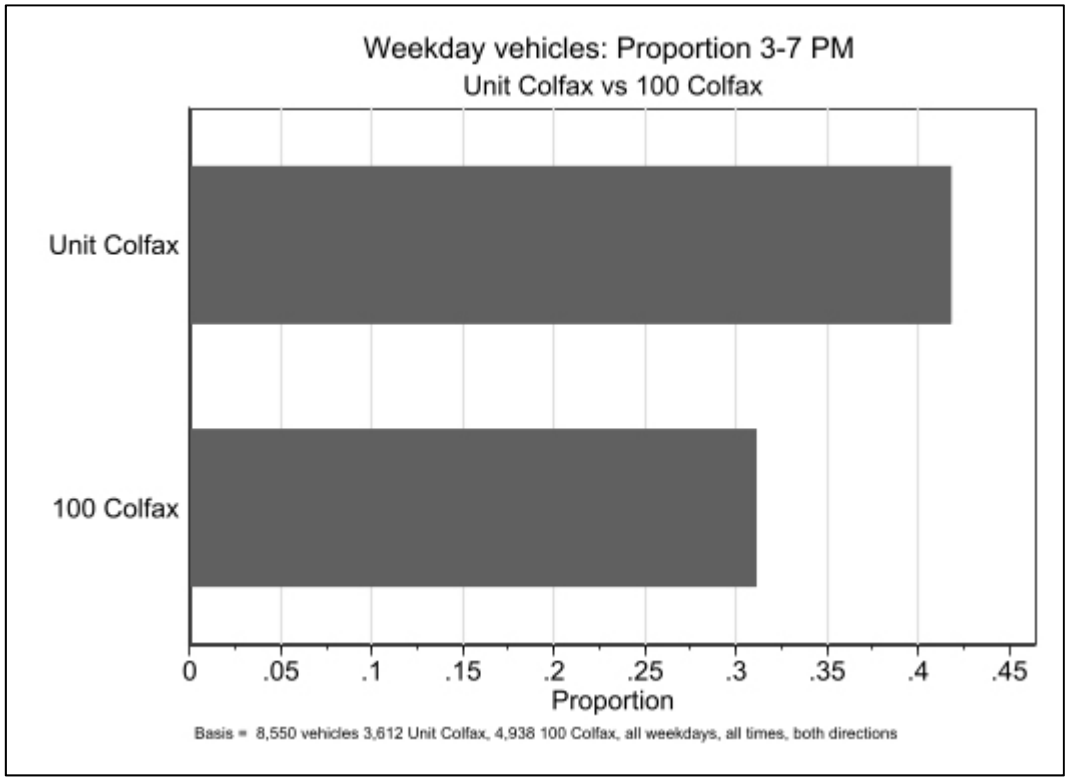
This analysis used the vehicle-level file.

Expanded weekday afternoon rush hours

Figure 6 shows the relative expanded weekday afternoon rush hour burden separately by block. Expanded afternoon rush hours go from 3:00 PM (15:00) hour to the end of the 6 PM hour

(through 18:59). On the unit block of Colfax, 41.8% of all weekday vehicles passed during expanded rush hours; the corresponding figure for the 100 block of Colfax block is 31.1%. These figures are expressed as proportions in the figure.

- In short, a bit more than 4/10th of unit block Colfax's total weekday traffic happens from 3-7 PM, whereas on the 10 block of Colfax only a bit more than 3/10th of its total weekday traffic passes during this time.
- ***Weekday traffic is more strongly funneled into afternoons from 3 – 7 PM on the unit block of Colfax compared to the 100 block.***



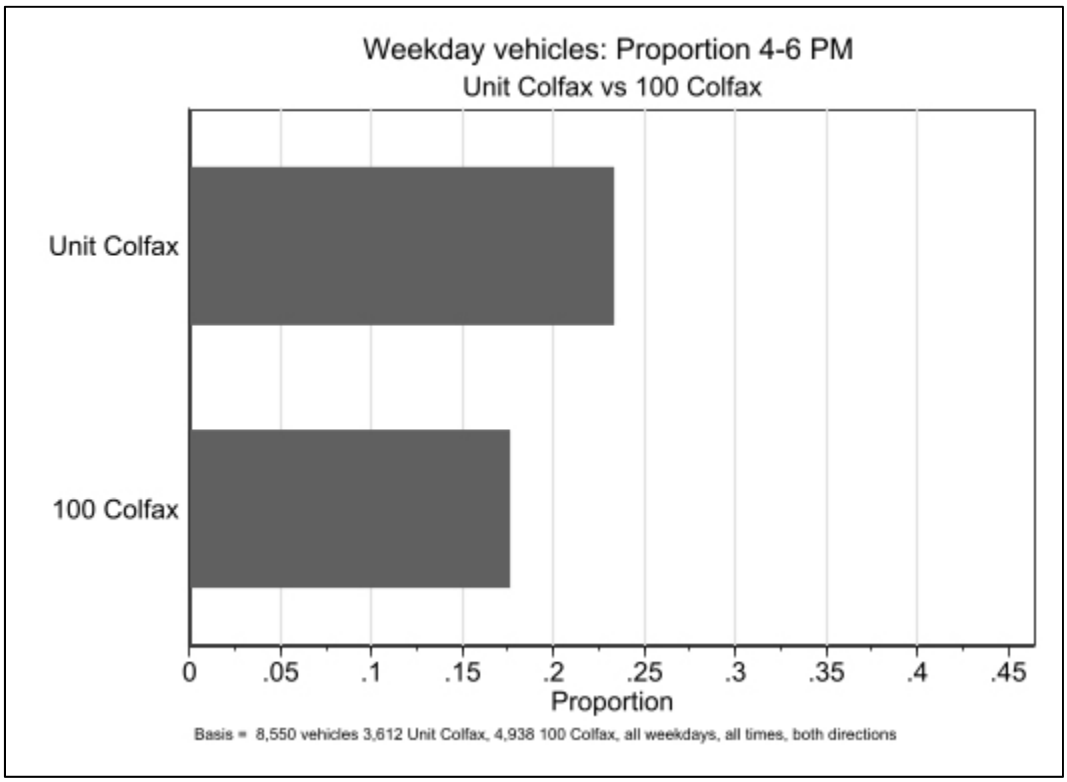
- Because this is a proportion of each block's weekday traffic, the test of block differences controls for traffic volume differences between the two blocks.

This is a marked difference. The difference between the two blocks is driven by more than random noise in the data. There is something going on, whether it be differences in timing of the two Colfax traffic studies, or standing block differences in travel patterns, that is funneling more of the unit block's weekday traffic into expanded afternoon rush hours. [19]

The heavier concentration of weekday vehicles into expanded afternoon rush hours on the unit block of Colfax provides the first indication, albeit indirect, that the unit block of Colfax has a weekday rush hour cut through problem. This is addressed more directly below when considering traffic direction.

[19] The likelihood ratio chi squared test (df=1) for this 2 x 2 table (unit vs 100 block x passing 3-7 PM vs. other times) yielded a value of 103.8 with one degree of freedom. The chances that a difference this extreme or more extreme could have arisen just due to chance differences are fewer than one in a thousand.

Figure 7 Proportion of weekday vehicles passing during regular afternoon rush hours, by block. From vehicle-level file.



Regular weekday afternoon rush hours

Results focusing just on regular weekday rush hours appear in Figure 7. Again, the block's weekday traffic is funneled more strongly into the afternoon rush hours on the unit block of Colfax compared to the 100 block of Colfax. Here, 23.3% of all weekday vehicles on the unit block of Colfax pass during regular afternoon rush hours, from 4 to 6 PM, while the corresponding figure for the 100 block of Colfax is 17.6%. [20]

[20] The likelihood ratio chi squared test (df=1) associated with the 2 x 2 table yielded a value of 42.3. The chances that a difference this extreme or more extreme between the two blocks could have arisen just due to chance are fewer than one in a thousand.

In short, considering only weekday vehicles, the temporal concentration of traffic into regular afternoon rush hours is stronger for the unit block of Colfax compared to the 100 block. This is true whether the regular afternoon rush hour frame is used (4-6 PM) or the expanded frame (3 – 7 PM). ***The weekday prevalence of rush hour vehicles is higher on the unit block. More simply, the unit block of Colfax bears a heavier rush hour traffic burden.***

One last point on this difference. Because these are differences in *column proportions* in each 2 x 2 table*,* the overall differences in weekday volume between the two blocks are controlled. Stated differently, the proportions standardize for block differences in weekday vehicle volume.

Summary on block differences in weekday afternoon rush hour burdens

Whether one considers regular 4- 6 PM weekday rush hours, or expanded 3 – 7 PM weekday rush hours, the unit block of Colfax compared to the 100 block of Colfax bears a heavier burden. Regardless of which time frame is used, a significantly greater fraction of each block's total weekday traffic is channeled into these rush hours on the unit block. For example, over 4/10th s of the unit block's weekday traffic passes during expanded afternoon rush hours, compared to over 3/10th of the 100 block's weekly traffic.

- ***The share of each block's weekday traffic volume is more heavily concentrated during afternoon rush hours on the unit block of Colfax compared to the 100 block.***

Documenting the weekday afternoon rush hour cut through problem on the unit block of Colfax

As mentioned above, the unit block of Colfax is a prime choice, given its positioning in the street network, and the afternoon rush hour entry prohibitions on unit West Hillcrest and 100 West Hillcrest, and the left turn prohibition onto Darby from East Hillcrest.

Recall that the traffic study recording device captures traffic flows in separate directions, here, eastbound and westbound. Evidence bearing directly on this potential unit block of Colfax cut through problem is available using that directionality variable.

According to the cut-through-from-Darby hypothesis, focusing *only* on westbound traffic, and only on weekdays, the proportion of westbound traffic happening during afternoon rush hour times compared to other weekday times, should be *higher* on the unit block of Colfax than on the 100 block of Colfax. This would suggest that drivers are cutting west onto unit Colfax, then turning left at Grasslyn to reach Eagle Road.

Westbound rush hour concentrations and the cut-through-from-Darby idea

Figure 8 describes the differences focusing on westbound weekday traffic during expanded rush hours between 3 PM and 7 PM, versus other weekday times.

On the unit block of Colfax, focusing only on westbound vehicles, 53.9% of its total weekday westbound vehicles pass during expanded rush hours between 3 and 7 PM. The corresponding figure on the 100 block of Colfax is 37.8%. This difference between blocks arises from more than random noise in the data. [21]

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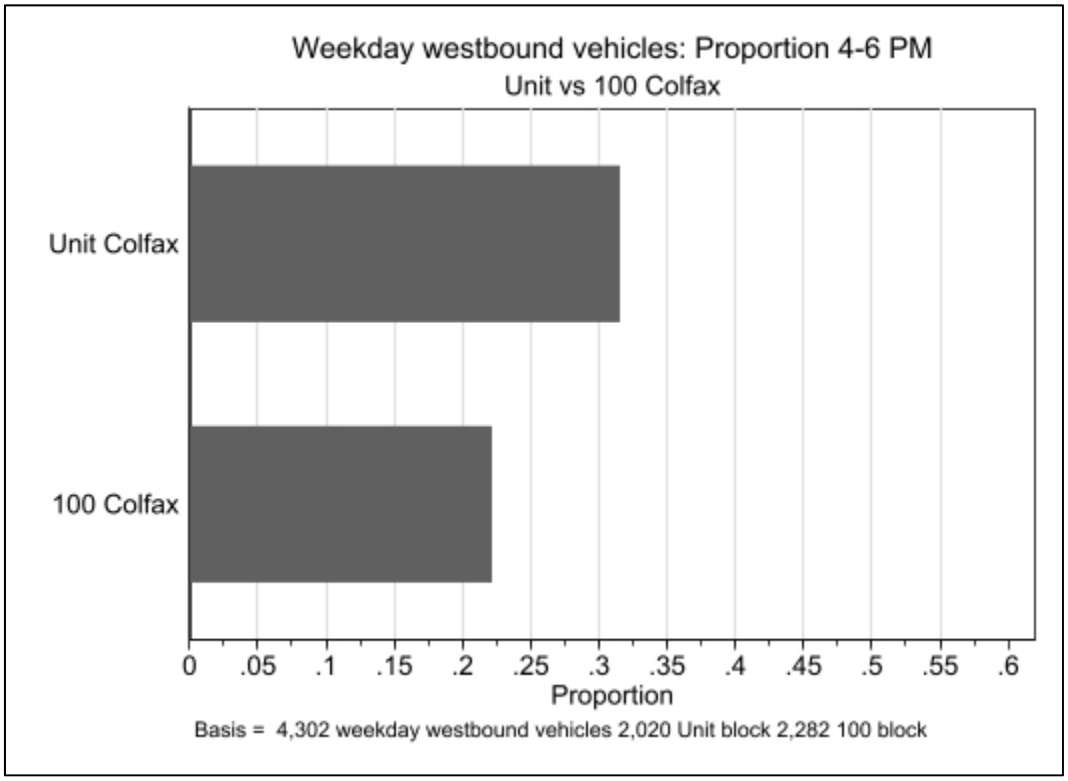
[21] The continuity corrected likelihood ratio chi squared test (df=1) for the 2 x 2 table yielded a value of 113 with one degree of freedom. The chances that a between-block difference on this variable this extreme or more extreme could have arisen just due to chance are fewer than one in a thousand.

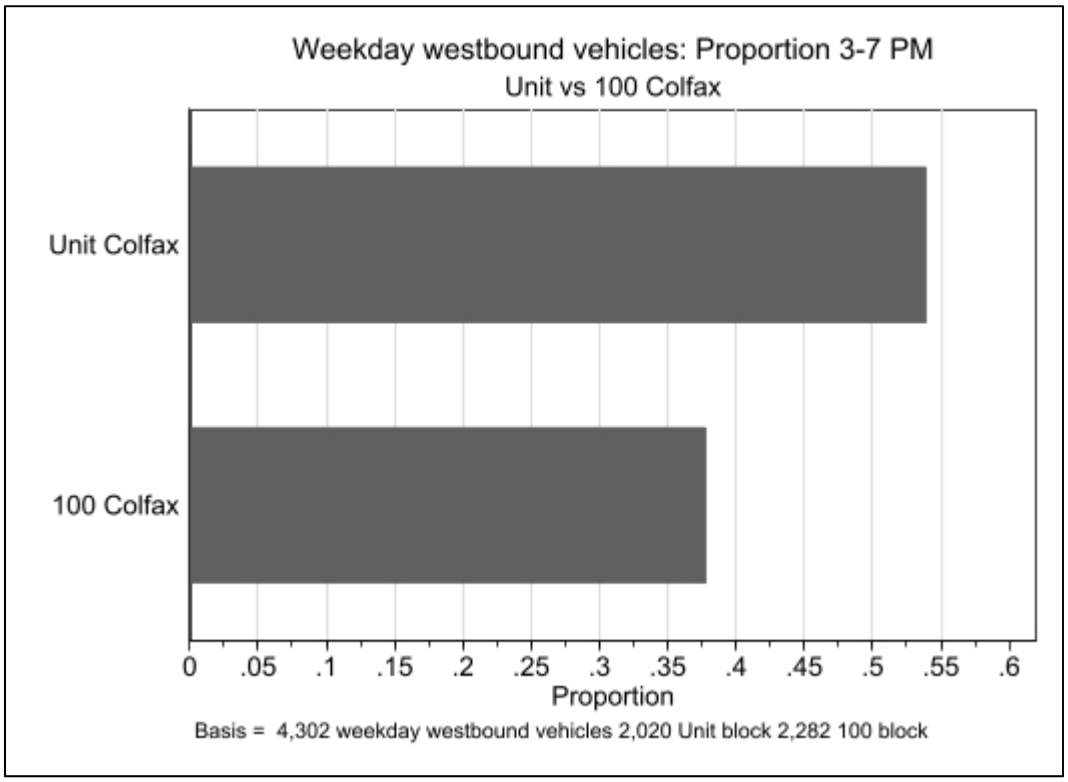
Figure 8 Expanded afternoon rush hours, weekdays only, proportion westbound by block



This difference is in line with the hypothesis that many weekday afternoon rush hour vehicles cut off of Darby onto Colfax, then turn at Grasslyn to get to Eagle Road westbound.

Figure 9 provides the corresponding figures for weekday westbound traffic, but contrasts regular afternoon rush hours from 4 to 6 PM with other weekday times. During these hours, on the unit block of Colfax 31.5% percent of its westbound weekday vehicles were passing through.

Figure 9 Regular afternoon rush hours, weekdays only, proportion westbound by block



The corresponding figure is 22.1% on the 100 block of Colfax. This difference arises from more than random noise in the data. [22]

- In short, whether the focus contrasts regular weekday afternoon rush hours with other weekday times, or contrasts expanded weekday afternoon rush hours with other weekday times, a greater fraction of the unit block's westbound weekday traffic volume is funneled into afternoon rush hour times compared to the 100 block.

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[22]. The likelihood ratio chi squared test (df=1) of the 2 x 2 table yielded a value of 48.6. The chances that a difference on this variable this extreme or more extreme between the two blocks could have arisen just due to chance were fewer than one in a thousand.

- The analysis in this section has concentrated solely on westbound traffic to address the cut through problem specifically. The pattern seen supports the idea that during these weekday afternoon rush hours, drivers are turning off of Darby to cut onto the unit block of Colfax, and then turning at Grasslyn.

Relative weekday rush hour concentrations: Traffic in both directions

What does the rush hour burden look like if traffic in both directions is considered? Regardless of direction, which block has more of its weekday traffic volume packed into the afternoon rush hours?

Regardless of vehicle direction, the unit block of Colfax's weekday traffic is more heavily concentrated into the afternoon rush hours, compared to the 100 block of Colfax. Considering weekday traffic in both directions, on the unit block of Colfax 41.8% (1,511 out of 3,612) of weekday vehicles pass during expanded afternoon rush hours between 3 and 7 PM. This contrasts with 31.1% (1,537 out of 4,938) for the hundred block of Colfax. [23]

If the focus shifts to contrasting regular weekday afternoon rush hours, from 4 to 6 P M, with other weekday times, the unit block of Colfax's traffic is still more concentrated during those rush hours compared to the 100 block of Colfax. Considering weekday traffic in both directions, on the unit block of Colfax 23.3% (843 out of 3,612) of its weekday vehicles pass during afternoon rush hours between 4 and 6 PM, compared to 17.6% (870 out of 4,938) on the 100 block of Colfax. [24]

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[23] The likelihood ratio chi squared test (df=1) of the 2 x 2 table yielded a value of 103.8. The chances that a between-block difference on this variable this extreme or more extreme between the two blocks could have arisen just due to chance differences are fewer than one in a thousand.

[24] The likelihood ratio chi squared test (df=1) of the 2 x 2 table yielded a value of 42.3. The chances that a difference on this variable this extreme or more extreme between the two blocks could have arisen just due to chance are fewer than one in a thousand.

In short, regardless of traffic direction, sizable cross-block differences appear in the extent to which weekday block traffic is funneled into the afternoon rush hours. The higher rush hour concentration, relative to other weekday times, on the unit block as compared to the 100 block of Colfax, holds up whether considering only westbound traffic or traffic in both directions, and whether considering regular or expanded afternoon rush hours. The overall block weekday traffic burden is more strongly funneled into afternoon rush hours on the unit block of Colfax compared to the 100 block of Colfax.

- Considering each block's total weekday traffic volume, going in either direction, a higher share of that volume on the unit block of Colfax is funneled into afternoon rush hours, compared to the 100 block of Colfax. Because this analysis is about relative concentrations, block differences in vehicle volumes are controlled. This difference arises from more than random noise in the data.

Vehicle packing during weekday afternoon rush hours: Both directions

When traffic in both directions is considered, how closely does one vehicle follow another during weekday afternoon rush hours? The answer is, typically, in less than half a minute. This holds regardless of whether regular or afternoon rush hours are considered.

Considering regular afternoon weekday rush hours between 4 and 6 PM and vehicles going either direction, one vehicle is typically preceded by another every 28 seconds on the unit block and every 27 seconds on the hundred block of Colfax. If the time frame is expanded rush hours, the typical gap is 32 seconds on the unit block and 30 seconds on the 100 block of Colfax.

Vehicle packing during weekday afternoon rush hours: Westbound only

If the weekday rush hour cut-through-from-Darby problem is afflicting the unit block of Colfax more seriously than the 100 block of Colfax, then westbound vehicles during this time

should be more densely packed on the unit block of Colfax compared to the 100 block of Colfax. Between-vehicle gaps should be shorter on the unit block.

This is the case. The median or typical gap between westbound vehicles during regular weekday afternoon rush hours is 35 seconds on the unit block of Colfax compared to 48 seconds on the 100 block of Colfax. This is a noteworthy difference. [25]

If weekday expanded rush hours from 3 to 7 PM are considered, typical inter-vehicle gaps are larger, but noteworthy block differences persist. On the unit block of Colfax the typical gap between westbound vehicles is 41 seconds compared to 55 seconds on the 100 block of Colfax. [26]

Volume of the weekday rush hour burden on unit block and the 100 block of Colfax

Another aspect of the weekday afternoon rush hour burden is hourly vehicle volume during this time frame. Figure 10 provides the average hourly totals. This is based on hourly totals from the hourly file. During these critical times, more than 60 or more cars per hour pass through on each block. Hourly vehicle volumes range from 60 per hour to 85 per hour on the unit block of Colfax, and from 64 to 91 per hour on the 100 block of Colfax.

The hourly weekday afternoon rush hour volumes look roughly comparable between the two blocks.

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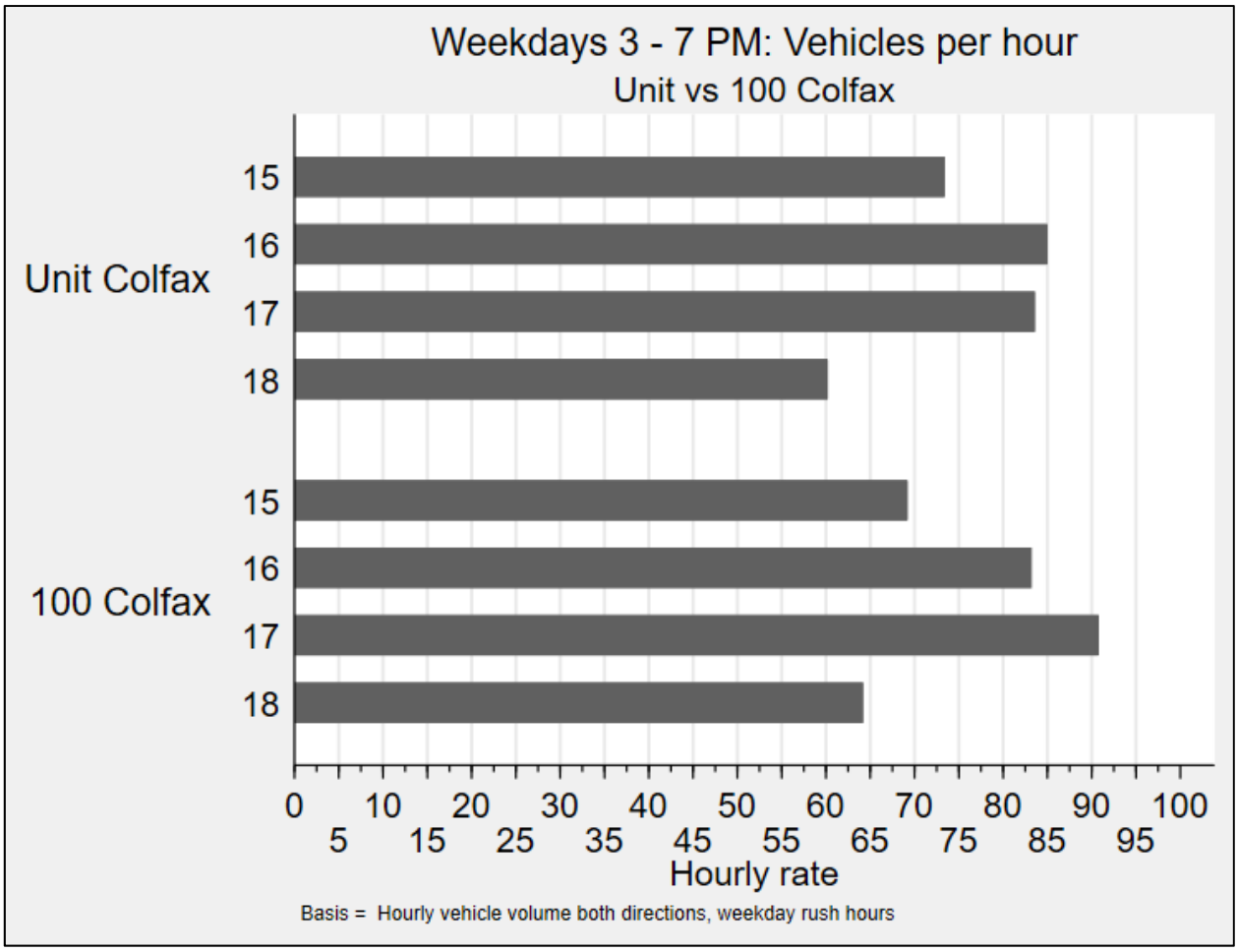
[25] The median test yielded a Pearson continuity corrected chi squared (df=1) value of 8.3. The chances that a difference between the two blocks on this variable this extreme or more extreme could have arisen just due to chance were fewer than five in a thousand.

[26] The median test yielded a Pearson continuity corrected chi squared (df=1) value of 14.2. The chances that a difference on this variable this sizable or more sizable could have arisen between the two blocks just due to chance were fewer than one in a thousand.

Figure 10 Vehicle volume during expanded weekday afternoon rush hours



When these roughly equivalent weekday afternoon rush hour hourly volumes are considered in the context of a weekly traffic volume on the 100 block that is 41.7 percent higher than on the unit block of Colfax, [27] it speaks to the unit block experiencing a higher share of its traffic during these hours.

[27] 6,521 / 4,603 = 1.417

Note these hourly volumes translate to high rates of through traffic. For example, 85 cars during the 4 PM hour on the unit block of Colfax translates to a vehicle passing every 42.3 seconds.

Summary: Evidence supporting the cut through from Darby Road pattern

Several data features from the vehicle file support the idea that residents on the unit block of Colfax experience a more severe weekday afternoon rush hour problem arising in part from Darby Road traffic using the unit block as a cut through to Eagle Road westbound.

- Consider weekday westbound vehicle volume for each block. A significantly higher fraction of the unit block's volume is funneled into the regular (4-6 PM) afternoon rush hours compared to the 100 block of Colfax (31.5% versus 22.1%). The difference persists if expanded afternoon rush hours (3 – 7 PM) are considered (53.9% versus 37.8%).
- Further, sticking with just westbound weekday rush hour traffic, vehicles are significantly more closely packed on the unit block of Colfax compared to the 100 block. During these times, on the unit block one westbound vehicle typically follows another westbound vehicle every 35 seconds. The typical gap on the 100 block of Colfax is 48 seconds.
- The block difference in vehicle packing is specific to the westbound traffic, in line with the Darby cut-through thesis. When vehicles in either direction are considered, there are no notable differences in the gaps between vehicles across the two blocks.

- Even though overall weekly volume on the 100 block is 41% higher than on the unit block, both blocks have hourly traffic volumes that are comparable during afternoon weekday rush hours.

Speeding vehicles during weekday afternoon rush hours

What is occurring during weekday afternoon rush hours with speeding vehicles on the two blocks of Colfax? How many are there per hour? What is the prevalence rate of speeding, that is, what is the hourly proportion of speeding vehicles on each block? Speeders are vehicles traveling at 27 mph and faster. These analyses rely on the file where the hour is the unit of analysis.

At the outset it bears mentioning that the configuration of all vehicle speeds for all times and days differs across the two blocks of Colfax. [28] Traffic goes more slowly on the unit compared to the 100 block of Colfax.

Speeder counts per hour during expanded weekday afternoon rush hours

Figure 11 shows the average number of speeders per hour, separately for each block of Colfax, separately for each hour of the weekday expanded afternoon rush hours.

- On average, there were two or three speeders per hour on the unit block of Colfax during expanded weekday afternoon rush hours.
- On average, on weekdays, from 3:00 PM to 6:59 PM, there were *ten or more speeders per hour on the 100 block of Colfax.*

[28] A Kolgomorov-Smirnov test confirmed that the distributions of vehicle speeds varied across the two blocks; the distribution of speeds on unit Colfax were lower (D=.31). That difference or one more extreme would have arisen just from chance differences between the two blocks less than one time in a thousand.

An analysis [29] of speeder counts during weekday hours confirmed the following.

- Weekday hourly speeder counts were significantly higher on the 100 block of Colfax compared to the unit block. [30]
- Weekday hourly speeder counts *were significantly higher during expanded weekday afternoon rush hours* from 3:00 through 6:59 PM compared to other weekday times. [31]
- Compared to the hourly speeder counts on Mondays, hourly speeder counts were significantly higher on Thursday [32] and Friday. [33]

In short, considering weekday traffic:

- Hourly speeder counts were markedly higher on the 100 block.

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[29] This was a negative binomial regression model. The outcome was speeder counts per hour. Data only from weekday hours were analyzed. The predictors were block ((0) unit block / (1) 100 block), expanded afternoon weekday rush hours (=1) versus all other times (=0), and a dummy (0/1) variable for each separate day of the week, Tuesday through Friday, leaving Monday as the reference string. Graphical analysis prior to the modeling confirmed that the hourly speeder counts during weekdays followed a theoretical negative binomial distribution. *Note* that the incidence rate ratios (IRRs) for expected counts presented below contrast the expected count mentioned with the expected count on the unit block of Colfax, during non-rush hour times, that is, before 3 PM and after 7 PM, on Monday.

[30] The expected hourly speeder count on the 100 compared to the unit block of Colfax was *more than three and a half times higher*. This difference arose from more than random noise in the data. A difference this extreme or more extreme was likely to have arisen *solely* from random noise in the data less than one time in a thousand. This result controlled for expanded afternoon rush hours versus other times, and for day of the week. (IRR = 4.63, $p < .001$.)

[31] The expected hourly speeder count was *eighty three percent higher* during expanded afternoon rush hours compared to other times on weekdays. This difference arose from more than random noise in the data. A difference this extreme or more extreme was likely to have arisen *solely* from random noise in the data less than one time in a thousand. This result controlled for differences between the two blocks and for the day of the week. (IRR=1.83; $p < .001$).

[32] IRR = 1.58, $p < .05$. Thursday expected speeder counts were 58 percent higher; a difference this extreme or more extreme could have arisen solely due to noise in the data fewer than five times in a hundred.

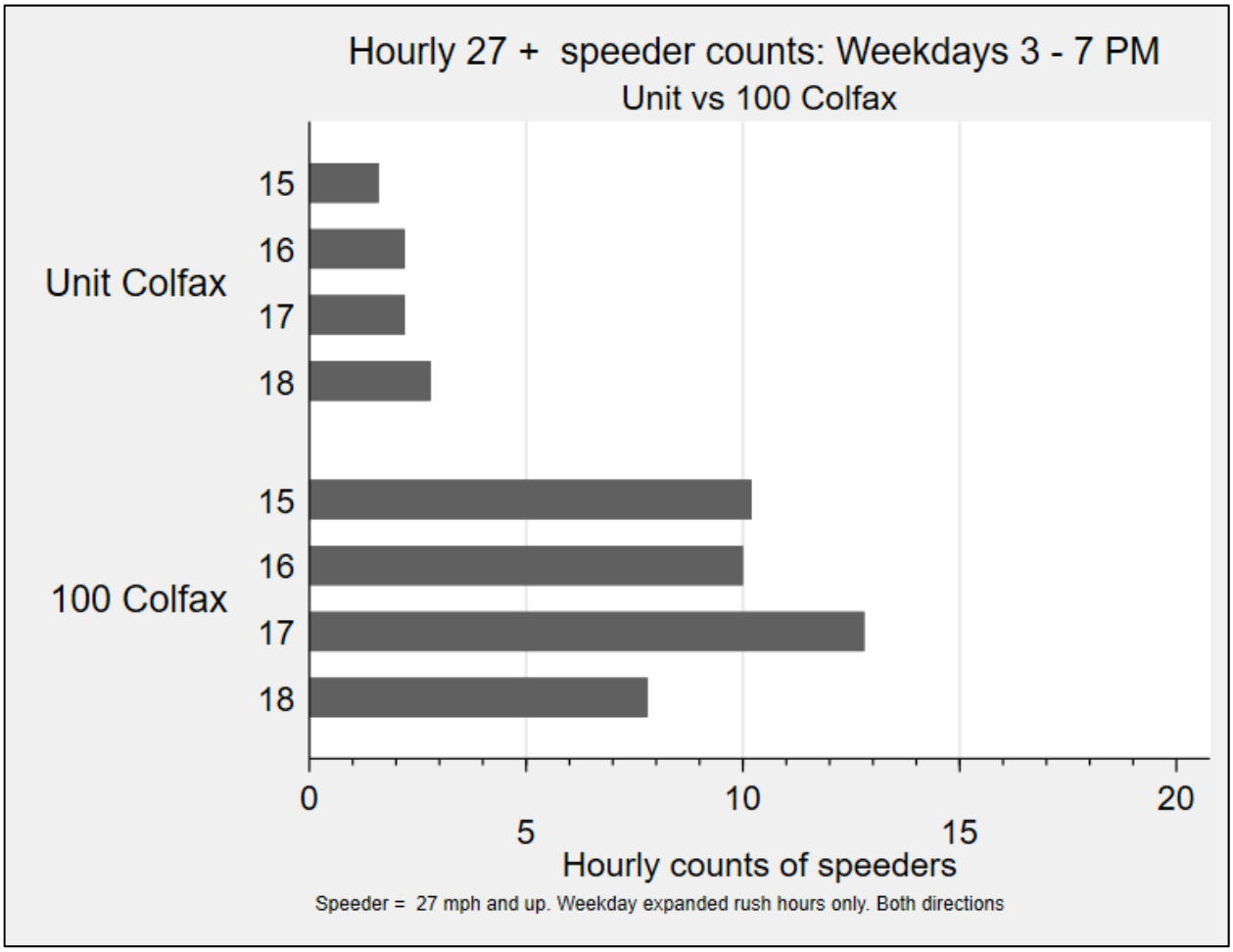
[33] IRR = 1.86, $p < .01$. Friday expected counts were 86 percent higher; a difference this extreme or more extreme could have arisen solely due to noise in the data less than one time in a thousand.

- Hourly speeder counts were markedly higher during expanded afternoon rush hours.
- During these times there were anywhere from 8 to 13 speeders per hour on the 100 block of Colfax.

Proportion of speeders per hour during expanded weekday afternoon rush hours

The preceding analysis suggested that the 100 block of Colfax has more of a problem with weekday afternoon rush hour speeders than the unit block. But we also know that the 100 block of Colfax has more traffic anyway. Can we examine the likelihood of speeders on the different blocks while controlling for block differences in vehicle volume? Again, analysis is restricted to just weekday hours, focusing specifically on expanded afternoon rush hours from 3 to 7 PM.

Figure 11 Average hourly counts of speeders, going 27 mph and faster, during expanded weekday afternoon rush hours



We can if we examine the *proportion* of speeding vehicles, by hour, that each block experiences. The hourly proportion of speeding vehicles in essence calculates the following, on an hourly basis:

[Number of speeding vehicles / Total number of vehicles] [34]

[34] More specifically, this hourly variable was built as follows. In the file where individual vehicles were the unit of analysis a variable (count7p) was coded 1 if the vehicle was traveling 27 mph or

Since the total number of vehicles appears in the denominator, total volume is taken into account, on an hourly basis, separately for each block.

Descriptive information about the prevalence of speeding vehicles, by hour, for expanded weekday afternoon rush hours, separated by block, appears in Figure 12.

- Controlling for hourly block differences in traffic volume, *speeding vehicles were much more likely on the 100 block of Colfax during expanded afternoon rush hours.*
- During expanded weekday afternoon rush hours, *per hour,* ***at least every one out of nine vehicles is speeding*** *on the 100 block of Colfax Road.*
- *For the* ***3:00 hour*** *and the* ***5:00 hour****,* ***one out of every seven vehicles is speeding on the 100 block of Colfax Road****.*

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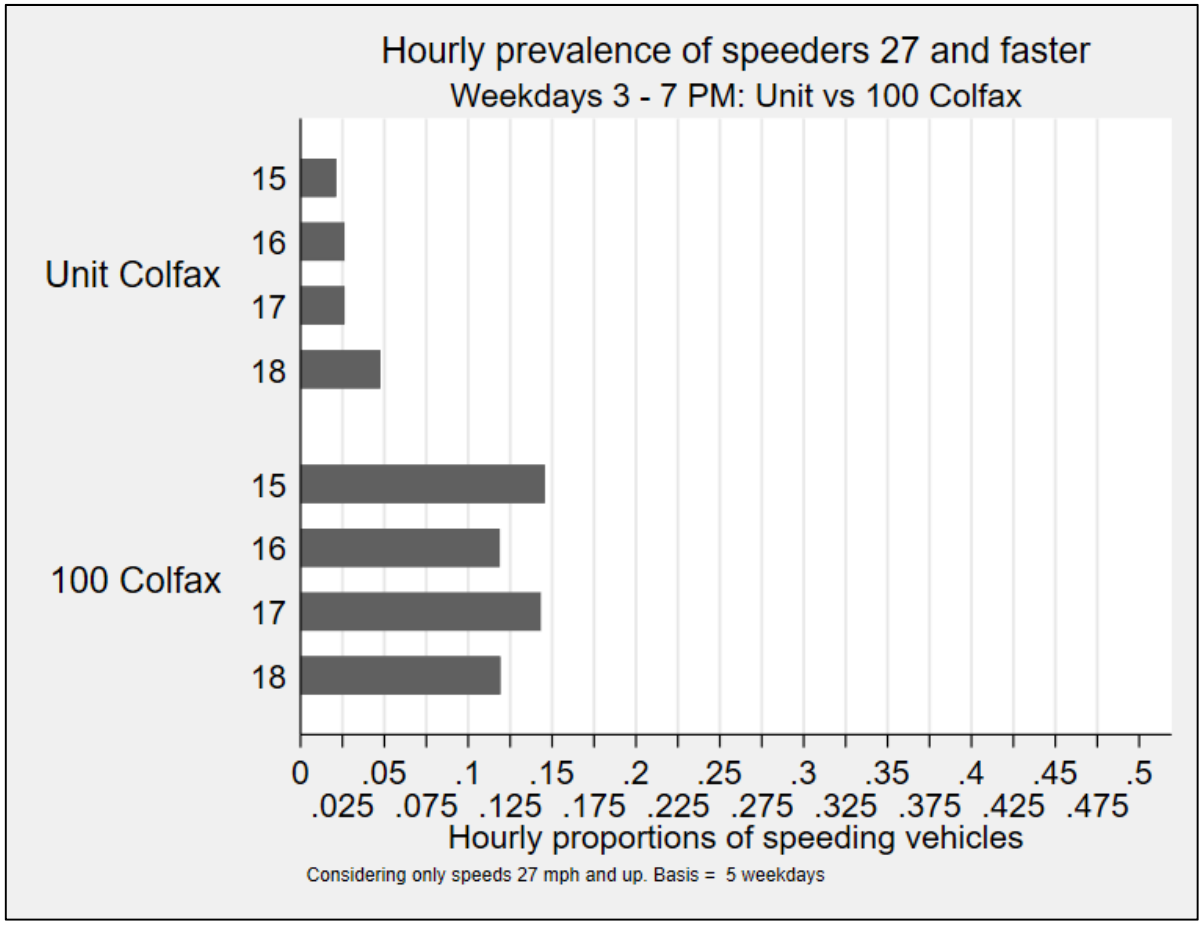
faster, 0 otherwise. Next, in constructing the hourly file, we requested the *average* on this variable, separately by block, and separately by hour within block. The average of a 0/1 variable reflects the proportion of cases scoring 1. So the result was a variable in the hourly file (p27p_hr) reflecting the proportion of speeding vehicles for each hour on each block.

Figure 12 Hourly proportions of speeders, going 27 mph and faster, during expanded weekday afternoon rush hours



The between block difference in proportion of speeding vehicles, by hour, during expanded weekday afternoon rush hours, is significant, that is, due to more than random

differences in the data between two blocks. This result controls for vehicle volume differences between blocks. [35]

Summary on speeding

The findings on speeding can be summarized as follows. These findings depend, of course, on the definition of a speeding vehicle as one going 27 MPH or faster. A different definition of "speeding" would generate different results.

- The 100 block of Colfax Road has more of a weekday speeding problem than does the unit block.
- On the 100 block, during weekday expanded afternoon rush hours from 3 – 7 PM, on an hourly basis speeding vehicles make up anywhere from one out every seven passing vehicles to one out of every nine passing vehicles.

Main Findings, Limitations, and Policy Implications

This section recaps the major findings and how they bear on residents' concerns; notes major limitations of the current work, and discusses how these findings bear on possible policy solutions.

Summary of Main Findings

1. The unit block of Colfax suffers excessive traffic volume from vehicles cutting through from Darby Road on during weekday afternoon rush hours. Several results support this point. (a) More of the respective total weekly weekday traffic volume is funneled into these times for the

[35] Using the hourly file, and restricting analysis to weekday expanded afternoon rush hours from 3 to 7 PM, a median test confirmed that proportions of speeding vehicles were markedly higher on the 100 block of Colfax. The continuity corrected chi squared (df=1) value associated with the median test = 22.5. A difference between the two blocks this extreme, or more extreme, could have arisen *solely* from random differences between the two less than one time in a thousand.

unit block compared to the 100 block of Colfax: 41.8% versus 31.1% if the 3-7 PM window is considered, and 23.3% versus 17.6% if the 4-6 PM window is considered. (b) More directly indicative of this problem is the stronger funneling of the unit block's weekday westbound traffic into afternoon rush hours. Whereas during expanded rush hours 53.9% of the unit block's westbound weekday traffic is funneled into the 3-7 PM window, on the 100 block the corresponding figure is only 37.8% of its weekday westbound traffic. If the 4-6 PM window is considered, the respective figures are 23.3% and 17.6%. (c) Even though the total weekly traffic volume on the 100 block is 41% higher than on the unit block, hourly vehicle volumes during weekday afternoon rush hours are roughly comparable, with each block experiencing roughly 80-90 vehicles per hour during the weekday afternoon rush hours from 4 to 6 PM.

2. High traffic volumes during afternoon weekday rush hours make for densely packed traffic, with short intervals between passing cars. During weekday afternoon rush hours, on each block, the typical gap between passing cars was 27-28 seconds.

3. Speeding, as it was defined here, going 27 MPH or faster, was more evident on the 100 block of Colfax. On that block, during afternoon rush hours, between one out of every 7 to one out of every 9 vehicles were speeding.

Reasons for Caution in Interpretation

Two points suggest caution in interpreting the current findings.

First, the author has not researched the accuracy of the data recording devices used by HTPD.

Second, the two Colfax block studies were separated by several months. The differences observed here between the two blocks could arise from long-standing between-block differences. Or they could arise from other differences, such as seasonal variation in traffic volume or driver

behavior. Block differences are bound up with seasonal differences given the current data sources.

Implications for Policy

The Safety risk documented

Residents' paramount concern in bringing Colfax traffic concerns to township personnel were safety of children on the block or moving through the block. ***Those concerns about the safety of children pedestrians, especially during weekday afternoon rush hours which are times of high levels of pedestrian as well as vehicle activity, seem warranted given the findings here.***

More specifically, for the unit block of Colfax Road, the weekday afternoon traffic volumes described here, and the dense packing of passing vehicles, present significant and foreseeable risks to children and other pedestrians on the block at this time, and to residents entering and exiting their driveways during these times.

Further, these foreseeable risks to the safety of children and other pedestrians on the block probably could be significantly reduced through specific Township actions. Specific recommendations to reduce these foreseeable risks follow below.

Easily implemented, short term solutions directly addressing the problem revealed

(1) Perhaps the policy action most relevant, given the data patterns reviewed here, would be a vehicle entry prohibition onto the unit block of Colfax from Darby Road for 4-6 PM on weekdays.

This policy would likely (a) significantly reduce vehicle volumes on both Colfax blocks at these times, (b) reduce the fraction of the unit block's share of weekday traffic occurring during these times, and (c) reduce the prevalence of speeding vehicles on the 100 block.

(2) A speed limit sign, preferably that either lights up or reflects passing vehicle speed, is recommended for the 100 block of Colfax to reduce speeding prevalence, especially during weekday afternoon rush hours.

(3) Resources permitting, a speed limit sign is also recommended for the unit block of Colfax which currently has no speed limit signage.

Evaluating impacts of short term policy changes

Any of these policy recommendations could be implemented on a trial basis with effectiveness and potential adverse displacement impacts, either spatial or temporal, gauged through collection of and analysis of subsequent traffic studies data.

Longer term solution requiring more extensive discussion and Township and PennDOT stakeholder commitment and funding

(4) Township stakeholders engage in serious discussion about locating the resources for and finding common ground about redesigning the intersection at Eagle and Darby Roads to include a right turn lane southbound to reduce southbound afternoon congestion on Darby Road.

Clearly, the intersection at Darby and Eagle Roads is dysfunctional. Given the unsold lot at the northwest corner of the intersection, now would be an excellent time to involved stakeholders in planning the redesign, and securing funding.

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