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How Are Dynamic Speed Feedback Signs (DSFS) Performing in Iowa? A Quick Look at Speeds and Crashes

Abstract

Dynamic Speed Feedback Signs (DSFS) provide real-time speed displays to drivers, with the goal of promoting safer travel by encouraging those who exceed the limit to slow down. This study investigates the efficacy of DSFS in Iowa, focusing on 20 installations selected from a larger dataset of 181 sites based on their high Average Annual Daily Traffic (AADT). By integrating crash records, speed data, and installation timelines, this project seeks to determine whether driver speeds drop and crash frequencies shift following DSFS deployment. To present these findings, two primary outputs will be developed: an interactive web map (highlighting the spatial distribution of DSFS and corresponding crash data) and a tailored dashboard (visualizing changes in speed and crash trends before versus after sign installation). By examining these high-volume road segments, the project aims to provide a concise yet detailed exploration of whether DSFS meaningfully impacts road safety outcomes.

Overview

Over the past several years, state and local agencies in Iowa have installed 181 Dynamic Speed Feedback Signs (DSFS) along roads with varying traffic volumes. These signs are commonly placed to alert drivers of their real-time speed, subtly encouraging them to remain within legal limits. While DSFS are a popular intervention, clear evidence of their safety benefits—particularly regarding crash reductions—has been mixed. With the goal of developing a deeper understanding of DSFS performance, this project focuses on a subset of 20 locations identified as high priority due to elevated Average Annual Daily Traffic (AADT). By directing attention to these busier corridors, any observed effects on driver behavior and crash rates are more likely to be robust and statistically meaningful.

To systematically assess DSFS impacts, three core data components will be integrated. First, DSFS site attributes (including geographic coordinates and the date of each installation) will define a precise “before” and “after” window for analysis. Second, speed measurements—sourced from connected vehicle data or aggregated traffic speed studies—will provide the foundation for identifying trends in driver behavior following DSFS implementation. Finally, crash records from the Iowa Department of Transportation will allow for a comparison of crash frequency and severity prior to and after each sign’s deployment. The resulting dataset will be used to investigate whether substantial shifts in average travel speeds coincide with fewer or less severe collisions.

Given the focus on rigorous but accessible communication, this study will produce two main outputs. An interactive web map will illustrate DSFS placements alongside relevant crash and speed data in a spatial context, enabling users to quickly locate sites of interest. In parallel, a dynamic dashboard will present time-series or comparative views of speed and crash metrics, allowing for filtering by location or time period. Both resources will be hosted online, making the findings readily available for transportation planners and other stakeholders.

Ultimately, by comparing key metrics at high-traffic sites, this work aims to shed light on whether DSFS truly foster safer driving behaviors, and under which conditions these signs might be most effective. If the analysis confirms clear benefits, the results could guide expanded use of DSFS or inform complementary measures—such as increased enforcement or modified infrastructure design—to further enhance road safety in Iowa.

Technology

- SQL to query and download the data from Athena.
- QGIS / ArcGIS to clean, geocode, and manage spatial data layers.
- Tableau for creating interactive dashboards and visual summaries.
- Leaflet for the web-based interactive mapping
- GitHub to host final documentation and deliverables.

- Suggestion: I would like to use deck.gl for advanced geospatial data rendering (I would like to be able to plot speed profiles or speed heatmaps along the roadway links upstream and downstream of the candidate locations, but I am not sure that I will be able to accomplish this)

I found these few examples on the dexk.gl using the heatmap or the paths Layers examples

- deck.gl - Highway Safety in the US
- deck.gl - Uber Pickup Locations In NewYork City

Data

- Dynamic Speed Feedback Signs (DSFS): CSV with lat/long coordinates, sourced from Iowa DOT.
- Speed Measurements: CSV (timestamps, speeds, waypoint ID), sourced from Institute for Transportation – Iowa State University (Amazon Athena).
- Crash Records: CSV or Shapefile (location, date, severity), sourced from Iowa DOT ICAT.
- Base Layers: Shapefiles (road networks, city boundaries), sourced from Iowa DOT Open Data.

Process / Methods

1. Data Collection & Cleaning

I'll start by gathering the main datasets—DSFS location info, crash records, and speed measurements. They're all coming from different sources (Iowa DOT, InTrans, etc.), so I'll need to spend a bit of time just getting everything into a usable format. That means standardizing date/time fields, cleaning duplicates, and making sure everything lines up spatially (same coordinate systems, etc.). This is kind of the foundation step so things don't fall apart later.

2. Preprocessing & Spatial Joins

Once the data is cleaned, I'll bring it into QGIS or ArcGIS—still deciding which one I'll use most for this. I'll use buffers around the DSFS points (maybe 0.25 or 0.5 miles?) to catch any relevant crash data nearby. I also want to sync up the speed data so I can compare "before" and "after" periods relative to when each DSFS was installed. Hopefully this makes it easier to look at temporal and spatial trends in one place.

3. Exploratory Analysis

With the cleaned-up, joined data in hand, I'll start exploring—just some basic stats first: average and median speeds, crash frequencies, stuff like that. I might run some significance tests to see if anything jumps out as a real difference vs. random noise, but I'll play that by ear depending on how the data looks. This is mostly to spot any interesting trends or outliers that are worth digging deeper into later.

4. Tableau Dashboard (Draft)

The plan is to build a Tableau dashboard to make all this data more interactive and visual. I want to be able to filter by location or time range, maybe even toggle between "before" and "after" views. I'm hoping to show changes in speed or crash data clearly (like percent reductions, etc.), but this depends on how smooth the data ends up being. Once I get something working, I'll host it online so people can click around and explore.

5. Leaflet Web Map

To go along with the dashboard, I also want to try building a Leaflet map that shows the 20 DSFS sites. This would be more of a high-level spatial view—each point would have a popup or something showing summary stats (maybe change in speed, crashes, etc.). The idea is to make it easy to visually scan through all 20 locations and quickly see where the signs might be helping. I'll export it as an HTML and host it on GitHub.

6. Interpretation & Reporting

At the end, I'll pull everything together and try to make sense of it—like, are speeds going down after the signs go up? Are crash rates shifting at all? I'll highlight any major takeaways and maybe suggest what could be done next (like, more signs? pairing with enforcement or lighting?). But this really depends on what the data shows. If nothing major stands out, that's still useful to report too.

Inspiration

- I’m genuinely interested in road safety and enjoy exploring different mitigation measures, especially how their effects show up in real-world data and driver behavior.
- I have access to DSFS site data and connected vehicle data as part of multiple projects I am researching at Intrans.
- Several city-level DSFS case studies offer valuable examples of how to measure changes in speed and crashes, guiding my own methods, and multiple FHWA’s resources put DSFS in perspective, showing how they can fit into a broader set of speed management strategies.
- Here are some projects I am using as inspiration for my final deliverable:
  - Integrating the HERE Raster Tile V3 & Traffic APIs with Leaflet.js | HERE – It would be great if I could mimic what is done here for the roadway segments' speeds in terms of labeling and visualization
  - Traffic Data Analysis (Tableau Project) – CJANGO– Overall, I like the way this project overview is written in terms of steps and flow but I can't locate the actual dashboard on Tableau
  - Traffic Speed Trends in SE Wisconsin (NPMRDS) | Tableau Public – The second sheet of this tableau also has what I am interested in doing in terms of mapping the speeds
  - Road Accidents Dashboard | Tableau Public - I like this dashboard for visualizing the crash side of the project. I won't necessarily visualize all these attributes, but I will be using it as an inspiration.

Potential Challenges

- **Complexity of Integration:** Merging multiple datasets of different formats—CSV, Shapefile—while ensuring time periods align.
- **Data Gaps:** Not all DSFS may have consistent speed metrics, or some crash reports might be missing exact geolocation.
- **Location Accuracy:** Crash locations can occasionally be off so hoping this wouldn’t compromise the final spatial representation.

Timeline for Completion

- April 18 – April 25: Finalize data acquisition, cleaning, wrangling, and spatial joins. Develop initial maps.

- April 28 – May 2: Build Tableau visualizations, perform calculations, and complete preliminary analyses.
- May 2 – May 9: Refine all outputs, integrate feedback, and finalize web pages.