# My title*

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First author Another author

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## 1 Introduction

With pandemic outbreaks, most schools in the United States turned to online teaching models, and students moved from physical places with more social interaction to screens (Lebanon staff 2021). While the transition to virtual education has been accompanied by a variety of challenges, including academic setbacks and economic disparities, significant gaps remain in understanding the impact of virtual education on the social dynamics within schools. Most research has focused on education, i.e., whether this change to an online delivery model will affect student achievement. In this article, we will focus on a new aspect of the pandemic that is having a positive impact: school bullying.

Bullying in schools is pervasive and can have significant social costs. In the US, 1 in 5 students ages 12-18 has been bullied during the school year, and approximately 160,000 teens have skipped school because of bullying (staff 2019). The COVID-19 pandemic has fundamentally changed the context of bullying dynamics. With the shift to online learning across the United States in March 2020, there is a sudden decrease in in-person communication and interaction while the use of technology increases dramatically. In fact, prior COVID-19 research has suggested that the higher the frequency of the Internet, the more incidents of cyberbullying and cyber-victimization reported by youth (Robin M. Kowalski 2019). However, in this paper, we conclude that both school bullying and cyberbullying have been decreased during the pandemic by analyzing a long panel of publicly available Google Trends online search data. These results provide insights into how schools can reduce bullying in a post-pandemic world and highlight a possible mechanism by which COVID-19 may have a differential impact on broader mental health.

*Code and data are available at: LINK.

# 2 Data

## 2.1 Data Source

This paper will replicate the data that was originally collected for the paper "The COVID-19 Pandemic Disrupted Both School Bullying and Cyberbullying" by [citation]. Using the online platform "Google Trends", which provide monthly internet search behavior for a given term or topic by states over a period of time, they collected three types of bullying data ("School Bullying", "Cyberbullying", and "Bullying") before, during, and after the pandemic COVID-19 from January 2012 to February 2021. They filtered the data to keep male and female individuals between ages of 5 and 17 (roughly the k-12 schooling population). Each dataset contains 5661 rows and 5 variables, each indicating a detailed summary of the month and position of the search, search keyword, number of searches and the ratio.

The researchers state that data from Google Trends are less likely to be subjected to potential bias, since the data are not self-reported. Moreover, the data from Google Trends represents the full population of Google search users in the United States, thus it does not have the potential issue of under-representation of a certain group.

## 2.2 Methodology

Since it is difficult to observe through 16683 (5661*3) rows with 5 variables, this report will only observe and analyze through specific aspects. The original dataset contains information through all the 51 states in the US. This paper focuses only on data and trends for three states, which are "US-LA", "US-NY" and "US-NJ" (Louisiana, New York, and New Jersey respectively). Some data cleaning is performed, such as renaming column names, filtering and mutating the column, etc. The cleaned data will be analyzed and performed using R (R Core Team (2022)) with `tidyverse` (Wickham et al. (2019)), `knitr` ((**citeKnitr?**)), `dplyr` (Wickham et al. (2023)), `ggplot2` (Wickham (2016)).

## 2.3 Features

The original dataset contained 5 variables, which are named as "dma_json_code", "date", "keyword", "hits", and "ratio". 1. dma_json_code: the states of the United States 2. date: the first day of every month from 2012. 01 to 2021. 02 3. keyword: specific words that the people search on Google Trends that relate to bullying. 4. hits: number of searchers of keywords in each month. 5. ratio:

```
file_path <- "../../outputs/data/bully_clean_data.csv"
bully_clean_data <- read.csv(file_path)
bully_clean_data$date <- as.Date(bully_clean_data$date)
```

```
pop_2019_clean<- read.csv("../../outputs/data/pop_2019_clean.csv")
pop_2020_clean<- read.csv("../../outputs/data/pop_2020_clean.csv")
state_ratios<- read.csv("../../outputs/data/state_ratios.csv")
sample_data <- head(bully_clean_data, 6)
```

Talk way more about it.

## 3 Results

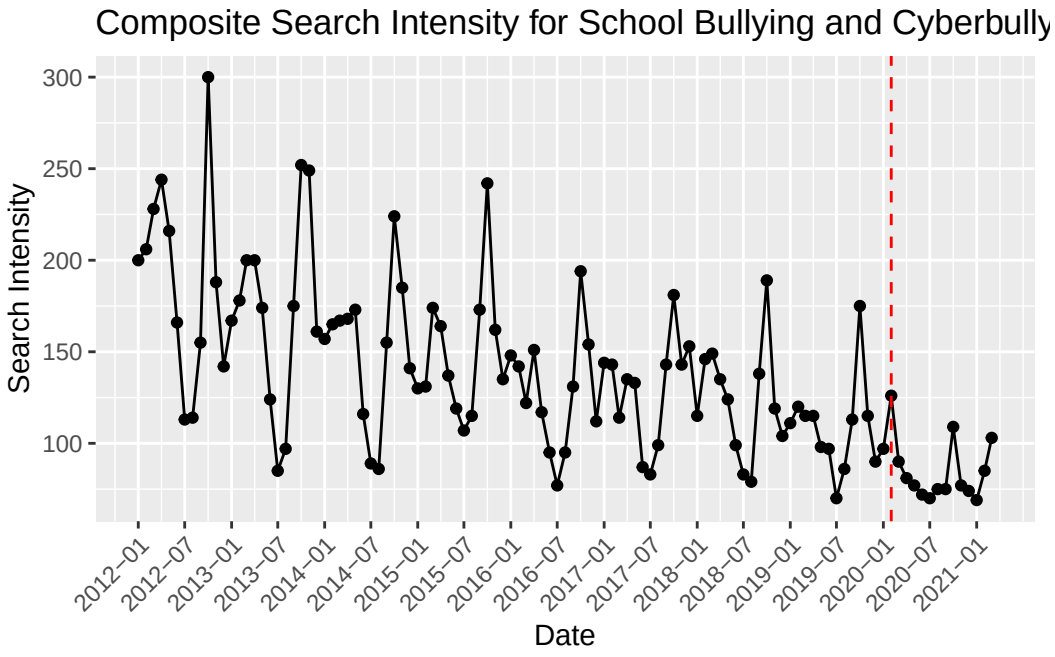


Figure 1: Composite-Search-Intensity by type

**?@fig-Composite-Search-Intensity** shows the number of searches for bullying (by category) starting in 2012 and ending in 2021. The graph visually shows how bullying searches relate to time. From this we can see every year during the first month of school, the number of searches for bullying rises to a peak, and then quickly dwindles to a trough in the summer. Depending on where the red dotted line is, that's when the pandemic started. Affected by online learning, the search volume for bullying broke the pattern of previous years and remained at a low level. Only searches for cyberbullying rebounded, but not by much.

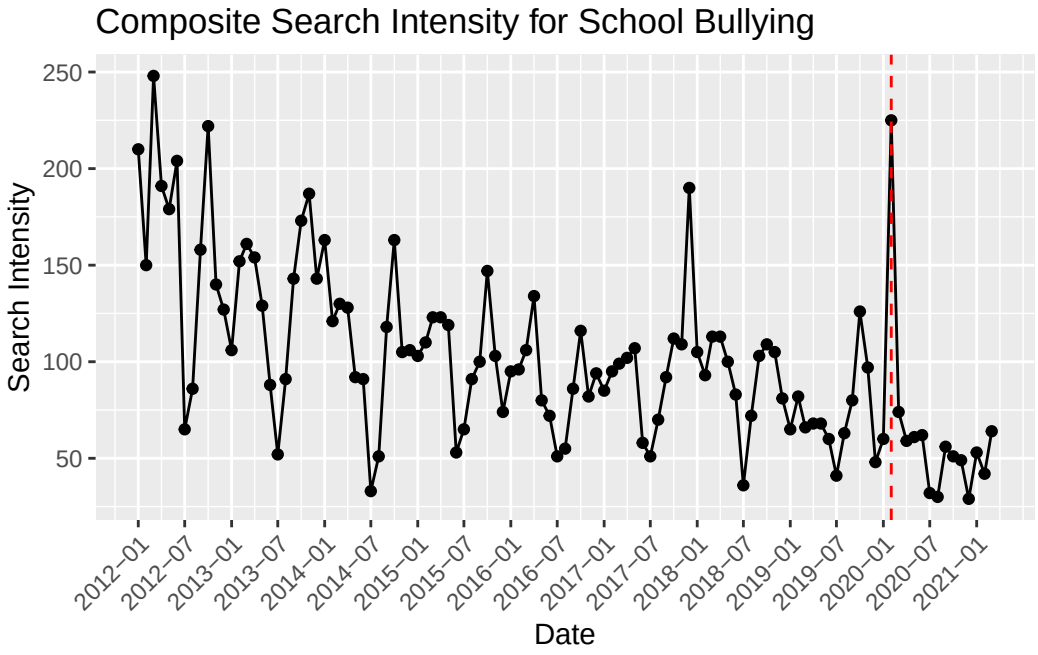


Figure 2: Composite-Search-Intensity by type

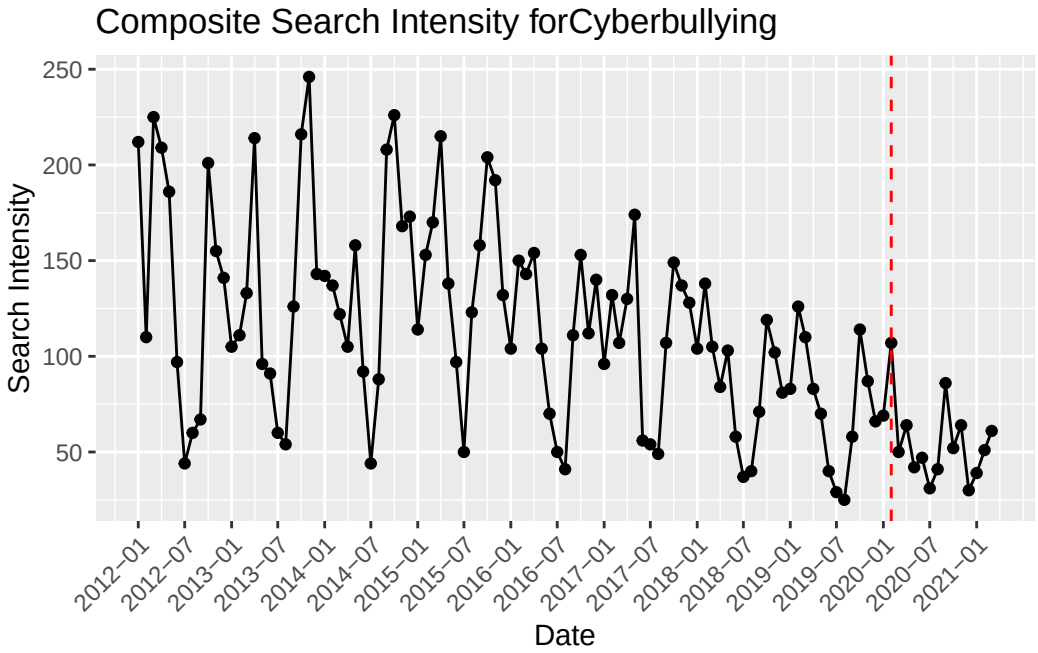


Figure 3: Composite-Search-Intensity by type

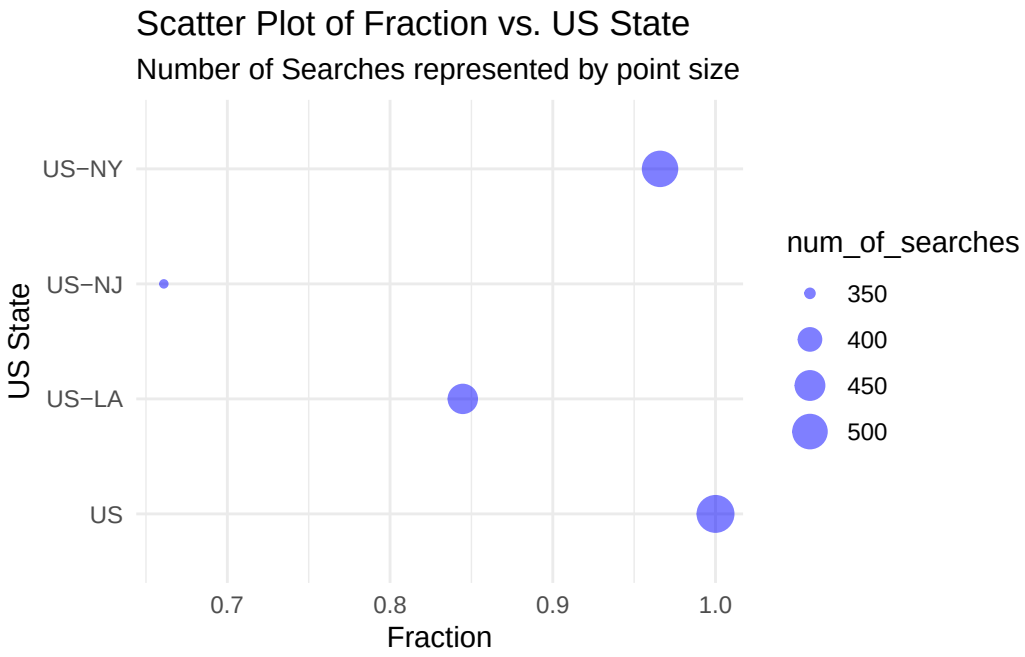


Figure 4: Composite-Search-Intensity by type

# 4 Discussion

## 4.1 COVID-19 Effects on Bullying

The overall bullying (**?@fig-Composite-Search-Intensity**) displays a decreasing trend over time, with a significant decline when COVID-19 pandemic emerged. The impact of COVID-19 on bullying cases results in a reduction to the lowest levels observed. The search intensities of bullying during and after remote learning sometimes almost reached zero.

It is clear that the incidence of school bullying has generally been decreasing over time. The original paper [cite] states that COVID-19 pandemic and remote learning has caused a decrease in school bullying cases. Our data has a slight different conclusion compared to the original paper (**?@fig-Composite-Search-Intensity**). It is observed that with the sudden COVID-19 outbreak in the United States around January 2020, instances of school bullying experienced a notable surge, almost reaching global maxima in February 2020. The unexpected rise in bullying during the pandemic could be attributed to various factors, for example, individuals seeking to alleviate stress through harmful behavior to other people. Furthermore, a disturbing trend of Chinese-hate emerged during this period, due to the misguided assumptions that China was responsible for spreading the virus (Jianhua Xu 2021). Asian students, especially Chinese ethnicity, might experience discriminatory actions, verbal abuse, or physical assaults due to this misinformation. So it most likely contributed to an increase in school bullying

cases. As schools closed down in February 2020, a consequential decline in bullying cases was observed, at times nearly reaching zero. This is understandable since student interactions have declined due to remote learning. They did not have as much opportunity or motivation to bully others as they had before.

Surprisingly, the shift to remote learning during the COVID-19 pandemic did not lead to an expected increase in cyberbullying cases. Given that students spent the majority of their time on digital devices (Fayiqa Ahamed Bahkir 2020), it was natural to assume that cyberbullying would increase. Instead, there was a noticeable decrease. This challenges the assumption about the relationship between online activity and cyberbullying. The reduction in personal interactions during remote learning may have played a role in diminishing students' motivations or reasons to engage in cyberbullying. Also, since students stayed at home, there would always be adult supervision, for students under 12 years old (Mónica Ruiz-Casares 2021), which may have regulated their behaviour. This indicates that face-to-face interactions and the environmental factors have a strong impact on the prevalence of online harassment.

## 4.2 Cyclic Pattern of Bullying During Semesters and Vacations

In all three types of bullying (school bullying, cyber-bullying, and bullying), a cyclic pattern can be observed. It is clear that the data peaks during the months of January and September, which are the commencement of school terms, followed by a gradual reduction in bullying cases as the semester progresses. The local trough occurs during the summer vacation when students are away from school. It can be inferred that there might be a positive correlation between academic stress and bullying and between in-person interactions and bullying (Hui Chen 2022).

As the semester begins, students need to transition from a relaxed vacation state to a rigorous school learning state. As they navigate the challenges of academic demands, they may experience stress and peer pressure from many sources (Adele Pitt 2018). This will urge students to release their emotions and stress by bullying other students. It is important for teachers and schools to see this trend and understand its implications. Effective strategies for mental health support should be carried out to deal with this, in order to reduce bullying.

Furthermore, there is obviously a clear positive correlation between in-person interactions and incidents of bullying. During the semesters, students engage in regular face-to-face interactions, potentially creating opportunities for bullying to occur. During summer vacation and the Christmas holiday, students typically limit their interactions to family members, with occasional exceptions when hanging out with friends. This reduction in direct, in-person interactions tends to reduce social pressures. Some individuals may feel the need to show dominance within the school by performing bullying behaviors in the presence of others (Albert Reijntjes 2016). However, during vacations, the reduced personal interaction may reduce their need for such assertive actions, resulting in a decrease in bullying activities.

## 4.3 Third discussion point

## 4.4 Limtations

### 4.4.1 Limited Comprehensive Representation

One key limitation of the study is the relatively low number of data entries for each bullying type within each state, which are only 111 entries. This sample size may not be able to provide a comprehensive representation of the entire state. The analysis about bullying might be skewed.

### 4.4.2 Biases in Data Collection

The paper has several biases in its data collection process. Firstly, it seems to lack consideration for various minority groups, such as those based on ethnicity, gender, or belonging to the LGBQT community. This could potentially cover up the bullying experiences faced by these groups, which limits the study's inclusivity.

Additionally, socio-economic status is a critical factor influencing the bullying situation. Communities facing economic challenges lack sufficient teaching resources, and children might learn negative behaviors due to their challenging circumstances. However, the current dataset does not seem to account for these socio-economic factors, which should be added as a data feature.

Moreover, the data collection method is conducted on Google Trends, which introduces another bias. People without access to a computer or Internet may not have their experiences included in the dataset. Unfortunately, these students, who face economic difficulties, are more likely to be targets of bullying. The data does not have their perspective which compromises the comprehensiveness of the study. Also, public data from Google Trends shows the trends in the search intensity. However, there is no information about the person who performed the search. It is hard to decide whether they are the victim, the bully, or a random person.

### 4.4.3 Time Inaccuracy

The study analyzes the bullying situation before, during, and after COVID-19, specifically focuses on the impact of remote learning. Therefore, there are some limitations related to the temporal aspect of data collection. The closure of schools during the COVID-19 pandemic occurred on different dates across states. This difference in the timing of school closures introduces potential inaccuracy in the analysis.

## 4.5 Future Steps

Future research should focus on gathering more inclusive and representative data by increasing the volume of data entries and mitigating bias in data collection. Beyond simply collecting data about bullying, researchers should investigate the mental well-being of students affected by bullying.By investigating their mental well-being, researchers can arrive at conclusions if the mental health support system is effective for students in the school. It is important to ensure that individuals who experience bullying have access to the necessary resources and support. This makes sure that the research not only analyzes the situation, but also contributes to actionable improvements for those affected.

# Appendix

## A Additional data details

## B Model details

### B.1 Posterior predictive check

### B.2 Diagnostics

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