In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import re

import plotnine
from plotnine import *
import matplotlib.pyplot as plt

import gc
import os.path
from os import path
import networkx

from research.data.sources import CachedDailyData, TickDB
from research.data.analysis import confusion

from research.functions import MultiFunction1D, SeriesFunction1D, TickFunction1D
from research.core.ggplot import ggcolors
from research.core.ggplot import scale_x_datetime_auto

pd.set_option('display.max_columns', 500)
pd.set_option('display.max_rows', 2000)
pd.options.display.max_colwidth = 100

plt.rcParams['figure.figsize'] = [8, 6]
plt.rcParams['figure.dpi'] = 100
```

1. older sites perform better and the impact outweighs other factors?
2. higher email sends lead to higher pvs. higher social leads to higher pvs?
3. certain words (clickbait or otherwise) lead to higher performance?
4. shorter stories outperform?
5. categories outperform, also that NY/CT vs NJ/PA have a bias on categories they report?
6. there is a sweet spot as to population that a given story should be sent to, however in general that most stories arent being sent to enough pop

Data Preparation

In [2]:

```
def categoryFor(x):
    if "Police" in x:
        return "Police & Fire"
    if "Lifestyle" in x:
        return "Lifestyle"
    if "Schools" in x:
        return "Schools"
    if "Obituaries" in x:
        return "Obituaries"
    if "Business" in x:
        return "Business"
    if "Sports" in x:
        return "Sports"
    if "Weather" in x:
        return "Weather"
    if "Politics" in x:
        return "Politics"
    if "Real Estate" in x:
        return "Real Estate"
    else:
        return x
```

In [3]:

```
df = pd.read_csv("../data/article_data_v3.csv", parse_dates=['publish_datetime']
df["nviews_geo"] = df["total_pageviews"] / df["population_covered"]
df["primary_category"] = df["primary_category"].apply(categoryFor)
df["clickrate"] = (df["email_clicks"] / df["email_opens"]).fillna(0.0).replace([
df["openrate"] = (df["email_opens"] / df["email_sends"]).fillna(0.0).replace([np
df["email_geo"] = (df["email_sends"] / df["population_covered"]).fillna(0.0).rep
```

Basic Stats

% view by population size distribution

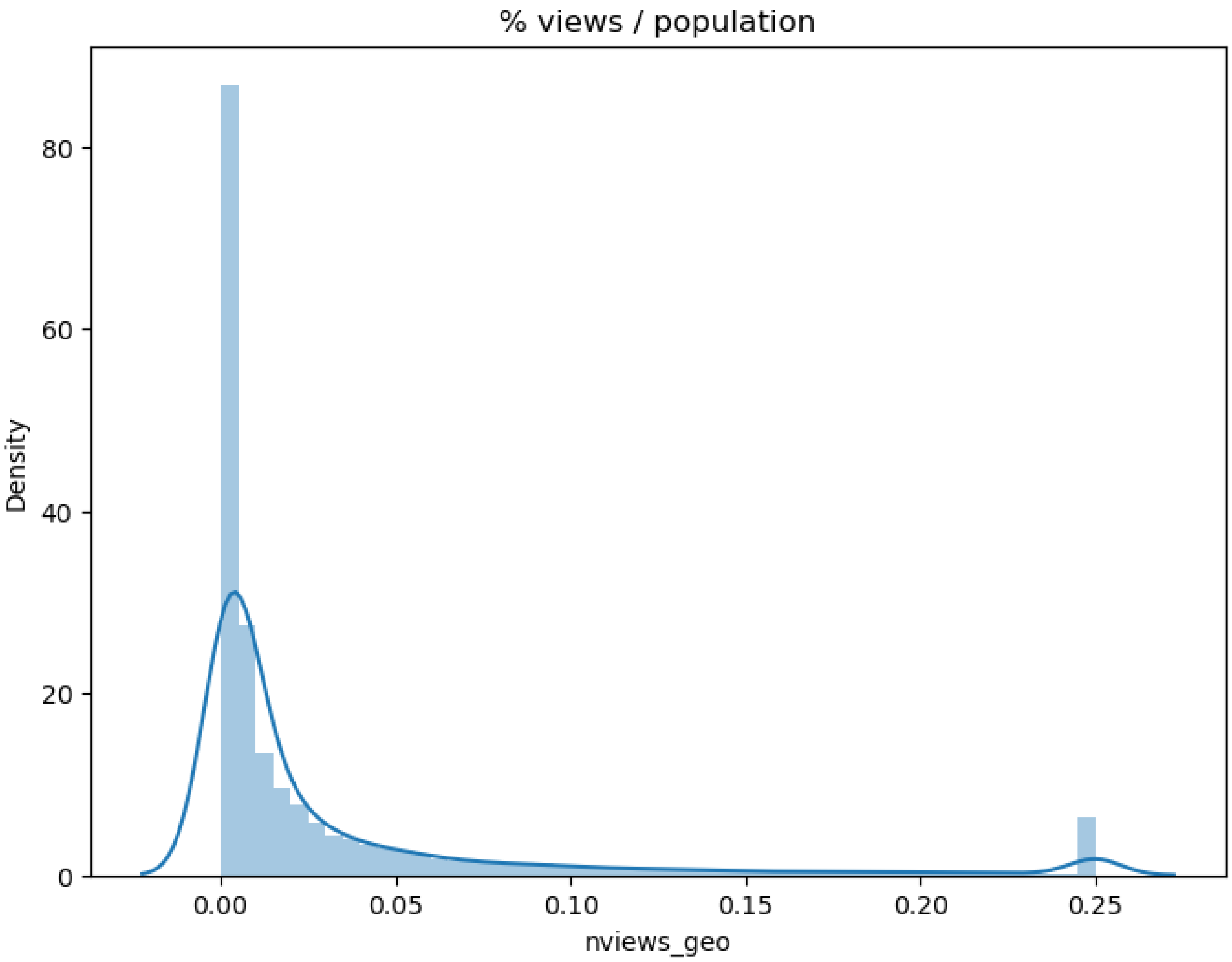
In [308…

```
sns.distplot(df["nviews_geo"].apply(lambda x: min(x,0.25))).set_title('% views /
```

```
/usr/local/conda/lib/python3.8/site-packages/seaborn/distributions.py:2551: Futu
reWarning: `distplot` is a deprecated function and will be removed in a future v
ersion. Please adapt your code to use either `displot` (a figure-level function
with similar flexibility) or `histplot` (an axes-level function for histograms).
```

Out[308…

```
Text(0.5, 1.0, '% views / population')
```



In [309…

```
df["nviews_geo"].describe()
```

Out[309…

```
count    25202.000000
mean         0.041171
std          0.162538
min          0.000000
25%          0.001906
50%          0.006984
75%          0.029476
max         10.525470
Name: nviews_geo, dtype: float64
```

Older Sites Perform Better than Newer?

In [275…

```
age_relation = df.groupby("primary_site").agg({'primary_site_age': np.mean, 'nvi
```

In [276…

```
pd.concat([
    df.query("primary_site_age < 365").nviews_geo.describe(),
    df.query("primary_site_age >= 365 and primary_site_age < 1500").nviews_geo.d
    df.query("primary_site_age >= 1500").nviews_geo.describe(),
], keys=['< 1 yr', '1-2 yrs', '> 2 yrs'], axis=1)
```

Out[276…

	< 1 yr	1-2 yrs	> 2 yrs
count	7469.000000	7202.000000	10531.000000
mean	0.006472	0.007365	0.088901
std	0.035400	0.015174	0.241385
min	0.000000	0.000000	0.000000
25%	0.000739	0.001381	0.012972
50%	0.002162	0.003196	0.034794
75%	0.005502	0.007536	0.088224
max	2.594834	0.475761	10.525470

Higher emails lead to more story page views?

- there is a postive correlation between emails and increased story views (though only 43%)

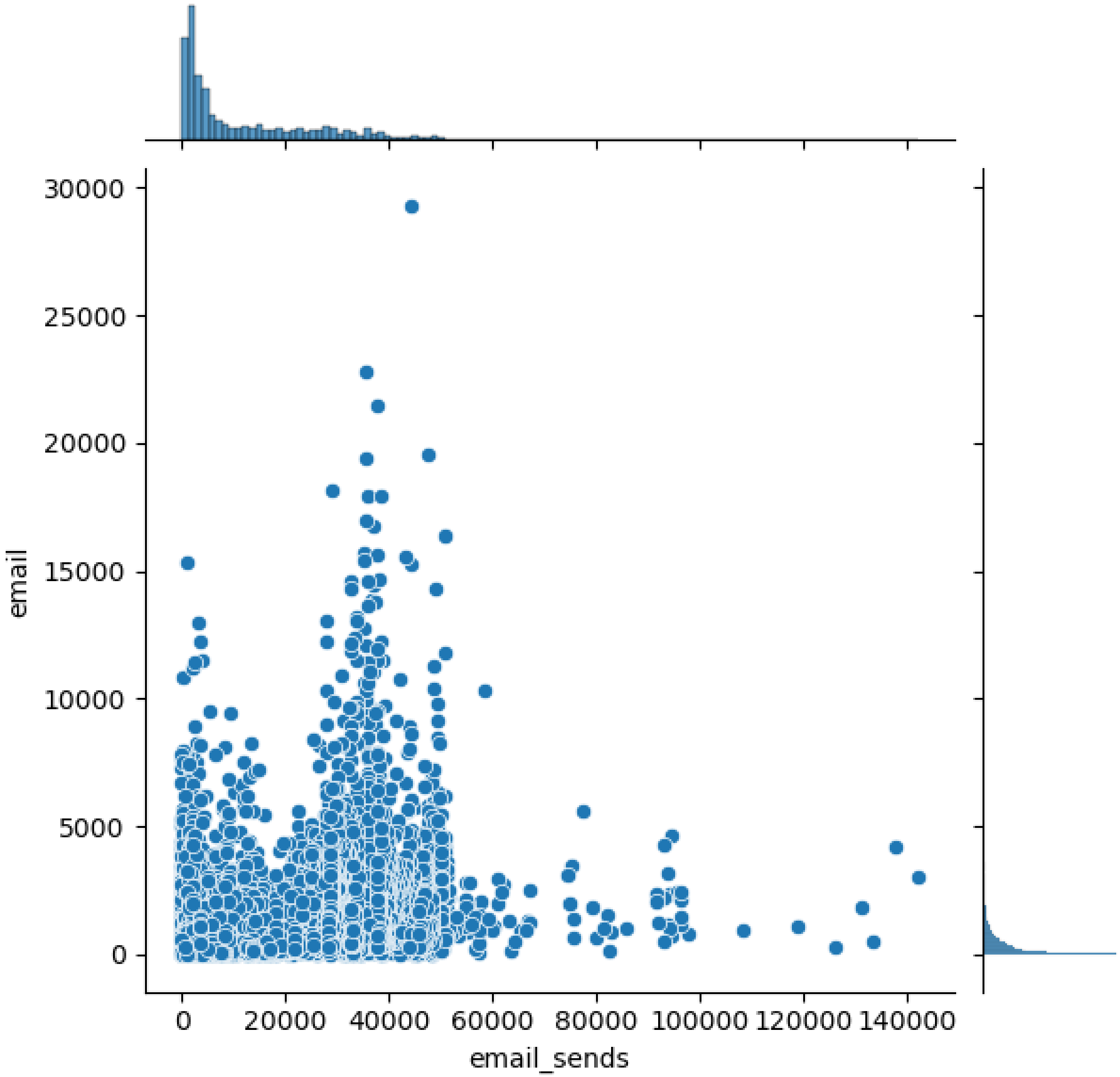
In [277…

```
sns.jointplot(df["email_sends"], df["email"])
```

```
/usr/local/conda/lib/python3.8/site-packages/seaborn/_decorators.py:36: FutureWa
rning: Pass the following variables as keyword args: x, y. From version 0.12, th
e only valid positional argument will be `data`, and passing other arguments wit
hout an explicit keyword will result in an error or misinterpretation.
```

Out[277…

```
<seaborn.axisgrid.JointGrid at 0x7fd30e9c18b0>
```



In [278…

```
df[["email_sends","email"]].corr()
```

Out[278…

	email_sends	email
email_sends	1.000000	0.428275
email	0.428275	1.000000

In [279…

```
df[["email_sends","email_opens"]].corr()
```

Out[279…

	email_sends	email_opens
email_sends	1.00000	0.59347
email_opens	0.59347	1.00000

In [280…

```
df[["email_sends","total_pageviews"]].corr()
```

Out[280…

	email_sends	total_pageviews
email_sends	1.000000	0.066597

	email_sends	total_pageviews
total_pageviews	0.066597	1.000000

Do shorter stories outperform?

- body length **does not** show any relationship to page view performance of story (3% correlation)
- this makes sense, as people will view a story based on title and then decide how much to read, as the story progresses

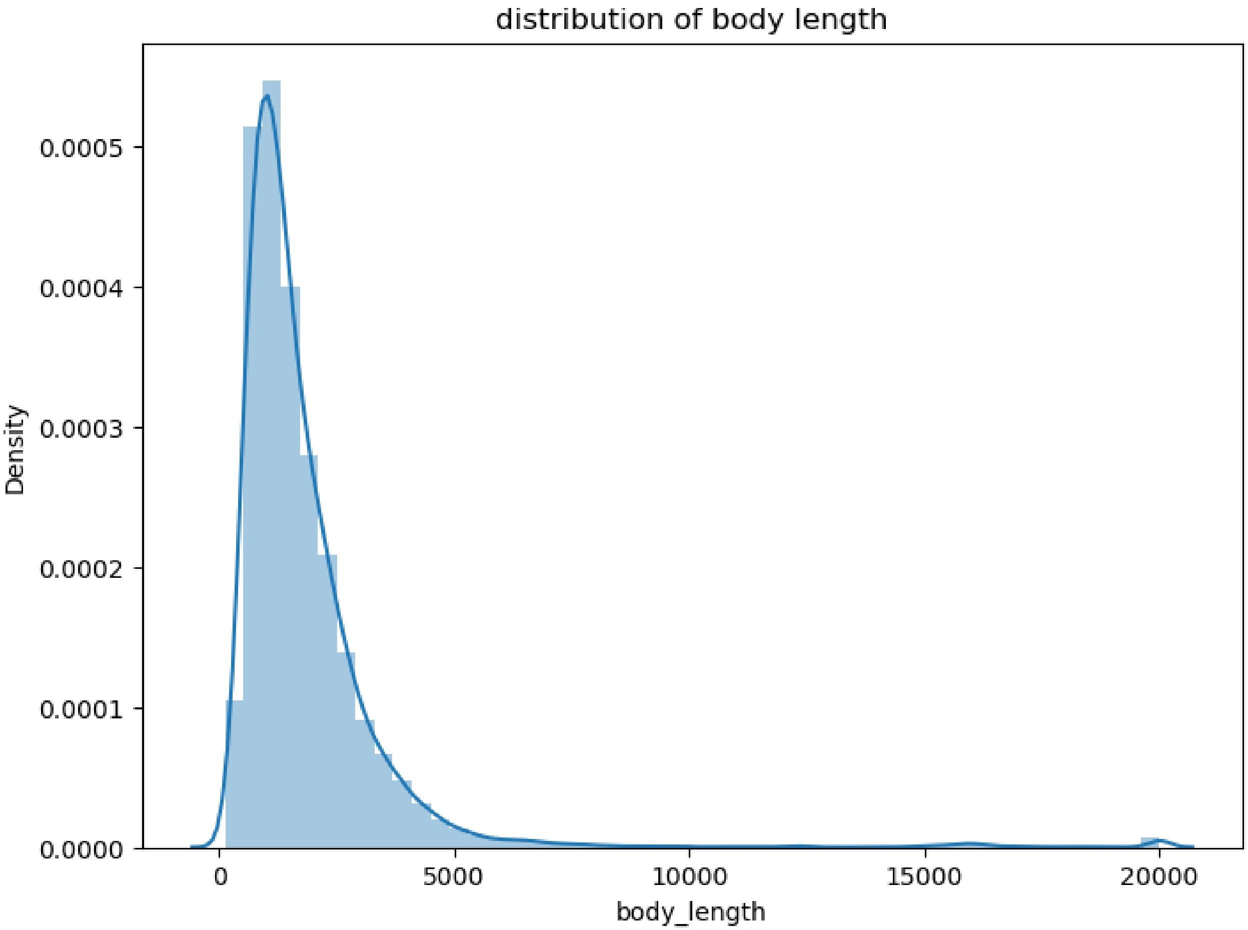
In [324…

```
sns.distplot(df["body_length"].apply(lambda x: min(x,20000))).set_title("distrib
```

```
/usr/local/conda/lib/python3.8/site-packages/seaborn/distributions.py:2551: Futu
reWarning: `distplot` is a deprecated function and will be removed in a future v
ersion. Please adapt your code to use either `displot` (a figure-level function
with similar flexibility) or `histplot` (an axes-level function for histograms).
```

Out[324…

```
Text(0.5, 1.0, 'distribution of body length')
```



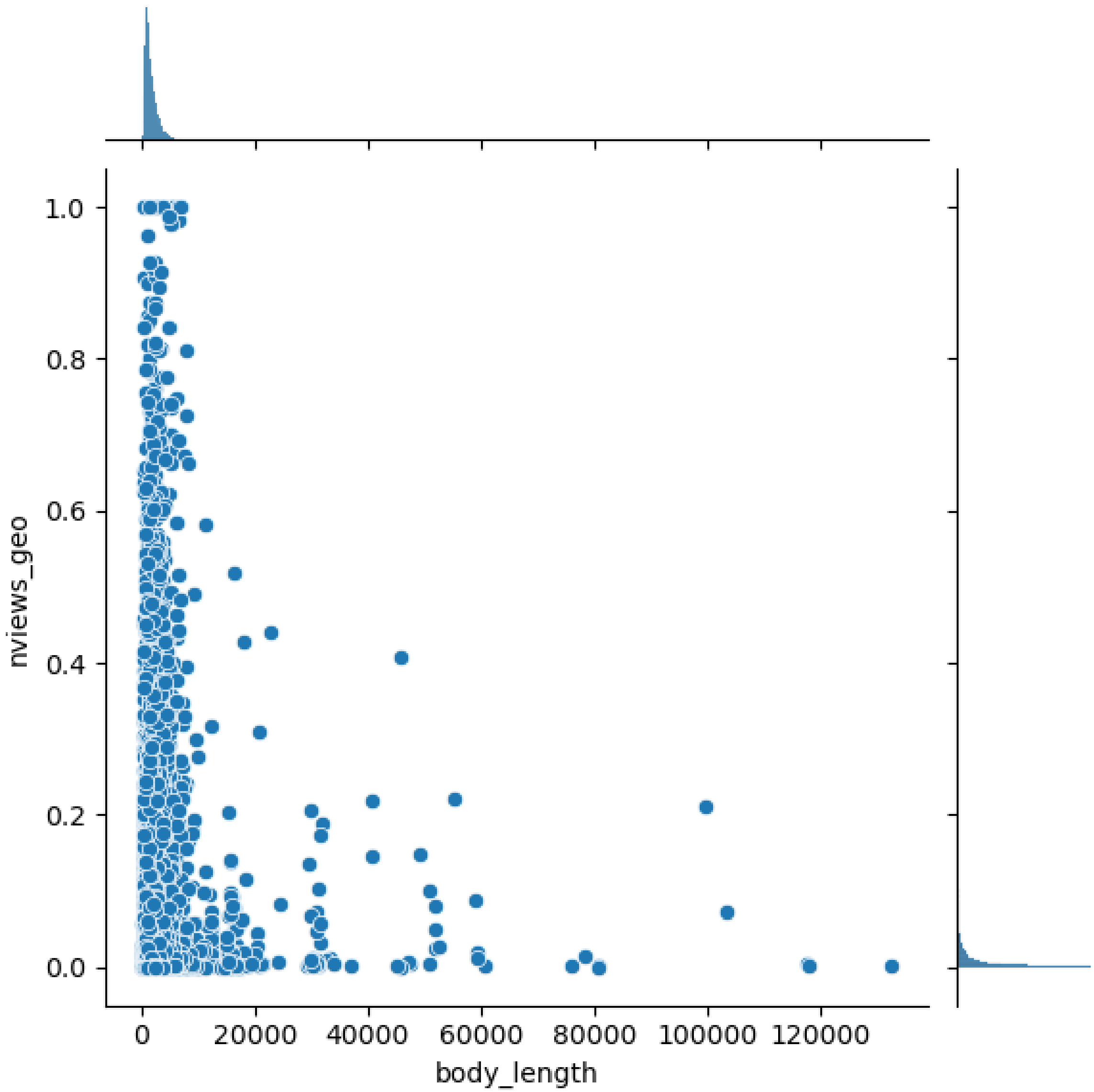
In [326…

```
sns.jointplot(df["body_length"],df["nviews_geo"].apply(lambda x: min(x,1)))
```

```
/usr/local/conda/lib/python3.8/site-packages/seaborn/_decorators.py:36: FutureWa
rning: Pass the following variables as keyword args: x, y. From version 0.12, th
e only valid positional argument will be `data`, and passing other arguments wit
hout an explicit keyword will result in an error or misinterpretation.
```

```
<seaborn.axisgrid.JointGrid at 0x7fd30fb560d0>
```

Out[326…



In [283…

```
df[["body_length","nviews_geo"]].corr()
```

Out[283…

	body_length	nviews_geo
body_length	1.000000	0.035623
nviews_geo	0.035623	1.000000

Which categories outperform, by geo?

- top absolute # views involve police and fire (but those are the most frequent stories)
- in terms of % views / population, police and fire range below the top 5 in most states

In [284…

```
agg = df.groupby (["primary_category"]).nviews_geo.agg(["mean", "count"])
agg.query("count > 5").sort_values("mean", ascending=False)
```

Out[284…

	mean	count

primary_category	mean	count
primary_category		
Schools	0.066937	757
News	0.058629	6517
Events	0.054936	10
Business	0.052768	1123
Obituaries	0.047849	478
Lifestyle	0.040955	1420
Police & Fire	0.031830	13523
Weather	0.031269	451
Real Estate	0.025130	209
Sports	0.021126	135
Politics	0.020616	413
Neighbors	0.016074	8
Traffic	0.014027	82
News, Politics	0.010168	53
News, Traffic	0.003853	13

In [285…

```
agg = df.groupby (["primary_state","primary_category"]).nviews_geo.agg(["mean",
agg.sort_values(["primary_state","mean"], ascending=False)
```

Out[285…

		mean	count
primary_state	**primary_category**		
PA	**Weather**	0.010223	20
	Obituaries	0.005713	73
	Police & Fire	0.002273	1230
	News	0.002255	141
	Lifestyle	0.001876	75
	Schools	0.001742	22
	Business	0.001630	47
	Real Estate	0.001171	6
	News, Politics	0.000664	12
NY	**Business**	0.094524	259
	Obituaries	0.091040	144
	Schools	0.086713	301
	News	0.076249	3597

		mean	count
primary_state	primary_category		
	Lifestyle	0.046845	648
	Weather	0.032048	223
	Police & Fire	0.024001	3682
	Traffic	0.020263	46
	Politics	0.020163	325
	Sports	0.018006	77
	Real Estate	0.016905	162
NJ	Schools	0.081630	257
	Politics	0.074791	15
	Business	0.070190	432
	Real Estate	0.068099	29
	Events	0.059771	9
	News	0.058133	1272
	Lifestyle	0.055405	380
	Police & Fire	0.046375	6607
	Obituaries	0.037823	230
	Sports	0.034890	37
	Weather	0.024937	49
	News, Politics	0.014973	35
	Traffic	0.005814	13
	News, Traffic	0.004618	10
MA	News	0.002453	369
	Business	0.002356	166
	Lifestyle	0.002204	87
	Police & Fire	0.001926	510
	Schools	0.001261	25
	News, Politics	0.001142	6
	Weather	0.000953	32
	Traffic	0.000435	9
CT	Real Estate	0.052768	10
	Weather	0.043297	127
	News	0.028693	1138
	Lifestyle	0.027884	230
	Schools	0.023168	152

		mean	count
primary_state	primary_category		
	Obituaries	0.023010	27
	Police & Fire	0.021340	1494
	Business	0.018204	219
	Traffic	0.015193	9
	Politics	0.012226	68
	Sports	0.011072	15

Headlines that drive views

In [315…

```
dropwords = [
    'the', 'for', 'at', 'as','of', 'with', 'are', 'was','were','is', 'a', 'an',
    'you','him','her', 'in','to','be','from','on','heres','say','two', "your",
    'connecticut','patterson','paramus','jersey','westchester','hudson','valley'
    'newark','rockland','long', 'island','year','route',"overpeck","ridgewood",
    'northern', 'nj', 'ny', 'ct', 'morris',
    '0','1','2','3','4','5','6','7','8','9',
    '10','11','12','13','14', '15', '16', '19',
    '20','21','22','23','24','25','26','27','28','29',
    '30','31','32','33','34','35','36','37','38','39',
    '40','41','42','43','44','45','46','47','48','49',
    '50','51','52','53','54','55','56','57','58','59',
]

def wordsFor (row):
    stamp = row["publish_datetime"]
    title = str(row["title"])
    state = str(row["primary_state"])
    category = str(row["primary_category"])
    score = float(row["nviews_geo"])
    words = [x.lower() for x in re.findall(r'\w+', title.replace("'",""))]
    filtered = [x for x in words if not x in dropwords]
    return pd.Series([stamp, state, category,filtered,score], index=['stamp','st

wordv = df.apply(wordsFor, axis=1)
```

In [287…

```
def filtered (query = "score > 0", by = 'freq'):
    freqs = {}
    counts = {}
    sub = wordv.query (query)
    for i in range(sub.shape[0]):
        words = sub.iloc[i].words
        score = float(sub.iloc[i].score)
        if by == "freq" or np.isnan(score):
            weight = 1
        else:
            weight = int(score * 100)

        for word in words:
            if word in freqs:
                freqs[word] += weight
                counts[word] += 1
            else:
                freqs[word] = weight
                counts[word] = 1

        if by == "mean1":
            for word in counts.keys():
                freqs[word] = freqs[word] / counts[word]
        elif by == "mean2":
            for word in counts.keys():
                freqs[word] = freqs[word] / np.sqrt(counts[word])

    return freqs
```

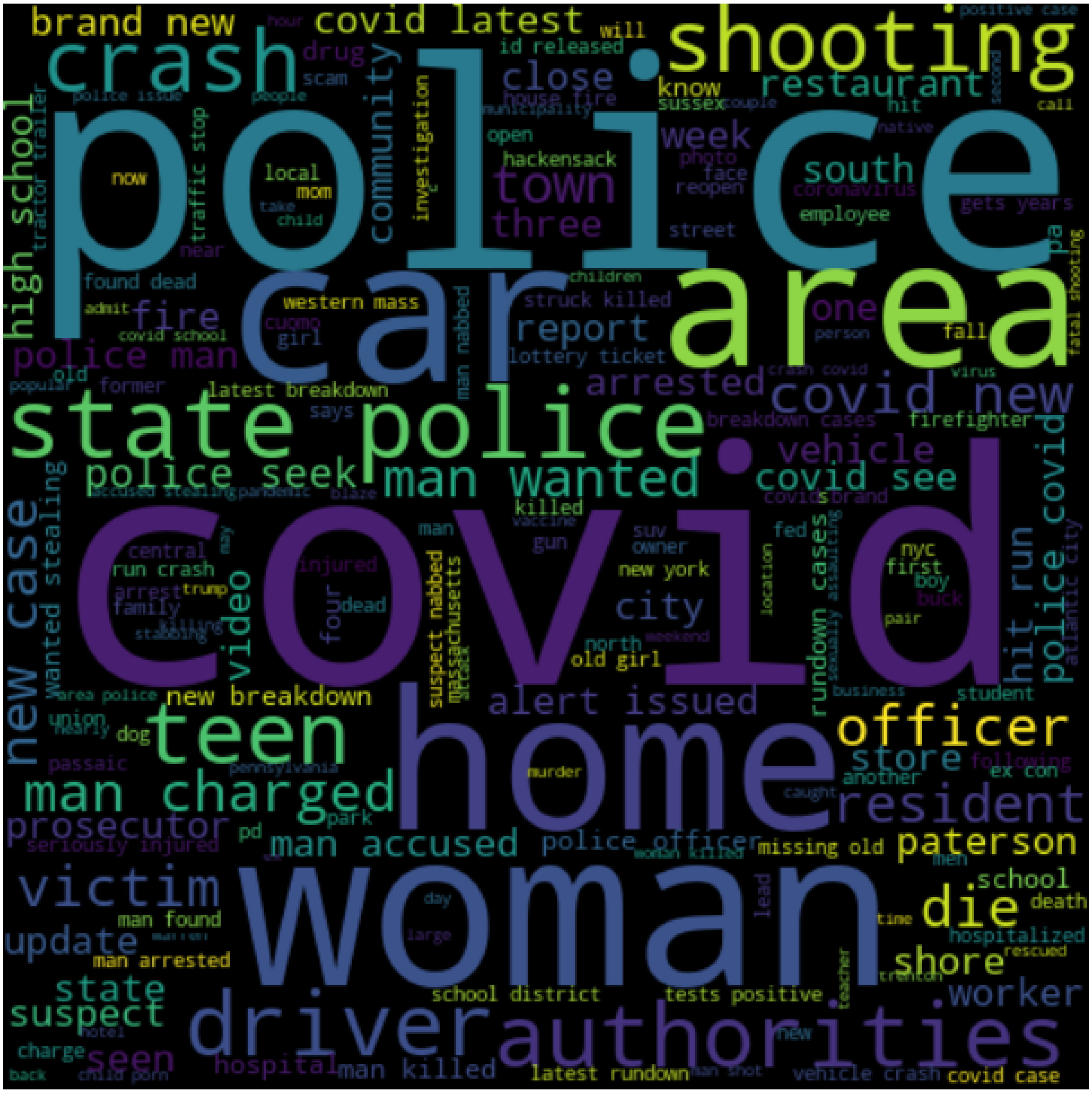
Overall word cloud

In [288…

```
allwords = []
for i in range(wordv.shape[0]):
    words = wordv.iloc[i].words
    allwords += words
```

In [289…

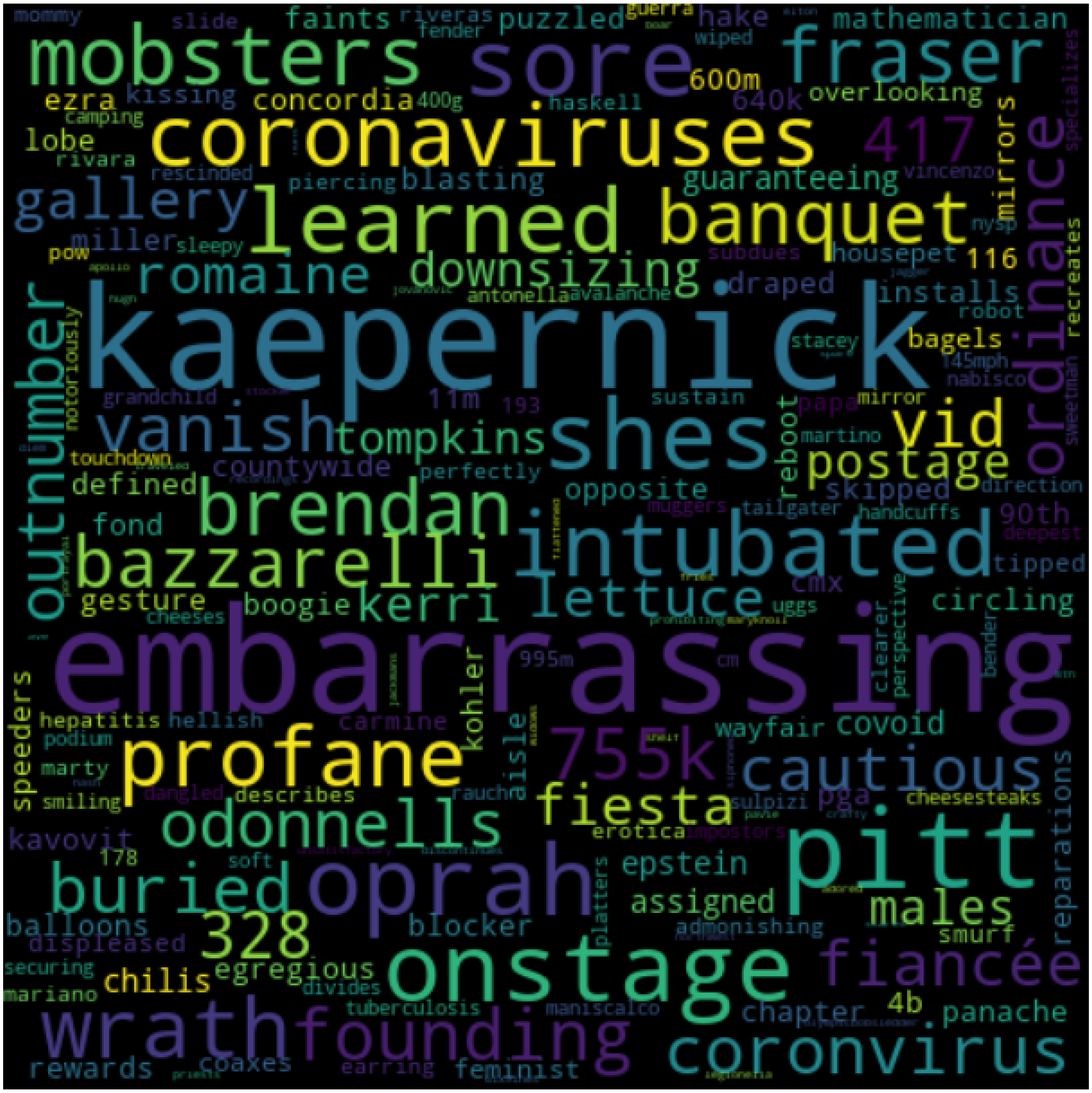
```
from wordcloud import WordCloud

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate(" ".join(allword

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```



Performance Adjusted: By Cum % of Views

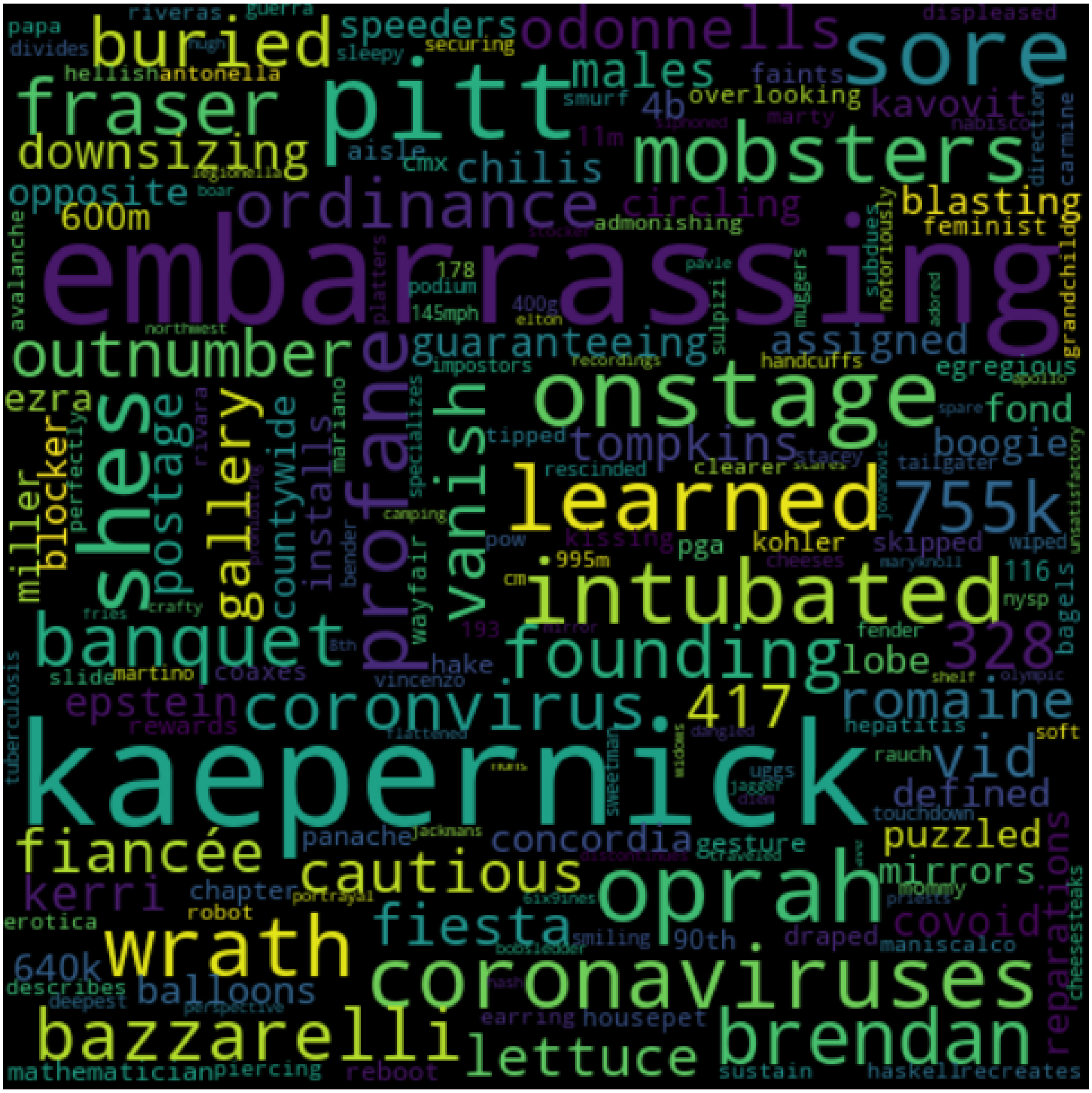
In [290…

```
freqs = filtered("score > 0", by='mean1')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```

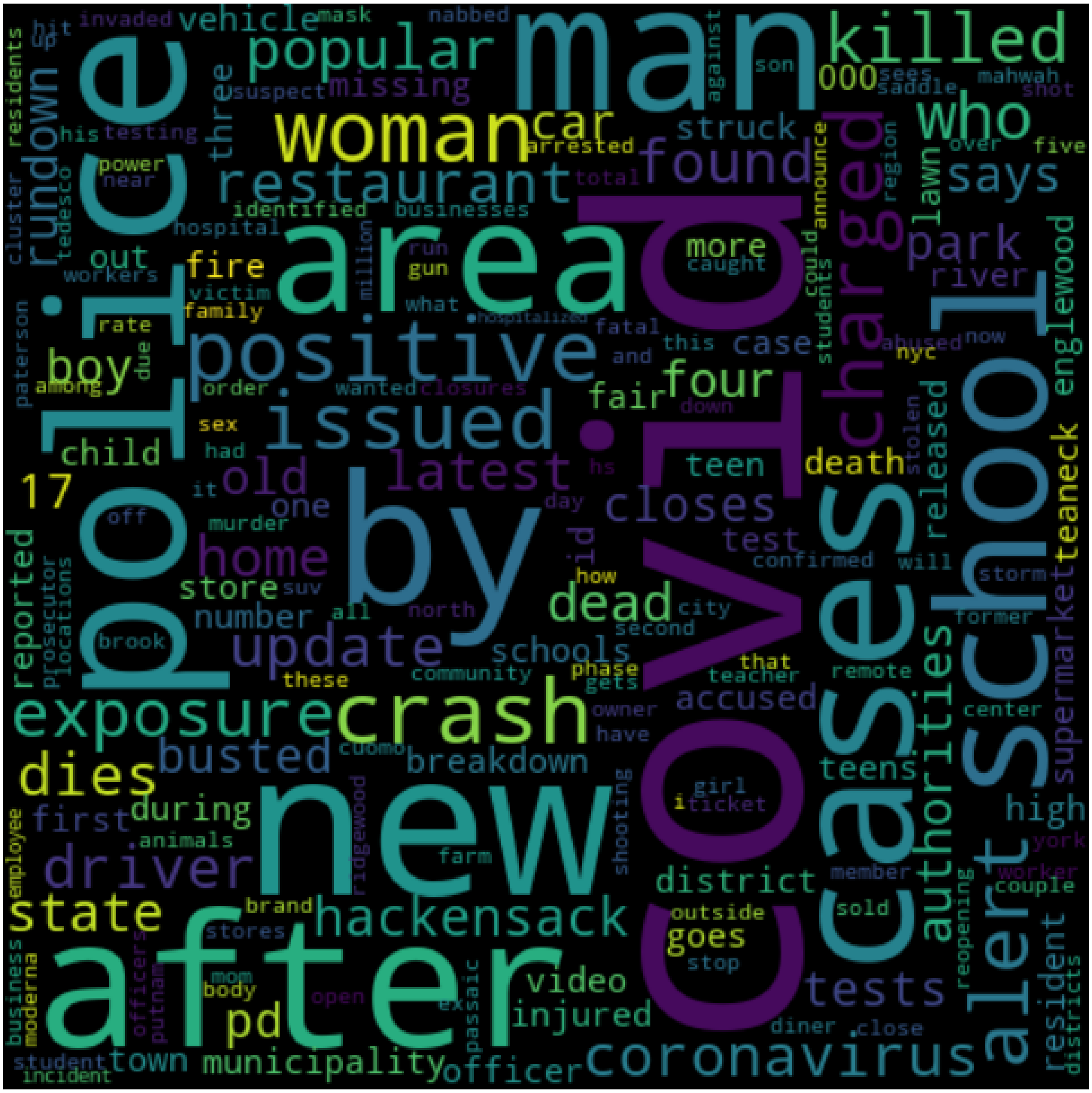


In [291…

```
freqs = filtered("score > 0", by='mean2')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```

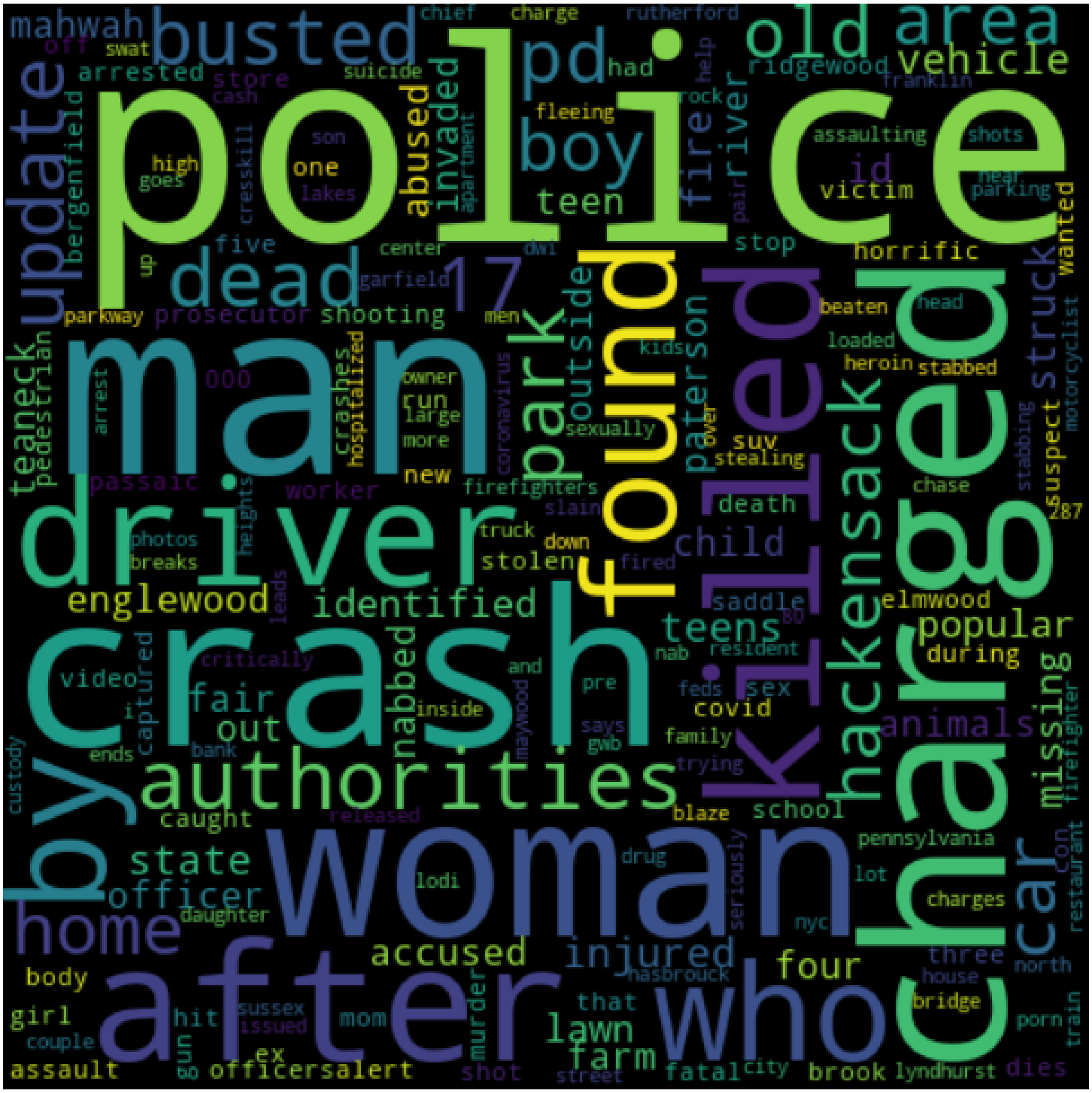


```
freqs = filtered("score > 0", by='score')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```



Performance: Police & Fire

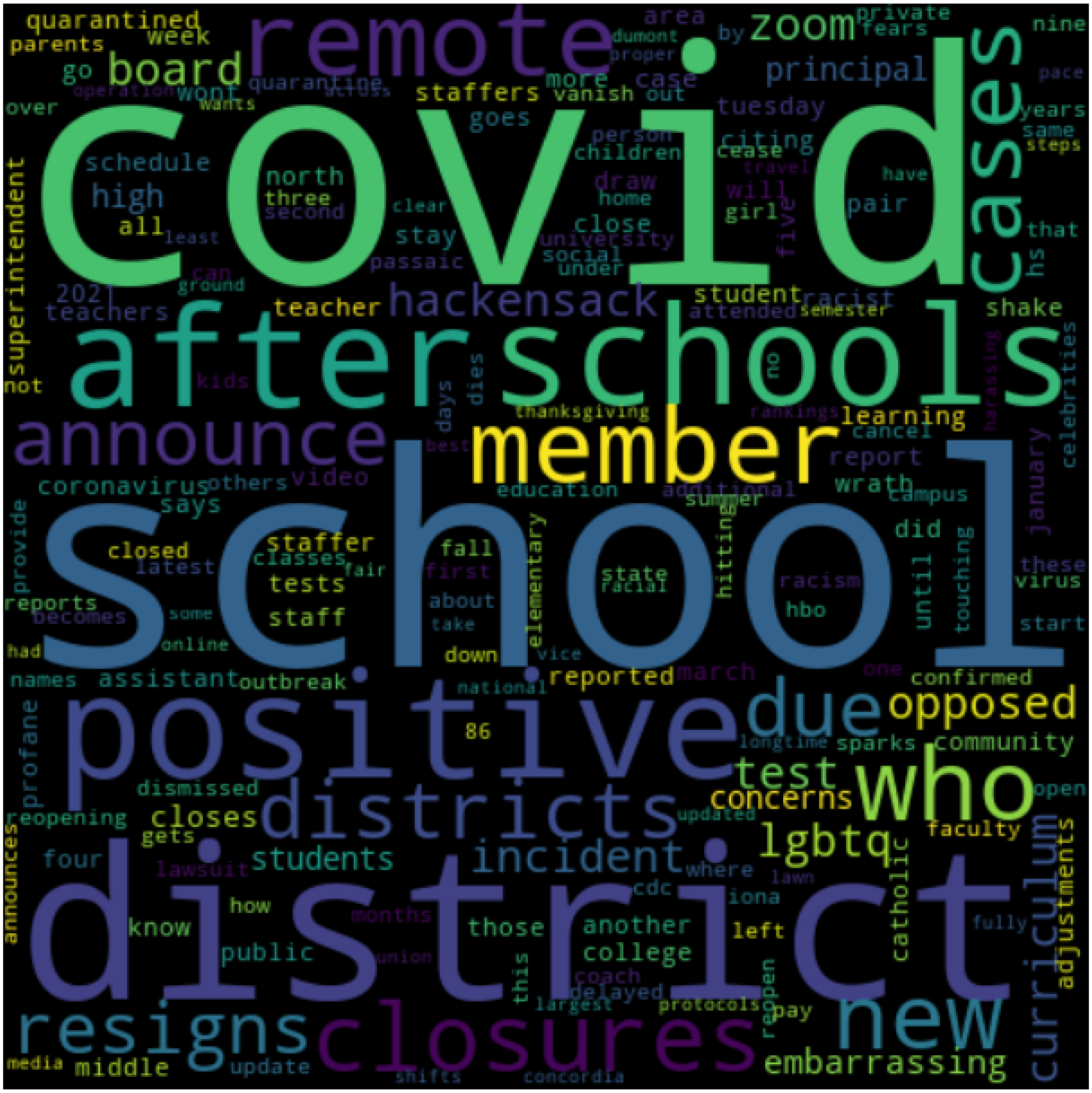
```
In [293…

freqs = filtered('category == "Police & Fire"', by='score')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```



Performance: Schools

In [294…

```
freqs = filtered('category == "Schools"', by='score')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```



Performance: Business

In [295…

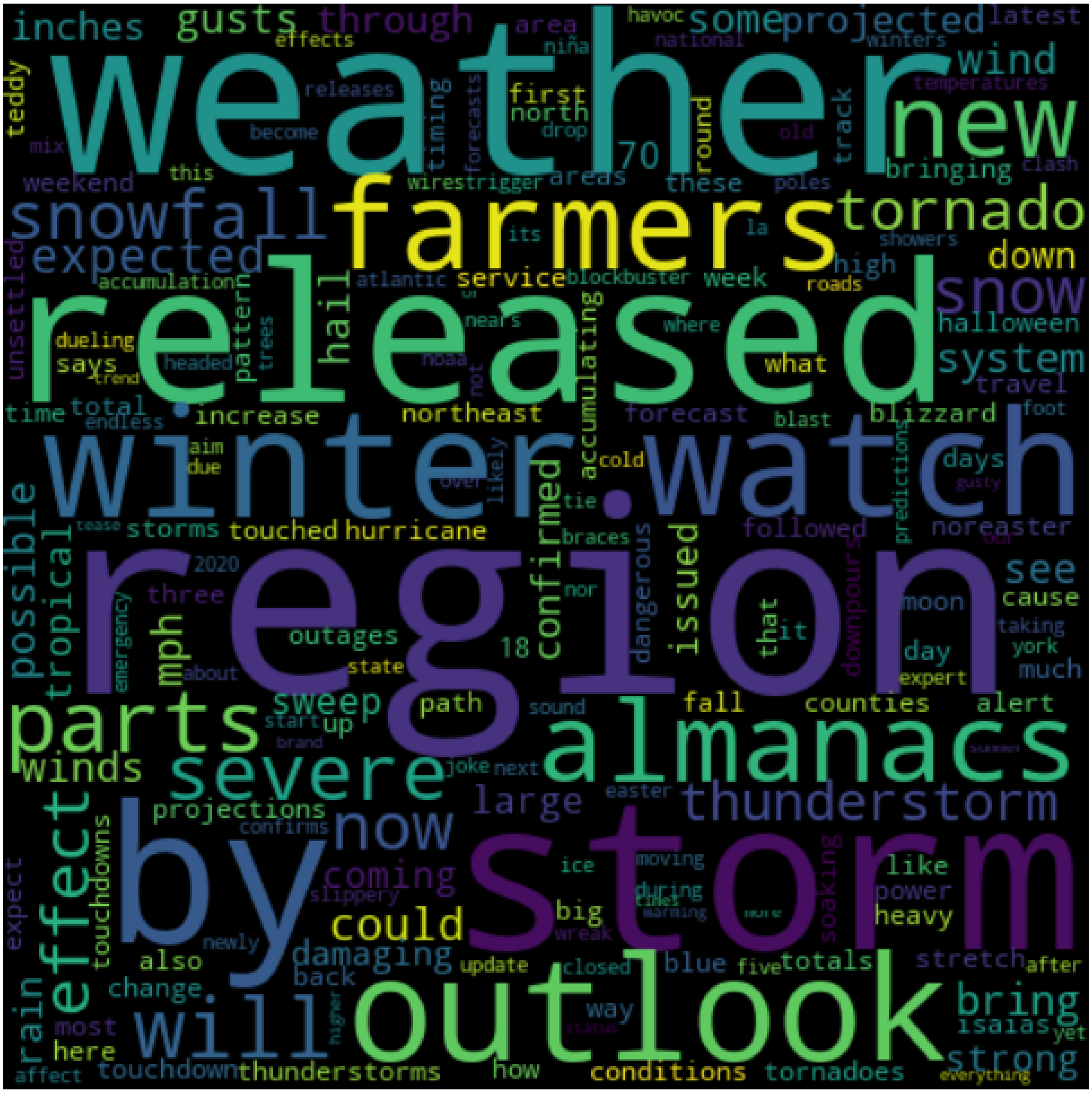
```
freqs = filtered('category == "Business"', by='score')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```

eatery
reopen
target
closure
shutters
quietly
theaters
macys
popular
jobs
have
his
empty
including
longtime
supervisor
payments
brothers
up
family
burgers
novel
close
open
bankruptcy
pizzeria
showtimes
branches
founding
iconic
hair
food
these
carlton
owners
147
approach
stop
after
boom
wegmans
coming
employee
positive
chain
sparks
amazon
closes
eateries
shelves
new
date
named
misses
questions
america
fire
shop
will
going
announce
commercial
pulls
175
employees
nordstrom
dream
violations
gets
joint
locations
known
shuttered
town
over
state
crowned
announces
joes
beef
bazzarelli
tenant
american
plans
coloring
fireplace
replacing
duck
ok
2nd
among
pizza
buying
owned
nearly
ruby
bagel
club
expands
covid
still
bank
criminally
its
diner
grills
factory
depot
wont
about
others
kreme
donuts
north
action
trader
store
strong
business
opens
closures
idea
this
plaza
location
market
take
cancelled
mall
sold
sudden
salon
closings
italian
million
100
nyc
restaurant
cautious
could
surround
mortgage
years
fairway
bar
developer
delivery
facility
closed
four
set
couple
ritz
call
permanently
fighting
drive
restaurants
closing
opening
saved
workers
greek
shakes
coronavirus
back
warehouse
area
tuesday
says
dies
how
report
shoprite
000
4b
replace
one
reopening
announced
stores
burger
other
krispy
charged
not
owner
massive
openings
pandemic
best
amid
lines
local
montvale
tests
due
cant
panic

Performance: Weather

In [311…

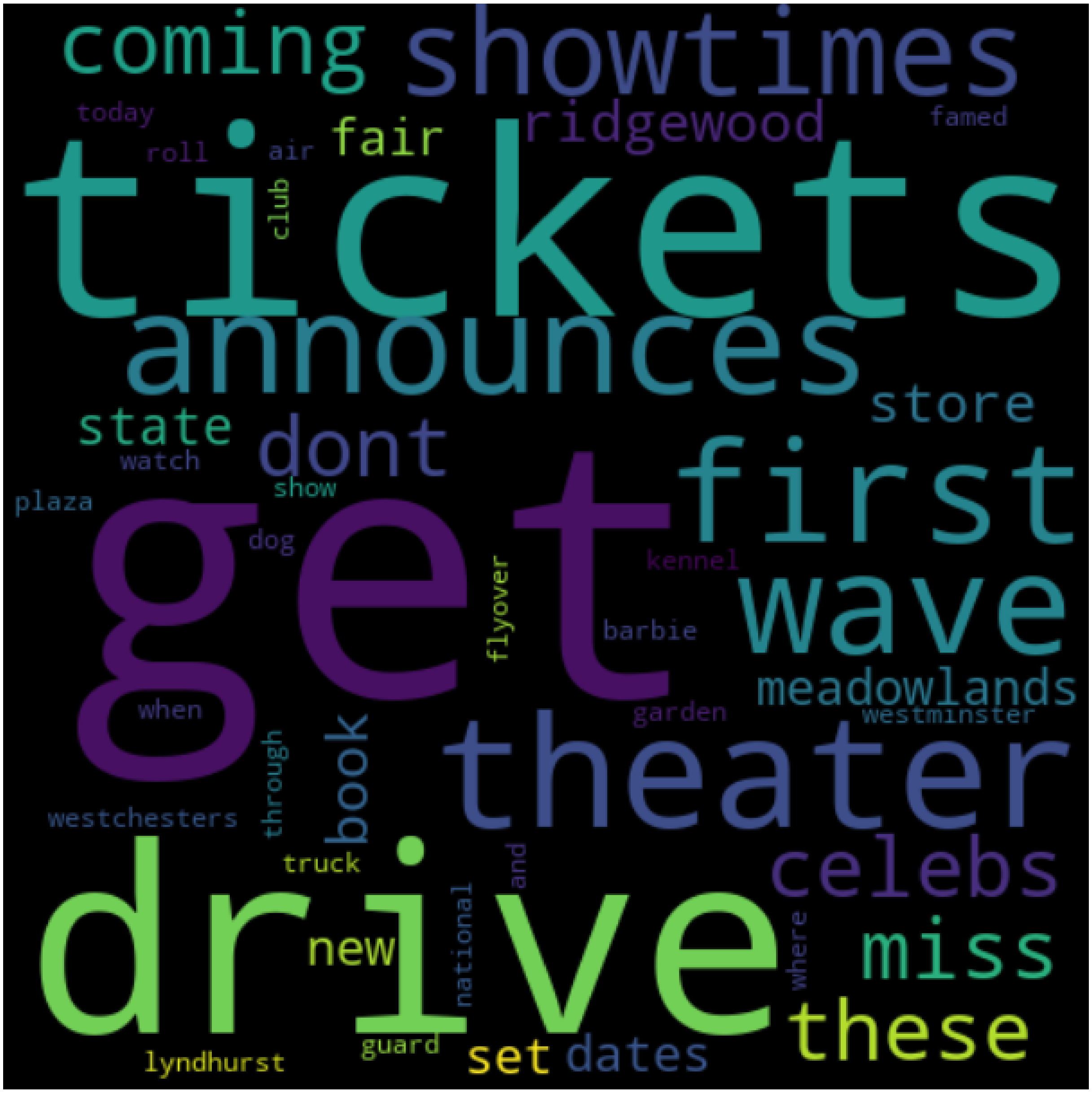
```
freqs = filtered('category == "Weather"', by='score')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```



Performance: Events

In [316…

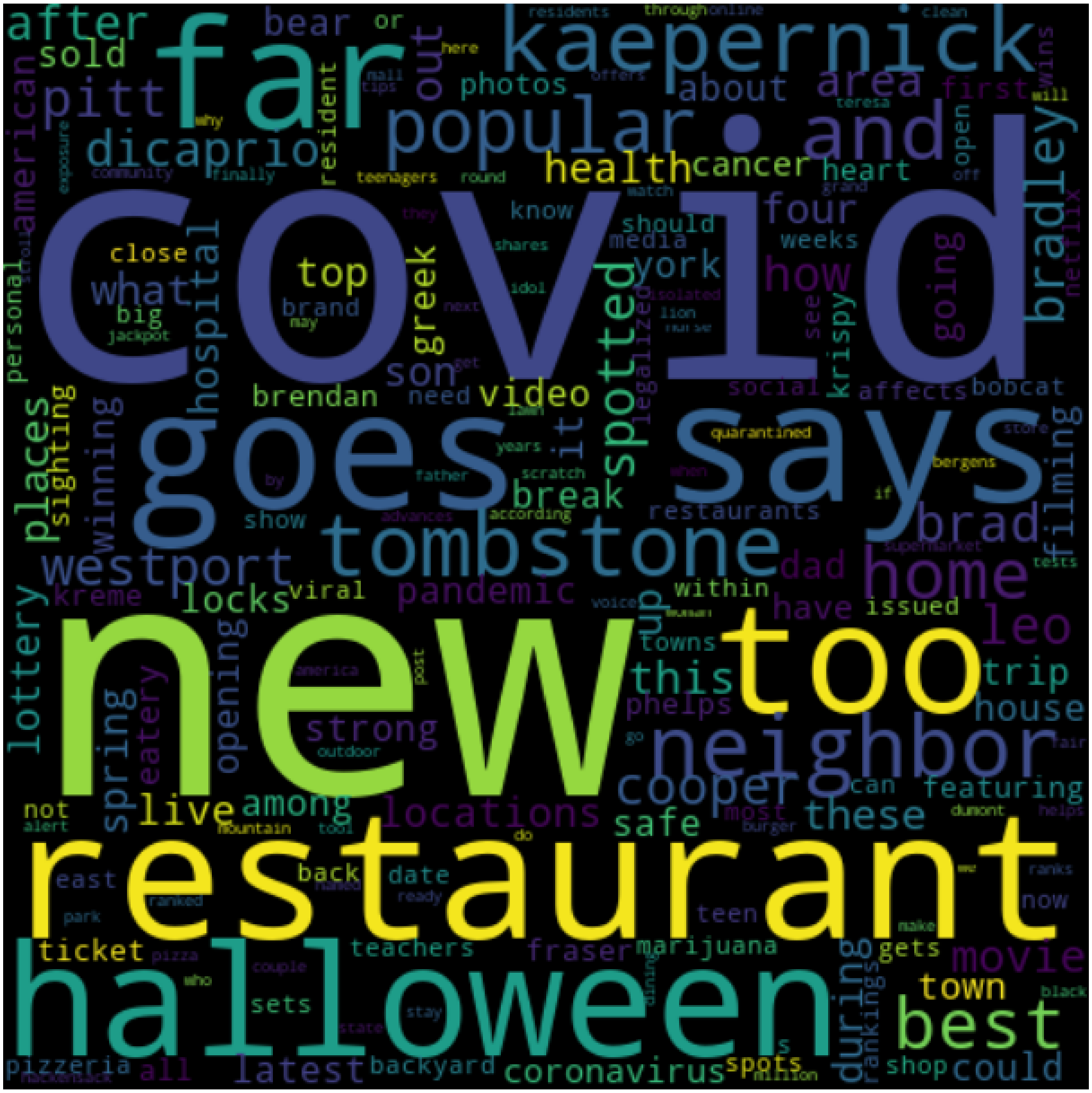
```
freqs = filtered('category == "Events"', by='score')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```



Performance: Lifestyle

In [317…

```
freqs = filtered('category == "Lifestyle"', by='score')

# Create the wordcloud object
wordcloud = WordCloud(width=480, height=480, margin=0).generate_from_frequencies

# Display the generated image:
fig = plt.figure(figsize=(12,8), dpi= 100)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.margins(x=0, y=0)
plt.show()
```



Differences between NY/CT and NJ/PA

In [320…

```
sub = df.query("primary_state != 'MA'").copy()
sub["area"] = sub.primary_state.apply (lambda x: "PANJ" if x == "PA" or x == "NJ
```

Click rates

In [321…

```
sub.groupby("primary_state").clickrate.mean()
```

Out[321…

```
primary_state
CT    0.167658
NJ    0.161063
NY    0.176344
PA    0.125623
Name: clickrate, dtype: float64
```

In [322…

```
sub.groupby("primary_state").openrate.mean()
```

Out[322…

```
primary_state
CT    0.237808
NJ    0.177021
NY    0.206826
PA    0.110641
Name: openrate, dtype: float64
```

In [323…

```
sub.groupby("primary_state").email_geo.mean()
```

Out[323…

```
primary_state
CT    0.025484
NJ    0.027881
NY    0.023573
PA    0.002807
Name: email_geo, dtype: float64
```

View rates

In [300…

```
sub.groupby("primary_state").nviews_geo.mean()
```

Out[300…

```
primary_state
CT    0.024702
NJ    0.049986
NY    0.050223
PA    0.002455
Name: nviews_geo, dtype: float64
```

In [301…

```
agg = sub.groupby (["area","primary_category"]).nviews_geo.agg(["mean", "count"]
agg.sort_values(["area","mean"], ascending=False)
```

Out[301…

		mean	count
area	**primary_category**		
PANJ	**Schools**	0.075331	279
	Politics	0.070125	16
	Business	0.063463	479
	Events	0.059771	9
	Real Estate	0.056626	35
	News	0.052557	1413
	Lifestyle	0.046582	455
	Police & Fire	0.039453	7837
	Sports	0.034056	38
	Obituaries	0.030087	303
	Weather	0.020672	69
	News, Politics	0.011320	47
	Traffic	0.004301	18
	News, Traffic	0.004230	11
NYCT	**Obituaries**	0.080298	171
	Schools	0.065391	453

		mean	count
area	primary_category		
	News	0.064819	4735
	Business	0.059557	478
	Lifestyle	0.041878	878
	Weather	0.036130	350
	Police & Fire	0.023233	5176
	Traffic	0.019434	55
	Real Estate	0.018990	172
	Politics	0.018790	393
	Sports	0.016876	92

In [310…

```
agg = sub.groupby (["area","primary_category"]).total_pageviews.agg(["sum", "cou
agg.sort_values(["area","sum"], ascending=False)
```

Out[310…

		sum	count
area	primary_category		
PANJ	Police & Fire	43286162	7838
	News	8660473	1413
	Lifestyle	3444741	455
	Business	3314769	479
	Schools	2742639	279
	Obituaries	1882894	303
	Weather	299016	69
	Real Estate	235159	35
	Sports	161614	38
	News, Politics	113896	47
	Politics	51789	16
	News, Traffic	43186	11
	Events	32225	9
	Traffic	30142	18
NYCT	News	43974779	4735
	Police & Fire	16635824	5176
	Weather	11327161	350
	Lifestyle	4567082	883
	Business	3019377	478
	Schools	3008611	473

		sum	count
area	primary_category		
	Politics	1644665	406
	Obituaries	1005842	171
	Real Estate	350702	172
	Sports	235643	92
	Traffic	207747	55

```
In [ ]:
```

```
In [ ]:
```