Topic 3: Sentiment Analysis I

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Sentiment Anaysis I

Using the Intergovernmental Panel on Climate Change (IPCC) Nexis Uni dataset, I was able to recreate Figure 1A from Public Perceptions of Aquaculture: Evaluating Spatiotemporal Patterns of Sentiment around the World, Froehlich et al.

First, I read in the data and created a data frame that contains the necessary data I need: `element_id`, `date`, and `headline`.

```
# downloaded data from eds 231 github
# don't have to specify file in here() bc list.files automatically looks
# for the files based on the pattern
ipcc_files <- list.files(pattern = ".docx",
                         path = here("hw/ipcc_data"),
                         full.names = TRUE,
                         recursive = TRUE,
                         ignore.case = TRUE)

ipcc_data <- lnt_read(ipcc_files) # class 'LNToutput'
```

```
## Creating LNToutput from 1 file...

##  ...files loaded [0.19 secs]

##  ...articles split [0.22 secs]

##  ...lengths extracted [0.22 secs]

##  ...headlines extracted [0.23 secs]

##  ...newspapers extracted [0.23 secs]

##  ...dates extracted [0.24 secs]

##  ...authors extracted [0.24 secs]

##  ...sections extracted [0.24 secs]

##  ...editions extracted [0.25 secs]
```

```
##  ...dates converted [0.25 secs]

##  ...metadata extracted [0.26 secs]

##  ...article texts extracted [0.26 secs]

##  ...superfluous whitespace removed [0.29 secs]

## Elapsed time: 0.29 secs
```

```
# pull out necessary data
meta_ipcc <- ipcc_data@meta
articles_ipcc <- ipcc_data@articles
paragraphs_ipcc <- ipcc_data@paragraphs

# create tibble
ipcc_data2 <- tibble(element_id = seq(1:length(meta_ipcc$Headline)),
                     date = meta_ipcc$Date,
                     headline = meta_ipcc$Headline)
```

Next I obtain all the headline sentences using `get_sentences()`, which resulted in a total of 100 lists. I then use `sentiment()` to approximate a polarity score of each sentence ranging from -1 to 1, or negative to positive. I join the data frame of headlines I created in the code chunk above with the data frame of sentiment polarity scores. My joined data frame has a length of 109 because some headlines are made up of multiple sentences.

`sentiment_by` provides a data frame that has estimated the sentiment grouped by `headline`.

```
ipcc_text <- get_sentences(ipcc_data2$headline)
sent_ipcc <- sentiment(ipcc_text)

sent_ipcc_df <- inner_join(ipcc_data2, sent_ipcc, by = "element_id")

sentiment_ipcc <- sentiment_by(sent_ipcc_df$headline)

sent_ipcc_df %>% arrange(sentiment_ipcc)
```

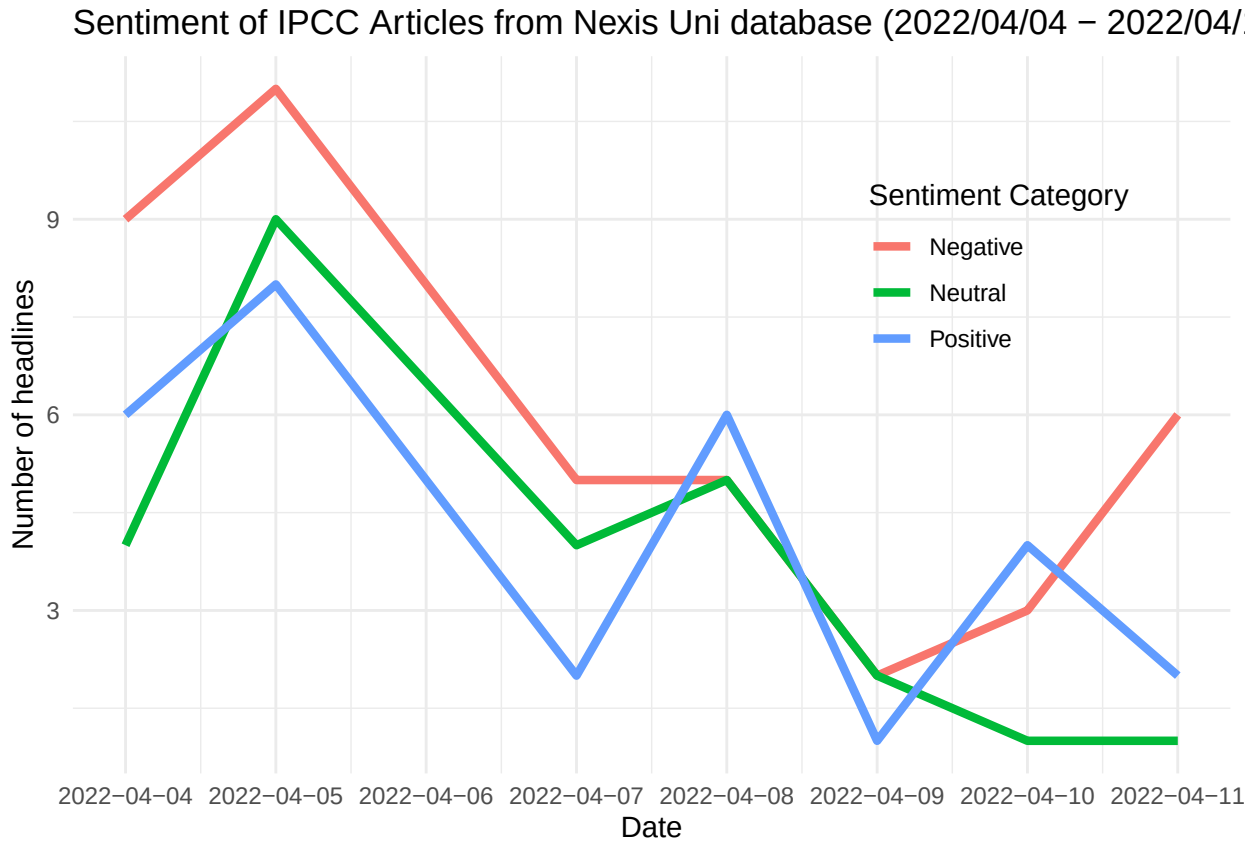
Here I am assigning each polarity score a sentiment category of Positive, Neutral, or Negative. Then I grouped by date and sentiment category to find the total counts of each sentiment category by date. I need these categories to recreate the Froehlich et al paper.

```
sent_ipcc_aggregate <- sent_ipcc_df %>%
  mutate(sentiment_category = case_when(sentiment > 0 ~ "Positive",
                                        sentiment == 0 ~ "Neutral",
                                        sentiment < 0 ~ "Negative")) %>%
  group_by(date, sentiment_category) %>%
  summarize(count = n())
```

```
## `summarise()` has grouped output by 'date'. You can override using the `.groups` argument.
```

Now that I have my data in the right format, I can recreate the plot.

```
ggplot(data = sent_ipcc_aggregate,
       aes(x = date, y = count, color = sentiment_category)) +
  geom_line(size = 1.5) +
  theme_minimal() +
  theme(legend.position = c(0.8, 0.7)) +
  scale_x_date(date_labels = "%Y-%m-%d",
               breaks = unique(sent_ipcc_aggregate$date)) +
  labs(title = "Sentiment of IPCC Articles from Nexis Uni database (2022/04/04 - 2022/04/11)",
       x = "Date",
       y = "Number of headlines",
       color = "Sentiment Category")
```



From the Nexis Uni database, I chose the key search term **"carbon management"**. *Note: when I used* ***lnt_read*** *I was prompted that more than one language was detected and I chose English only.*

```
my_files <- list.files(pattern = ".docx",
                       path = here("hw/data"),
                       full.names = TRUE,
                       recursive = TRUE,
                       ignore.case = TRUE)

# used exclude lines to remove unnecessary lines
data <- lnt_read(my_files,
                 exclude_lines = "^LOAD-DATE: |^UPDATE: |^GRAFIK: |^GRAPHIC: |^DATELINE: |^Graphic |^CO
```

```
## Warning in lnt_asDate(date.v, ...): More than one language was detected. The
```

```
## most likely one was chosen (English 99%)
```

Here I am extracting the metadata, articles, and paragraphs from the LNT object and converting them into data frames. I had to create two separate data frames and then join the data together because the paragraph data did not have date or other metadata.

```
meta_df <- data@meta
articles_df <- data@articles
paragraphs_df <- data@paragraphs

# metadata like date and headline
data2 <- tibble(element_id = seq(1:length(meta_df$Headline)),
                date = meta_df$Date,
                headline = meta_df$Headline)

# text data from paragraphs
paragraphs_data <- tibble(element_id = paragraphs_df$Art_ID,
                          text = paragraphs_df$Paragraph)

# have to join because paragraphs_df doesn't contain date or other metadata
data3 <- inner_join(data2, paragraphs_data, by = "element_id")
```

Here I am doing some cleaning of the text (this feels like it could be an endless task).

```
data3_clean <- data3 %>%
  # remove short values i.e. link to story, visit us on social media, etc.
  filter(nchar(text) > 50) %>%
  # remove websites
  mutate(text = str_remove_all(string = text,
                               pattern = "\\S*.com\\S*")) %>%
  # remove email addresses
  mutate(text = str_remove_all(string = text,
                               pattern = "\\S*@\\S*")) %>%
  # remove dashes at the start of a string
  mutate(text = str_remove_all(string = text,
                                pattern = "^-")) %>%
  # remove short values after removing websites, addresses, etc
  filter(nchar(text) > 50)

# Note(HD): \\S* match any number of non-space characters
```

To finish cleaning the data, I create a data frame of stop words to remove from the text.

```
custom_stop_words <- bind_rows(tibble(word = c("your_word"),
                                      lexicon = c("custom")),
                               stop_words)
```

Now I can unnest the text to word-level tokens and remove stop words.

```
 text_words <- data3_clean  %>%
  unnest_tokens(output = word, input = text, token = 'words') %>%
  anti_join(custom_stop_words, by = "word")
```

To start my sentiment analysis, I am using the Bing sentiment analysis lexicon. I join the Bing lexicon with the cleaned and unnested data set to retain only sentiment words and a binary categorical sentiment value of positive or negative.

```
bing_sent <- get_sentiments('bing')

sent_words <- text_words %>% inner_join(bing_sent, by = 'word')
```

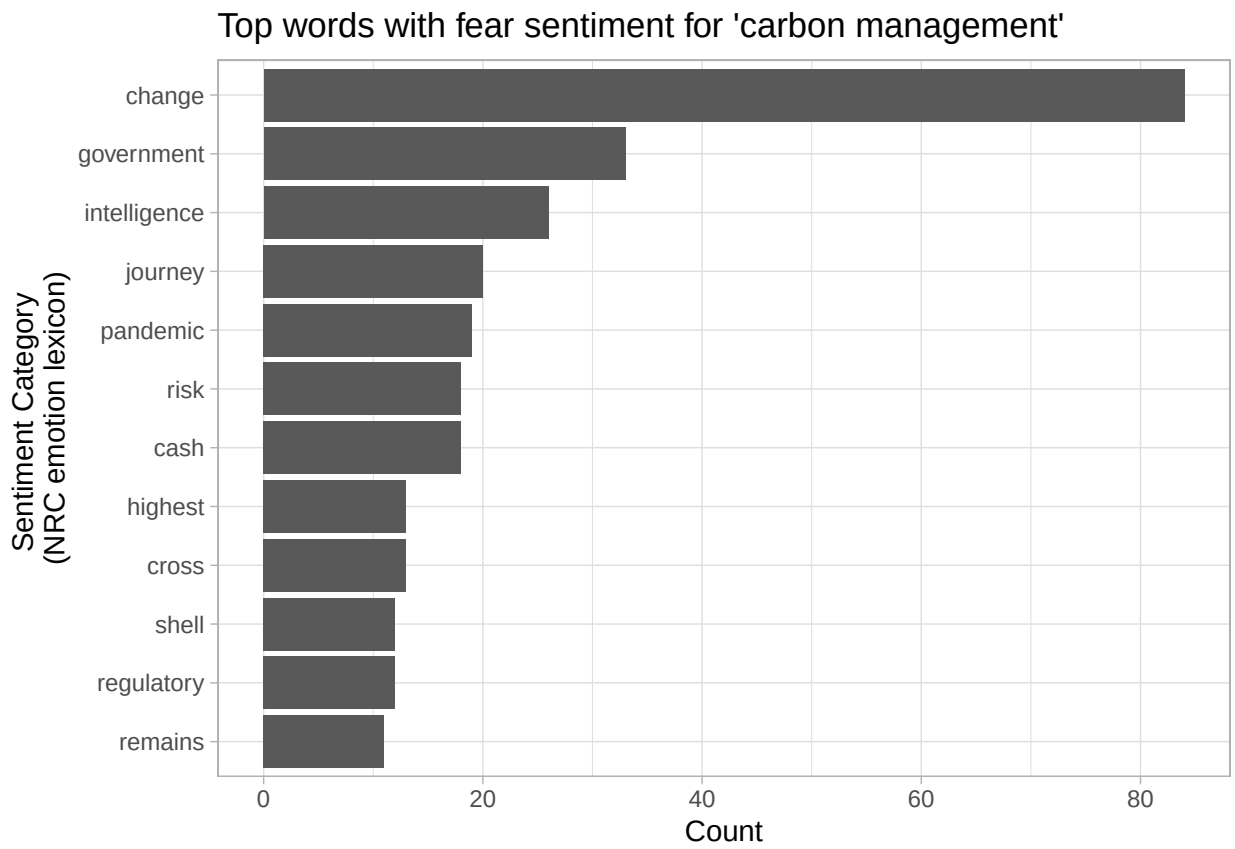
To obtain more specific sentiment values, I use the NRC emotion lexicon and filtered out the binary positive and negative sentiments. I did some exploratory analysis with the sentiment "fear" and found the top "fear" related words for carbon management. I plotted these results. I thought it was interesting that the top three words were change, government, and intelligence.

```
# obtaining nrc sentiments remove positive and negative
nrc_sent <- get_sentiments('nrc') %>%
  filter(!sentiment %in% c("positive", "negative"))

# exploratory analysis with fear sentiment
nrc_fear <- get_sentiments("nrc") %>%
  filter(sentiment == "fear")

# most common words for fear sentiment
fear_words <- data3_clean  %>%
  unnest_tokens(output = word, input = text, token = 'words') %>%
  inner_join(nrc_fear) %>%
  count(word, sort = TRUE) %>%
  filter(n > 10)

ggplot(data = fear_words, aes(x = reorder(word, n), y = n)) +
  geom_bar(stat = 'identity') +
  coord_flip() +
  theme_light() +
  labs(title = "Top words with fear sentiment for 'carbon management'",
       y = "Count",
       x = "Sentiment Category \n(NRC emotion lexicon)")
```

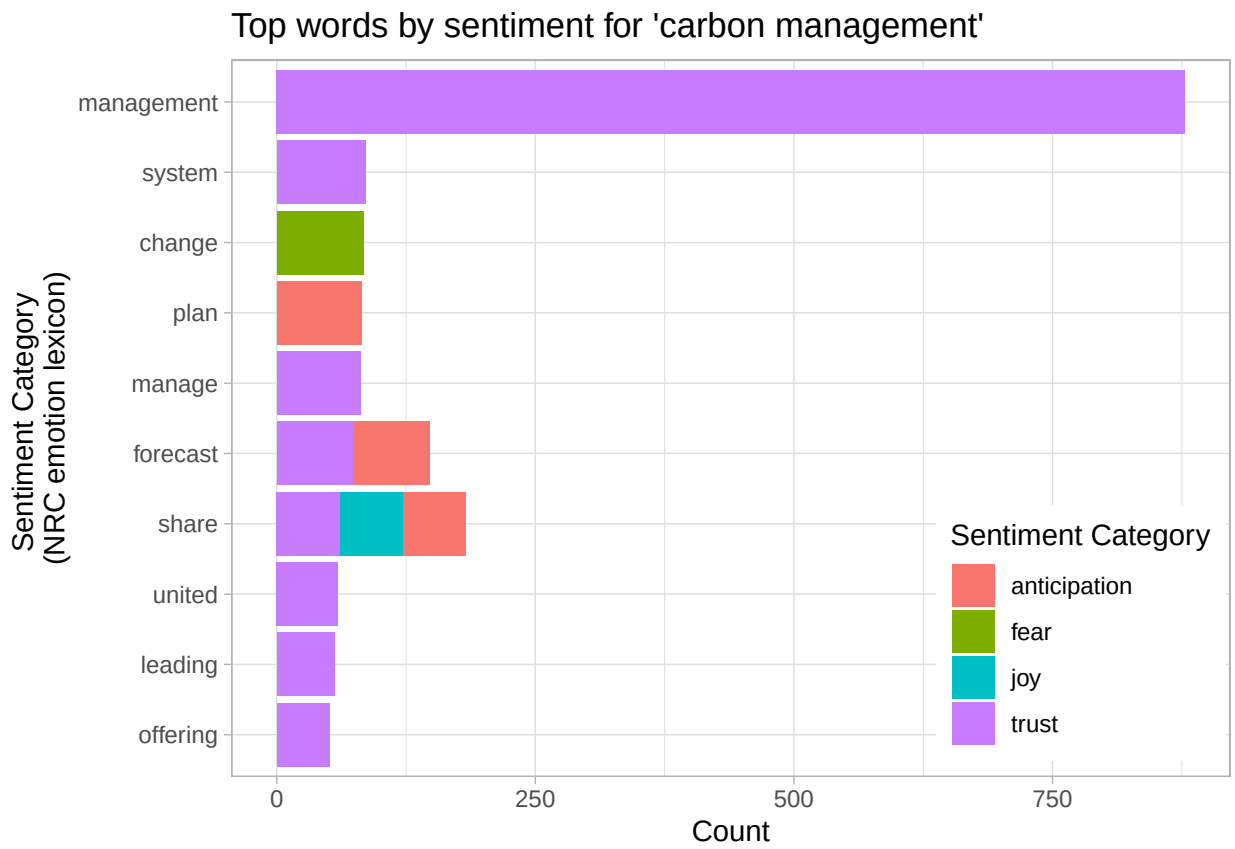


I also found the most common sentiment words in the data set and plotted these results. With more time, I would stem the word management and manage.

```
# most common words by sentiment
nrc_word_counts <- text_words %>%
  inner_join(nrc_sent) %>%
  count(word, sentiment, sort = TRUE) %>%
  ungroup() %>%
  filter(n > 50)
```

```
## Joining, by = "word"
```

```
ggplot(data = nrc_word_counts, aes(x = reorder(word, n), y = n, fill = sentiment)) +
  geom_bar(stat = 'identity') +
  coord_flip() +
  theme_light() +
  theme(legend.position = c(0.85, 0.2)) +
  labs(title = "Top words by sentiment for 'carbon management'",
       y = "Count",
       x = "Sentiment Category \n(NRC emotion lexicon)",
       fill = "Sentiment Category")
```



Lastly, I am going to plot the amount of emotion words (all eight from the NRC) as a percentage of all the emotion words used each day (aggregate text from articles published on the same day) to show how the emotion words change over time.

To do this I joined the NRC lexicon data frame with my unnested paragraph words and then calculate the total words per day and the percentage of all emotion words per day.

```
emotion_plot <- text_words %>%
  inner_join(nrc_sent, by = "word") %>%
  group_by(date) %>%
  count(sentiment) %>%
  mutate(total_words_day = sum(n)) %>%
  mutate(pct_sent_day = n / total_words_day)

ggplot(data = emotion_plot,
       aes(x = date,
           y = pct_sent_day)) +
  geom_line(color = "#8da0cb",
            size = .5) +
  geom_smooth(method = "lm", se = F, color = "red") +
  scale_x_date(date_labels = "%b-%Y") +
  scale_y_continuous(labels = scales::percent) +
  theme_light() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  facet_wrap(~ str_to_title(sentiment), ncol = 4) +
  labs(title = "Daily percentage of emotion sentiment for 'carbon management' \nAugust 2020 - April 202
       x = "Date",
```

```
       y = "Daily Percentage")
```

```
## `geom_smooth()` using formula 'y ~ x'
```

```
## Warning: Removed 7 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1 row(s) containing missing values (geom_path).
```