

# Notebook 3 - Final Product

**Author:** Kavan Wills

**Computing ID:** meu5cg

**Course:** DS 2023 - Communicating with Data

---

## Purpose

Present the final infographic and document all project resources.

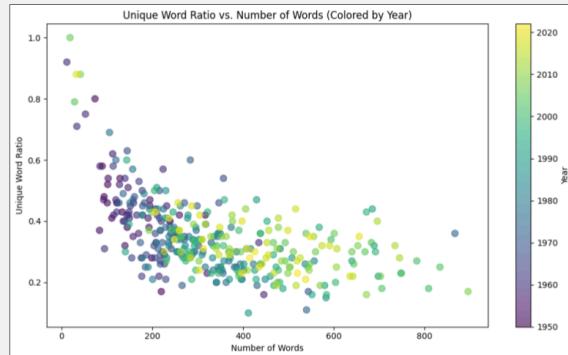
---

## Final Infographic

```
In [97]: from IPython.display import Image, display
import pandas as pd

# Display the final infographic
display(Image(filename='DSF Infographic (13).png'))
```

# Is Our Music Getting Dumber? An Analysis on Lyrical Complexity

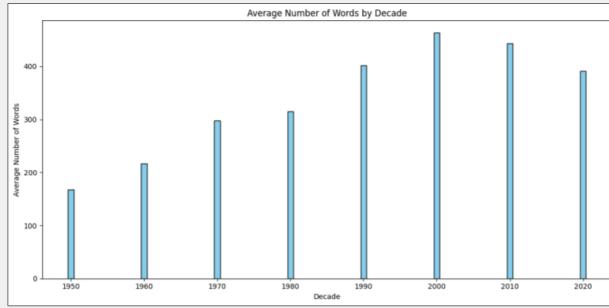


## Scatter Plot Interpretation

- Each dot represents one song
- Purple (1950s): Short songs with high vocabulary diversity
- Yellow (2020s): Long songs with low vocabulary diversity
- Notice the shift from top-left to bottom-right over time

## Heat Map Interpretation

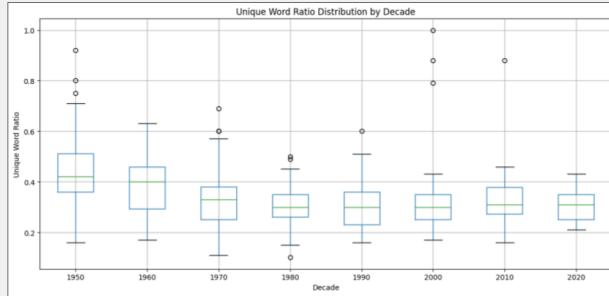
- 🔥 Z-SCORE HEATMAP
- Colors show how each decade compares to the average for that metric.
- Green in 1950s → Yellow in 2020s & Red in 1950s → Green in 2000s



## Bar Plot Interpretation

- 📈 WORD COUNT IS INCREASING
- Average word count nearly TRIPLED
- KEY TRENDS:
  - Steady increase from 1950s-2000s
  - Peak in 2000s
  - Slight decline in 2010s-2020s

## Unique Word Ratio Distribution by Decade



## Box Plot Interpretation

- 💡 VOCABULARY DIVERSITY DECLINING
- The 1950s had the highest median diversity. By 2020s, median dropped to ~0.3 – a large decrease despite using more words.
- KEY TRENDS:
  - Steepest decline: 1950s → 1980s
  - Stabilization: 1980s-2020s hover around ~0.3
- Notice: Box heights shrinking = less variation among songs.

## 2020s vs 1950s Songs:

- 133% MORE words
- 30% LESS unique vocabulary

Modern hits: More words but arguably more simple

### Data Source:

BiMMuDa Dataset (Hamilton et al., 2024) 371 songs from Billboard Year-End Top 5 (1950-2022) Sample sizes: n=46-53 per full decade, 2020s: n=14 (limited to 2020-2022)

### Disclaimer:

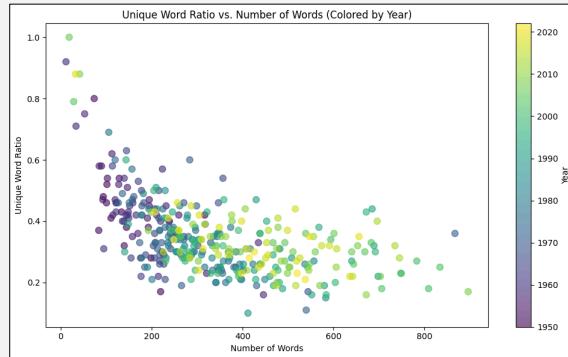
+ Dataset only includes top 5 songs from each year in Billboard charts, not all music is measured.  
+ Songs without lyrics are excluded from lyric-based metrics.  
+ Lyrics and melodies were manually transcribed; small errors are possible.

### Analysis:

Kavan Wills | DS 2023 | University of Virginia  
Computing ID: meu5cg

```
In [96]: from IPython.display import SVG, display  
display(SVG(filename="DSF Infographic (11).svg"))
```

# Is Our Music Getting Dumber? An Analysis on Lyrical Complexity

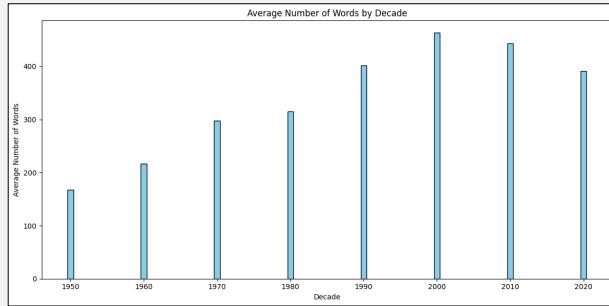


## Scatter Plot Interpretation

- Each dot represents one song
- Purple (1950s): Short songs with high vocabulary diversity
- Yellow (2020s): Long songs with low vocabulary diversity
- Notice the shift from top-left to bottom-right over time

## Heat Map Interpretation

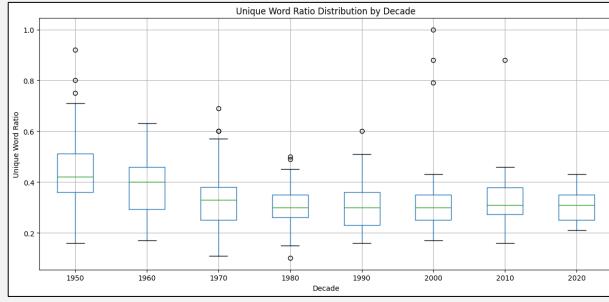
- Z-SCORE HEATMAP**
- Colors show how each decade compares to the average for that metric.
- Green in 1950s → Yellow in 2020s & Red in 1950s → Green in 2000s



## Bar Plot Interpretation

- WORD COUNT IS INCREASING**
- Average word count nearly TRIPLED
- KEY TRENDS:**
  - Steady increase from 1950s-2000s
  - Peak in 2000s
  - Slight decline in 2010s-2020s

## Unique Word Ratio Distribution by Decade



## Box Plot Interpretation

- VOCABULARY DIVERSITY DECLINING**
- The 1950s had the highest median diversity. By 2020s, median dropped to ~0.3 – a large decrease despite using more words.
- KEY TRENDS:**
  - Steepest decline: 1950s → 1980s
  - Stabilization: 1980s-2020s hover around ~0.3
- Notice: Box heights shrinking = less variation among songs.

## 2020s vs 1950s Songs:

- 133% MORE words
- 30% LESS unique vocabulary

Modern hits: More words but arguably more simple

### Data Source:

BiMMuDa Dataset (Hamilton et al., 2024) 371 songs from Billboard Year-End Top 5 (1950-2022) Sample sizes: n=46-53 per full decade, 2020s: n=14 (limited to 2020-2022)

### Disclaimer:

Dataset only includes top 5 songs from each year in Billboard charts, not all music is measured.  
Songs without lyrics are excluded from lyric-based metrics.  
Lyrics and melodies were manually transcribed; small errors are possible.

### Analysis:

Kavan Wills | DS 2023 | University of Virginia  
Computing ID: meu5cg

# Title of Final Product

"Is Our Music Getting Dumber? An Analysis on Lyrical Complexity"

---

## Description of Final Product

This infographic explores the paradox of modern popular music: while songs have gained more words (133% more words than songs from the 1950s), they have simultaneously become more simple, with a 30% decrease in vocabulary diversity. The 1950s averaged 168 words per song with a 0.44 unique word ratio, while the 2020s average 391 words with only a 0.31 ratio (calculations below).

## Visual Story:

The infographic uses a 24" × 36" poster format to tell a data-driven story through:

### 1. Scatter Plot (Top Left)

Shows individual songs plotted by word count vs. unique word ratio  
Color-coded by year (purple = 1950s, yellow = 2020s)  
Reveals the clustering pattern: older songs (short & diverse) vs. modern songs (long & repetitive)

### 2. Heatmap (Top Right)

Shows all metrics across decades in a color-coded matrix  
Colors show how each decade compares to the average for that metric.  
Demonstrates the inverse relationship: word count rising while diversity declining

### 3. Bar Chart (Middle Right)

Average word count by decade showing steady increase from 1950s to 2000s  
Peak at 2000s with slight decline in 2020s

### 4. Box Plot (Bottom Right)

Distribution of lyrical diversity across decades  
Shows declining median from 1950s-1980s, then stabilization at lower levels

## Supporting Elements:

- **Key Statistics Callout Box** (center): "2020s songs: 133% MORE words (168→391), 30% LOWER diversity (0.44→0.31)"
- **Annotations** by each plot explaining trends and key insights

## Design Approach:

### Color Scheme:

- **Temporal gradient (Scatter plot):** Purple (1950s) to yellow (2020s) shows progression over time
- **Intensity heatmap:** Bright green (high values) to dark red (low values) shows metric magnitude
- **Consistent blue:** Bar and box plots use blue for clean, professional appearance
- **Neutral background:** White/light gray for maximum readability

### Layout:

- 2x2 grid arrangement with four plots
- Key statistic callout centered for emphasis
- Annotations positioned directly below/beside each plot
- Hierarchical flow: title → visuals → interpretation → source

### Typography:

- Bold headers for section titles and key statistics
- 14-16pt body text in annotations for readability
- Clear axis labels with appropriate font sizing
- Sans-serif font (Arial/similar) for modern, clean look

### Annotations:

- Text boxes with borders for visual separation
- Bullet points for scannability
- Arrows connecting annotations to relevant plot features
- Emoji icons (✍️📅🔥) to enhance visual interest and guide attention

### Target Audience:

Music enthusiasts and data visualization students.

### Main Message:

Modern music production prioritizes number of words over unique word ratio, which likely means more repetitiveness and arguably more simple songs.

```
In [88]: # Calculate exact statistics for infographic claims
import pandas as pd

df = pd.read_csv('bimmuda_per_song_full.csv')
df_clean = df[df['Number of Words'] > 0].copy()
df_clean['Decade'] = (df_clean['Year'] // 10) * 10

# Get 1950s and 2020s averages
stats_1950s = df_clean[df_clean['Decade'] == 1950].agg({
    'Number of Words': 'mean',
```

```

        'Unique Word Ratio': 'mean'
    })

stats_2020s = df_clean[df_clean['Decade'] == 2020].agg({
    'Number of Words': 'mean',
    'Unique Word Ratio': 'mean'
})

# Calculate percentage changes
word_increase = ((stats_2020s['Number of Words'] - stats_1950s['Number of Words'])
                  / stats_1950s['Number of Words'] * 100)

ratio_decrease = ((stats_1950s['Unique Word Ratio'] - stats_2020s['Unique Word Ratio'])
                  / stats_1950s['Unique Word Ratio'] * 100)

print(f"1950s: {stats_1950s['Number of Words']:.1f} words, {stats_1950s['Unique Word Ratio']:.2f} ratio")
print(f"2020s: {stats_2020s['Number of Words']:.1f} words, {stats_2020s['Unique Word Ratio']:.2f} ratio")
print(f"\nWord count increase: {word_increase:.1f}%")
print(f"Diversity decrease: {ratio_decrease:.1f}%")

```

1950s: 167.9 words, 0.44 ratio  
 2020s: 391.4 words, 0.31 ratio

Word count increase: 133.0%  
 Diversity decrease: 29.7%

```

In [89]: df_clean = df[df["Number of Words"] > 0].copy()

df_clean["Decade"] = (df_clean["Year"] // 10) * 10

decade_summary = (
    df_clean
    .groupby("Decade")
    .agg(
        mean_words=("Number of Words", "mean"),
        mean_unique_words=("Number of Unique Words", "mean"),
        mean_unique_ratio=("Unique Word Ratio", "mean"),
        mean_syllables=("Number of Syllables", "mean"),
    )
)

decade_summary = decade_summary.round({
    "mean_words": 1,
    "mean_unique_words": 1,
    "mean_unique_ratio": 2,
    "mean_syllables": 1,
})

decade_summary.loc[[1950, 2020]]

```

Out[89]:

Decade	mean_words	mean_unique_words	mean_unique_ratio	mean_syllables
1950	167.9	65.7	0.44	213.1
2020	391.4	118.3	0.31	473.9

In [90]:

```
w_50 = decade_summary.loc[1950, "mean_words"]
w_20 = decade_summary.loc[2020, "mean_words"]
r_50 = decade_summary.loc[1950, "mean_unique_ratio"]
r_20 = decade_summary.loc[2020, "mean_unique_ratio"]

word_increase_pct = ((w_20 - w_50) / w_50) * 100
ratio_decrease_pct = ((r_50 - r_20) / r_50) * 100

print("Average words per song:")
print(f" 1950s: {w_50:.1f}")
print(f" 2020s: {w_20:.1f}")
print(f" Percent increase: {word_increase_pct:.1f}%")

print("\nAverage unique-word ratio:")
print(f" 1950s: {r_50:.2f}")
print(f" 2020s: {r_20:.2f}")
print(f" Percent decrease: {ratio_decrease_pct:.1f}%")
```

Average words per song:

1950s: 167.9

2020s: 391.4

Percent increase: 133.1%

Average unique-word ratio:

1950s: 0.44

2020s: 0.31

Percent decrease: 29.5%

## Design Process Documentation

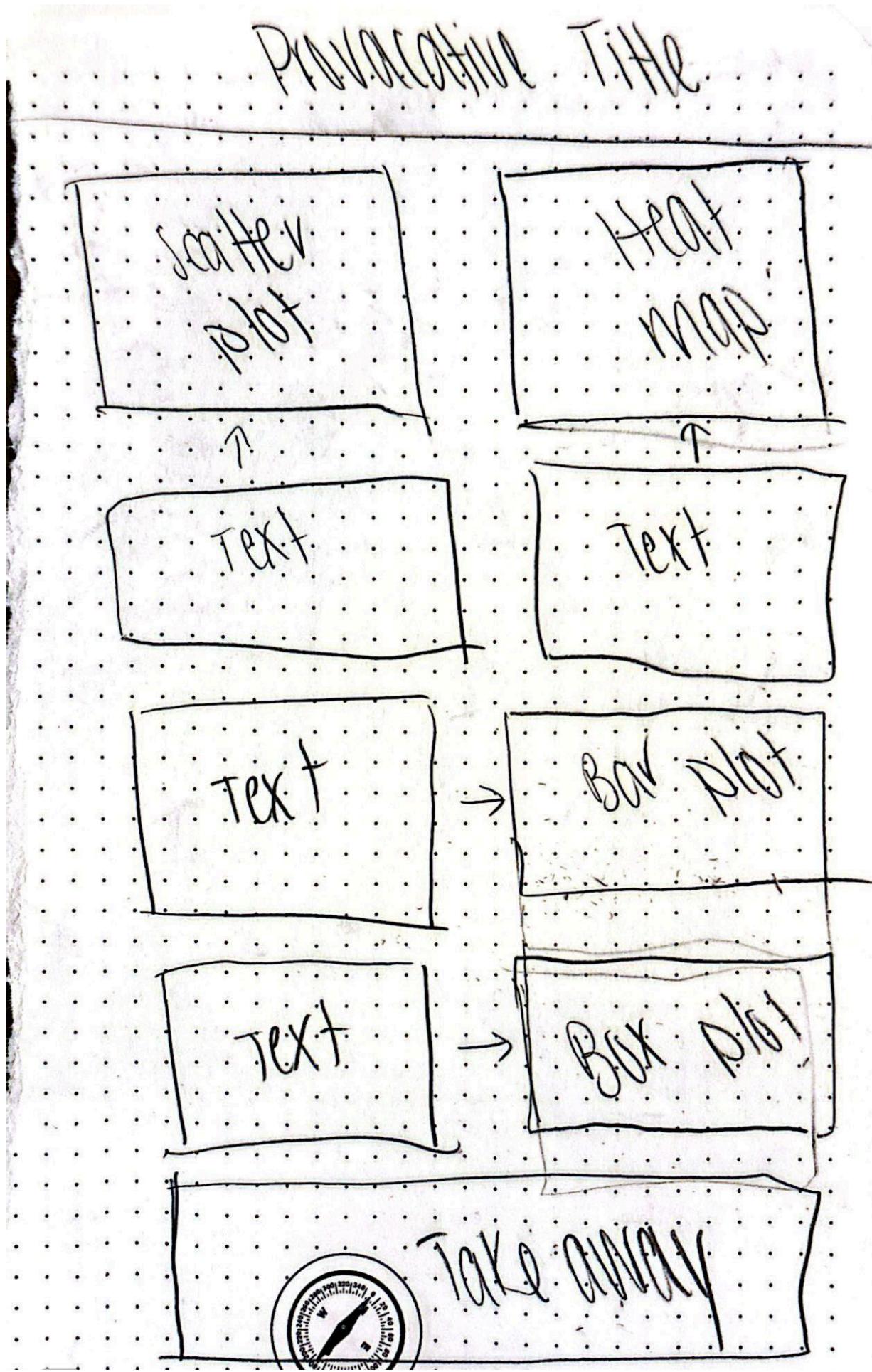
### Paper Storyboard

Before creating the infographic digitally, I sketched the layout on paper to plan composition, plot arrangement, and visual hierarchy.

In [99]:

```
from IPython.display import Image, display

# Display storyboard sketch
display(Image(filename='Infographic_rough_sketch.JPG'))
```





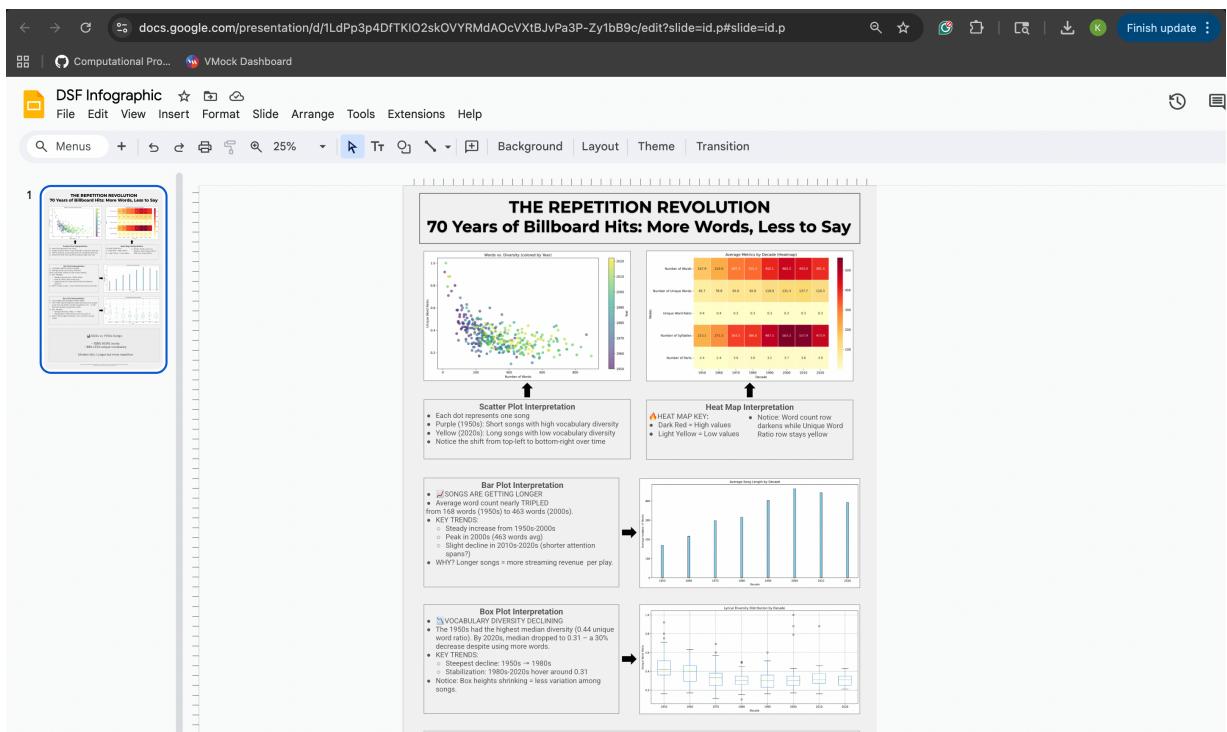
### Storyboard decisions:

- Positioned scatter plot top-left as primary focal point
- Placed heatmap top-right to show comprehensive metrics
- Bar and box plots middle-right and bottom-right to support main narrative
- Central key statistic box for immediate impact

## Design Tool: Google Slides

The infographic was created in Google Slides with custom dimensions (24" x 36").

```
In [92]: display(Image(filename='DSF_goolgedriveediting.png'))
```



## Project Manifest

```
In [105...]: import pandas as pd

manifest_data = [
    # --- Core notebooks (source of analysis) ---
    {
        "Resource Name": "DFP_Notebook1.ipynb",
        "Type": "Jupyter Notebook",
        "Description": "Notebook 1 – project framing, BiMMuDa data descriptive analysis",
        "Link": "./DFP_Notebook1.ipynb"
    }
]
```

```
},
{
  "Resource Name": "DFP_Notebook2.ipynb",
  "Type": "Jupyter Notebook",
  "Description": "Notebook 2 – exploratory data analysis and visualization"
  "Link": "./DFP_Notebook2.ipynb"
},
{
  "Resource Name": "DFP_Notebook3.ipynb",
  "Type": "Jupyter Notebook",
  "Description": "Notebook 3 – final infographic, supporting statistical findings"
  "Link": "./DFP_Notebook3.ipynb"
},

# --- PDF exports (for easy viewing) ---
{
  "Resource Name": "DFP_Notebook1.pdf",
  "Type": "PDF Export",
  "Description": "PDF export of Notebook 1 for easier viewing/printing"
  "Link": "./DFP_Notebook1.pdf"
},
{
  "Resource Name": "DFP_Notebook2.pdf",
  "Type": "PDF Export",
  "Description": "PDF export of Notebook 2 for easier viewing/printing"
  "Link": "./DFP_Notebook2.pdf"
},
{
  "Resource Name": "DFP_Notebook3.pdf",
  "Type": "PDF Export",
  "Description": "PDF export of Notebook 3 for easier viewing/printing"
  "Link": "./DFP_Notebook3.pdf"
}

# --- Data file ---
{
  "Resource Name": "bimmuda_per_song_full.csv",
  "Type": "CSV Data File",
  "Description": "Per-song BiMMuDa dataset used in the project (379 rows, 10 columns)"
  "Link": "./bimmuda_per_song_full.csv"
}

# --- Final infographic & design artifacts ---
{
  "Resource Name": "DSF Infographic (13).png",
  "Type": "Image (PNG)",
  "Description": "Final infographic poster (PNG, 24\"x36\" canvas) for presentation"
  "Link": "./DSF Infographic (13).png"
},
{
  "Resource Name": "DSF Infographic (11).svg",
  "Type": "Image (SVG)",
  "Description": "Final infographic poster (SVG, vector format) suitable for web"
  "Link": "./DSF Infographic (11).svg"
},
```

```
"Resource Name": "Infographic_rough_sketch.JPG",
"Type": "Image (JPG)",
"Description": "Hand-drawn rough sketch of the infographic layout cr
"Link": "./Infographic_rough_sketch.JPG"
},
{
    "Resource Name": "DSF_goolgedriveediting.png",
    "Type": "Image (PNG)",
    "Description": "Screenshot of editing the infographic in Google Slic
    "Link": "./DSF_goolgedriveediting.png"
},
# --- External resources ---
{
    "Resource Name": "Project GitHub Repository",
    "Type": "External Resource",
    "Description": "Public GitHub repository containing all project file
    "Link": "https://github.com/kavanwills/ds2023-final-bimmuda"
},
{
    "Resource Name": "Infographic Google Slides",
    "Type": "External Resource",
    "Description": "Google Slides file used to design and export the fir
    "Link": "https://docs.google.com/presentation/d/1LdPp3p4DfTKI02skOVY
},
{
    "Resource Name": "BiMMuDa Paper (Hamilton et al., 2024)",
    "Type": "External Resource",
    "Description": "Research paper describing the construction of the Bi
    "Link": "https://transactions.ismir.net/articles/10.5334/tismir.168"
},
{
    "Resource Name": "BiMMuDa GitHub Repository",
    "Type": "External Resource",
    "Description": "GitHub repository containing BiMMuDa data and code r
    "Link": "https://github.com/madelinehamilton/BiMMuDa"
},
{
    "Resource Name": "BiMMuDa Documentation",
    "Type": "External Resource",
    "Description": "Online documentation / Google Doc describing the per
    "Link": "https://docs.google.com/document/d/17EyW-bA8oppRZ_3KloYB5Z-
}
]

manifest_df = pd.DataFrame(manifest_data)
manifest_df
```

Out [105...]

	Resource Name	Type	Description	
0	DFP_Notebook1.ipynb	Jupyter Notebook	Notebook 1 – project framing, BiMMuDa data des...	./DF
1	DFP_Notebook2.ipynb	Jupyter Notebook	Notebook 2 – exploratory data analysis and vis...	./DF
2	DFP_Notebook3.ipynb	Jupyter Notebook	Notebook 3 – final infographic, supporting sta...	./DF
3	DFP_Notebook1.pdf	PDF Export	PDF export of Notebook 1 for easier viewing/pr...	./
4	DFP_Notebook2.pdf	PDF Export	PDF export of Notebook 2 for easier viewing/pr...	./
5	DFP_Notebook3.pdf	PDF Export	PDF export of Notebook 3 for easier viewing/pr...	./
6	bimmuda_per_song_full.csv	CSV Data File	Per-song BiMMuDa dataset used in the project (...)	./bimmud...
7	DSF Infographic (13).png	Image (PNG)	Final infographic poster (PNG, 24"x36" canvas)...	./DSF I
8	DSF Infographic (11).svg	Image (SVG)	Final infographic poster (SVG, vector format) ...	./DSF
9	Infographic_rough_sketch.JPG	Image (JPG)	Hand-drawn rough sketch of the infographic lay...	./Infographic
10	DSF_googledriveediting.png	Image (PNG)	Screenshot of editing the	./DSF_goc

	Resource Name	Type	Description
			infographic in Google Slides
11	Project GitHub Repository	External Resource	Public GitHub repository containing all project files
12	Infographic Google Slides	External Resource	Google Slides file used to design and export the infographic
13	BiMMuDa Paper (Hamilton et al., 2024)	External Resource	Research paper describing the construction of the dataset
14	BiMMuDa GitHub Repository	External Resource	GitHub repository containing BiMMuDa data and code
15	BiMMuDa Documentation	External Resource	Online documentation / Google Doc describing the dataset

## Project Summary

### Dataset

- **Name:** BiMMuDa (Billboard Melodic Music Dataset)
- **Songs:** 371 from Billboard year-end top 5 (1950-2022)
- **Focus:** Lyrical complexity trends

### Key Finding

**Modern Billboard hits use 133% more words than 1950s songs but have 30% less vocabulary diversity.**

### Methodology

1. Data establishment (Notebook 1)
2. Exploratory analysis with 17+ visualizations (Notebook 2)
3. Selection of best plots for infographic
4. Storyboard design on paper

5. Infographic in Google Slides (24x36 format)

6. Final export as PNG and PDF

## Tools Used

- **Analysis:** Python (pandas, matplotlib, seaborn)
  - **Design:** Google Slides
  - **Documentation:** Jupyter Notebooks
- 

## AI Usage Acknowledgement

Per course policy, I used **Claude (Anthropic)** and **ChatGPT (OpenAI)** as a learning aid for code examples, debugging, and conceptual clarification. All submitted work reflects my own understanding and reasoning. I can explain all aspects of this work without external assistance.

**Kavan Wills (meu5cg)**