

The Words of the Beast

An Entropy-driven Analysis of Iron Maiden Lyrics

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1 Introduction

As a passionate fan of Iron Maiden, I merged my love for heavy metal with the analytical framework information theory provides. This project aims to analyse the entropy of Iron Maiden's lyrics by exploring their evolution over time and examining the connection between lyrical complexity and the band's popularity. By using entropy as a unit of measure, I explored how the variability and unpredictability in their lyrics correlates with their enduring success since they formed in 1975.

2 Background

Building upon recent findings from studies that analyse trends in lyrical complexity and repetitiveness in music, my project investigates the entropy of Iron Maiden's lyrics to understand their evolution and its connection to the band's popularity. Varnum et al. (2021) argued that the simplicity of song lyrics in popular American music has increased over six decades, attributing this trend to the ever growing variety of genres and the cognitive processing advantages of simpler lyrics. Parada-Cabaleiro et al. (2024) further explored these dynamics, showing that English-language lyrics in popular music have become simpler, more repetitive, and more personal. Both studies provide a solid starting point for using entropy as a measure of variability and complexity in lyrics. So, with that in mind, this project aims to determine whether similar trends are present in Iron Maiden's unique discography, with hypotheses derived directly from the findings of these research papers.

3 Hypotheses

Building on the academic background, my experience as an Iron Maiden fan leads me to believe that these general trends regarding increasing lyrical simplicity might not apply to them. In addition to this, I also aim to explore whether Spotify streams correlate with lyrical entropy in their songs. That said, this project is guided by two primary hypotheses:

1. Iron Maiden's lyrical entropy has increased over time
2. Iron Maiden songs with lower lyrical entropy are more likely to accumulate more Spotify streams

4 Dataset

The dataset for this project was handcrafted using a combination of web scraping for extracting lyrics from AZLyrics and a manual curation approach. In total, the dataset includes 158 studio songs from 17 Iron Maiden albums released between 1980 and 2021. Songs from EPs, special editions, and live albums were not

considered for this analysis. Additionally, instrumental songs were excluded too, resulting in the omission of four songs:

1. *Transylvania* (Iron Maiden, 1980)
2. *The Ides of March* (Killers, 1981)
3. *Genghis Khan* (Killers, 1981)
4. *Losfer Words* (Big ‘Orra) (Powerslave, 1984)

During the data cleaning process, vocalisations such as “ow”, “oow”, “ooh”, and “yeah” were removed to normalise the text, as the criteria for their inclusion in the raw text were not consistent. In addition, song annotations like [CHORUS], [BRIDGE], and others were also removed to ensure lyrical consistency. Finally, contractions within the lyrics were expanded to maintain uniformity for analysis.

Regarding the data for number of streams, only information from Spotify was considered. The streaming data is updated as of January 28, 2025 (Kwordb, 2025), and it only considers studio album versions as well.

The cleaned dataset is organized into five columns. Each entry in the dataset included the following fields:

song_title	album	release_year	lyrics	streams
Wasted Years	Somewhere in Time	1986	From the coast of gold across the seven seas I'm travelling on far and wide ...	165762363

Figure 1: Dataset sample

5 Calculating Word Entropy

To calculate word entropy, the lyrics of each song were tokenised. The occurrences of each unique word, denoted as $\text{count}(w_i)$, were then summed up. With that said, the probability $p(w_i)$ of each unique word w_i was computed using the formula:

$$p(w_i) = \frac{\text{count}(w_i)}{\text{total number of words in the song}}$$

Finally, the entropy H was determined by applying the entropy formula:

$$H = - \sum_{i=1}^n p(w_i) \log_2 p(w_i)$$

6 Iron Maiden’s Lyrical Entropy

6.1 Lyrical Entropy in Songs

A preliminar analysis of Iron Maiden’s lyrical entropy reveals variations in lyrical complexity across their discography. Table 1 highlights the top 10 songs with the highest word entropy, which mostly consists of songs from recent albums such as Senjutsu (2021) and The Book of Souls (2015), with ”The Parchment” (Senjutsu, 2021) exhibiting the highest entropy score of 7.38. In contrast, Table 2 presents the top 10 songs with the lowest word entropy, mainly from earlier albums like Iron Maiden (1980) and Seventh Son of a Seventh Son (1988), with ”Don’t Look To The Eyes Of A Stranger” (Virtual XI, 1998) recording the lowest entropy of 4.36. These findings suggest Iron Maiden’s lyrical variability and complexity have increased in their more recent albums compared to their earlier songs.

Song Title	Album	Release Year	Word Entropy
The Parchment	Senjutsu	2021	7.38
Empire Of The Clouds	The Book of Souls	2015	7.22
The Talisman	The Final Frontier	2010	7.16
Paschendale	Dance of Death	2003	7.14
Rime Of The Ancient Mariner	Powerslave	1984	7.11
The Legacy	A Matter of Life and Death	2006	7.09
When The Wild Wind Blows	The Final Frontier	2010	7.00
Death Of The Celts	Senjutsu	2021	6.98
The Red And The Black	The Book of Souls	2015	6.80
The Apparition	Fear of the Dark	1992	6.80

Table 1: Top 10 Songs with Highest Word Entropy

Song Title	Album	Release Year	Word Entropy
Don’t Look To The Eyes Of A Stranger	Virtual XI	1998	4.36
Out Of The Silent Planet	Brave New World	2000	4.46
Running Free	Iron Maiden	1980	4.58
Seventh Son Of A Seventh Son	Seventh Son of a Seventh Son	1988	4.82
Sun And Steel	Piece of Mind	1983	5.00
Deja-vu	Somewhere in Time	1986	5.10
The Evil That Men Do	Seventh Son of a Seventh Son	1988	5.16
Brave New World	Brave New World	2000	5.20
Remember Tomorrow	Iron Maiden	1980	5.21
Bring Your Daughter... To The Slaughter	No Prayer for the Dying	1990	5.23

Table 2: Top 10 Songs with Lowest Word Entropy

6.2 Lyrical Entropy by Album

The mean word entropy of Iron Maiden’s albums, as shown in Table 3 and Figure 2, demonstrates a general increase in lyrical complexity over the band’s career. Early albums like Iron Maiden (1980) and Killers (1981) have lower mean entropy scores of 5.54 and 5.75, respectively. Starting with The Number of the Beast (1982), there is a chaotic but steady increase in word entropy, reaching peaks with The Final Frontier (2010) at 6.64 and Senjutsu (2021) at 6.44.

While some albums such as Virtual XI (1998) and Brave New World (2000) show slight decreases, the overall trend indicates increasing variability and complexity in Iron Maiden’s lyrics over time. More importantly, it is possible to see it achieves a stable high entropy from the 2003 and onwards. This progression supports my first hypothesis which argued that the band’s lyrical entropy has increased over the years.

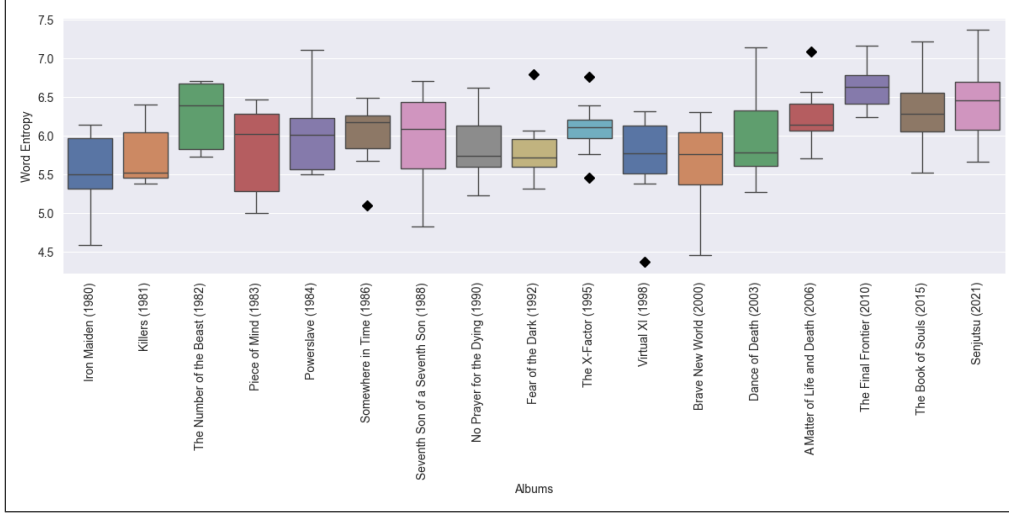


Figure 2: Entropy for Words by Albums

7 Entropy and Spotify Streams

To check whether there is relationship between lyrical entropy and Spotify streams, the streaming data was log-transformed to better visualise possible trends in a scatter plot. The dataset was then divided into training and test sets for regression analysis. Both linear and polynomial (degree 2) regression models were fitted to predict $\log(\text{streams})$ based on word entropy. The mean squared error (MSE) for the linear regression model was 0.2541, while the polynomial regression model yielded an MSE of 0.2544. The similar MSE values suggest that the linear model captures the relationship between lyrical entropy and Spotify streams, with no significant improvement observed from the polynomial approach. These findings suggest that there is little to no strong association between a song's lyrical entropy and its streaming popularity on Spotify, therefore providing little support for my second hypothesis which argued that Iron Maiden songs with lower entropy are more likely to accumulate higher streams.

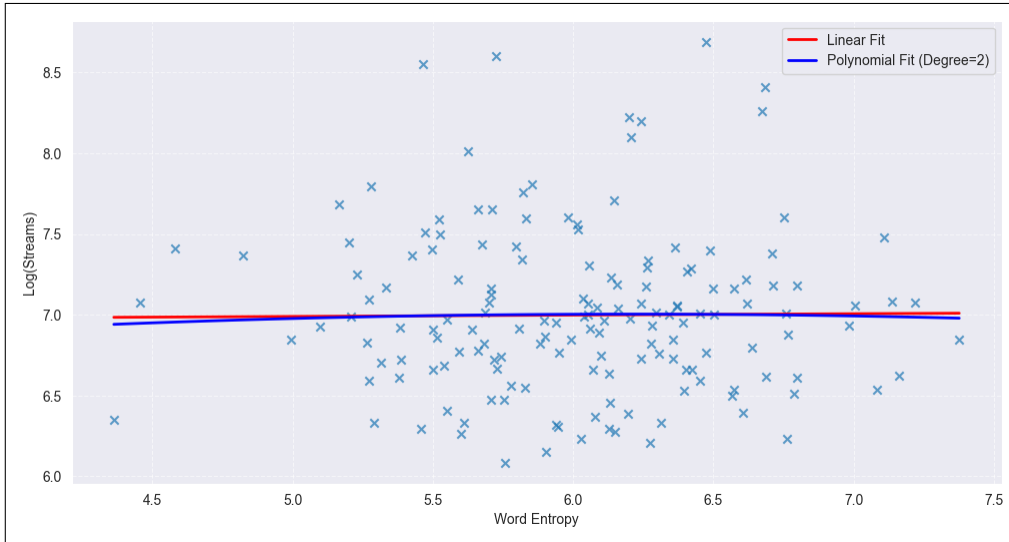


Figure 3: Regression fits

Album	Release Year	Mean Word Entropy
Iron Maiden	1980	5.54
Killers	1981	5.75
The Number of the Beast	1982	6.27
Piece of Mind	1983	5.83
Powerslave	1984	6.03
Somewhere in Time	1986	6.01
Seventh Son of a Seventh Son	1988	5.95
No Prayer for the Dying	1990	5.84
Fear of the Dark	1992	5.81
The X-Factor	1995	6.09
Virtual XI	1998	5.68
Brave New World	2000	5.66
Dance of Death	2003	5.98
A Matter of Life and Death	2006	6.26
The Final Frontier	2010	6.64
The Book of Souls	2015	6.31
Senjutsu	2021	6.44

Table 3: Mean Word Entropy of Iron Maiden Albums

8 Discussion

The findings of this short project partially support the proposed hypotheses I started with. The first hypothesis, which asserted that Iron Maiden’s lyrical entropy has increased over time, is visually confirmed by the observed trend of rising entropy scores in their more recent albums. This may indicate a deliberate evolution towards greater lyrical complexity and variability in Iron Maiden songs. However, the second hypothesis, which stated that songs with lower lyrical entropy are more likely to accumulate higher Spotify streams, is not supported by the regression analysis. The negligible difference in mean squared error (MSE) between the linear and polynomial models suggests that there is no significant relationship between lyrical entropy and streaming popularity. This implies that the popularity of Iron Maiden’s songs may be influenced by factors beyond lyrical complexity, such as musical factors, for example. Taking this into consideration, while analyzing lyrical entropy provides valuable insights into the thematic and linguistic development of Iron Maiden’s lyrics, a comprehensive understanding of a song’s popularity would benefit from incorporating musical analysis alongside lyrical examination.

References

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