

# From Pathology to Technology: A Corpus-based Case Study of AI-driven Semantic Change

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## Abstract

The widespread adoption of generative artificial intelligence (GenAI) stands among the most significant developments of recent years, bringing about substantial changes in the English lexicon. While existing dictionaries have documented this shift through examples such as the new technological sense of the word 'hallucinate,' empirical investigations into the mechanics and speed of such semantic change occurrences remain relatively scarce. To address this research gap, the present corpus-based mixed-methods case study investigated the semantic and collocational evolution of the lemma 'hallucinate,' together with its nominal and adjectival forms, across a ten-year period (2016–2026). Using data from the 25-billion-word 'News on the Web' (NOW) corpus, triangulated with the 89-billion-word 'English Trends' corpus, the research compared patterns of lexical behavior during the pre-AI and post-AI periods. Quantitative analyses demonstrated a statistically significant increase in usage frequency following the diffusion of GenAI in late 2022, accompanied by a substantial shift in the target word's collocational profile from the medical domain (e.g., schizophrenia) toward technological and epistemic contexts (e.g., LLMs, output). Qualitative concordance analysis revealed that this semantic transition was naturalized in discourse through metalinguistic framing and direct anthropomorphism, reflecting a cognitive tendency to map human psychological conditions onto complex machine operations. The findings provide empirical evidence that semantic change can emerge and stabilize within months, offering critical implications for real-time lexicography and EFL pedagogy.

**Keywords:** Collocational Profile, Conceptual Metaphor, Corpus Linguistics, Generative AI, Semantic Shift.

## Introduction

Large-scale events in the life of a society are among the principal factors that give rise to linguistic change (1). From this perspective, the public diffusion of generative artificial intelligence (GenAI) and Large Language Models (LLMs) represents one of the most significant technological developments of recent years (2). The rapid spread of artificial intelligence (AI) technologies has brought them into widespread use across diverse domains. ChatGPT, one of the best-known examples, reached 100 million users within a few months of its launch at the end of 2022 (3), creating an unusually rapid expansion of AI-mediated language practices. Although considerable research has examined AI in language education (4, 5), comparatively less attention has been devoted to the effects of AI on language itself, particularly on changes in the English lexicon. This issue is important because technological developments can lead not only to the introduction of new lexical items but also to the reassignment of meanings to words already established in the

language. The present study examines this process through the case of the verb 'hallucinate' and its morphological variants, which have increasingly been used to describe the production of false or misleading outputs by GenAI systems. The word 'hallucinate' provides a particularly clear case of this development. The verb was traditionally associated primarily with medical experience, referring to the perception of objects, sounds, or smells that do not actually exist (6). In contemporary AI discourse, however, it is used for situations in which an AI system produces outputs that appear correct but contain false information. The new technological sense was selected as the Cambridge Dictionary Word of the Year for 2023 (7) and an additional technological sense was subsequently recorded in the Oxford English Dictionary (8). These developments indicate that the AI usage is part of an ongoing lexical development rather than merely a short-lived online expression. Semantic change has traditionally been examined through such mechanisms as

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broadening, narrowing, metaphor, metonymy and evaluative change, while more recent approaches have emphasized reanalysis and the role of contextual usage in the emergence of new meanings (9-11). Importance is also attached to collocational environment within the Neo-Firthian tradition: the meaning of a word is understood partly through the company it keeps and recurring co-occurrence patterns may reveal changes in semantic preference (12-14). This perspective is especially relevant to the present study because a change in meaning should be accompanied by a corresponding change in the lexical environment in which the word regularly occurs. Cognitive Semantics and Conceptual Metaphor Theory provide a complementary account of the mechanism involved, since meanings may be extended by mapping a familiar source domain onto a new and less accessible target domain (15, 16). In the case examined here, a term associated with human psychological experience has been transferred to AI systems and used to characterize their production of factually incorrect outputs.

Previous corpus research has shown that semantic change can be detected through shifts in collocational patterns. Changes in the immediate linguistic environment have been used to trace the development of words such as 'gay', while studies of terms including 'anxiety', 'depression' and 'trauma' have demonstrated that meanings may expand, contract, or become more strongly associated with conceptual domains (17-19). At the same time, semantic change need not take place over very long historical periods. Rapid shifts have been documented in response to major social events, suggesting that substantial changes in lexical meaning can emerge over relatively short periods (20). Research on the AI-related use of 'hallucinate' has already addressed its metaphorical character, sociological consequences and critical implications, including the concern that the term anthropomorphizes machines and may reduce attention to their actual computational limitations (21-22). Corpus-based research has also begun to examine AI-related semantic change, but existing studies have relied on relatively small or highly specific datasets, including Reddit, or on short observation periods following the release of ChatGPT (23). What remains less clearly established is how rapidly the semantic transition can be observed in large-scale diachronic data,

whether it is reflected systematically in the collocational profile of the lexical item and how the new usage becomes naturalized in discourse.

The originality of the present study lies in addressing these dimensions together. First, it examines 'hallucinate' and its morphological variants across 2016–2026 using the large-scale, internationally compiled News on the Web (NOW) corpus, with additional evidence from the English Trends corpus (24). Second, semantic change is operationalized not simply as the appearance of a new dictionary sense but as a measurable transformation in frequency and collocational profile, with statistical tests used to assess the relationship between historical period and semantic domain. Third, the study combines quantitative corpus analysis with qualitative concordance analysis to examine how the technological meaning is framed and naturalized in post-AI discourse. In this way, the study seeks to contribute empirical evidence concerning the speed, linguistic manifestation and discursive mechanism of AI-driven semantic change, rather than merely documenting that such a meaning exists.

The study therefore asks the following questions:

- (a) Has the frequency of use of the verb 'hallucinate' and its morphological variants changed following the widespread adoption of GenAI?
- (b) What changes has their collocational profile undergone in recent years?
- (c) Does the shift in collocational profile correspond to the period of widespread GenAI adoption?
- (d) How is the semantic transition discursively framed and naturalized in post-AI discourse?

## Methodology

To uncover how and why the word 'hallucinate' and its morphological forms underwent semantic change following the widespread diffusion of AI technologies, the study employed a corpus-based mixed-methods approach. A corpus-based methodology was selected because corpora make it possible to investigate language based on authentic data while reducing researcher bias. The use of corpora also allows large volumes of data to be processed computationally – something that would not be feasible manually.

## Corpus Selection

The study is based on the NOW corpus. This corpus was not chosen arbitrarily; several substantive considerations motivated its selection. First, unlike well-known corpora such as the Corpus of Contemporary American English (COCA) and the British National Corpus (BNC), the NOW corpus is not limited to data from the period preceding the emergence of GenAI. Instead, millions of new words are added to it every month. In terms of size, the NOW corpus surpasses corpora such as COCA and BNC by a considerable margin. It contains about 25 billion words. These characteristics make it particularly suitable for tracking linguistic developments that have occurred following the widespread adoption of GenAI. A second consideration is that the NOW corpus is not restricted to a single variety of English. It contains English-language news materials from twenty different countries. This makes it possible for the findings to capture changes across multiple varieties of English rather than reflecting only one dialect. Despite these advantages, the fact that the NOW corpus consists exclusively of news texts may be regarded as a limitation of the present study. It should therefore be emphasized that the findings concern media discourse in English; everyday conversation and academic writing fall outside the scope of this investigation.

## Data Extraction

To determine both how the frequency of the target word has changed over time and how its most frequent collocates differ across distinct time periods, a search was conducted for the wildcard lemma 'hallucinat\*' within the NOW corpus. Given that a word family comprising a lexical item and its morphological variants possesses psychological reality (25) and that an isolated word form cannot fully represent the semantic scope of a lexical item (12), data collection was not restricted to searching only for the infinitival form of the verb 'hallucinate.' Instead, the query 'hallucinat\*' was used to include all morphological variants of the word, including its nominal and adjectival forms. During the search process, both the frequency of use of the target item and its most commonly occurring collocates were identified through the search interface. First, the keyword was searched in the 'Chart' section of the corpus interface and data concerning its frequency of use across the 2016–2026 period were extracted. Subsequently,

to determine how the collocational profile of 'hallucinat\*' had changed, the query 'hallucinat\*' was entered into the 'Word/phrase' field of the 'Collocates' section, while '\*' was entered into the 'Collocates' field so that all collocates could be retrieved. To identify a potential relationship between collocational change and the period during which GenAI achieved widespread prominence, the search results were divided using the 'Sections' function into two categories: pre-AI and post-AI. The first category included search results from 2016 through the end of 2022, while the second comprised results from the beginning of 2023 through June 2026. The end of 2022 was selected as the finishing point of the first period because it was at that time that ChatGPT surpassed 100 million users (3).

## Data Analysis

In the first stage of the study, quantitative methods were employed to investigate changes in the usage frequency and collocational profile of 'hallucinat\*'; relevant statistical analyses were subsequently conducted. The second stage of the study relied on qualitative methods.

To answer the first research question, a search for the lemma 'hallucinat\*' was conducted through the 'Chart' section of the NOW corpus. Data concerning the frequency of use of the word from 2016 to 2026 were extracted from the corpus interface, specifically the rate of occurrence per million words. The decision to use occurrences per million words rather than raw frequency counts was motivated by the fact that raw frequencies vary according to the size of each yearly subcorpus, which would undermine reliable comparison across years. The frequency data for the pre-AI period (2016–2022) and the post-AI period (2023–2026) were then compared to determine whether usage frequency had undergone a statistically significant change. The statistical comparison was performed using jamovi, version 2.7.8 (The jamovi project, Sydney, Australia), with an independent-samples t-test.

To address the second research question, a comparative search was conducted in the 'Collocates' section of the NOW corpus for the most frequent collocates of the target lemma during the periods 2016–2022 and 2023–2026. The results were sorted by relevance rather than frequency, since this criterion identifies collocates that occur disproportionately often with the target word

compared to other words, thereby filtering out conjunctions and other function words with little lexical content. Given the very large size of the corpus and the intention to eliminate words that occurred only rarely, the minimum frequency threshold for collocates in each period was set at 30. As a result, the corpus interface generated a list of collocates ranked from the highest to the lowest relevance score across both time periods.

To answer the third research question, the semantic fields of the twenty most frequent collocates of 'hallucinat\*' in each of the periods 2016–2022 and 2023–2026 were identified. Thus, a total of forty collocates were classified according to whether they belonged primarily to the medical or technological domain. Following this semantic categorization, the frequency with which each collocate co-occurred with the node word in the respective periods was recorded. Statistical analyses for this comparison were performed using jamovi, version 2.7.8 (The jamovi project, Sydney, Australia), with a chi-square test of independence supplemented by Fisher's exact test. These tests were used to assess whether the distribution of semantic domains differed significantly between the pre-AI and post-AI periods.

To address the fourth research question and elucidate the mechanisms underlying the observed semantic change, a qualitative concordance analysis was conducted. A selection of sentence examples containing the wildcard lemma 'hallucinat\*' was extracted from the 'KWIC' section of the NOW corpus, which allows the surrounding context of the keyword to be examined more closely. Given the vast number of occurrences of the target item in the post-AI period (2023–2026), examining every instance manually was not feasible. Therefore, to avoid selection bias and ensure methodological rigor, a systematic random sample of 200 concordance lines was generated from this subcorpus.

This randomized dataset was subsequently subjected to manual coding. The objective of this procedure was to identify the principal syntactic and discursive strategies employed by language users to facilitate the semantic shift of the target word. During the coding process, the concordance lines were categorized into distinct discursive patterns, such as metalinguistic framing (where the novel usage is explicitly defined or hedged) and

direct anthropomorphism (where the machine is positioned as a literal cognitive agent). Following this categorization, the data were interpreted qualitatively based on Cognitive Semantics and Conceptual Metaphor Theory.

### Reliability and Validity

As noted above, one limitation of the NOW corpus is that it covers only news discourse. To mitigate this issue to some extent, the study also made use of the 'English Trends' corpus through Sketch Engine – a monitor corpus of English containing approximately 89 billion words. This provided corpus-based triangulation, which increases the reliability of research findings.

Because the classification of collocates into semantic fields prior to the chi-square analysis depended to some degree on researcher interpretation, an intercoder reliability assessment was carried out. First, a codebook was developed to guide the classification procedure. A second researcher then independently classified the selected collocates. To assess the degree of agreement between coders, Cohen's kappa was calculated, yielding a value of  $\kappa = 0.846$ . Since this value falls within the range of 0.81 to 1.00, it indicates "almost perfect" agreement between coders (26), which in turn suggests that the classification procedure was highly reliable.

## Results

The analyses conducted in the NOW corpus, with additional evidence from the English Trends corpus, reveal substantial changes in both the frequency and collocational profile of 'hallucinat\*' following the widespread diffusion of GenAI. The quantitative results are presented first, followed by the qualitative analysis of post-AI concordance patterns.

### The Usage Frequency of 'hallucinat\*'

Figure 1 presents the annual frequency of the wildcard lemma 'hallucinat\*' in the NOW corpus between 2016 and 2026. Because the sizes of the yearly subcorpora differ, normalized frequencies per million words are used for comparison. The figure shows that the frequency remained relatively stable throughout the pre-AI period, followed by a marked increase beginning in 2023. This upward pattern continued during the post-AI years, indicating a clear rise in the use of the lexical family after the widespread diffusion of GenAI.

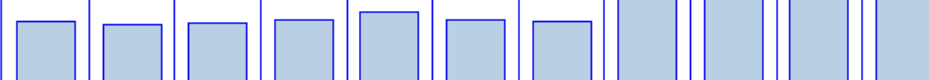
| SECTION                            | 2016                                                                               | 2017    | 2018    | 2019    | 2020    | 2021    | 2022    | 2023    | 2024    | 2025    | 2026    |
|------------------------------------|------------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| FREQ                               | 2275                                                                               | 2466    | 2253    | 3050    | 4536    | 3721    | 3798    | 5491    | 6906    | 11420   | 3987    |
| WORDS (M)                          | 1,531.3                                                                            | 1,746.5 | 1,569.1 | 1,987.5 | 2,607.8 | 2,449.2 | 2,588.0 | 1,897.9 | 1,050.2 | 3,246.1 | 1,125.5 |
| PER MIL                            | 1.49                                                                               | 1.41    | 1.44    | 1.53    | 1.74    | 1.52    | 1.47    | 2.89    | 3.22    | 3.52    | 3.54    |
| SEE ALL<br>SUB-SECTIONS<br>AT ONCE |  |         |         |         |         |         |         |         |         |         |         |

**Figure 1:** Diachronic Frequency Distribution of the 'hallucinat\*' lemma in the NOW Corpus

**Note:** NOW = News on the Web, FREQ = raw frequency, WORDS (M) = yearly subcorpus size in millions of words, PER MIL = occurrences per million words.

Between 2016 and 2022, the frequency of 'hallucinat\*' remained comparatively stable, ranging from 1.41 occurrences per million words in 2017 to 1.74 in 2020. The mean frequency for the pre-AI period was 1.51 occurrences per million words. A marked increase appeared in 2023, when the frequency reached 2.89 occurrences per million words and the upward tendency continued thereafter, reaching 3.54 in 2026. The mean frequency for the post-AI period was 3.29 occurrences per million words.

An independent-samples t-test was initially considered for comparison of the two periods. Since the Levene test indicated unequal variances,  $F(1, 9) = 7.10$ ,  $p = 0.026$ , Welch's t-test was used. The Shapiro-Wilk test did not indicate a violation of normality,  $W = 0.888$ ,  $p = 0.132$ . The analysis

revealed a statistically significant difference between the pre-AI and post-AI periods, Welch's  $t(3.44) = -11.23$ ,  $p < 0.001$ . The mean normalized frequency was substantially higher during the post-AI period. Cohen's  $d$  was  $-7.76$ , indicating a very large effect size. The results are presented in Table 1. The Welch's t-test shows a statistically significant difference in the normalized frequency of 'hallucinat\*' between the pre-AI and post-AI periods, with a substantially higher mean frequency in the post-AI period. The associated p-value was below 0.001, indicating that the observed difference is highly unlikely to be attributable to chance. The very large Cohen's  $d$  further indicates that the magnitude of the difference between the two periods was substantial.

**Table 1:** Independent-samples t-test Results Generated in jamovi, version 2.7.8 (The jamovi project, Sydney, Australia)

|               |           | Statistic | df   | p       |           | Effect size |
|---------------|-----------|-----------|------|---------|-----------|-------------|
| Per_Mil_Score | Welch's t | -11.2     | 3.44 | < 0.001 | Cohen's d | -7.76       |

**H<sub>a</sub>:**  $\mu_{\text{Pre-AI}} < \mu_{\text{Post-AI}}$

**Note:** df = Degrees of Freedom, p = Probability Value, H<sub>a</sub> = Alternative Hypothesis,  $\mu$  = Population Mean, Per\_Mil\_Score = occurrences per million words.

Because the NOW corpus consists exclusively of news discourse, the frequency pattern was additionally examined in the English Trends corpus through Sketch Engine. Figure 2 shows the corresponding frequency trend in the English Trends corpus. The frequency of 'hallucinat\*' remained relatively stable before 2023, at approximately 1.5 occurrences per million words,

before increasing sharply after the widespread diffusion of GenAI. The upward pattern continued through the post-AI period, reaching approximately 5.1 occurrences per million words by 2026. This independent corpus pattern closely parallels the increase observed in the NOW corpus and therefore provides additional support for the robustness of the diachronic trend.

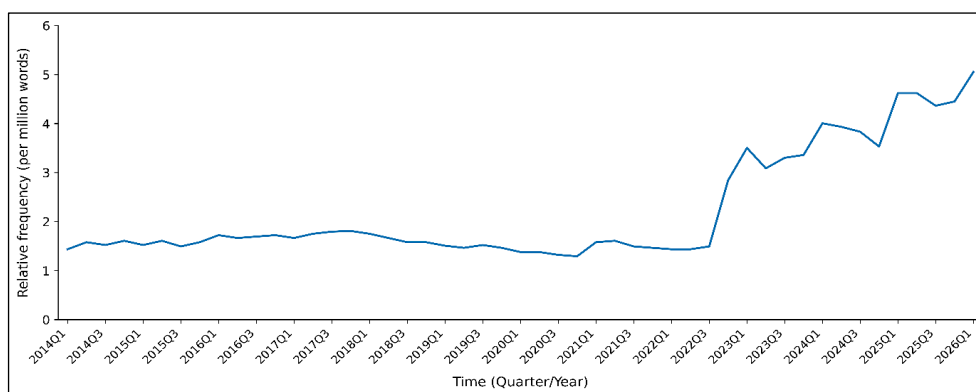


**Figure 2:** Frequency Trend of the 'hallucinat\*' lemma per million words, Generated with the Help of the Timeline Tool in Sketch Engine

The frequency of 'hallucinat\*' remained close to 1.5 occurrences per million words until the beginning of 2023, after which a pronounced increase was observed. By 2026, the frequency had reached 5.1 occurrences per million words. Thus, the direction of change observed in the English Trends corpus corresponds to that found in the NOW corpus.

### The Collocational Profile of 'Hallucinat\*'

Figures 3A and 3B compare the principal collocates of 'hallucinat\*' in the pre-AI (2016–2022) and post-AI (2023–2026) periods in the

NOW corpus. The ranking is based on the relative ratio between the two periods rather than raw frequency, while raw token counts are also displayed. The figure reveals a clear contrast between the two periods, with medically oriented collocates predominating before the widespread adoption of GenAI and technological and epistemic collocates becoming prominent afterward. This contrast provides visual evidence of the substantial reorganization of the lexical environment of 'hallucinat\*' following the diffusion of GenAI.

A

|    | WORD/PHRASE   | TOKENS 1 | TOKENS 2 | PM 1 | PM 2 | RATIO |
|----|---------------|----------|----------|------|------|-------|
| 1  | CAREER        | 34       | 3        | 0.0  | 0.0  | 6.6   |
| 2  | SCHIZOPHRENIA | 882      | 90       | 0.1  | 0.0  | 5.7   |
| 3  | SCHIZOPHRENIC | 33       | 4        | 0.0  | 0.0  | 4.8   |
| 4  | COMMON        | 827      | 109      | 0.1  | 0.0  | 4.4   |
| 5  | REFLECT       | 30       | 4        | 0.0  | 0.0  | 4.4   |
| 6  | CAUSES        | 895      | 133      | 0.1  | 0.0  | 3.9   |
| 7  | APC           | 38       | 6        | 0.0  | 0.0  | 3.7   |
| 8  | PDP           | 41       | 7        | 0.0  | 0.0  | 3.4   |
| 9  | MOST          | 829      | 146      | 0.1  | 0.0  | 3.3   |
| 10 | TREATMENT     | 140      | 26       | 0.0  | 0.0  | 3.1   |
| 11 | INSPIRED      | 36       | 7        | 0.0  | 0.0  | 3.0   |
| 12 | STRONG        | 53       | 12       | 0.0  | 0.0  | 2.6   |
| 13 | VERBAL        | 53       | 12       | 0.0  | 0.0  | 2.6   |
| 14 | DELIRIOUS     | 38       | 10       | 0.0  | 0.0  | 2.2   |
| 15 | CHASING       | 30       | 8        | 0.0  | 0.0  | 2.2   |
| 16 | SPACE         | 42       | 12       | 0.0  | 0.0  | 2.0   |
| 17 | ASSOCIATED    | 192      | 61       | 0.0  | 0.0  | 1.8   |
| 18 | CONSENSUAL    | 44       | 14       | 0.0  | 0.0  | 1.8   |
| 19 | MERE          | 51       | 18       | 0.0  | 0.0  | 1.6   |
| 20 | TOOK          | 42       | 15       | 0.0  | 0.0  | 1.6   |
| 21 | CONVULSIONS   | 33       | 12       | 0.0  | 0.0  | 1.6   |
| 22 | ELSE          | 35       | 13       | 0.0  | 0.0  | 1.6   |

B

|    | WORD/PHRASE    | TOKENS 2 | TOKENS 1 | PM 2 | PM 1 | RATIO |
|----|----------------|----------|----------|------|------|-------|
| 1  | AI             | 2923     | 12       | 0.3  | 0.0  | 419.3 |
| 2  | DATA           | 179      | 1        | 0.0  | 0.0  | 308.1 |
| 3  | RESPONSES      | 147      | 1        | 0.0  | 0.0  | 253.0 |
| 4  | RATES          | 122      | 1        | 0.0  | 0.0  | 210.0 |
| 5  | CITATIONS      | 105      | 1        | 0.0  | 0.0  | 182.5 |
| 6  | INFORMATION    | 400      | 4        | 0.0  | 0.0  | 172.1 |
| 7  | TOOLS          | 95       | 1        | 0.0  | 0.0  | 163.5 |
| 8  | MODELS         | 471      | 5        | 0.1  | 0.0  | 162.2 |
| 9  | MODEL          | 280      | 3        | 0.0  | 0.0  | 160.7 |
| 10 | BIAS           | 185      | 2        | 0.0  | 0.0  | 159.2 |
| 11 | BIASES         | 86       | 1        | 0.0  | 0.0  | 148.0 |
| 12 | MISINFORMATION | 74       | 1        | 0.0  | 0.0  | 127.4 |
| 13 | ANSWERS        | 208      | 3        | 0.0  | 0.0  | 119.4 |
| 14 | MISTAKES       | 136      | 2        | 0.0  | 0.0  | 117.1 |
| 15 | OUTPUT         | 63       | 1        | 0.0  | 0.0  | 108.4 |
| 16 | REASONING      | 60       | 1        | 0.0  | 0.0  | 103.3 |
| 17 | PROPENSITY     | 59       | 1        | 0.0  | 0.0  | 101.6 |
| 18 | ISSUE          | 117      | 2        | 0.0  | 0.0  | 100.7 |
| 19 | SYSTEMS        | 102      | 2        | 0.0  | 0.0  | 87.8  |
| 20 | LOWER          | 48       | 1        | 0.0  | 0.0  | 82.6  |
| 21 | CHATGPT        | 277      | 6        | 0.0  | 0.0  | 79.5  |
| 22 | CONTEXT        | 84       | 2        | 0.0  | 0.0  | 72.3  |

**Figure 3:** Top collocates of the lemma 'hallucinat\*' across pre-AI and post-AI periods in the NOW corpus.

(A) Section 1 (2016–2022) – 14,479,806,024 words, (B) Section 2 (2023–2026) – 8,411,523,544 words

**Note:** NOW = News on the Web, AI = Artificial Intelligence, TOKENS 1 and TOKENS 2 = collocate token counts in Sections 1 and 2, respectively, PM1 and PM2 = normalized occurrences per million words in Sections 1 and 2, respectively, RATIO = Relative Ratio Between the Section-specific Normalized Frequencies.

The contrast between the two periods is pronounced. The collocate 'AI' occurred 419.3 times more frequently with 'hallucinat\*' in the post-AI period, whereas 'schizophrenia' occurred 5.7 times more frequently in the pre-AI period. Other high-ranking pre-AI collocates, including 'causes,' 'treatment,' 'verbal,' 'delirious,' and 'convulsions,' were associated primarily with the traditional medical sense. The post-AI profile, in contrast, contained technological terms such as 'model,' 'output,' and 'ChatGPT,' as well as epistemic terms such as 'citations,' 'data,' 'information,' and 'answer.'

A second collocational analysis was conducted using the English Trends corpus. Since this corpus does not support the wildcard query 'hallucinat\*', separate searches were carried out for the verb

'hallucinate' and the noun 'hallucination.' Table 2 presents collocates occurring exclusively in either the pre-AI or post-AI period. The pre-AI collocates are predominantly associated with human, perceptual and pathological contexts, whereas the post-AI collocates are strongly related to AI, language models, generated outputs and factual inaccuracy. The contrast is evident across the grammatical relations examined, including subjects and objects of 'hallucinate' and modifiers of 'hallucination.' This pattern further supports the view that the lexical family underwent a substantial shift from a primarily medical-human semantic environment to a technological-epistemic one after the widespread diffusion of GenAI.

**Table 2:** Comparative Collocational Profiles of 'hallucinate' and 'hallucination' across pre-AI and post-AI eras Based on Sketch Engine Data

| Grammatical Relation                  | Exclusive Pre-AI Collocates (2016-2022)                                                                                                                          | Exclusive Post-AI Collocates (2023-2026)                                                                     |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Results for the Lemma 'Hallucinate'   |                                                                                                                                                                  |                                                                                                              |
| <b>Subjects</b>                       | Batman, Depp, Rue, Carol, schizophrenia, Homer, Rick, Louella, Tyreese, Peggy, Crews, Santana, Elliot                                                            | model, AI, ChatGPT, LLM, chatbot, LLMs, bot, Claude, GPT-5, Gemini, Bard, perplexity, Grok, copilot          |
| <b>Objects</b>                        | vision, conversation, ghost, encounter, monster, smell, creature, elephant                                                                                       | answer, citation, reference, output, URL, chatbot, nonsense, misinformation, dependency, falsehood, endpoint |
| Results for the Lemma 'Hallucination' |                                                                                                                                                                  |                                                                                                              |
| <b>Modifiers</b>                      | auditory, visual, vivid, severe, intense, uncommon, rare, frightening, terrifying, unpleasant, hypnopompic, delirium, paranoia, delusion, amnesia, schizophrenia | AI, LLM, bias, chatbot, ChatGPT, AI-generated, GenAI, LLMs, inaccuracy, extrinsic, inevitable                |

**Note:** AI = Artificial Intelligence, GenAI = Generative Artificial Intelligence, LLM = Large Language Model, LLMs = Large Language Models, URL = Uniform Resource Locator.

The pre-AI subjects and objects of 'hallucinate' were primarily associated with human or pathological contexts, including names of human characters, 'schizophrenia,' 'vision,' and 'smell.' Similarly, modifiers of 'hallucination' included 'auditory,' 'visual,' 'severe,' 'delirium,' 'paranoia,' 'delusion,' and 'amnesia.' No technological or clearly epistemic collocates appeared in these categories. During the post-AI period, the pattern changed substantially. Subjects included 'model,' 'AI,' 'ChatGPT,' 'LLM,' and 'chatbot,' while objects included 'answer,' 'citation,' 'reference,' and 'output.' The modifiers of 'hallucination' likewise shifted toward terms such as 'AI,' 'LLM,' 'chatbot,' 'ChatGPT,' 'AI-generated,' and 'GenAI.'

### The Link between the Collocates of 'Hallucinat\*' and the GenAI Boom

To test the relationship between the historical period and the semantic domain of the strongest collocates, the twenty principal collocates from each period were classified according to a predefined codebook. Twenty-four of the forty collocates were assigned to either the medical or technological domain; the remaining sixteen were classified as general vocabulary and excluded from this comparison.

Seven collocates were classified as medical, with 2,074 occurrences in the pre-AI period and 287 in the post-AI period, as shown in Table 3. Table 3 shows that the medical collocates were concentrated overwhelmingly in the pre-AI period. 'Causes' and 'schizophrenia' accounted for the

largest shares, while every listed medical collocate declined in the post-AI period. This pattern indicates a marked reduction in the traditional

medical semantic environment of 'hallucinat\*' after 2022.

**Table 3:** The Medical Collocates of the 'hallucinat\*' lemma in the NOW corpus

| Collocate       | Pre-AI Occurrence Counts | Post-AI Occurrence Counts |
|-----------------|--------------------------|---------------------------|
| Causes          | 895                      | 133                       |
| Schizophrenia   | 882                      | 90                        |
| Treatment       | 140                      | 26                        |
| Verbal          | 53                       | 12                        |
| Delirious       | 38                       | 10                        |
| Convulsions     | 33                       | 12                        |
| Schizophrenic   | 33                       | 4                         |
| Total Frequency | 2074                     | 287                       |

Seventeen collocates were classified as technological. Their combined frequency increased from 47 occurrences in the pre-AI period to 5,792 in the post-AI period, as presented in Table 4. Table 4 shows the opposite pattern for technological collocates. 'AI' was by far the most frequent item, while 'models,' 'information,'

'ChatGPT,' 'answers,' and related terms also increased sharply in the post-AI period. The distribution demonstrates that technological and epistemic vocabulary became a dominant part of the collocational environment of 'hallucinat\*' after 2022.

**Table 4:** The Technological Collocates of the 'hallucinat\*' lemma in the NOW corpus

| Collocate       | Pre-AI Occurrence Counts | Post-AI Occurrence Counts |
|-----------------|--------------------------|---------------------------|
| AI              | 12                       | 2923                      |
| Models          | 5                        | 471                       |
| Information     | 4                        | 400                       |
| Model           | 3                        | 280                       |
| ChatGPT         | 6                        | 277                       |
| Answers         | 3                        | 208                       |
| Bias            | 2                        | 185                       |
| Data            | 1                        | 179                       |
| Responses       | 1                        | 147                       |
| Mistakes        | 2                        | 136                       |
| Citations       | 1                        | 106                       |
| Systems         | 2                        | 102                       |
| Tools           | 1                        | 95                        |
| Biases          | 1                        | 86                        |
| Misinformation  | 1                        | 74                        |
| Output          | 1                        | 63                        |
| Reasoning       | 1                        | 60                        |
| Total Frequency | 47                       | 5792                      |

**Table 5:** Chi-square and Fisher's exact test results generated in jamovi, version 2.7.8 (The jamovi project, Sydney, Australia)

| Contingency Tables  |                 |               |         |
|---------------------|-----------------|---------------|---------|
| Period              | Semantic Domain |               | Total   |
|                     | Medical         | Technological |         |
| Pre-AI              | 2074            | 47            | 2121    |
| Post-AI             | 287             | 5792          | 6079    |
| Total               | 2361            | 5839          | 8200    |
| $\chi^2$ Tests      | Value           | df            | p       |
| $\chi^2$            | 6642            | 1             | < 0.001 |
| Fisher's exact test |                 |               | < 0.001 |
| N                   | 8200            |               |         |

**Note:** AI = Artificial Intelligence,  $\chi^2$  = Chi-square Statistic, df = Degrees of Freedom, p = Probability Value, N = Number of Classified Collocate Tokens.

A chi-square test of independence, supplemented by Fisher's exact test, was conducted to determine whether the distribution of semantic domains differed between the two historical periods. The contingency table and test results are presented in Table 5. Both tests indicated a highly significant association between historical period and semantic domain, with  $p < 0.001$ . The very large effect size further shows that the shift from predominantly medical collocates in the pre-AI period to predominantly technological collocates in the post-AI period was substantial rather than marginal.

A highly significant association was found between historical period and semantic domain,  $\chi^2(1) = 6642.00$ ,  $p < 0.001$ ; Fisher's exact test also yielded  $p < 0.001$ . The effect size was very large,  $\phi = 0.90$  (Cramer's  $V = 0.90$ ). In the pre-AI period, 97.8% of the classified collocate tokens belonged to the medical domain ( $n = 2,074$ ), whereas in the post-AI period 95.3% belonged to the technological domain ( $n = 5,792$ ). The collocational distribution therefore changed sharply across the two periods.

## The Mechanism of the Semantic Change of 'Hallucinat\*'

A qualitative analysis was conducted on a systematic random sample of 200 concordance lines containing 'hallucinat\*' from the post-AI period. The analysis focused on the discursive strategies through which the emerging technological meaning was presented and interpreted.

Two recurrent discursive patterns were identified: metalinguistic framing and direct anthropomorphism. In metalinguistic framing, the technological use of 'hallucinat\*' was explicitly defined, explained, or otherwise marked, whereas in direct anthropomorphism, AI systems were presented directly as entities capable of 'hallucinating.' Representative examples of these patterns are presented in Table 6. The concordance lines illustrate how the newer technological meaning ranges from explicitly explained usage to more conventionalized usage in which no additional clarification is required.

**Table 6:** Selected Post-AI Concordance Lines from the NOW Corpus

| Discursive Category     | Key Word in Context                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Metalinguistic Framing  | ... to interact directly with the digitised knowledge. Unlike typical AI that might 'hallucinate' -- generating false information -- this chatbot draws directly from verified metadata. Users ...<br>... Instant is a reduction in incorrect or misleading responses, often referred to as "hallucinations" in AI systems. These occur when a model presents false information as if ...<br>... also launched a reporting system for residents. Officials warn that AI chatbots can 'hallucinate,' producing incorrect or misleading information. They stress that no chatbot holds a ... |
| Direct Anthropomorphism | ... just improve how often it gives the right answer. AI can completely hallucinate by confidently answering a question when the correct answer is I don't ...<br>... of unbelievable proportion in literary fiction, while also acknowledging that AI models can hallucinate and make factual errors, especially with economics and hard data. In another ...                                                                                                                                                                                                                             |

**Note:** NOW = News on the Web, AI = Artificial Intelligence.

The metalinguistic examples frequently supplied an explicit explanation of the new sense, as in expressions referring to "generating false information" or "incorrect or misleading responses." In the examples classified as direct anthropomorphism, by contrast, AI systems were directly represented as entities that "hallucinate." The latter pattern indicates that the technological usage can function without explicit explanation of its metaphorical origin.

## Discussion

The findings indicate that the semantic development of 'hallucinate' is reflected simultaneously in three dimensions: increased frequency, a substantial reorganization of

collocational associations and the emergence of discourse patterns in which the technological usage can be employed without explicit explanation. Considered together, these findings provide a more precise account of AI-driven semantic change than a dictionary definition alone can provide.

The frequency results are consistent with previous research showing that semantic change may accelerate under conditions of major social or technological disruption. Rapid semantic developments have previously been documented in connection with large-scale events, demonstrating that lexical change is not necessarily restricted to processes unfolding over decades or centuries (20). The present findings extend this observation

to the AI context. In both the NOW and English Trends corpora, the frequency of 'hallucinat\*' remained comparatively stable before 2023 and increased sharply thereafter. The close correspondence between the two corpora is particularly important because they differ in their composition, reducing the likelihood that the observed pattern is attributable solely to one corpus.

At the same time, the present results differ from many earlier investigations of semantic change in terms of temporal scale. Research on words such as 'gay,' for example, has traced a semantic transition over approximately 150 years (17), while studies of 'anxiety,' 'depression,' and 'trauma' have examined gradual changes in conceptual scope across historical periods (18, 19). The present case develops within a much shorter period. Such speed is compatible with findings showing that major social events can produce measurable semantic changes over relatively short intervals (20), but the scale of the present corpus evidence provides a more direct quantitative view of this process in AI-related language.

The collocational findings provide the clearest evidence for the recontextualization of the lexical item. Before the widespread diffusion of GenAI, the dominant semantic environment was strongly medical: 'schizophrenia,' 'treatment,' 'delirious,' 'convulsions,' 'vision,' 'smell,' and related expressions were associated with the traditional sense. After 2022, this profile was largely replaced by technological and epistemic collocates, including 'AI,' 'model,' 'ChatGPT,' 'LLM,' 'output,' 'answer,' 'citation,' and 'information.' This pattern is consistent with the Neo-Firthian view that lexical meaning is partly constituted through recurrent collocational relations and semantic preference (12-14). The statistical association found in the present analysis,  $\chi^2(1) = 6642.00$ ,  $p < 0.001$ , with  $\phi = 0.90$ , shows that the observed change is not merely a matter of a few salient examples but a substantial redistribution of the lexical environment.

The findings also extend earlier corpus-based work on semantic change. Collocational evidence has previously been used to demonstrate the semantic development of lexical items over time, including the transition of 'gay' from an earlier meaning associated with happiness to its

contemporary sexual meaning (17). Similarly, changes in the semantic environments of psychological terms have been used to distinguish between conceptual expansion and increasing pathologization (18). In the present case, the direction of change is different: rather than moving further into or away from a single established conceptual domain, 'hallucinate' is increasingly distributed between its traditional medical sense and a technological-epistemic sense, with the latter becoming dominant in the post-AI data.

The qualitative findings provide an additional dimension to this development. The occurrence of metalinguistic framing suggests that speakers initially treated the technological use as a term that required explanation. This pattern is compatible with the observation that semantic innovations may initially appear as marked or context-dependent usages before becoming more established. The subsequent presence of direct anthropomorphism suggests a reduced need for such explanation, with AI systems increasingly being presented as legitimate subjects of the verb. The process can therefore be conceptualized as movement from explicitly marked metaphorical usage toward increasingly conventionalized technological usage.

Cognitive Semantics and Conceptual Metaphor Theory explain why this transfer may have been successful. The source domain involves a human psychological condition associated with the perception or production of information that does not correspond to external reality, whereas the target domain involves the production of factually incorrect but linguistically convincing outputs by an AI system. A conceptual mapping between these domains allows a relatively unfamiliar computational phenomenon to be described through a familiar human experience (16). The data suggest that this mapping was not restricted to isolated metaphorical expressions but became increasingly embedded in recurrent collocational patterns.

This interpretation is also consistent with previous discussions of the 'hallucination' metaphor in AI discourse. The term has been criticized for anthropomorphizing machines and for potentially obscuring questions of technological responsibility. The present corpus evidence cannot establish how the terminology originated or whether technology companies were responsible for

introducing it into wider discourse. It does, however, show that the technological framing became widely reproducible in news discourse and that its lexical environment changed together with its frequency. In this respect, the study provides corpus-based evidence for the stabilization of a metaphor that had previously been examined primarily from critical or conceptual perspectives (21, 22).

A further contribution concerns the relationship between semantic change and frequency. The post-AI increase in frequency occurred together with a strong transformation in semantic preference. This is relevant to previous findings that lexical frequency can influence susceptibility to semantic change (27), although the present study does not establish frequency as an independent causal mechanism. Rather, the results show that rapid increases in frequency and shifts in collocational environment occurred together following the expansion of GenAI discourse.

The findings therefore contribute to existing knowledge in three related ways. First, they provide large-scale diachronic evidence for the speed with which an AI-related semantic innovation can become established in contemporary English. Second, they demonstrate that the change can be observed quantitatively through a marked redistribution of collocational associations across semantic domains. Third, they connect this quantitative development with qualitative evidence showing how the technological meaning is first explained and subsequently used more independently. The combination of these dimensions allows semantic change to be treated not simply as a change in dictionary definition but as a process involving frequency, semantic preference, conceptual mapping and discourse conventionalization.

From a practical perspective, the findings suggest that lexicographic resources should continue to monitor rapidly changing technological vocabulary through large-scale corpora. Traditional dictionary publication cycles may not capture the speed at which a technological sense emerges and becomes sufficiently frequent to warrant separate treatment. Continuous corpus-based monitoring could allow lexicographers to identify substantial changes in semantic preference at an earlier stage.

The findings are also relevant to English Language

Teaching (ELT) and English as a Foreign Language (EFL) vocabulary instruction. Learners increasingly encounter words whose traditional meanings coexist with meanings that have developed in technology-related discourse. In the case of 'hallucinate,' both the medical sense and the technological-epistemic sense remain in use. Vocabulary instruction should therefore distinguish between these domains rather than treating the newer meaning as simply replacing the older one. Attention to collocational patterns may be particularly useful because the surrounding vocabulary provides important cues for interpretation.

The results may also have practical relevance for educational technology and AI interface design. Awareness of the language through which users conceptualize AI behavior may assist in developing terminology that is comprehensible to non-specialist and non-native users. At the same time, the findings suggest that the widespread metaphorical framing of AI errors deserves critical attention, particularly where anthropomorphic terminology may influence perceptions of responsibility.

Several limitations should be considered when interpreting the findings. First, the principal corpus, NOW, consists of news discourse. The patterns identified here therefore represent media English and cannot automatically be generalized to spoken interaction, academic writing, or informal social-media communication. Although the English Trends corpus provided additional evidence, further research using corpora representing different registers would be necessary to establish whether the same semantic distribution occurs more broadly.

Second, the statistical comparison of annual frequencies is based on eleven yearly observations, with seven observations in the pre-AI period and four in the post-AI period. The relatively small number of annual data points limits the robustness of parametric inference, even though the observed differences are large. The very large effect size should therefore be interpreted together with the limited number of temporal observations.

Third, the wildcard search 'hallucinat\*' combines the verb, noun and adjectival forms into a single analytical category. While this procedure captures the broader lexical family, it may obscure

differences in the speed or direction of semantic change across individual morphological forms. Separate analyses of 'hallucinate,' 'hallucination,' and related forms may reveal more fine-grained developments.

Fourth, the classification of collocates into medical and technological domains necessarily involves an interpretive component, despite the use of a predefined codebook and intercoder reliability assessment. The strong agreement between coders supports the consistency of the procedure, but alternative classification schemes might produce somewhat different categorical distributions.

Finally, the present study establishes a strong temporal association between the post-AI period and the technological recontextualization of 'hallucinat\*'; it does not, by itself, establish that GenAI was the sole causal factor responsible for the semantic change. Other developments in technology, media discourse and public discussion may also have contributed to the observed transformation.

Future research should extend the analysis to academic, spoken and social-media corpora to determine whether the pattern identified here is characteristic of English more generally or is particularly strong in news discourse. A more detailed morphological analysis could also establish whether the verb, noun and adjectival forms undergo semantic change at the same rate. Cross-linguistic research would provide another important direction, particularly by examining whether languages other than English adopt the metaphor directly, translate it through calquing, or develop alternative conceptualizations of AI-generated error.

Further studies could also investigate the relationship between semantic innovation and the institutional actors involved in its diffusion. Since the present corpus cannot independently establish the origin of the terminology, research combining corpus evidence with historical documentation of technology-company discourse could clarify how the expression entered wider public use.

## Conclusion

The present article investigated the phenomenon of AI-driven semantic change through a corpus-based mixed-methods approach, using the verb 'hallucinate' and its morphological variants as a case study. The study did not seek to restate a

semantic shift that is already widely recognized and documented in dictionaries. Instead, it examined dimensions of this phenomenon that remain beyond the scope of dictionary entries, namely, the speed at which the semantic shift occurred, the transformation of its collocational profile and the discursive mechanisms through which it was naturalized in post-AI discourse. By treating this semantic development as a case study, the article also aimed to draw conclusions relevant to both theoretical inquiry and practical applications.

In the first stage of the research, findings and statistical analyses derived from the NOW and 'English Trends' corpora demonstrated that, since late 2022, the investigated lexical items have undergone both a sharp increase in frequency and a substantial transformation of their collocational profile. The data obtained from these corpora further showed that collocates associated with the medical domain in the pre-AI period (e.g., schizophrenia, treatment) were largely replaced in the post-AI period by technological-epistemic concepts (e.g., AI, ChatGPT, output, answers). Statistical testing confirmed a strong relationship between the historical period associated with the spread of AI and the semantic preference of the word, indicating a close association between the GenAI boom and this semantic shift.

The second stage of the study clarified the mechanism through which this change in meaning took place. The results indicated that, in attempting to explain how AI chatbots function, speakers relied on the mechanism of conceptual mapping and equated errors produced by language models with hallucinations, a pathological phenomenon associated with the human psyche. Through sustained widespread usage, the term gradually lost its metaphorical function and acquired a new, independent denotative meaning belonging to the technological domain. This finding provides useful insights for technology developers and AI designers regarding the ways in which users conceptualize this technology.

Among the most significant findings of the study is the demonstration, based on authentic linguistic evidence, that semantic change need not unfold over decades, as traditionally assumed. Under the influence of large-scale global technological developments, it may emerge within only a few months. This result points to the necessity of

revising existing lexicographic approaches. Against the backdrop of the accelerated pace of the AI era, modern dictionaries should move beyond traditional methods and adopt corpus-based monitoring systems operating in real time. In addition, the exceptionally rapid transformation of technology-related vocabulary points to an urgent need to renew pedagogical approaches, particularly in the field of EFL. ELT materials and vocabulary curricula need to remain flexible and undergo continuous revision so that they reflect contemporary language use.

### Abbreviations

AI: Artificial Intelligence, BNC: British National Corpus, COCA: Corpus of Contemporary American English, EFL: English as a Foreign Language, ELT: English Language Teaching, GenAI: Generative Artificial Intelligence, LLMs: Large Language Models, NOW: News on the Web.

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### Author Contributions

Eljan Salimli is the sole author of this manuscript and was solely responsible for all stages of the research. This includes the conceptualization, methodology, formal analysis, data curation, investigation and the drafting, reviewing and final editing of the text.

### Conflict of Interest

The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Data Availability

The data supporting the findings of this study are derived from the 'News on the Web' (NOW) corpus and the 'English Trends' corpus through Sketch Engine. These datasets are available through their respective online corpus interfaces.

### Declaration of Artificial Intelligence (AI) Assistance

The original manuscript was written entirely by

the author. Generative AI tools were used only for limited language-editing purposes, such as checking grammar, syntax, wording and stylistic clarity. AI was not used to generate the research design, data, corpus, statistical analyses, scientific findings, arguments, or interpretations. All substantive intellectual and scientific contributions are the author's own. The author has reviewed the final text in full and takes complete responsibility for its originality, accuracy and content.

### Ethics Approval

This study constitutes a corpus-based linguistic analysis utilizing pre-existing, widely accessible news texts and web data. As the research does not involve human subjects, patient rights, or animal experiments, approval from an Institutional Review Board (IRB) or local Ethics Committee was not required.

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