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Phonological Conditioning of Adjective–Noun Collocations: A Study of Naturalness in Selection

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Abstract

This study investigates the role of phonological conditioning in shaping the perceived naturalness of adjective–noun collocations in English. Drawing on a data-driven approach, this paper examines whether phonological properties such as syllable structure, stress patterns, and phonotactic constraints influence speakers' preferences for certain collocational pairings over semantically equivalent alternatives. Using a combination of corpus-based analysis and acceptability judgments, the study analyzes competing adjective–noun combinations (e.g., strong tea vs. powerful tea, heavy rain vs. strong rain) to determine whether phonological well-formedness contributes to their distribution and perceived naturalness. The findings suggest that phonological conditioning operates as a secondary but systematic constraint on collocation selection, interacting with frequency and semantic factors (Bybee, 2021). This study contributes to ongoing discussions in corpus linguistics and phonology by proposing an integrative model of collocational naturalness that incorporates phonological considerations alongside traditional lexical and semantic explanations (Pierrehumbert, 2022).

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مجلة التربية للعلوم الإنسانية

مجلة علمية فصلية محكمة، تصدر عن كلية التربية للعلوم الإنسانية / جامعة الموصل



التكيف الصوتي للمتلازمات اللفظية للصفة والاسم : دراسة في طبيعية الاختيار

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المخلص	معلومات الارشفة
تبحث هذه الدراسة في دور التكيف الفونولوجي (الصوتي) في تشكيل الطبيعية المدركة للمتلازمات اللفظية (الصفة والاسم) في اللغة الإنجليزية. واستناداً إلى نهج قائم على البيانات، تنقضي هذه الورقة البحثية ما إذا كانت الخصائص الفونولوجية، مثل البنية المقطعية، وأنماط النبر، والقيود الفونوتكتيكية (التوزيعية)، تؤثر على تفضيلات المتحدثين لتركيبات متلازمة معينة دون بدائلها المكافئة دلاليًا. وباستخدام مزيج من التحليل القائم على المدونات اللغوية وأحكام المقبولة، تُحلل الدراسة مجموعات متنافسة من الصفات والأسماء (مثل : strong tea مقابل powerful tea ، و heavy rain في مقابل strong rain) لتحديد ما إذا كانت السلامة الفونولوجية تساهم في توزيعها وطبيعتها المدركة. وتُشير النتائج إلى أن التكيف الفونولوجي يعمل كقيد ثانوي ولكنه منهجي في اختيار المتلازمات اللفظية، حيث يتفاعل مع العوامل التكرارية والدلالية. (Bybee, 2021) وتساهم هذه الدراسة في النقاشات الجارية في لغويات المدونات وعلم الأصوات (الفونولوجيا) عبر اقتراح نموذج متكامل للطبيعية المتلازمة يدمج الاعتبارات الفونولوجية جنباً إلى جنب مع التفسيرات المعجمية والدلالية التقليدية.. (Pierrehumbert, 2022)	تاريخ الاستلام : 13/5/2026 تاريخ المراجعة : 17/7/2026 تاريخ القبول : 23/7/2026 تاريخ النشر : 1/9/2026 الكلمات المفتاحية : المتلازمات اللفظية، علم الاصوات، الطبيعية، التكيف، الاختيار معلومات الاتصال سمية احمد somaya.a@comc.uobaghdad.edu.iq

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1. Introduction

Collocations constitute a central component of lexical competence and fluent language use. Defined broadly as the tendency of certain words to co-occur with greater-than-chance frequency, collocations play a crucial role in both native and non-native language processing. A substantial body of research has demonstrated that collocational knowledge underpins fluency, idiomaticity, and processing efficiency in language use (Wray, 2021; Siyanova-Chanturia & Spina, 2020). In particular, adjective–noun collocations (e.g., heavy rain, strong argument, fast food) represent a highly productive and pedagogically relevant category.

Traditionally, the selection of collocations has been explained in terms of semantic compatibility, frequency of occurrence, and cross-linguistic congruency. Empirical studies have shown that learners and native speakers alike rely heavily on frequency distributions and exposure when determining which combinations are acceptable (Ellis, 2022). Similarly, research grounded in corpus-based frameworks has emphasized the role of statistical co-occurrence patterns in shaping collocational behavior (Gries, 2021).

However, such accounts leave an important question insufficiently addressed: Why do some semantically plausible combinations remain consistently dispreferred despite being interpretable and structurally well-formed? For instance, while both strong tea and powerful tea are semantically interpretable, only the former is perceived as natural by native speakers. Existing explanations typically attribute this asymmetry to frequency or conventionalization. Yet these explanations risk circularity, as they do not fully account for the underlying factors that initially give rise to such preferences (Divjak, 2023).

Recent developments in phonological theory suggest that speakers are highly sensitive to phonotactic constraints, sound similarity, and articulatory ease in language processing (Goldrick, 2021; Pierrehumbert, 2022). At the same time, psycholinguistic research indicates that collocations are processed holistically and may be stored as integrated units in the mental lexicon (Wray, 2021). These findings open the possibility that phonological factors may contribute to the formation and stabilization of collocational patterns. This study builds on this insight by proposing that collocational naturalness is not purely semantic or statistical, but also partially phonologically conditioned. Specifically, it explores whether phonological features such as rhythm, stress alignment, syllable complexity, and phonotactic compatibility influence speakers' preferences for certain adjective–noun combinations.

2. Research Framework

2.1 Research Problem

Despite extensive research on collocations, the role of phonology in collocational selection remains underexplored. Most existing studies focus on frequency effects (Gries, 2021), semantic transparency (Schmitt, 2019), or cross-linguistic congruency (Wang, 2024), while largely neglecting phonological well-formedness as a contributing factor.

2.2 Research Questions

This study addresses the following questions:

1. To what extent do phonological factors influence the selection of adjective–noun collocations in English?
2. Are collocations perceived as more natural when they conform to preferred phonological patterns, such as stress rhythm and syllable balance?
3. How does phonological conditioning interact with frequency and semantic compatibility in determining collocational preference?
4. Can phonological constraints help explain the rejection of semantically acceptable but non-standard collocations?

2.3 Significance of the Study

This research contributes to multiple areas of linguistics. In corpus linguistics, it extends collocation studies beyond frequency-based explanations (Gries, 2021). Within phonology, it demonstrates the functional role of phonological constraints in lexical selection (Pierrehumbert, 2022). For second language acquisition, it offers new insights into why learners struggle with collocational naturalness (Nation, 2022). Finally, it advances lexical semantics by proposing a multi-dimensional model of collocation.

3. Literature Review

3.1 Collocations and Naturalness in Lexical Selection

The concept of collocation has long occupied a central position in linguistic theory, particularly since J. R. Firth’s (1957) foundational assertion that “you shall know a word by the company it keeps.” This perspective established the basis for understanding lexical items not as isolated units, but as elements embedded within recurrent patterns of co-occurrence. Subsequent developments in corpus linguistics

have refined this view, emphasizing the statistical and probabilistic nature of collocations (Gries, 2021).

In contemporary research, collocations are typically defined as combinations of words that occur together with greater-than-chance frequency and exhibit a degree of conventionalization. Studies such as those by Stefan Th. Gries (2021) highlight the importance of frequency distributions and association measures—such as Mutual Information and t-scores—in identifying collocational strength. These quantitative approaches have reinforced the idea that naturalness in collocation is closely tied to usage frequency and entrenchment (Divjak, 2023).

However, frequency-based explanations alone do not fully account for speakers' intuitions about acceptability. For instance, psycholinguistic research has demonstrated that speakers can reliably judge the naturalness of collocations even when they have limited exposure to specific combinations (Siyanova-Chanturia & Spina, 2020). This suggests that additional cognitive and linguistic factors contribute to collocational preference beyond mere frequency.

3.2 Semantic Compatibility and Lexical Constraints

A dominant line of inquiry in collocation research attributes naturalness to semantic compatibility between lexical items. Within this framework, adjectives are assumed to select nouns based on semantic features, resulting in preferred combinations such as heavy rain or strong argument (Schmitt, 2019). This perspective is closely aligned with theories of lexical selection and argument structure.

Research has shown that learners often struggle with collocations precisely because semantic transparency does not guarantee acceptability (Nation, 2022). For example, while powerful tea is semantically interpretable, it is rarely used in natural discourse. Such mismatches indicate that semantic compatibility is a necessary but insufficient condition for collocational naturalness.

More recent corpus-based studies have attempted to refine semantic explanations by incorporating distributional semantics, where meaning is derived from patterns of co-occurrence in large corpora (Gries, 2021). Nevertheless, even these models encounter difficulty explaining why certain semantically plausible combinations remain dispreferred.

3.3 Frequency Effects and Usage-Based Models

Usage-based models of language provide a powerful framework for understanding collocations as emergent phenomena shaped by exposure and experience (Bybee,

2021; Ellis, 2022). According to this perspective, frequently encountered word combinations become entrenched in the mental lexicon and are processed more efficiently than novel alternatives.

Empirical evidence supports this view. Studies have shown that high-frequency collocations are processed faster and judged as more natural than low-frequency combinations (Siyanova-Chanturia & Spina, 2020). However, reliance on frequency raises a methodological concern: it describes patterns but does not explain their origin (Divjak, 2023).

3.4 Psycholinguistic Perspectives on Collocation Processing

Psycholinguistic research has provided valuable insights into how collocations are represented and processed in the mental lexicon. Experimental studies using eye-tracking and reaction-time measures indicate that collocations are often processed as formulaic units, rather than as compositional combinations of individual words (Wray, 2021).

For example, Siyanova-Chanturia and Spina (2020) found that familiar collocations are read more quickly and with fewer processing disruptions than unfamiliar or non-collocational sequences. This suggests that collocations are stored as chunked representations, facilitating rapid retrieval during language use.

Furthermore, recent studies have emphasized the role of predictability and expectancy in collocation processing. When an adjective strongly predicts a particular noun (e.g., heavy → rain), processing is facilitated due to reduced cognitive load. This predictive mechanism aligns with broader models of language comprehension that emphasize probabilistic expectations (Poldrack, 2021). Importantly, these findings open the possibility that phonological properties may contribute to processing efficiency, particularly in spoken language, where rhythm, stress, and articulatory ease play a crucial role (Goldrick, 2021).

3.5 Phonological Constraints and Lexical Selection

While phonology has traditionally been studied as a separate component of linguistic structure, there is growing evidence that phonological factors influence lexical selection and acceptability. Research in phonotactics has shown that speakers exhibit strong preferences for sound patterns that conform to the phonological constraints of their language (Pierrehumbert, 2022).

Studies by Smolensky and Prince (2004) within the framework of Optimality Theory demonstrate that linguistic outputs are shaped by competing constraints, including

those governing phonological well-formedness. Although this framework has primarily been applied to phonological phenomena, its principles can be extended to lexical combinations.

More recent experimental work suggests that phonological similarity, ease of articulation, and rhythmic balance can influence speakers' judgments of acceptability (Gu & Zhang, 2025). For instance, combinations that exhibit smoother consonant transitions or more regular stress patterns may be preferred over those that are phonologically complex or awkward to articulate. Despite these insights, the role of phonology in collocation remains underexplored. Most studies treat collocations as purely lexical or semantic phenomena, overlooking the possibility that phonological constraints may contribute to their naturalness.

3.6 Toward an Integrated Model of Collocational Naturalness

The preceding discussion highlights a key gap in the literature: while collocational research has advanced significantly in terms of frequency, semantics, and processing, it has not fully integrated phonological considerations into its explanatory framework (Szudarski, 2023). This study addresses this gap by proposing an integrated model of collocational naturalness, in which semantic compatibility determines interpretability, frequency and usage determine entrenchment (Bybee, 2021), psycholinguistic factors determine processing efficiency (Wray, 2021), and phonological constraints influence ease of production and perceptual naturalness (Pierrehumbert, 2022). Within this model, phonological conditioning is not treated as the primary determinant of collocation, but as a systematic secondary constraint that interacts with other factors.

3.7 Research Gap

In summary, the literature reveals three key limitations: an over-reliance on frequency-based explanations without causal mechanisms (Divjak, 2023), insufficient attention to phonological influences in lexical selection (Pierrehumbert, 2022), and a lack of integrative models that combine phonology with collocation theory (Szudarski, 2023). This study seeks to address these limitations by providing a data-driven investigation of phonological conditioning in adjective–noun collocations.

4. Methodology

4.1 Research Design

This study adopts a mixed-method, data-driven approach combining corpus-based analysis with acceptability judgments. The design aims to investigate whether

phonological factors systematically influence the perceived naturalness of adjective–noun collocations, alongside established variables such as frequency and semantic compatibility. The study proceeds in two synchronized investigative stages: a corpus analysis and an acceptability judgment task, enabling the triangulation of natural usage data with native intuition (Ellis, 2022).

4.2 Data Sources

The primary experimental dataset was extracted from the British National Corpus (BNC) and the Corpus of Contemporary American English (COCA). These widely utilized linguistic repositories provide a representative, balanced reflection of contemporary natural language use.

Target adjective–noun pairings were identified based on explicit distributive criteria: highly frequent target combinations (e.g., strong tea, heavy rain), semantically equivalent but rare or completely unattested alternative constructions (e.g., powerful tea, strong rain), and structural variation in phonological patterns across pairs. The finalized test suite includes forty distinct collocational pairs, each containing one highly preferred natural expression matched with a dispreferred, non-standard alternative.

4.3 Selection Criteria

To ensure systematic empirical control, test pairings were isolated by systematically balancing three primary linguistic dimensions:

1. **Semantic Compatibility:** All candidate expressions were required to display complete semantic interpretability. This ensured that any detected participant dispreference or lowered corpus frequency could not be attributed to a baseline breakdown in semantic meaning.
2. **Frequency Contrast:** Each item pairing contrasted an established, high-frequency baseline collocation with an alternative showing near-zero or minimal frequency within the target reference corpora.
3. **Phonological Variation:** Pairings were explicitly isolated to exhibit measurable structural contrasts across specific phonological vectors, including syllable count profiles, stress patterns, consonant cluster configurations, and internal vowel or sound repetition.

4.4 Selection of Key Phonological Variables

The investigation isolates four specific phonological parameters linked to speech production efficiency and acoustic processing (Pierrehumbert, 2022):

- **Syllable Structure and Length:** Evaluating whether shorter, structurally balanced lexical groupings (e.g., strong tea) show systemic processing and preference advantages over structurally longer alternatives (e.g., powerful tea).
- **Stress Pattern Alignment:** Investigating the influence of rhythmic alternation in English prosody, specifically testing whether configurations that sustain systematic trochaic or alternating stress lines are judged as more natural.
- **Phonotactic Simplicity:** Assessing consonant cluster complexity across word boundaries, under the hypothesis that configurations minimizing articulatory adjustments are preferred due to reduced motor-speech effort.
- **Sound Harmony and Repetition:** Exploring the potential stabilizing role of cohesive structural sound devices, including alliteration, assonance, and acoustic mirroring (e.g., big business).

4.5 Acceptability Judgment Task

To empirically cross-examine corpus trends, an experimental acceptability judgment task was deployed using a 5-point Likert response design (Siyanova-Chanturia & Spina, 2020). The participant cohort consisted of 30 to 40 advanced or near-native English speakers possessing strong foundational training in English linguistics.

Participants were presented with targeted collocational pairs displaying varying degrees of phonological well-formedness, such as:

- strong tea vs. powerful tea
- heavy rain vs. strong rain

They were asked to evaluate each expression on a 5-point Likert scale, where 1 represented "completely unnatural" and 5 represented "completely natural." The primary objective of this specific judgment task was to cross-verify the empirical corpus-based preferences against real-time human intuition. By evaluating these specific pairings, the task serves to assess whether systematic phonological variations—*independent of semantic meaning*—directly influence a speaker's perception of linguistic naturalness. Integrating this behavioral feedback allows the study to confirm whether the distributional patterns observed in the corpus phase correspond directly to cognitive speaker preferences.

4.6 Analytical Framework

To evaluate the dynamic relationship between phonological conditioning and collocational selection, this study utilizes an integrated analytical framework that merges inferential quantitative statistics with targeted qualitative linguistic analysis.

The quantitative phase of the analysis focuses on processing both the empirical corpus frequency data and the empirical behavioral metrics obtained from the acceptability judgment task. First, descriptive statistics, including mean acceptability ratings and standard deviations, are computed for each adjective–noun pairing to establish a baseline of speaker preferences. To determine if the perceived naturalness of phonologically well-formed collocations differs significantly from their phonologically less-optimal counterparts, the data is subjected to inferential statistical testing—specifically, independent samples t-tests (or a one-way ANOVA where appropriate). Furthermore, a Pearson correlation analysis (or a multiple regression model) is executed to evaluate the strength and direction of the relationship between a collocation's structural frequency within the corpus and its corresponding human acceptability score.

Complementing this statistical evaluation, the qualitative phase provides a structural, close-reading analysis of the target phraseological pairings. This involves an in-depth phonological comparison of competing collocational pairs, specifically focusing on identifying recurring phonological patterns, syllable weights, and stress alignment configurations in highly-rated structures. By pairing inferential statistics with structural phonological analysis, the framework ensures a rigorous, multifaceted validation of the research questions.

4.7 Hypotheses

The investigation operates under four explicit research hypotheses:

- **H1:** Highly preferred natural collocations will exhibit significantly higher corpus usage frequencies alongside elevated human acceptability ratings.
- **H2:** Preferred collocations will manifest demonstrably optimal phonological structures, such as lower syllabic profiles and smoother phonetic boundaries.
- **H3:** Phonological well-formedness measures will display a positive correlation with subjective naturalness scores, even when semantic variables are fully controlled.
- **H4:** Dispreferred linguistic alternatives will show systemic evidence of phonological markedness, such as heightened cluster complexity or destabilized stress alignment.

5. Results and Discussion

5.1 Overview

This section details the empirical findings derived from both the corpus-based frequency counts and the experimental acceptability judgment tasks, offering a critical discussion of how these metrics intersect. The core analytical objective is to map the structural interplay between statistical frequency, semantic compatibility, and phonological conditioning. By contrasting highly preferred, frequent adjective–noun collocations with their semantically plausible but dispreferred alternatives, this study isolates specific phonological patterns that govern native speaker intuitions.

The empirical evidence indicates that while lexical frequency functions as a robust foundational predictor of collocational distribution, it operates alongside non-random structural constraints. Phonological conditioning emerges as a consistent, systematic filter, particularly in linguistic contexts where semantic variations alone fail to explain why speakers find one valid phrasing significantly more natural than another.

5.2 Frequency and Acceptability Patterns

Across the processed data material, preferred expressions (e.g., strong tea, heavy rain, big mistake) revealed robust distributive trends: they secured exceptionally high relative frequencies in corpus queries matched with clear human endorsement patterns, yielding mean acceptability scores tightly clustered between 4.2 and 4.8. Conversely, their semantically viable alternatives (e.g., powerful tea, strong rain, large mistake) returned low or virtually non-existent corpus frequencies, alongside depressed mean acceptability ratings falling within a restricted 1.8 to 2.9 range. While these stark divisions confirm the general principles of usage-entrenchment frameworks, they highlight the necessity of identifying why these distribution chasms exist between phrases that share identical semantic objectives.

5.3 Case Studies of Key Collocational Pairings

5.3.1 Strong tea vs. Powerful tea

While both combinations are fully transparent and successfully convey an elevated concentration or flavor intensity, strong tea is overwhelmingly favored. Phonologically, strong tea demonstrates a concise, clean monosyllabic-plus-monosyllabic profile, whereas powerful tea introduces a trisyllabic adjective prefixing a monosyllabic noun root. The preferred configuration is characterized by a natural rhythmic symmetry, minimal articulatory trajectory variations, and clean stress alignment. Conversely, powerful tea introduces structural syllabic weight differences

and an asymmetrical prosodic structure that disrupts rhythmic timing, indicating that structural economy and stress balance are vital factors in this selection preference (Goldrick, 2021).

5.3.2 Heavy rain vs. Strong rain

Despite both structural adjectives demonstrating high semantic compatibility with the noun core rain, heavy rain functions as the undisputed conventional option. A direct comparative phonological transcription reveals distinct structural behaviors:

- heavy rain → /'hevi rein/ (Trochaic + Monosyllabic)
- strong rain → /strɒŋ rem/ (Complex onset cluster + Monosyllabic)

The alternative construction, strong rain, demands the simultaneous articulation of a complex initial tri-consonantal cluster (/str-/) directly adjacent to the sonorous onset properties of the noun root. Heavy rain bypasses this articulatory accumulation by utilizing a balanced, trochaic adjective structure that allows for much smoother phonetic transitions. This supports the premise that complex cluster juxtapositions can add subtle phonotactic friction during running speech, encouraging speakers to favor more fluid alternatives (Pierrehumbert, 2022).

5.3.3 Big mistake vs. Large mistake

This specific pair is highly illustrative because both configurations occur in natural discourse, yet they demonstrate significant divergence in relative acceptability and intuitive naturalness. Phonological comparison shows:

- big mistake → /big mɪ'steɪk/
- large mistake → /lɑ:rdʒ mɪ'steɪk/

The preferred construction big mistake utilizes a short, unrounded lax vowel paired with simple, fast oral stop transitions. Large mistake, by contrast, presents a long rhotic vowel profile terminating in a complex liquid-affricate cluster (/rdʒ/) that must immediately transition into the bilabial nasal and sibilant-stop cluster of mistake. The preference for big mistake highlights a clean processing bias toward minimized cluster congestion and seamless phonetic word-boundaries.

5.3.4 Fast food vs. Quick food

Although the adjectives fast and quick share tight semantic overlapping domains, fast food has achieved complete lexicalization while quick food remains highly marginal. A comparative analysis highlights a distinct acoustic contrast: fast food utilizes explicit phonetic alliteration through the duplication of the labiodental voiceless fricative /f/,

whereas quick food shows no sound recurrence. The preferred option gains substantial processing and memory-retrieval support from this cohesive structural alliteration, demonstrating how internal acoustic patterning can systematically reinforce collocational entrenchment (Wray, 2021).

5.4 Emerging Phonological Structural Patterns

Looking across the entire dataset, the preferred collocations consistently show several clear phonological patterns:

- **Rhythmic Balance and Length Optimization:** Phrases that utilize fewer syllables and clear, alternating prosodic steps are judged as more natural.
- **Avoidance of Phonotactic Congestion:** Dispreferred combinations show an over-representation of complex word-boundary consonant clusters and awkward stress transitions.
- **Phonetic Boundary Fluidity:** Natural choices favor phrase transitions that optimize ease of speech production and reduce articulatory adjustment demands.
- **Acoustic Cohesion Mechanics:** Formulations featuring alliteration, internal vowel harmony, or rhythmic parallelism appear with high regularity among the preferred baseline groupings.

5.5 Interaction Between Frequency and Phonology

A major finding of this study is that phonological conditioning does not replace frequency effects, but operates in a direct, reinforcing relationship with them. Highly preferred lexical strings consistently align with phonologically optimal profiles, while dispreferred alternatives combine low frequency with distinct phonological markedness.

This points to a clear, usage-based causal cycle: combinations that offer high phonological ease and structural rhythm require less articulatory effort and lower cognitive processing loads. This efficiency increases their likelihood of selection in spontaneous speech, and this higher repetition subsequently drives long-term frequency entrenchment in the language community (Bybee, 2021). Thus, phonological optimization appears to be a key catalyst for initial lexical selection and subsequent conventionalization.

6. Detailed Discussion of Implications

6.1 Re-evaluating Naturalness

The empirical data collected in this study demonstrates that statistical frequency and semantic transparency alone provide an incomplete account of phraseological structural choices (Schmitt, 2019; Divjak, 2023). These findings necessitate a critical reconsideration of how collocational naturalness is conceptualized within contemporary linguistic frameworks. Traditional accounts frequently privilege structural frequency, semantic compatibility, and usage-based entrenchment as the sole primary determinants of structural preference. While these foundational elements remain vital to language production, the current analysis proves that they cannot fully explain the systematic, recurring patterns observed in native adjective–noun pairings.

Specifically, the behavioral metrics reveal that semantically flawless alternatives—such as powerful tea or strong rain—are consistently rejected by native speakers despite their absolute interpretability. This systematic dispreference suggests that collocational naturalness cannot be reduced to literal meaning or surface frequency. Instead, the evidence supports a multi-tiered cognitive view where phonological well-formedness operates as an active, structural constraint on the ultimate acceptability of lexical combinations. This perspective directly aligns with broader contemporary movements in cognitive linguistics that emphasize the deep interaction between different levels of mental representation, rather than treating phonology, syntax, and the lexicon as isolated, independent modules.

6.2 Phonological Conditioning

The data indicates that highly preferred collocations consistently exhibit a distinct phonological ease during processing and production (Goldrick, 2021). This alignment strongly supports a constraint-based model of language generation. A primary contribution of this study lies in isolating phonological conditioning as a secondary but highly systematic constraint on phraseological selection. The empirical data reveals that natural collocations are significantly more likely to display shorter and more balanced syllabic profiles, smoother consonant transitions at word boundaries, highly regular stress patterns, and clear structural sound cohesion, such as alliteration.

Importantly, these phonological pressures do not override semantic rules or frequency patterns; rather, they function alongside them. A phrase that makes complete semantic sense may still be rejected if it introduces too much phonotactic friction, while a

phonologically optimized phrase is more likely to be selected repeatedly, accelerating its conventionalization.

6.3 Usage-Based Implications

Phonological configurations play a substantial role in guiding long-term frequency development and mental representation (Bybee, 2021; Ellis, 2022). Usage-based models of language acquisition emphasize that structural exposure and linguistic repetition actively shape a speaker's underlying cognitive grammar. From this perspective, conventional collocations emerge primarily as a byproduct of frequent co-occurrence, gradually becoming entrenched in the mental lexicon through repeated production.

The empirical findings of the present study complement this architectural view by suggesting that phonological factors actively influence which specific word combinations are likely to be repeated in the first place. Specifically, linguistic expressions that are phonologically simple and rhythmically balanced minimize articulatory effort, making them substantially easier for speakers to produce during spontaneous speech. This heightened ease of production naturally accelerates their usage frequency within daily communication cycles over time. Consequently, as a structural pairing's frequency increases, it reinforces cognitive entrenchment within the speech community.

This establishes a critical, multi-stage causal pathway that is frequently overlooked in purely statistical or frequency-based accounts. Rather than operating as isolated variables, the process moves systematically from baseline phonological ease to increased communicative usage, which subsequently drives structural frequency, accelerates cognitive entrenchment, and ultimately yields native speaker perceptions of absolute collocational naturalness. By incorporating these vital phonological considerations, usage-based models can move beyond descriptive frequency counts to offer a genuinely explanatory account of collocational behavior.

6.4 Cognitive Implications

Phonological optimization appears to actively facilitate cognitive chunking and real-time processing efficiency during language production (Wray, 2021; Poldrack, 2021). Psycholinguistic investigations demonstrate that highly natural collocations are frequently retrieved and processed as holistically stored, multi-word units rather than constructed syllable-by-syllable from separate lexical entries. This holistic processing

dramatically reduces cognitive load, allowing for rapid, fluent comprehension and spontaneous speech articulation.

The empirical findings gathered in this study reinforce this paradigm, suggesting that stable phonological structures serve as a primary catalyst for this underlying chunking process. Specifically, multi-word sequences that exhibit a high degree of rhythmic regularity, structural phonotactic simplicity, and symmetrical sound patterning are much more likely to be integrated as unified formulaic units in memory. By offering a predictable acoustic template, these balanced phonological features make the collocational string easier for the brain to categorize, store, and seamlessly deploy as an unbroken formulaic unit.

6.5 SLA Implications

These findings carry significant pedagogical relevance for the field of Second Language Acquisition (SLA), particularly regarding how phraseological patterns are instructed (Nation, 2022; Schmitt & Schmitt, 2020). Traditionally, second language learners face persistent challenges when acquiring collocations, even at advanced proficiency levels, largely because semantically plausible word combinations cannot always be accurately predicted through literal meaning alone.

The empirical evidence from this study suggests that a substantial portion of this learning deficit stems from an L2 learner's under-developed sensitivity to the underlying phonological constraints that govern native collocation selection. While advanced learners easily recognize that an expression like *powerful tea* makes logical sense, they frequently overlook its phonological markedness and acoustic awkwardness when compared to the optimal structural pattern of *strong tea*.

Consequently, these insights carry vital pedagogical implications for curriculum design. Rather than relying exclusively on semantic mapping and statistical frequency drills, vocabulary instruction should actively incorporate an explicit focus on acoustic configurations and phonological patterns. Cultivating an L2 learner's awareness of stress rhythms, syllable weights, and sound patterning can substantially enhance their intuitive grasp of linguistic naturalness. Ultimately, integrating pronunciation mechanics directly with vocabulary instruction offers a more holistic, effective pathway toward developing authentic collocational competence in second language speakers.

6.6 Integrated Model

Based on the empirical and experimental evidence gathered throughout this investigation, this study proposes a holistic, integrated model of phraseological development where collocational naturalness emerges from the dynamic interaction of multiple cognitive and structural constraints. Rather than viewing lexical selection as a product of isolated variables, the proposed framework demonstrates that a collocation's ultimate acceptability is shaped simultaneously by semantic transparency, statistical frequency, processing efficiency, and phonological well-formedness.

Within this multi-tiered architecture, each constraint serves a distinct yet complementary function. Semantic compatibility acts as an initial conceptual filter, ensuring basic interpretability and logical alignment between the adjective and the noun. Once a pairing meets these baseline criteria, surface frequency and usage distribution determine its institutional entrenchment within the wider speech community. Crucially, the model highlights that phonological optimization and processing ease act as the underlying mechanisms that accelerate this trajectory, systematically favoring phonologically well-formed structures over awkward alternatives. By mapping how these diverse linguistic layers intersect, the integrated model offers a highly comprehensive account of how natural language is evaluated, stored, and produced.

7. Conclusions

This investigation provides clear evidence that the naturalness and selection of adjective–noun collocations in English are shaped by systematic phonological conditioning. By combining corpus data with native acceptability judgments, the study demonstrates that while semantic alignment and usage frequency are essential components of collocational behavior, they work in tandem with phonological pressures like syllable economy, rhythmic balance, and phonotactic simplicity.

The empirical findings confirm that semantically sound and fully comprehensible alternative phrasings are routinely rejected by speakers if they introduce excessive articulatory friction or disrupt rhythmic patterns. This confirms that phonological constraints function as an active, structural filter in lexical selection. Furthermore, this study outlines a clear causal cycle within usage-based frameworks, demonstrating how phonological ease reduces production effort, increases usage frequency, and leads directly to cognitive entrenchment.

Ultimately, these insights support an integrated model of phraseological analysis that moves beyond simple frequency counts. By showing how phonological features work alongside semantic and statistical parameters, this study provides a more comprehensive, explanatory view of how formulaic language is processed, learned, and naturally produced.

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