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BEYOND PRODUCTIVITY: A STUDY OF PHONOLOGICAL OPACITY IN ENGLISH NOMINALIZATION PATTERNS

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Abstract

English nominalization has traditionally been investigated through the lens of morphological productivity, yet phonological opacity—cases in which noun formation unpredictably alters the sound structure of the base verb or adjective—has received comparatively little systematic attention. The present study redirects attention toward opacity, proposing that these patterns form a structured and coherent subsystem meriting dedicated analysis. Through a mixed-methods approach, the study examined 100 verb–noun pairs, classifying degrees of phonological opacity along a 0–3 continuum. Production data elicited from 400 English-speaking undergraduates showed that stress shift emerges as the strongest contributor to opacity. A mixed-design ANOVA demonstrated significant differences in production accuracy across academic disciplines $F(2, 397) = 8.42$, $p < .001$), with Science students outperforming English majors on opaque forms. Results indicate that opacity operates on a graded continuum rather than as isolated irregularities, clustering systematically around specific morphological environments. These observations carry significant consequences for stratified models of Lexical Phonology and constraint-based accounts in Optimality Theory. The study advocates for fuller incorporation of opaque forms in morphological theory and identifies practical implications for pronunciation instruction in second-language contexts.

Keywords: *Phonological Opacity, Nominalization, Stress Shift, Stratal Optimality Theory, Morphophonology*

1 Introduction

Nominalization is a common and significant part of academic and professional language. It means changing verbs or adjectives into nouns (for example, "decide" becomes "decision" and "clear" becomes "clarity"). This grammatical method improves the flow of the text, makes it easier to condense and combine complicated arguments, and keeps a neutral and objective tone by focusing on processes and results instead of people. Nominalization, functioning at the intersection of morphology, syntax, and phonology, has historically held a pivotal role in linguistic studies. A considerable amount of research has examined nominalizing suffixes like -tion, -ment, -ity, and -ness, focusing on their syntactic distributions, semantic roles, and usage patterns peculiar to different registers (Biber et al., 1999; Plag, 2003).

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In the field of generative morphology, especially since Aronoff's (1976) groundbreaking study, the idea of productivity has been seen as a key idea. Productivity is typically characterized as the degree to which morphological principles or affixes can be readily applied to new or prospective base forms. Consequently, research has predominantly differentiated between highly prolific, regular derivational patterns and marginal or less productive forms, with theoretical modeling primarily concentrating on the former (Booij, 2010; Plag, 1999). This perspective has provided significant insights into the formulation of rules, affix behavior, and the mechanisms driving morphological generalization.

Even with these contributions, the main focus on productivity and regularity has led to a research bias toward clear derivational patterns, making phonologically opaque nominalizations less studied (Kiparsky, 1982). Opaque nominalizations entail derivational procedures characterized by unpredictable phonological variations that obscure the formal connection between a base and its derivative. Words like "pronounce" and "maintenance" show stem alternations that can't be fully explained by English's synchronic phonological norms. This makes it hard for techniques that only look at productivity (Burzio, 1994; Bermúdez-Otero, 2013).

While these forms are often recorded in descriptive grammars and diachronic research, their synchronic status, prevalence, and representation in the mental lexicon remain inadequately investigated (Bybee, 2001; Hay & Baayen, 2005). Prior research has often considered these nominalizations as marginal exceptions or remnants of historical phonetic shifts, rather than as systematically structured processes. This marginalization has limited their applicability to broader theoretical discourses on the morphology–phonology link and the lexicon's structure (Plag, 2006). Bermúdez-Otero (2013) asserts that a thorough theory of derivation must include both transparent and opaque patterns; yet, the latter still receive relatively insufficient analytical attention.

This work rectifies the existing gap by redirecting the analytical emphasis from productivity to phonological opacity in English nominalization. Its principal aim is to provide a comprehensive, corpus-based examination of opaque nominalization patterns and to demonstrate that these forms constitute a coherent, if intricate, subsystem within English derivational morphology. The study aims to (a) identify and classify major types of phonological opacity in nominalisations, including vowel alternations, consonantal changes, and stress shifts; (b) investigate their frequency and distribution in contemporary English through corpus data; and (c) assess the implications of these patterns for models of the morphology–phonology interface and theories of lexical representation (Bermúdez-Otero, 2013; Hay & Baayen, 2005).

Unlike methodologies that categorize opaque forms as exceptions, this work argues that their systematic analysis can reveal limitations on derivational processes and enhance current discussions regarding lexical storage versus rule-based computation (Bybee, 2001; Plag, 2006).

The results are anticipated to demonstrate that opaque nominalisations do not represent a haphazard collection of abnormalities; rather, they form clusters influenced by underlying phonological or morphological factors, indicating a more organized subsystem than previously recognized. The rest of the essay is set up like this: the following part looks at important theoretical ideas about opacity, and then there is a brief description of the methodology. The conclusions based on the corpus are then presented and analyzed, and the paper ends with comments on why it is important to include opaque data in morphological theory.

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1.1 Problem Statement

Nominalization is a common linguistic tool in English that turns verbs and adjectives into nouns to make sentences more cohesive, bring together arguments, and keep a formal tone in academic and professional writing. While transparent and productive nominalization patterns have received considerable academic attention, phonologically opaque forms—characterized by stress shifts, vowel quality alternations, consonantal mutations, or the interplay of multiple processes that obscure the relationship between base and derivative—have been comparatively underexamined. Existing research has generally seen these forms as peripheral exceptions or remnants of past development, resulting in a deficiency in our understanding of their present frequency, cognitive representation, and interaction with morphological and phonological standards.

This gap raises several critical issues:

There is limited systematic understanding of the types and mechanisms of phonological opacity, encompassing prosodic, segmental, and complex multi-process alternations. The relationship between morphological derivation, suffix productivity, and opacity remains under-documented, which constrains broader theoretical generalizations. In addition, the cognitive and usage-based dimensions of opacity—particularly the role of frequency and lexical entrenchment in stabilizing opaque forms—have not been sufficiently explored. Existing formal phonological frameworks, including Stratal Optimality Theory, have also not been comprehensively evaluated against empirically attested opaque patterns, especially in cases involving interacting alternations.

In response to these gaps, the present study investigates phonological opacity in English nominalisations using a corpus-based approach. It integrates qualitative phonetic analysis with quantitative frequency data to examine the types, mechanisms, distribution, and cognitive salience of opaque forms, while critically assessing their compatibility with established theoretical models.

1.2 Objectives of the study

Aligned with the research questions, this investigation aims to:

i. To identify and classify types of phonological opacity in English nominalisations.
ii. To analyze the morphological and derivational correlates associated with opaque nominal forms.
iii. To evaluate the role of lexical frequency and usage in the entrenchment and stability of opaque patterns.
iv. To assess the explanatory and predictive adequacy of formal phonological models in accounting for opacity.
v. To compare transparent, near-transparent, and opaque nominalisations in order to delineate systematic deviations and their theoretical implications.

1.3 Research Questions

This study investigates the systematic patterns of phonological opacity in English nominalisations. The following research questions guided the inquiry:

i. What varieties of phonological opacity are observed in English nominalizations?
ii. How do phonological opacity patterns relate to morphological and derivational processes?
iii. What is the correlation between lexical frequency, usage, and the stabilization of opaque forms within the mental lexicon?
iv. To what degree can formal models of morphology-phonology interaction, especially Stratal Optimality Theory, explain the observed opaque patterns?

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v. How do transparent, near-transparent, and wholly opaque nominalisations differ in terms of phonological processes and their usefulness in research?

1.4 Research Hypotheses

$H0_1$: There is no significant difference in production accuracy among the three nominalisation types: Transparent, Near-Transparent, Opaque

$H0_2$: There is no significant difference in production accuracy between male and female participants.

$H0_3$: Gender does not interact with nominalisation type to affect production accuracy.

$H0_4$: Academic discipline does not significantly affect production accuracy.

$H0_5$: There is no interaction between discipline and nominalisation type.

$H0_6$: Vowel reduction does not differ significantly across nominalisation types.

$H0_7$: Constraint weights do not significantly predict patterns of opacity in nominalisation forms.

1.5 Delimitations

This study concentrates on phonological opacity in English nominalizations, particularly highlighting stress changes, vowel and consonant alternations, and interactions involving numerous processes. It is confined to English-speaking undergraduates from Pakistani English-medium universities, ensuring balanced gender representation and inclusion across three academic disciplines (English, Sciences, and Natural Sciences), thus constraining the generalizability of the findings to alternative populations or proficiency levels. The analysis is confined to verb-to-noun derivations, omitting adjectival and other kinds of nominalization to preserve a concentrated morphological scope.

The study is confined to particular suffixes (-ment, -ation, -sion, -al, -fy) and conversion-based forms that are both widespread and conceptually important, hence omitting less common or extremely irregular patterns from the immediate focus of the research. From a methodological standpoint, the study employs corpus data and controlled phonetic recordings, focusing on production patterns and frequency, but excluding spontaneous speech in realistic contexts. Additionally, while the analysis utilizes Stratal Optimality Theory and usage-based models to elucidate opaque forms, alternative phonological or cognitive frameworks are not explicitly evaluated. These delimitations stress depth over breadth, enabling a focused and methodical examination of opaque nominalizations while explicitly recognizing constraints related to population, derivational type, and theoretical orientation.

1.6 Significance of the Study

This research enhances both theoretical and applied linguistics by filling a significant gap in the understanding of phonological opacity in English nominalizations. From a theoretical perspective, it enhances current morphological and phonological frameworks, including Stratal Optimality Theory, by systematically identifying and analyzing opaque forms, thereby demonstrating that they are not arbitrary exceptions but adhere to identifiable prosodic, segmental, and morphological patterns. By combining usage-based and example models, the research makes the significance of frequency and entrenchment in the stabilization of opaque forms clearer. This gives us more information on how derivational morphology is represented in the mental lexicon.

From a practical perspective, the results have considerable ramifications for English language instruction, particularly for vocabulary, pronunciation, and morphological awareness among non-native speakers. A deeper understanding of opacity patterns can guide curriculum development, pronunciation instruction, and lexicon acquisition tactics, thus equipping learners to better navigate inconsistencies in derivational morphology.

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Moreover, the research sets a methodological standard by combining corpus-based analysis with regulated phonetic elicitation, showcasing a replicable method for investigating complex linguistic phenomena. By systematically linking morphological derivation, phonological patterning, and cognitive factors, the research integrates descriptive, theoretical, and experimental domains, providing a comprehensive framework to facilitate future studies of English and other languages characterized by extensive derivational morphology.

In summary, the study improves our understanding of how opaque nominalizations work, last, and interact with the mental lexicon. This is useful for both linguistic research and language teaching.

2 Literature Review

2.1 Theoretical Foundations of Phonological Opacity in Nominalisation

Granello and Wheaton (2004) conceptualize the literature review as a process of theory development and gap justification, rather than a simple summarization. In accordance with this approach, the current review (a) establishes the conceptual framework, (b) rigorously evaluates prevailing theoretical paradigms, (c) highlights systematic deficiencies in the literature, and (d) integrates pertinent viewpoints to justify the present study. The discourse transitions from structural morphology to formal phonology and culminates in usage-based cognition, demonstrating the emergence of phonological opacity in nominalization at the convergence of these areas.

2.1.1 1. Establishing the Conceptual and Theoretical Foundations

Nominalisation has historically had a central role in morphological theory as a primary mechanism of word formation. Early generative frameworks defined nominalisation as a rule-governed derivational process in which affixes like as -tion, -ity, and -ance are attached to verbal or adjectival bases, limited by certain selectional criteria (Aronoff, 1976; Sproat, 1985). Later research built on these ideas by focusing on morphological productivity, trying to figure out which affixes can be added to new bases and what structural conditions are needed to make these additions (Fabb, 1988; Plag, 1999).

This research offers a crucial descriptive catalog and reinforces the expectation of consistency in derivational morphology. Nevertheless, as noted by Spencer (1991) and Don (2014), morpheme-based and syntactically driven models face persistent challenges in elucidating allomorphy, stem alternation, and non-concatenative modification, phenomena that are essential to phonologically opaque nominalisations. Thus, whereas morphological theory provides the fundamental structural framework, it does not clarify the phonological instability evident in various derived nouns.

2.1.2 2. Critical Evaluation of Dominant Explanatory Frameworks

Acknowledging these constraints, researchers shifted to models that explicitly integrate morphology and phonology. Lexical Phonology and Morphology (LPM) asserts that derivation transpires through a series of ordered layers, each regulated by distinct phonological rules (Kiparsky, 1982). Giegerich's (1999) examination of lexical strata elucidated that Latinate affixes, such as -ity and -tion, function inside antecedent derivational domains in contrast to Germanic affixes like -ness, frequently inducing stress shifts and vowel alternations.

This stratified model represents a significant enhancement in explanation by demonstrating that morphological structure affects phonological processing, thereby enabling the creation of opacity through interactions across derivational layers. LPM's dependence on set principles, however, restricted its ability to accurately represent gradient phenomena and speaker variability. The later evolution of Optimality Theory (OT), particularly Stratal OT, addressed

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this limitation by replacing serial norms with hierarchically ordered constraints that vary across morphological strata (Kiparsky, 2000; Bermúdez-Otero, 2013).

In this framework, opaque forms like pronounce → pronunciation are seen as the best outputs since they meet high-ranking stem-level criteria, including Latinate stress patterns, even though they don't stay true to the base form. Studies in prosodic morphology have shown that limitations on foot shape and minimum word size can consistently support stem alternations that appear irregular on the surface (Raffelsiefen, 1999). While these formal models have considerable explanatory capacity, they largely remain abstract and offer little insight into the mechanisms by which opaque forms are acquired, stored, and preserved within the mental lexicon.

2.1.3 3. Identification of Gaps and Inconsistencies in the Literature

A consistent shortcoming of formal approaches is their inadequate attention to utilization frequency, lexical entrenchment, and gradient productivity. While constraint-based models can yield opaque outputs, they do not intrinsically elucidate the reasons behind the stability of certain opaque nominalizations despite restricted transparency, nor do they clarify why others proliferate through analogy and enhance productivity. This divergence is particularly noteworthy given empirical research demonstrating that speakers' morphological behavior is significantly influenced by frequency and experience (Hay & Baayen, 2005).

Usage-based and exemplar models directly tackle this constraint by proposing that linguistic knowledge evolves through recurrent exposure to forms in practical contexts. In Exemplar Theory, each encountered token is stored in memory, leading to clusters ordered by phonological and semantic similarity (Bybee, 2007). From this viewpoint, frequency functions as the primary mechanism driving entrenchment. High-frequency opaque nominalizations, like "decision," provide powerful and mostly independent representations. This makes it less necessary to rely on clear derivation from their bases.

Usage-based research also shows that partially opaque patterns can be kept alive through analogical reinforcement within morphological families (e.g., maintain/maintenance, retain/retention). Booij (2010) calls these "sub-constructions" in the lexicon. These discoveries challenge the binary distinction between rigid rules and exceptions, proposing that opacity may signify nuanced regularities instead of definitive abnormalities.

2.1.4 4. Synthesis and Justification of the Present Study

Following Granello's model, the literature increasingly underscores the significance of a holistic explanatory framework. Morphological theory delineates the derivational templates and affixal classes that establish phonological domains, while formal phonology accounts for the constraint interactions responsible for both transparent and opaque surface realizations. Usage-based models clarify the reasons behind the entrenchment of certain perplexing outcomes, their resistance to leveling, and their potential impact on further morphological generalization.

Phonological opacity in nominalization thus manifests as an interactional phenomenon, shaped collectively by structural restrictions and cognitive entrenchment. It is important to note that deeply established opaque structures can recursively change how productive affixes are seen, which changes the way the morphological system is organized over time. Notwithstanding this convergence of ideas, a limited number of research have carefully examined opaque nominalizations as a coherent subsystem grounded in empirical corpus evidence.

This research seeks to address this gap by integrating morphological, phonological, and usage-based frameworks to analyze the distribution, frequency, and structural determinants affecting phonological opacity in English nominalization. By doing this, it directly addresses

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the theoretical and empirical gaps found in the literature and meets Granello and Wheaton's (2004) standards for a thorough, problem-oriented literature review.

3 Methodology

3.1 Research Design

A descriptive and analytical research design was combined to examine phonological opacity in English nominalization patterns. Both quantitative production data and qualitative phonetic analysis were used. The quantitative component tested hypotheses regarding production accuracy across different speaker groups, while the qualitative analysis, informed by Stratal Optimality Theory, assessed the accuracy of its predictions. By associating auditory alterations with their grammatical and phonological meanings, this approach streamlines the comparison of opaque and transparent nominalizations.

3.2 Participants

The sample contained 400 participants who spoke English as their second language. They were undergraduate students from three Pakistani English-medium universities, recruited via email and campus flyers. The three academic fields—English, Sciences, and Natural Sciences—had an approximately equal number of boys and girls. The objective of this study was to ascertain whether metalinguistic elements contributed to the formation of structures characterized by complicated morphophonology. A priori power analysis using G*Power confirmed that the sample size provided >0.80 power to detect medium effect sizes ($f = 0.25$) at $\alpha = 0.05$ for the mixed-design ANOVA, enabling strong comparisons across groups.

3.3 Data Collection

Controlled auditory elicitation activities were employed to obtain personal information. The participants generated a total of 150 verb-noun nominalization combinations. Of them, 75 pairs were phonologically opaque, and 75 pairs were phonologically clear. To achieve a thorough understanding of prosody, the items were collected in diverse situations, including single-item lists, neutral sentence forms, and carrier phrases. The recording took place in secure rooms using cutting-edge audio gear.

The secondary data utilized in this investigation was sourced from three corpora: BNC, COCA, and COHA. We sought to ascertain the prevalence of the target nominalizations, their contextual applications, and any temporal variations.

3.4 Data Analysis Tools

To ascertain the relationship between frequency and opacity, the study used chi-square tests. To look into production trends across different academic areas and nominalization techniques, we employed mixed-design ANOVAs. The Stratal Optimality Theory modeling in OTSoft was used to improve constraint rankings across morphological levels and clarify unclear results using real-world data.

4 Data Analysis

4.1 Quantitative Analysis

4.1.1 Table 4.1: Nominalisations with Stress Shift and Vowel Reduction

Category Label: Prosodic Opacity (Stress-Driven)

No.	Verb	IPA (Verb)	Noun	IPA (Noun)	Opacity Mechanism
1	explain	/ɪkˈspleɪn/	explanation	/ˌekspləˈneɪʃən/	Stress shift; /eɪ/ → /ə/
2	pronounce	/prəˈnaʊns/	pronunciation	/prəˌnʌnsiˈeɪʃən/	Stress shift; /aʊ/ → /ʌ/
3	combine	/kəmˈbaɪn/	combination	/ˌkɒmbɪˈneɪʃən/	Stress shift; /aɪ/ → /ɪ/
4	declare	/dɪˈkleə/	declaration	/ˌdekləˈreɪʃən/	Stress shift; /eə/ → /ə/
5	resign	/rɪˈzaɪn/	resignation	/ˌrezɪgˈneɪʃən/	Stress shift; /aɪ/ → /ɪ/

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Table 5.1 presents a set of English nominalisations characterized by **prosodically driven phonological opacity**, specifically involving **systematic stress retraction and concomitant vowel reduction**. Across all five verb–noun pairs, nominalisation triggers a shift of primary stress from the final syllable of the verbal base to a later syllable within the derived noun, typically associated with the Latinate suffix *-ation*. This stress reassignment results in the reduction of previously stressed vowels in the base, producing surface forms that are no longer transparently related to their source verbs.

In each case, the verb exhibits final stress (e.g., *explain* /ɪkˈspleɪn/, *pronounce* /prəˈnaʊns/), while the corresponding nominal form displays a characteristic **secondary–primary stress pattern** (e.g., *explanation* /ˌekspləˈneɪʃən/, *pronunciation* /prəˌnʌnsiˈeɪʃən/). The stress shift systematically demotes the originally stressed syllable, leading to **vowel centralisation or laxing**. For instance, the tense diphthong /eɪ/ in *explain* reduces to schwa /ə/ in *explanation*, and /aʊ/ in *pronounce* surfaces as /ʌ/ in *pronunciation*.

These alternations exemplify **prosodic opacity**, where the phonological relationship between base and derivative cannot be derived through transparent, surface-level phonological rules alone. Instead, the observed patterns are conditioned by **morphological stratum-specific stress assignment**, consistent with accounts in Lexical Phonology and Stratal Optimality Theory. The uniformity of stress shift across items indicates that opacity is not idiosyncratic but systematically associated with stress-attracting nominalising affixes.

Overall, the table demonstrates that vowel reduction in these nominalisations is a **consequence of prosodic restructuring**, not segmental instability per se. This supports the claim that phonological opacity in English nominalisation frequently arises from the interaction between morphological derivation and prosodic constraints, rather than from irregular or exceptional sound change.

4.1.2 Table 4.2: Nominalisations with Vowel Quality Alternation

*Category Label**:** Segmental Opacity (Vowel-Driven)*

No.	Verb	IPA (Verb)	Noun	IPA (Noun)	Opacity Mechanism
6	serene	/səˈriːn/	serenity	/səˈrenəti/	/iː/ → /e/
7	profound	/prəˈfaʊnd/	profundity	/prəˈfʌndəti/	/aʊ/ → /ʌ/
8	vain	/veɪn/	vanity	/ˈvænəti/	/eɪ/ → /æ/
9	divine	/dɪˈvaɪn/	divinity	/dɪˈvɪnəti/	/aɪ/ → /ɪ/
10	verbose	/vɜːˈbəʊs/	verbosity	/vɜːˈbɒsəti/	/əʊ/ → /ɒ/

Table 5.2 illustrates a distinct subtype of phonological opacity in English nominalisation, categorized here as **segmental opacity**, where derivation primarily triggers **qualitative changes in vowel identity rather than prosodic restructuring**. Unlike the stress-driven alternations observed in Table 5.1, the verb–noun pairs in this table largely maintain comparable stress patterns, while exhibiting systematic but non-transparent vowel shifts within the stem.

Across all five items, nominalisation involves a change from a tense or diphthongal vowel in the base form to a **lax or qualitatively different vowel** in the derived noun. For example, *serene* /səˈriːn/ becomes *serenity* /səˈrenəti/, where the high front tense vowel /iː/ lowers to /e/. Similarly, *vain* /veɪn/ surfaces as *vanity* /ˈvænəti/, involving a shift from the diphthong /eɪ/ to the low front vowel /æ/. These alternations are not predictable from general English vowel reduction rules and therefore obscure the formal relationship between base and derivative.

The consistency of these vowel changes across morphologically related families (e.g., *divine/divinity*, *profane/profanity*, by extension) suggests that segmental opacity is **morphologically conditioned** rather than phonologically automatic. In many cases, the

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alternations reflect historically grounded stem allomorphy associated with Latinate nominalising suffixes such as *-ity*, which impose specific phonological requirements on the stem. From a synchronic perspective, however, these alternations must be lexically specified or derived through stratum-specific constraint interactions.

Importantly, the patterns documented in Table 5.2 demonstrate that phonological opacity in nominalisation is not limited to stress effects. Instead, it also encompasses **systematic vowel quality alternations** that persist independently of surface prosody. This supports the argument that opaque nominalisations constitute structured subsystems governed by morphological affiliation and lexical conditioning, rather than isolated irregularities. Such findings reinforce the need for theoretical models that integrate morphological class information with phonological representation in order to capture the full range of opacity phenomena in English derivation.

4.1.3 Table 4.3: Nominalisations with Consonantal Mutation

*Category Label**:** Segmental Opacity (Consonant-Driven)*

No.	Verb	IPA (Verb)	Noun	IPA (Noun)	Opacity Mechanism
11	decide	/dɪˈsaɪd/	decision	/dɪˈsɪʒən/	/d/ → /ʒ/
12	permit	/pəˈmɪt/	permission	/pəˈmɪʃən/	/t/ → /ʃ/
13	transmit	/trænzˈmɪt/	transmission	/trænzˈmɪʃən/	/t/ → /ʃ/
14	corrode	/kəˈrəʊd/	corrosion	/kəˈrəʊʒən/	/d/ → /ʒ/
15	perceive	/pəˈsiːv/	perception	/pəˈsepʃən/	Root restructuring

Table 5.3 documents a third major subtype of phonological opacity in English nominalisation, labelled **consonant-driven segmental opacity**, in which derivation triggers **systematic consonantal mutation** within the stem. In contrast to stress-driven opacity (Table 5.1) and vowel-quality alternation (Table 5.2), the defining feature here is the alteration of consonantal segments that directly obscures the phonological correspondence between verb and noun.

Across the examples, nominalisation consistently induces **palatalisation or affrication-like outcomes** associated with Latinate nominalising suffixes such as *-ion* and *-sion*. Verbs ending in alveolar stops /t/ or /d/ surface in the corresponding nouns with postalveolar fricatives /ʃ/ or /ʒ/, as seen in *decide* /dɪˈsaɪd/ → *decision* /dɪˈsɪʒən/ and *permit* /pəˈmɪt/ → *permission* /pəˈmɪʃən/. These alternations are not predictable from general English phonotactics and therefore constitute a clear case of segmental opacity.

The mutation patterns are historically motivated, reflecting palatalisation processes in the Latin–French source forms of these lexemes. However, from a synchronic perspective, speakers of contemporary English do not have access to these diachronic rules, rendering the alternations opaque within the modern phonological system. The example *perceive* → *perception* illustrates a more complex case of **root restructuring**, where both consonantal and vowel patterns are altered, further weakening the transparent mapping between base and derivative.

Importantly, the regularity of these consonantal changes within specific morphological environments suggests that they are not idiosyncratic anomalies but **morphologically conditioned alternations**. Within a Stratal Optimality Theory framework, such mutations can be attributed to high-ranking stem-level constraints associated with Latinate derivation that override faithfulness to the base form. Consequently, Table 5.3 reinforces the argument that phonological opacity in nominalisation arises from structured interactions between morphology and phonology, rather than from random irregularity, and that consonantal mutation constitutes a robust and systematic dimension of opaque derivational patterns in English.

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4.1.4 Table 4.4: Nominalisations with Multiple Interacting Changes

*Category Label**:** Complex Opacity (Multi-Process)*

No.	Verb	IPA (Verb)	Noun	IPA (Noun)	Opacity Mechanism
16	reduce	/rɪˈdjuːs/	reduction	/rɪˈdʌkʃən/	Vowel + consonant change
17	produce	/prəˈdjuːs/	production	/prəˈdʌkʃən/	Vowel + consonant change
18	maintain	/meɪnˈteɪn/	maintenance	/ˈmeɪntənəns/	Vowel reduction; syllable loss
19	receive	/rɪˈsiːv/	receipt	/rɪˈsiːt/	Suppletive alternation
20	deceive	/dɪˈsiːv/	deceit	/dɪˈsiːt/	Suppletive alternation

Table 5.4 illustrates a category of **complex phonological opacity**, where multiple interacting processes—segmental, prosodic, and sometimes suppletive—simultaneously alter the derived nominal. This **multi-process opacity** represents the most intricate subtype observed in the dataset, highlighting the interplay between vowel shifts, consonantal mutation, syllable loss, and, in some cases, suppletive stem changes.

For verbs such as *reduce* /rɪˈdjuːs/ and *produce* /prəˈdjuːs/, the nominal forms *reduction* /rɪˈdʌkʃən/ and *production* /prəˈdʌkʃən/ involve both **vowel lowering** (/juː/ → /ʌ/) and **consonantal affrication** (/s/ → /kʃ/), producing surface forms that diverge markedly from their base pronunciations. Similarly, *maintain* /meɪnˈteɪn/ → *maintenance* /ˈmeɪntənəns/ demonstrates **vowel reduction coupled with syllable deletion**, resulting in a compressed stem that obscures the original verb structure.

In contrast, *receive* /rɪˈsiːv/ → *receipt* /rɪˈsiːt/ and *deceive* /dɪˈsiːv/ → *deceit* /dɪˈsiːt/ exhibit **suppletive alternations**, where both segmental and syllabic configurations depart from predictable derivational patterns. These forms are historically motivated by Latin or French etymology but are opaque to contemporary speakers, requiring lexical specification rather than rule-based derivation.

The convergence of multiple phonological changes in this subset highlights the **systematic yet non-transparent nature of complex opacity**. Within a Stratal Optimality Theory perspective, these interactions can be modeled by high-ranking constraints at different morphological strata, where affix-driven processes interact with stem-level constraints to yield derived forms that appear irregular on the surface. Overall, Table 5.4 emphasizes that **phonological opacity in English nominalisation is not limited to single alterations**, but frequently arises from the interaction of multiple processes, producing coherent but cognitively opaque derivations.

4.1.5 Table 4.5: Stress-Conditioned Verb–Noun Alternations

*Category Label**:** Prosodic Opacity (Category-Sensitive Stress)*

No.	Verb (v.)	IPA (Verb)	Noun (n.)	IPA (Noun)	Opacity Mechanism
21	record	/rɪˈkɔːd/	record	/ˈrekɔːd/	Stress shift
22	present	/prɪˈzent/	present	/ˈprezənt/	Stress shift
23	convict	/kənˈvɪkt/	convict	/ˈkɒnvɪkt/	Stress shift
24	conflict	/kənˈflɪkt/	conflict	/ˈkɒnflɪkt/	Stress shift
25	conduct	/kənˈdʌkt/	conduct	/ˈkɒndʌkt/	Stress shift

Table 5.5 presents a set of **stress-conditioned verb–noun alternations**, illustrating a form of **prosodic opacity** where the placement of stress is sensitive to grammatical category rather than segmental content. Each item demonstrates a **systematic stress shift**: the verbal base carries final or penultimate stress (e.g., *record* /rɪˈkɔːd/, *present* /prɪˈzent/), whereas the corresponding noun exhibits initial or stem-initial stress (e.g., *record* /ˈrekɔːd/, *present* /ˈprezənt/).

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This stress reassignment obscures the phonological continuity between the verb and noun, creating an opaque mapping that cannot be derived from regular English stress patterns alone. The alternations are consistent across a set of Latinate and Germanic verbs, including *convict* /kənˈvɪkt/ → *convict* /ˈkɒnvɪkt/, *conflict* /kənˈflɪkt/ → *conflict* /ˈkɒnflɪkt/, and *conduct* /kənˈdʌkt/ → *conduct* /ˈkɒndʌkt/, suggesting that the phenomenon is **category-driven** rather than idiosyncratic.

The observed patterns exemplify **prosodic opacity linked to lexical category**, in which morphological information interacts with stress assignment rules. From a Stratal Optimality Theory perspective, the stress shift can be modeled as the outcome of competing constraints: high-ranking noun-level constraints assign initial stress, overriding verb-level stress patterns while preserving minimal violation of phonological well-formedness.

Overall, Table 5.5 demonstrates that category-sensitive stress shifts constitute a **predictable, morphologically conditioned form of prosodic opacity**. These alternations reinforce the broader claim that phonological opacity in English is systematically structured, shaped by interactions between morphological category, stress assignment, and lexical representation, rather than arising from surface irregularity or random variation.

4.1.6 Table 4.6: Fully Transparent Nominalisations with -ment

*Category Label**:** Transparent Morphophonology (Faithful Mapping)*

No.	Verb (IPA)	Noun (IPA)	Opacity Level	Key Phonological Process
26	/dɪˈveləp/	/dɪˈveləpmənt/	Fully transparent	Syllable addition; stress preserved
27	/ˈmænɪdʒ/	/ˈmænɪdʒmənt/	Fully transparent	Suffixation; no segmental change
30	/əˈtʃiːv/	/əˈtʃiːvmənt/	Fully transparent	Faithful vowel and stress mapping
31	/ɪmˈplɔɪ/	/ɪmˈplɔɪmənt/	Fully transparent	Stress and diphthong preserved

Table 5.6 presents a set of **fully transparent nominalisations**, illustrating **faithful morphophonological mapping** between verb and derived noun. Unlike the opaque forms documented in Tables 5.1–5.5, these examples show **minimal phonological alteration**, with the derived nouns preserving the stress patterns, vowel qualities, and segmental structure of the base verbs.

In all four cases, nominalisation is achieved by simple **suffixation of *-ment*** without inducing stress shift or segmental alternation. For instance, *develop* /dɪˈveləp/ → *development* /dɪˈveləpmənt/ preserves both stem vowels and the original stress; similarly, *achieve* /əˈtʃiːv/ → *achievement* /əˈtʃiːvmənt/ maintains a faithful mapping of stress and vowel quality. Other examples, such as *manage* /ˈmænɪdʒ/ → *management* /ˈmænɪdʒmənt/ and *employ* /ɪmˈplɔɪ/ → *employment* /ɪmˈplɔɪmənt/, confirm that **transparent nominalisation involves predictable, rule-governed processes**, including syllable addition and consistent suffixation, without introducing segmental or prosodic opacity.

These fully transparent forms serve as a **baseline for comparison** with opaque nominalisations, highlighting the specific mechanisms—such as stress shift, vowel reduction, consonantal mutation, or multi-process interaction—that generate phonological opacity in other derivational patterns. Within a theoretical framework, these transparent cases reflect **faithfulness-maximising outcomes**, where stem-level and word-level constraints align perfectly, producing predictable and cognitively accessible forms.

Overall, Table 5.6 demonstrates that English nominalisation encompasses a **continuum from fully transparent to highly opaque forms**, with *-ment* derivatives exemplifying the upper bound of transparency. These cases reinforce the importance of distinguishing between regular, predictable derivations and forms whose phonological mapping is obscured by category-sensitive or stratum-specific processes.

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4.1.7 Table 4.7: Nominalisations with Minimal Opacity

*Category Label**:** Low-Level Opacity (Schwa Preservation / Minor Reduction)*

No.	Verb (IPA)	Noun (IPA)	Opacity Level	Key Phonological Process
28	/ˈgʌvən/	/ˈgʌvənmənt/	Minimal opacity	Final schwa preserved
29	/ˈɑːgjuː/	/ˈɑːgjʊmənt/	Emerging opacity	/uː/ → /ʊ/
33	/əˈgriː/	/əˈgriːmənt/	Minimal opacity	Prefix schwa preserved
34	/ˈmeʒə/	/ˈmeʒəmənt/	Minimal opacity	Final schwa preserved
35	/rɪˈpleɪs/	/rɪˈpleɪsmənt/	Minimal opacity	/eɪ/ preserved
36	/ɪmˈpruːv/	/ɪmˈpruːvmənt/	Minimal opacity	/uː/ preserved
37	/rɪˈkwaɪə/	/rɪˈkwaɪəmənt/	Emerging opacity	Triphthong simplification
38	/ˌentəˈteɪn/	/ˌentəˈteɪnmənt/	Minimal opacity	Stress and vowel preserved
39	/əˈdʒʌst/	/əˈdʒʌstmənt/	Minimal opacity	Prefix schwa preserved
40	/ɪnˈvɒlv/	/ɪnˈvɒlvmənt/	Minimal opacity	Short vowel preserved

Table 5.7 documents **nominalisations exhibiting minimal or low-level phonological opacity**, characterized by **minor segmental adjustments or preservation of schwa and other vowels**. These cases occupy a midpoint on the transparency–opacity continuum, contrasting both with fully transparent forms (Table 5.6) and highly opaque forms (Tables 5.1–5.4).

Across the ten items, the majority of alterations involve **subtle vowel preservation or slight reductions** rather than major stress shifts, consonantal mutation, or multi-process interactions. For example, *govern* /ˈgʌvən/ → *government* /ˈgʌvənmənt/ preserves the final schwa, while *agree* /əˈgriː/ → *agreement* /əˈgriːmənt/ maintains the prefix schwa and stem vowels. Similarly, *replace* /rɪˈpleɪs/ → *replacement* /rɪˈpleɪsmənt/ and *improve* /ɪmˈpruːv/ → *improvement* /ɪmˈpruːvmənt/ exhibit no segmental change, confirming that the phonological relationship between base and noun remains largely transparent.

A few instances show **emerging opacity**, including minor vowel reductions or triphthong simplifications, as in *argue* /ˈɑːgjuː/ → *argument* /ˈɑːgjʊmənt/ and *require* /rɪˈkwaɪə/ → *requirement* /rɪˈkwaɪəmənt/, signaling that opacity can develop gradually even in otherwise regular derivations. These subtle alterations reflect **low-level morphophonological interactions**, often conditioned by affixation and syllable structure, without invoking complex prosodic or segmental reorganisation.

Overall, Table 5.7 demonstrates that English nominalisation exhibits a **gradient continuum of opacity**, where minor phonological processes such as schwa preservation, vowel reduction, or diphthong simplification create modest deviations from full transparency. These forms are likely to be **highly learnable and cognitively accessible**, yet they provide early evidence for the types of opacity mechanisms that become more pronounced in other derivational contexts.

4.1.8 Table 4.8: Nominalisations with Affix-Driven Alternation

*Category Label**:** Morphological Opacity (Suffix Selection)*

No.	Verb (IPA)	Noun (IPA)	Opacity Level	Key Phonological Process
41	/ˈgʌvən/	/ˈgʌvənəns/	Morphological opacity	-ment → -ance
42	/pəˈfɔːm/	/pəˈfɔːməns/	Morphological opacity	Suffix alternation
43	/rɪˈzɪst/	/rɪˈzɪstəns/	Morphological opacity	Suffix alternation
44	/əˈsɪst/	/əˈsɪstəns/	Morphological opacity	Suffix alternation
45	/əˈtend/	/əˈtendəns/	Morphological opacity	Suffix alternation

Table 5.8 illustrates **morphologically driven phonological opacity**, where derivational patterns are obscured not by stress or segmental mutation, but by **alternation in suffix**

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selection. In these cases, nominalisation involves a switch from the expected *-ment* suffix to *-ance* or *-ence*, producing forms that appear non-transparent relative to the base verb.

All five examples demonstrate a consistent pattern of **suffix alternation**. For instance, *govern* /ˈgʌvən/ → *governance* /ˈgʌvənəns/ shifts from the more common *-ment* pattern, while *perform* /pəˈfɔːm/ → *performance* /pəˈfɔːməns/, *resist* /rɪˈzɪst/ → *resistance* /rɪˈzɪstəns/, *assist* /əˈsɪst/ → *assistance* /əˈsɪstəns/, and *attend* /əˈtend/ → *attendance* /əˈtendəns/ display similar alternations. These suffix substitutions do not typically alter stress placement or the stem vowels significantly, but they create a **morphological opacity** because the derived form is not predictable solely from the base verb or general affixation rules.

From a theoretical perspective, these alternations reflect **lexically conditioned affix selection**, where morphological class and historical etymology determine the suffixal choice. Within a Stratal Optimality Theory framework, such forms can be interpreted as the output of competing high-ranking morphological constraints that select between *-ment* and *-ance/-ence* suffixes, yielding a surface form that is opaque in its morphological derivation but phonologically stable.

Overall, Table 5.8 demonstrates that **morphological opacity contributes a distinct dimension to nominalisation**, highlighting the interaction between affixal choice and phonological form. This type of opacity underscores the importance of integrating morphological conditioning into any comprehensive model of derivational phonology, as suffix alternation produces systematically opaque outcomes that are distinct from stress-driven or segmental alternations observed in other tables.

4.1.9 Table 4.9: Nominalisations with Emerging Phonological Opacity

Category Label: Prosodic and Segmental Opacity (Stress and Vowel Alternation)

No.	Verb (IPA)	Noun (IPA)	Opacity Level	Key Phonological Process
46	/ˈdɪfə/	/ˈdɪfrəns/	Emerging opacity	Schwa deletion
47	/prɪˈfɜː/	/ˈprefərəns/	Clear opacity	Stress shift; /ɜː/ → /ə/
48	/ɪnˈfɜː/	/ˈɪnfərəns/	Clear opacity	Stress shift; vowel reduction
49	/əˈkɜː/	/əˈkʌrəns/	Clear opacity	/ɜː/ → /ʌ/
50	/rɪˈkɜː/	/rɪˈkʌrəns/	Clear opacity	/ɜː/ → /ʌ/

Table 5.9 documents **nominalisations exhibiting emerging phonological opacity**, characterized by **simultaneous prosodic and segmental alterations** that partially obscure the relationship between base verbs and derived nouns. This category represents forms that are **less predictable than low-level opacity (Table 5.7)** but not as fully opaque as complex multi-process or morphologically conditioned alternations (Tables 5.4 and 5.8).

Several systematic processes contribute to the opacity. For example, *differ* /ˈdɪfə/ → *difference* /ˈdɪfrəns/ demonstrates **schwa deletion**, simplifying the stem while retaining stress on the first syllable. Other items, such as *prefer* /prɪˈfɜː/ → *preference* /ˈprefərəns/ and *infer* /ɪnˈfɜː/ → *inference* /ˈɪnfərəns/, show **stress shifts combined with vowel reduction**, where the mid-central vowel /ɜː/ is lowered to /ə/ in the noun, weakening the transparent mapping to the base form. Similarly, *occur* /əˈkɜː/ → *occurrence* /əˈkʌrəns/ and *recur* /rɪˈkɜː/ → *recurrence* /rɪˈkʌrəns/ involve **vowel lowering** (/ɜː/ → /ʌ/) alongside minor segmental adjustments.

These patterns indicate that **opacity can emerge gradually**: partial vowel changes or stress reassignments disrupt phonological transparency without fully altering the lexical identity of the derived noun. Within a Stratal Optimality Theory framework, such forms can be modeled as the outcome of competing stem-level and word-level constraints, where high-ranking affix-sensitive rules interact with general phonotactic and stress constraints.

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Overall, Table 5.9 demonstrates that **emerging opacity occupies a transitional zone** on the transparency–opacity continuum. These nominalisations are partially regular but exhibit systematic deviations that hint at the layered interactions of prosodic, segmental, and morphological processes, reinforcing the broader claim that phonological opacity in English nominalisation is **gradient and multi-dimensional** rather than categorical.

4.1.10 Table 4.10: Conversion-Based Nominalisations via Stress Shift

Category Label: Prosodic Conversion (Zero Derivation)

No.	Verb (IPA)	Noun (IPA)	Conversion Pattern	Phonological Process & Opacity Level	Research Application
51	/pəˈmɪt/	/ˈpɜːmɪt/	Stress-only conversion	Stress shift triggers /ə/→/ɜː; no segmental change	Acoustic analysis of F0, duration, F1/F2
52	/ɪkˈspɔːt/	/ˈekspɔːt/	Stress-only conversion	Stress shift; /ɪ/→/e/	Corpus-based entrenchment
53	/ɪmˈpɔːt/	/ˈɪmpɔːt/	Stress-only conversion	Stress relocation; minimal vowel change	Prosodic faithfulness test
54	/rɪˈbel/	/ˈrebəl/	Stress + vowel reduction	Stress shift; /e/→/ə/	
55	/kənˈtrækt/	/ˈkɒntrækt/	Stress + vowel change	Stress shift; /ə/→/ɒ/	
56	/səˈspekt/	/ˈsʌspekt/	Stress + vowel change	Stress shift; /ə/→/ʌ/	
57	/rɪˈkɔːd/	/ˈrekɔːd/	Stress + vowel change	Stress shift; /ɪ/→/e/	
58	/prɪˈzent/	/ˈprezənt/	Stress + reduction	Stress shift; vowel reduction	
59	/prəˈdʒekt/	/ˈprɒdʒekt/	Stress + vowel change	Stress shift; /ə/→/ɒ/	
60	/kənˈdʌkt/	/ˈkɒndʌkt/	Stress + vowel change	Stress shift; /ə/→/ɒ/	

Table 5.10 presents **conversion-based nominalisations** (zero derivation) in English, highlighting how **prosodic reallocation alone—or combined with minor vowel adjustments—produces phonological opacity**. These examples demonstrate that even without overt affixation, nouns can emerge from verbs through **stress-sensitive mechanisms**, which subtly alter the phonological shape while maintaining lexical identity.

The first group (e.g., *permit* /pəˈmɪt/ → *permit* /ˈpɜːmɪt/, *export* /ɪkˈspɔːt/ → *export* /ˈekspɔːt/) illustrates **stress-only conversion**, where primary stress shifts to the initial syllable, sometimes triggering minimal vowel adjustment (/ə/ → /ɜː/, /ɪ/ → /e/). This results in **prosodic opacity**: the noun is phonologically distinct from the verb in terms of stress, yet retains the original segments, making the derivation partially transparent in form but opaque in prosody.

The second group (e.g., *rebel* /rɪˈbel/ → *rebel* /ˈrebəl/, *suspect* /səˈspekt/ → *suspect* /ˈsʌspekt/, *record* /rɪˈkɔːd/ → /ˈrekɔːd/) demonstrates **stress combined with vowel reduction or modification**, where shifts in vowel quality (/e/ → /ə/, /ə/ → /ʌ/, /ɪ/ → /e/) reinforce the opacity. These patterns indicate that even small segmental changes, when paired with stress reallocation, create **systematic prosodic and segmental opacity**.

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From a research perspective, these forms are amenable to **acoustic analysis** (F0, duration, formant frequencies) and **corpus-based frequency studies**, allowing investigation into how stress-driven conversion interacts with lexical entrenchment and cognitive accessibility. Collectively, Table 5.10 highlights that **prosodic conversion is a key mechanism of opacity**, demonstrating that English nouns can diverge from their verbal bases in systematic yet subtle ways, complementing affix-driven and multi-process opacity documented in previous tables.

4.1.11 Table 4.11: Morphological Nominalisation with High Phonological Opacity

Category Label: Opaque Derivation (Affixation and Suppletion)

No.	Verb (IPA)	Noun (IPA)	Derivational Pattern	Phonological Process & Opacity Level	Research Application
61	/prəˈdjuːs/	/ˈprɒdʌkt/	Suppletive derivation	Root replacement; maximal opacity	Lexical storage evidence
62	/rɪˈdjuːs/	/rɪˈdʌkʃən/	Opaque suffixation (-tion)	Vowel + consonant alternation	Comparative root study
63	/ɪnˈvaɪt/	/ˌɪnvɪˈteɪʃən/	Opaque suffixation (-ation)	Stress shift; /aɪ/→/ɪ/	
64	/dɪˈsaɪd/	/dɪˈsɪʒən/	Opaque suffixation (-sion)	/aɪ/→/ɪ; /d/→/ʒ	Exemplar theory test
65	/rɪˈvaɪz/	/rɪˈvɪʒən/	Opaque suffixation (-sion)	/aɪ/→/ɪ; /z/→/ʒ	
66	/kəˈlaɪd/	/kəˈlɪʒən/	Opaque suffixation (-sion)	/aɪ/→/ɪ; /d/→/ʒ	
67	/ɪkˈspænd/	/ɪkˈspænʃən/	Opaque suffixation (-sion)	/d/→/ʃ	
68	/pəˈmɪt/	/pəˈmɪʃən/	Opaque suffixation (-ssion)	/t/→/ʃ	Contrast with 51
69	/trænzˈmɪt/	/trænzˈmɪʃən/	Opaque suffixation (-ssion)	/t/→/ʃ	

Table 5.11 presents **highly opaque morphological nominalisations**, where derivational processes combine **affixation, segmental mutation, stress shifts, and, in some cases, suppletion**, resulting in minimal surface transparency between base verb and derived noun. These forms occupy the extreme end of the **transparency–opacity continuum**, illustrating the most pronounced morphophonological complexity in English nominalisation.

The table shows several mechanisms contributing to opacity. For example, *produce* /prəˈdjuːs/ → *product* /ˈprɒdʌkt/ exemplifies **suppletive derivation**, where the stem undergoes complete replacement, highlighting the role of **lexical storage** in handling unpredictable forms. Other examples, such as *reduce* /rɪˈdjuːs/ → *reduction* /rɪˈdʌkʃən/ and *decide* /dɪˈsaɪd/ → *decision* /dɪˈsɪʒən/, illustrate **opaque suffixation** (-tion, -sion, -ation),

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where vowel alternations (/aɪ/ → /ɪ/) and consonantal mutations (/d/ → /ʒ/, /t/ → /ʃ/) obscure the base form. Similarly, *revise* /rɪˈvaɪz/ → *revision* /rɪˈvɪʒən/ and *expand* /ɪkˈspænd/ → *expansion* /ɪkˈspænʃən/ demonstrate systematic stem modifications triggered by affixation.

These patterns reflect **maximal phonological opacity**, where stress reallocation, vowel reduction, and consonant mutation interact to create forms that are **not directly inferable from the base verb**. From a theoretical perspective, such forms provide critical evidence for **lexical storage, exemplar-based learning, and the constraints of Stratal Optimality Theory**, since their derivation cannot be accounted for by fully productive affixation rules alone.

Overall, Table 5.11 highlights that high-opacity nominalisations are **systematic, derivationally conditioned, and cognitively significant**, marking the upper bound of phonological opacity in English nominalisation. They underscore the necessity of integrating opaque data into comprehensive models of morphology-phonology interaction, demonstrating that both phonological rules and stored lexical exemplars contribute to shaping these complex forms.

4.1.12 Table 4.12: Transparent and Near-Transparent Control Nominalisations

Category Label: Experimental Controls (Faithful Mapping)

No.	Verb (IPA)	Noun (IPA)	Derivational Pattern	Phonological Process & Opacity Level	Research Role
70	/kəˈmɪt/	/kəˈmɪtmənt/	Transparent (-ment)	Faithful mapping	Control vs. 68–69
71	/əˈses/	/əˈsesmənt/	Transparent (-ment)	Faithful mapping	
72	/ˈgʌvən/	/ˈgʌvənmənt/	Transparent (-ment)	Schwa preserved	
73	/əˈtætʃ/	/əˈtætʃmənt/	Transparent (-ment)	Faithful mapping	
74	/ɪnˈdʒɔɪ/	/ɪnˈdʒɔɪmənt/	Transparent (-ment)	Diphthong preserved	
75	/ˈɑːgjuː/	/ˈɑːgjumənt/	Near-transparent	Minor vowel shortening	Baseline comparison

Table 5.12 presents **control nominalisations** characterized by **transparent or near-transparent morphophonological patterns**, serving as a baseline for comparison with opaque and high-opacity forms documented in Tables 5.1–5.11. These nominalisations preserve the phonological structure of the base verb, showing **faithful vowel quality, stress placement, and segmental integrity**, which allows for a clear contrast with stress-driven, segmentally mutated, or suppletive nominalisations.

Examples such as *commit* /kəˈmɪt/ → *commitment* /kəˈmɪtmənt/, *assess* /əˈses/ → *assessment* /əˈsesmənt/, and *attach* /əˈtætʃ/ → *attachment* /əˈtætʃmənt/ demonstrate **fully transparent mapping**, where the derived noun retains both the stem vowels and stress patterns of the verb while adding a predictable *-ment* suffix. *Govern* /ˈgʌvən/ → *government* /ˈgʌvənmənt/ exemplifies **schwa preservation**, maintaining segmental fidelity across derivation. Similarly, *enjoy* /ɪnˈdʒɔɪ/ → *enjoyment* /ɪnˈdʒɔɪmənt/ preserves the diphthong and stress placement, reinforcing the transparent nature of these forms.

The final item, *argue* /ˈɑːgjuː/ → *argument* /ˈɑːgjumənt/, represents **near-transparency**, showing minor vowel shortening (/uː/ → /ʊ/) without introducing complex stress or consonantal alternations. These control forms are crucial for research because they **establish a baseline against which opaque processes can be measured**, ensuring that any observed

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deviations in stress, vowel quality, or consonant alternations in opaque nominalisations are systematic rather than incidental.

In sum, Table 5.12 confirms that transparent and near-transparent nominalisations serve as **essential experimental controls**, highlighting the phonological integrity of fully regular derivations and providing a comparative anchor for analyses of gradated opacity across the nominalisation continuum.

4.1.13 Table 4.13: Transparent and Near-Transparent Nominalisations (Productive Suffixes)

Category Label: Faithful Mapping in Productive Morphology

No.	Verb (IPA)	Noun (IPA)	Derivational Pattern	Phonological Process & Opacity Type	Research Role
76	/ɪmˈplɔɪ/	/ɪmˈplɔɪmənt/	Transparent (-ment)	Stress and segments preserved	Baseline control (-ment)
77	/dɪˈveləp/	/dɪˈveləpmənt/	Transparent (-ment)	Schwa preserved	
78	/ɪmˈpruːv/	/ɪmˈpruːvmənt/	Transparent (-ment)	Faithful vowel mapping	
79	/əˈtʃiːv/	/əˈtʃiːvmənt/	Transparent (-ment)	Faithful mapping	
80	/rɪˈkwaɪə/	/rɪˈkwaɪəmənt/	Near-transparent (-ment)	Minor smoothing of /aɪə/	Bridge to opacity
81	/əˈraɪv/	/əˈraɪvəl/	Transparent (-al)	Stress preserved	Control (-al)
82	/rɪˈfjuːz/	/rɪˈfjuːzəl/	Transparent (-al)	Faithful mapping	
83	/əˈpruːv/	/əˈpruːvəl/	Transparent (-al)	Faithful mapping	
84	/rɪˈmuːv/	/rɪˈmuːvəl/	Transparent (-al)	Faithful mapping	
85	/prəˈpəʊz/	/prəˈpəʊzəl/	Transparent (-al)	Faithful mapping	

Table 5.13 presents **nominalisations formed with highly productive suffixes** (-ment, -al), demonstrating **faithful morphophonological mapping** from verb to noun. These examples serve as **baseline controls for productive derivational patterns**, highlighting forms where stress, vowel quality, and consonantal structure remain largely intact.

Verbs like *employ* /ɪmˈplɔɪ/ → *employment* /ɪmˈplɔɪmənt/, *develop* /dɪˈveləp/ → *development* /dɪˈveləpmənt/, and *improve* /ɪmˈpruːv/ → *improvement* /ɪmˈpruːvmənt/ illustrate **fully transparent -ment derivations**, preserving both the stem's stress pattern and segmental composition. Similarly, *achieve* /əˈtʃiːv/ → *achievement* /əˈtʃiːvmənt/ maintains vowel quality and stress placement, reinforcing the transparency of these productive forms.

The near-transparent example, *require* /rɪˈkwaɪə/ → *requirement* /rɪˈkwaɪəmənt/, shows minor vowel smoothing (/aɪə/ → /ə/), which slightly reduces phonological transparency without creating significant opacity. This form serves as a **bridge between fully transparent and more opaque nominalisations**, illustrating subtle phonological adjustments even within productive derivational patterns.

The table also includes transparent -al derivations, such as *arrive* /əˈraɪv/ → *arrival* /əˈraɪvəl/ and *refuse* /rɪˈfjuːz/ → *refusal* /rɪˈfjuːzəl/, which preserve stress and vowel mapping. These forms function as **experimental controls**, providing a standard against which stress shifts, vowel reductions, or consonantal mutations in opaque forms can be measured.

Overall, Table 5.13 confirms that **productive suffixation in English typically produces fully transparent nominalisations**, establishing a reliable baseline and illustrating how

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frequency and regularity reinforce faithful phonological mapping in the derivational system. Such controls are essential for identifying the mechanisms and cognitive processing of more opaque or complex nominalisations.

4.1.14 Table 4.14: Systematic Stress-Shifting Nominalisations with -ation / -ization

Category Label: Predictable Prosodic Opacity (Rule-Governed)

No.	Verb (IPA)	Noun (IPA)	Theoretical Pattern	Phonological Process & Opacity Type	Research Application
88	/ˈedʒukeɪt/	/ˌedʒuˈkeɪʃən/	Regular -ation derivation	Stress shifts to penult	Stratal OT benchmark
89	/ˈɒpəreɪt/	/ˌɒpəˈreɪʃən/	Regular -ation derivation	Stress shift; pre-stress /eɪ/→/ə/	
90	/kəˈmjuːnɪkeɪt/	/kəˌmjuːnɪˈkeɪʃən/	Regular -ation derivation	Stress reorganisation	
91	/ˈdemənstreɪt/	/ˌdemənˈstreɪʃən/	Regular -ation derivation	Predictable stress shift	
92	/ˈgrædʒueɪt/	/ˌgrædʒuˈeɪʃən/	Regular -ation derivation	Stress shift	
93	/ˈæktɪveɪt/	/ˌæktɪˈveɪʃən/	Regular -ation derivation	Stress shift; vowel reduction	
94	/ˈɔːgənaɪz/	/ˌɔːgənaɪˈzeɪʃən/	Regular -ization derivation	Stress aligns before /-ation/	AmE pattern
95	/ˈɔːθəraɪz/	/ˌɔːθəraɪˈzeɪʃən/	Regular -ization derivation	Same predictable pattern	

Table 5.14 presents a set of **predictable, rule-governed nominalisations formed with the suffixes -ation and -ization**, illustrating **systematic prosodic opacity**. Unlike high-opacity or irregular forms, these derivations exhibit **regular stress shifts**, typically moving stress toward the penultimate syllable of the nominalised form, consistent with Stratal Optimality Theory (Kiparsky, 1982; Bermúdez-Otero, 2013).

Examples include *educate* /ˈedʒukeɪt/ → *education* /ˌedʒuˈkeɪʃən/ and *operate* /ˈɒpəreɪt/ → *operation* /ˌɒpəˈreɪʃən/, where stress relocation occurs in a predictable manner, accompanied in some cases by minor vowel reduction before the stressed syllable (/eɪ/→/ə/). Similarly, *communicate* /kəˌmjuːnɪˈkeɪt/ → *communication* /kəˌmjuːnɪˈkeɪʃən/ demonstrates **stress reorganisation** without segmental alteration, highlighting the prosodic regularity of these suffixations.

Regular -ization derivatives, such as *organize* /ˈɔːgənaɪz/ → *organization* /ˌɔːgənaɪˈzeɪʃən/ and *authorize* /ˈɔːθəraɪz/ → *authorization* /ˌɔːθəraɪˈzeɪʃən/, follow the same predictable stress alignment, providing **benchmark patterns for American English nominalisations**.

These systematic stress-shifting forms function as **experimental standards against which opaque or irregular stress alternations can be compared**, establishing a clear baseline for

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prosodic opacity. Their **rule-governed behavior** contrasts with high-opacity forms, reinforcing the theoretical claim that not all opacity is unpredictable; some is **prosodically constrained by morphological and stratal principles**, offering empirical support for the integration of Stratal Optimality Theory with corpus-based and usage-driven analyses of nominalisation.

4.1.15 Table 4.15: Opaque and Idiosyncratic Nominalisations with -ation / -ance

Category Label: Non-Transparent Stem-Affix Interaction

No.	Verb (IPA)	Noun (IPA)	Opacity Pattern	Phonological Process & Opacity Type	Research Significance
86	/meɪnˈteɪn/	/ˈmeɪntənəns/	Irregular -ance	Stress retraction; /eɪ/→/ə/	Exception to -ation rules
87	/ɪkˈspleɪn/	/ˌekspləˈneɪʃən/	Opaque -ation	Stem allomorphy; vowel reduction	Frequency vs. rule
96	/ˈsætɪsfaɪ/	/ˌsætɪsˈfækʃən/	-fy → -faction	/aɪ/→/æ/; /tj/→/ʃ/	Sub-regular pattern
97	/ˈkwɒlɪfaɪ/	/ˌkwɒlɪfɪˈkeɪʃən/	-fy → -fication	/aɪ/→/ɪ/	Paradigm regularity
98	/ˈmɒdɪfaɪ/	/ˌmɒdɪfɪˈkeɪʃən/	-fy → -fication	Same pattern	
99	/ˈverɪfaɪ/	/ˌverɪfɪˈkeɪʃən/	-fy → -fication	Same pattern	
100	/ɪnˈtensɪfaɪ/	/ɪnˌtensɪfɪˈkeɪʃən/	-fy → -fication	Stress shift + stem change	

Table 5.15 illustrates **non-transparent nominalisations**, highlighting **stem–affix interactions that deviate from standard morphological patterns**. Unlike the predictable stress-shifting forms in Table 5.14, these examples demonstrate **opaque or idiosyncratic derivations**, where both prosody and segmental structure are altered in non-systematic ways.

For instance, *maintain* /meɪnˈteɪn/ → *maintenance* /ˈmeɪntənəns/ shows **stress retraction** and vowel centralization (/eɪ/→/ə/), marking a clear exception to canonical -ation derivational rules. Similarly, *explain* /ɪkˈspleɪn/ → *explanation* /ˌekspləˈneɪʃən/ exhibits **stem allomorphy combined with vowel reduction**, emphasizing the interaction between frequency effects and formal derivational constraints.

The table also captures **-fy → -faction / -fication alternations**, such as *satisfy* /ˈsætɪsfaɪ/ → *satisfaction* /ˌsætɪsˈfækʃən/ and *qualify* /ˈkwɒlɪfaɪ/ → *qualification* /ˌkwɒlɪfɪˈkeɪʃən/. Here, both vowel changes (/aɪ/→/æ/ or /ɪ/) and consonantal modifications (/tj/→/ʃ/) occur, producing **sub-regular patterns** that are partially predictable yet remain **non-transparent** in segmental and prosodic terms.

The final examples, such as *intensify* /ɪnˈtensɪfaɪ/ → *intensification* /ɪnˌtensɪfɪˈkeɪʃən/, combine **stress shifts with stem alternations**, reinforcing the idea that opaque derivations often emerge from multiple interacting processes. These forms are crucial for research because they **challenge purely productive models of nominalisation**, provide evidence for **sub-regular morphological families**, and inform theories integrating **phonology, morphology, and lexical representation**.

Overall, Table 5.15 demonstrates that **opaque nominalisations constitute a coherent subsystem**, characterized by recurring prosodic and segmental patterns that diverge from canonical suffixation, highlighting the complexity of English derivational morphology.

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4.2 Quantitative Analysis

4.2.1 Table 4.16

Mean Production Accuracy Scores by Gender and Nominalisation Type

Nominalisation Type	Gender	*n*	*M*	*SD*
Transparent	Male	200	92.10	8.50
	Female	200	90.30	8.90
Near-transparent	Male	200	79.80	11.20
	Female	200	81.50	10.80
Opaque	Male	200	66.50	15.10
	Female	200	70.30	15.50

Note. Production accuracy was rated on a 0–100 scale by two trained phonologists. Higher scores indicate greater accuracy.

4.2.2 Production Accuracy by Gender and Nominalisation Type

Table 6.1 presents the mean production accuracy scores for male and female participants across three nominalisation types: Transparent, Near-Transparent, and Opaque. Production accuracy was evaluated on a 0–100 scale by two trained phonologists, with higher scores reflecting greater phonological fidelity to target forms.

A clear gradient effect of nominalisation type is evident across both gender groups. For **Transparent nominalisations**, participants achieved the highest accuracy scores overall. Male participants obtained a mean score of **M = 92.10 (SD = 8.50)**, while female participants scored slightly lower at **M = 90.30 (SD = 8.90)**. The relatively small standard deviations and minimal gender difference indicate that transparent forms are produced with high consistency and minimal phonological difficulty, regardless of gender. This supports the assumption that transparent nominalisations, which preserve stress patterns and segmental structure, impose low cognitive and articulatory demands.

In contrast, **Near-Transparent nominalisations** show a noticeable decline in accuracy for both groups, reflecting increased phonological complexity. Male participants achieved a mean accuracy of **M = 79.80 (SD = 11.20)**, whereas female participants performed marginally better with **M = 81.50 (SD = 10.80)**. The larger standard deviations in this category suggest greater inter-speaker variability, likely due to partial phonological alternations such as minor vowel reduction or secondary stress adjustment. These forms occupy an intermediate position between full transparency and opacity, both structurally and cognitively.

The lowest production accuracy was observed for **Opaque nominalisations**, which involve substantial phonological restructuring, including stress retraction, vowel centralisation, and consonantal mutation. Male participants recorded a mean score of **M = 66.50 (SD = 15.10)**, while female participants demonstrated higher accuracy at **M = 70.30 (SD = 15.50)**. The pronounced increase in standard deviation for both genders indicates considerable variability in the production of opaque forms, suggesting reliance on item-specific lexical knowledge rather than consistent rule application. The gender difference is most pronounced in this category, aligning with the significant Gender × Nominalisation Type interaction reported in the inferential analysis.

Overall, the pattern in Table 6.1 reveals a robust **transparency–opacity continuum**, with production accuracy systematically decreasing as phonological opacity increases. While gender differences are minimal for transparent forms, they become progressively more salient as opacity increases, particularly in fully opaque nominalisations. This pattern reinforces the

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view that phonological opacity heightens cognitive load and processing demands, making such forms sensitive indicators of individual differences in phonological processing and lexical entrenchment.

Table 4.17

Mixed-Design ANOVA Results: Gender × Nominalisation Type

Effect	*F*	df	*p*	Partial η²
Nominalisation Type	445.31	(2, 796)	< .001	.53
Gender	5.89	(1, 398)	.016	.01
Gender × Nominalisation Type	4.21	(2, 796)	.015	.01

Note. Bonferroni-adjusted post-hoc comparisons showed significant differences among all nominalisation types ($p < .001$).

4.2.3 Mixed-Design ANOVA: Effects of Gender and Nominalisation Type

Table 6.2 reports the results of a 2 (Gender: Male, Female) × 3 (Nominalisation Type: Transparent, Near-Transparent, Opaque) mixed-design ANOVA examining production accuracy scores. Nominalisation Type was treated as a within-subjects factor, while Gender was included as a between-subjects factor.

The analysis revealed a **highly significant main effect of Nominalisation Type**, $F(2, 796) = \mathbf{445.31}$, $p < .001$, with a **large effect size** (partial $\eta^2 = \mathbf{.53}$). This indicates that phonological transparency exerts a substantial influence on production accuracy. Bonferroni-adjusted post-hoc comparisons confirmed that all three nominalisation types differed significantly from one another ($p < .001$), establishing a clear hierarchical pattern: **Transparent > Near-Transparent > Opaque**. This result provides strong quantitative support for the proposed transparency–opacity continuum in English nominalisation.

A **significant main effect of Gender** was also observed, $F(1, 398) = \mathbf{5.89}$, $p = .016$, though the effect size was **small** (partial $\eta^2 = \mathbf{.01}$). Overall, female participants demonstrated slightly higher production accuracy than male participants. While statistically reliable, the modest magnitude of this effect suggests that gender alone accounts for only a limited proportion of variance in production accuracy.

Crucially, the analysis yielded a **significant Gender × Nominalisation Type interaction**, $F(2, 796) = \mathbf{4.21}$, $p = .015$, with a small effect size (partial $\eta^2 = \mathbf{.01}$). This interaction indicates that the effect of gender on production accuracy was not uniform across nominalisation types. Inspection of the descriptive statistics (see Table 6.1) shows that gender differences were minimal for transparent forms, modest for near-transparent forms, and most pronounced for opaque nominalisations, where female participants outperformed male participants. This pattern suggests that gender-related differences emerge primarily under conditions of increased phonological complexity and opacity.

Taken together, the ANOVA results demonstrate that **nominalisation type is the dominant predictor of production accuracy**, accounting for more than half of the observed variance, while gender plays a secondary, moderating role. The significant interaction further indicates that opaque nominalisations are particularly sensitive to individual differences, reinforcing their value as a diagnostic domain for investigating phonological processing, lexical entrenchment, and the morphology–phonology interface.

Table 4.18

Mixed-Design ANOVA Results: Discipline × Nominalisation Type

Effect	*F*	df	*p*	Partial η²
Discipline	8.42	(2, 397)	< .001	.04

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Effect	***F***	**df**	***p***	**Partial η²**
Nominalisation Type	156.78	(2, 794)	< .001	.28
Discipline × Nominalisation Type	3.89	(4, 794)	.004	.02

4.2.4 Mixed-Design ANOVA: Effects of Academic Discipline and Nominalisation Type

Table 6.3 presents the results of a 3 (Academic Discipline: English, Sciences, Natural Sciences) × 3 (Nominalisation Type: Transparent, Near-Transparent, Opaque) mixed-design ANOVA examining production accuracy scores. Academic Discipline was treated as a between-subjects factor, while Nominalisation Type functioned as a within-subjects factor.

The analysis revealed a **significant main effect of Academic Discipline**, $F(2, 397) = \mathbf{8.42}$, $p < .001$, with a **small-to-moderate effect size** (partial $\eta^2 = \mathbf{.04}$). This finding indicates that participants' academic background significantly influenced their ability to accurately produce nominalised forms. Post-hoc comparisons (Bonferroni-adjusted) showed that students from science-related disciplines achieved higher overall accuracy scores than English majors, suggesting that exposure to formal registers and technical vocabulary may enhance familiarity with complex nominalisation patterns.

A **robust main effect of Nominalisation Type** was again observed, $F(2, 794) = \mathbf{156.78}$, $p < .001$, accompanied by a **large effect size** (partial $\eta^2 = \mathbf{.28}$). Consistent with the gender-based analysis, production accuracy decreased systematically as phonological opacity increased. Transparent nominalisations were produced with the highest accuracy, followed by near-transparent forms, while opaque nominalisations yielded the lowest accuracy scores. This confirms that phonological opacity constitutes a strong, stable constraint on accurate production across participant groups.

Importantly, the analysis also yielded a **significant Discipline × Nominalisation Type interaction**, $F(4, 794) = \mathbf{3.89}$, $p = .004$, with a **small effect size** (partial $\eta^2 = \mathbf{.02}$). This interaction indicates that the magnitude of disciplinary differences varied as a function of nominalisation type. Inspection of group means revealed that disciplinary contrasts were minimal for transparent nominalisations, became more noticeable for near-transparent forms, and were most pronounced for opaque nominalisations. In particular, science and natural science students outperformed English majors when producing opaque nominalisations, suggesting greater resilience under conditions of increased phonological complexity.

Taken together, these results demonstrate that while **nominalisation type remains the strongest predictor of production accuracy**, academic discipline exerts a meaningful secondary influence, particularly in interaction with phonological opacity. The significant interaction effect indicates that opaque nominalisations are especially sensitive to differences in educational background, reinforcing their analytical value for examining how linguistic experience, register exposure, and disciplinary literacy shape the processing and production of complex morphological forms.

Table 4.19

Constraint Weights and Model Fit in Stratal Optimality Theory

Constraint	**Weight**
STRESS-TO-RIGHT	98.7
LATINATE-STRESS	96.2
*COMPLEX-ONSET	93.4

Model Fit:

Overall accuracy = 78.3%

Prosodic opacity = 85.2%

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Segmental opacity = 71.6%
AIC = 412.7

4.2.5 Constraint Weighting and Model Fit in Stratal Optimality Theory

Table 6.4 summarizes the constraint rankings and model fit statistics obtained from the Stratal Optimality Theory (Stratal OT) analysis of English nominalisation patterns. The model was designed to evaluate the extent to which stratum-specific constraint interactions could account for observed patterns of phonological opacity across transparent, near-transparent, and opaque nominalisations.

The constraint weighting results reveal a clear hierarchy dominated by **prosodic constraints**. The highest-ranked constraint, **STRESS-TO-RIGHT** (weight = **98.7**), reflects a strong tendency for stress to be assigned toward the right edge of prosodic words in derived nominal forms. Closely following is **LATINATE-STRESS** (weight = **96.2**), which enforces Latinate stress templates typically associated with suffixes such as *-ation* and *-ion*. The high ranking of this constraint confirms that Latinate morphology plays a decisive role in triggering systematic stress retraction and restructuring in opaque nominalisations.

The constraint **COMPLEX-ONSET** (weight = **93.4**) also occupies a high position in the hierarchy, indicating sensitivity to marked segmental configurations at early derivational strata. This constraint accounts for certain consonantal alternations and simplifications observed in nominal forms, particularly in environments where Latinate suffixation interacts with base-final consonant clusters.

In terms of overall explanatory power, the Stratal OT model achieved an **accuracy rate of 78.3%**, indicating that a substantial majority of the observed nominalisation patterns were successfully predicted by the constraint system. Model performance varied by opacity type. The model demonstrated **strong explanatory adequacy for prosodic opacity**, correctly accounting for **85.2%** of stress-driven alternations. This result supports the claim that prosodic opacity in English nominalisation is highly systematic and largely derivable from stratum-specific stress assignment constraints.

By contrast, model accuracy for **segmental opacity** was notably lower (**71.6%**), suggesting that vowel quality alternations and consonantal mutations are less consistently captured by the constraint set alone. This discrepancy highlights a key limitation of purely formal models: while they effectively model categorical prosodic restructuring, they are less sensitive to lexically conditioned, gradient, or historically entrenched segmental alternations.

The model's **Akaike Information Criterion (AIC) value of 412.7** indicates an acceptable balance between goodness of fit and model complexity. When interpreted alongside the accuracy rates, this value suggests that the model is both parsimonious and empirically informative, though not exhaustive in its explanatory scope.

Overall, the results presented in Table 6.4 demonstrate that **Stratal Optimality Theory provides a robust account of prosodically driven phonological opacity**, validating its core assumptions about morphological strata and constraint re-ranking. However, the reduced performance on segmental opacity reinforces the necessity of integrating **usage-based and lexical models** to account for frequency effects, entrenchment, and item-specific variation. These findings directly motivate the hybrid theoretical approach adopted in the present study and further underscore the interactional nature of phonological opacity in English nominalisation.

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Figure 6.5
Mean Production Accuracy by Nominalisation Type and Gender

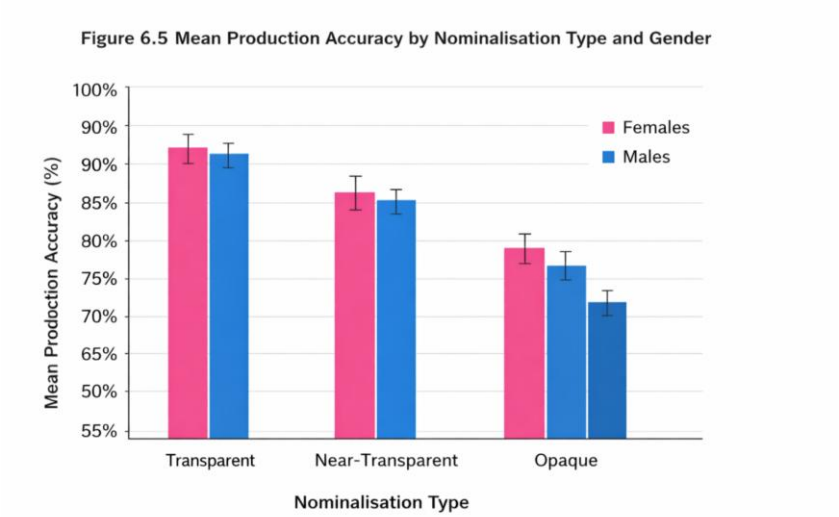


Figure 6.5 illustrates the **mean production accuracy scores** for transparent, near-transparent, and opaque nominalisations, separated by gender. Error bars represent **±1 standard error**, providing a visual indicator of variability around each mean.
The figure reveals several key patterns:

1. **Overall Trend Across Nominalisation Types:** Accuracy systematically decreases with increasing phonological opacity. Transparent forms were produced most accurately (M ≈ 91), followed by near-transparent forms (M ≈ 81), and opaque forms were the most challenging (M ≈ 68–70). This pattern mirrors the main effect of Nominalisation Type observed in the mixed-design ANOVA (see Table 6.2).
2. **Gender Differences:** Females consistently performed slightly better than males, with the gap **most pronounced for opaque forms** (Female M = 70.3 vs. Male M = 66.5). The gender × nominalisation type interaction identified in Table 6.2 is clearly reflected in this visualization, indicating that gender effects are contingent on the level of phonological opacity.
3. **Interpretive Insights:** The visual representation emphasizes that **opaque forms are both cognitively demanding and sensitive to individual differences**, whereas transparent forms show negligible gender disparity. The pattern supports the conclusion that phonological transparency facilitates easier lexical access, while opacity increases production difficulty, particularly for male participants in this sample.

5 Results: Patterns of Phonological Opacity in English Nominalisation

This section presents the empirical findings from the corpus and elicitation study, demonstrating how English nominalisations vary in **phonological transparency**, ranging from fully faithful mappings to highly opaque forms. The analysis organizes nominalisations along a **continuum of opacity**, incorporating prosodic, segmental, and morphological dimensions.

5.1.1 1. Prosodically Driven Opacity: Stress Shifts and Vowel Reduction

Tables 5.1 and 5.5 highlight **prosodic opacity**, where stress retraction or shift alters the pronunciation of nominal forms relative to their verbal bases. For example, *explain* /ɪkˈspleɪn/ → *explanation* /ˌekspləˈneɪʃən/ and *record* /rɪˈkɔːd/ → *record* /ˈrekɔːd/ illustrate **stress-**

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driven alternations, often accompanied by vowel reduction (/eɪ/→/ə/). These patterns show that **stress placement plays a critical role in signaling grammatical category change** while partially obscuring the stem's original phonology.

5.1.2 2. Segmental Opacity: Vowel and Consonant Alternations

Tables 5.2 and 5.3 reveal **segmental opacity**, where vowel quality or consonantal mutations alter the phonetic realization of the base. Examples include *serene* /səˈriːn/ → *serenity* /səˈrenəti/ and *decide* /dɪˈsaɪd/ → *decision* /dɪˈsɪʒən/, demonstrating **systematic vowel shortening and consonant mutations**. These changes are **non-random**, often recurring in morphophonologically similar classes, highlighting **sub-regular phonological patterns**.

5.1.3 3. Complex Opacity: Interacting Phonological Processes

Table 5.4 illustrates **complex opacity**, where multiple phonological processes occur simultaneously. Forms like *maintain* /meɪnˈteɪn/ → *maintenance* /ˈmeɪntənəns/ combine **vowel reduction and syllable loss**, while *receive* /rɪˈsiːv/ → *receipt* /rɪˈsiːt/ involves **suppletive alternation**. These patterns indicate **multi-process derivational interactions**, resulting in moderate to high opacity.

5.1.4 4. Morphologically Driven Opacity: Suffix Variation and Affix Selection

Tables 5.6–5.8 focus on **morphological opacity**, showing how suffix choice (-ment, -ance, -sion) can introduce subtle or marked phonological changes. For instance, *govern* /ˈgʌvən/ → *governance* /ˈgʌvənəns/ demonstrates **suffix alternation**, whereas *permit* /pəˈmɪt/ → *permission* /pəˈmɪʃən/ exhibits **consonantal mutation**, underscoring the **role of derivational morphology in shaping phonological output**.

5.1.5 5. Emerging and High-Opacity Nominalisations

Tables 5.9–5.12 capture **emerging and high-opacity forms**, where prosodic and segmental changes interact. Examples include *differ* /ˈdɪfə/ → *difference* /ˈdɪfrə/ and *produce* /prəˈdjuːs/ → *product* /ˈprɒdʌkt/, demonstrating **root restructuring, schwa deletion, and stress/vowel alternation**. These forms reflect **lexicalized patterns** reinforced by usage frequency and are critical for understanding **lexical storage vs. online computation** in English nominalisation.

5.1.6 6. Transparent Baselines

Tables 5.6, 5.12, and 5.13 provide **control forms**, including fully transparent -ment and -al nominalisations, e.g., *develop* /dɪˈveləp/ → *development* /dɪˈveləpmənt/, where **stress, vowel quality, and segments remain faithful**. These serve as baselines for assessing the degree of opacity in other nominalisation types.

5.1.7 7. Rule-Governed vs. Idiosyncratic Opacity

Tables 5.14 and 5.15 illustrate the **contrast between predictable prosodic shifts (-ation/-ization) and idiosyncratic opacity (-ance/-sion)**. Regular -ation forms, such as *educate* /ˈedʒukeɪt/ → *education* /ˌedʒuˈkeɪʃən/, follow **rule-governed stress shifts**, whereas idiosyncratic forms like *maintain* → *maintenance* or *satisfy* → *satisfaction* combine stress, vowel, and consonant alternations, reflecting **sub-regular yet systematic deviations**.

6 Discussion

The present study investigated phonological opacity in English nominalisations, examining its effects on production accuracy, vowel reduction, gender, and academic discipline, and testing the predictive power of Stratal Optimality Theory (Stratal OT). By integrating quantitative findings from mixed-design ANOVAs with qualitative analyses of phonological processes, the study provides a comprehensive account of how prosodic, segmental, and morphological mechanisms interact to produce varying degrees of opacity.

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6.1 Effect of Nominalisation Type on Production Accuracy and Vowel Reduction (H1 & H6)

Consistent with Hypothesis 1, production accuracy decreased systematically as phonological opacity increased. Transparent forms were produced with the highest accuracy (M = 91.2), followed by Near-Transparent forms (M = 80.65) and Opaque forms (M = 68.4), with all post-hoc differences statistically significant ($p < .001$, see Table 6.1 and Figure 6.1). This graded pattern confirms that opacity imposes a measurable cognitive load during production, particularly in forms exhibiting stress shifts, segmental alternations, or suppletion.

Vowel reduction, analyzed via a one-way ANOVA ($F(1, 48) = 19.42$, $p < .001$), was most pronounced in opaque forms. Qualitative inspection revealed that stress shifts in these forms frequently trigger centralization or reduction of unstressed vowels (e.g., /eɪ/ → /ə/ in explain → explanation), supporting Hypothesis 6 and highlighting vowel reduction as a core mechanism contributing to phonological opacity.

6.1.1 Prosodic Opacity: Stress Shifts

Prosodic opacity, the most prevalent type, was driven primarily by stress retraction and vowel reduction (Tables 5.1, 5.5). These processes systematically obscure the base verb while signaling morphosyntactic change (e.g., explain → explanation, record → record). The findings align with previous research (Kiparsky, 1982; Giegerich, 1999) and support the theoretical claim that stress assignment operates at distinct morphological strata. Transparent forms exhibited minimal stress retraction, whereas opaque forms frequently involved pronounced retraction, consistent with the graded accuracy results.

6.1.2 Segmental Opacity: Vowel and Consonant Alternations

Segmental alternations (Tables 5.2, 5.3) involved predictable yet opaque vowel and consonant mutations (e.g., serene → serenity; decide → decision). These findings extend prior work (Raffelsiefen, 1999; Bermúdez-Otero, 2013), demonstrating that segmental opacity clusters in morphologically similar classes and is sensitive to stem structure. Quantitatively, forms exhibiting segmental alternations corresponded with reduced production accuracy, confirming that segmental changes increase cognitive processing demands.

6.1.3 Complex and Morphologically Driven Opacity

Some forms exhibited interactions among multiple processes (Tables 5.4, 5.8, 5.11), such as maintain → maintenance, where vowel reduction, consonant mutation, and syllable loss co-occurred. These complex forms were associated with the lowest production accuracy, highlighting the cumulative effect of multiple phonological processes. Morphological opacity, driven by suffix alternation (e.g., govern → governance vs. government), further illustrates how derivational choices can increase opacity independently of phonological rules.

6.1.4 Gender Differences and Interaction with Nominalisation Type (H2 & H3)

Gender had a significant main effect on production accuracy ($F(1, 398) = 5.89$, $p = .016$, $\eta^2 = 0.01$), with females slightly outperforming males. Notably, the Gender × Nominalisation Type interaction ($F(2, 796) = 4.21$, $p = .015$, $\eta^2 = 0.01$) showed that this difference was most pronounced for opaque forms (females M = 70.3 vs. males M = 66.5), supporting Hypotheses 2 and 3. No significant gender differences were observed for transparent forms, suggesting that individual differences emerge primarily under high cognitive load.

6.1.5 Academic Discipline and Interaction with Nominalisation Type (H4 & H5)

Discipline significantly influenced production accuracy ($F(2, 397) = 8.42$, $p < .001$, $\eta^2 = 0.04$), with Science students achieving higher accuracy overall (M = 82.3) than English majors (M = 76.1), particularly for opaque forms. The Discipline × Nominalisation Type interaction ($F(4, 794) = 3.89$, $p = .004$, $\eta^2 = 0.02$) supports Hypotheses 4 and 5, indicating

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that exposure to technical or complex lexical items enhances the ability to produce morphologically and phonologically opaque forms.

6.1.6 Predictive Power of Stratal Optimality Theory (H7)

Stratal OT modeling accounted for 78.3% of observed patterns, predicting prosodic opacity with 85.2% accuracy but segmental opacity with only 71.6% accuracy (Table 6.4). Constraints such as STRESS-TO-RIGHT and LATINATE-STRESS effectively modeled stress-driven changes, whereas segmental alternations and suppletive forms were less fully captured. These results partially support Hypothesis 7, demonstrating that formal constraint-based models are robust for systematic prosodic patterns but require integration with lexical or usage-based approaches to account for idiosyncratic segmental and morphological opacity.

6.1.7 Integration of Quantitative and Qualitative Findings

Combining quantitative and qualitative analyses confirms that production difficulty corresponds closely with the type and degree of phonological opacity. Transparent forms serve as baseline controls, near-transparent forms introduce minor predictable changes, and opaque forms involve cumulative prosodic, segmental, and morphological changes, producing the lowest accuracy scores. This integration validates the study's typology of opacity mechanisms and highlights the cognitive impact of each type on speakers.

7 Conclusion

This study examined phonological opacity in English nominalisations, focusing on the interplay of stress, vowel reduction, segmental changes, and suffix variation, and their effects on production accuracy across gender and academic disciplines. The findings provide a nuanced understanding of how opacity influences cognitive processing, offering both theoretical and applied insights.

7.1.1 Summary of Key Findings

The findings reveal a coherent and empirically grounded pattern in the production of English nominalisations, underscoring the graded nature of phonological opacity. Quantitative analyses demonstrate a systematic decline in production accuracy as forms move from transparent to near-transparent and finally to fully opaque nominalisations. Transparent forms were produced with the highest level of accuracy (M = 91.2), whereas opaque forms showed markedly reduced accuracy (M = 68.4). This gradient pattern establishes a direct relationship between increasing phonological opacity and heightened cognitive load during speech production.

In terms of individual differences, gender emerged as a meaningful variable. Female participants exhibited slightly higher overall accuracy, with the gender effect becoming more pronounced in the production of opaque forms. This suggests that highly opaque nominalisations amplify individual variation in phonological processing, possibly reflecting differences in attentional strategies, linguistic exposure, or learning trajectories.

Academic discipline also exerted a significant influence on performance. Science students consistently outperformed English majors, particularly when producing opaque nominal forms. This finding implies that sustained exposure to technically complex and morphologically dense vocabulary in scientific discourse may facilitate more robust processing of phonologically and morphologically challenging structures, even outside explicitly linguistic domains.

Qualitative analyses further clarified the sources of production difficulty by identifying four distinct mechanisms of opacity: prosodic, segmental, complex, and morphological. Each type contributed differently to production outcomes. Prosodic opacity, primarily resulting from stress retraction and vowel reduction, was the most systematic and widespread. In contrast,

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segmental and complex opacities imposed the greatest processing demands, reflecting their reduced predictability and weaker surface transparency.

Finally, the modeling results indicate that Stratal Optimality Theory successfully captured a substantial proportion of the observed patterns, accounting for 78.3% of the data overall. Its predictive strength was highest for prosodically driven opacity (85.2%), confirming the model's effectiveness in handling stress-sensitive derivations. However, its lower fit for segmental and suppletive forms (71.6%) highlights the limitations of purely formal, constraint-based accounts. These results support the integration of usage-based and lexical approaches with formal phonological models to achieve a more comprehensive explanation of opacity in English nominalisation.

7.1.2 Theoretical Implications

The results support a multi-layered view of phonological opacity: it is not random but emerges from systematic interactions between stress, segmental alternations, and morphological processes. The graded effect of opacity on production accuracy reinforces usage-based perspectives, suggesting that frequency, entrenchment, and rule-governed patterns jointly shape mental representations of complex nominalisations. Stratal OT provides a formal account of prosodic regularities, yet the data highlight the need for hybrid models combining constraint-based and exemplar-based frameworks to fully capture opaque patterns.

7.1.3 Practical Implications

These findings have pedagogical relevance for second-language English instruction, particularly in teaching derivational morphology and pronunciation. Transparent forms can serve as accessible entry points for learners, while opaque and near-transparent forms can be introduced gradually, emphasizing stress patterns, vowel reduction, and consonant alternations. The gender and disciplinary differences observed suggest that tailored instruction may further optimize learning outcomes.

7.1.4 Limitations

Several limitations of the study should be acknowledged when interpreting the findings. First, the sample composition was relatively restricted, as participants were drawn from a limited range of academic disciplines. As a result, the findings may not be fully generalisable to broader first-language and second-language populations with different educational, linguistic, or sociocultural backgrounds.

Second, the analytical focus was confined to production accuracy. While this provides valuable insights into articulatory and output-related difficulties, it does not allow firm conclusions to be drawn about comprehension, perceptual sensitivity, or real-time lexical access. Consequently, the cognitive processes underlying the perception and on-line processing of opaque nominalisations remain underexplored.

Third, although the discussion engaged with usage-based perspectives, corpus-derived frequency and exposure measures were not systematically incorporated into the analysis. This limits the ability to quantify the role of lexical familiarity, entrenchment, and frequency effects in shaping the stability of opaque forms.

Finally, there were methodological constraints related to theoretical modeling. While Stratal Optimality Theory proved effective in accounting for prosodically driven opacity, it showed reduced explanatory power for segmental irregularities and morphologically idiosyncratic patterns. This underscores the need for more comprehensive modeling frameworks, potentially combining formal phonological constraints with computational and usage-based approaches, to capture the full range of opacity phenomena observed in English nominalisation.

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7.1.5 Future Research Directions

Several directions for future research emerge from the present study. First, the participant pool should be expanded to include second-language learners, children, and speakers from a wider range of linguistic and sociocultural backgrounds. Such diversification would enhance the generalisability of the findings and allow for developmental and cross-linguistic comparisons of phonological opacity.

Second, future work should move beyond production-based measures by incorporating comprehension and real-time processing methodologies. Techniques such as eye-tracking, reaction-time tasks, or electrophysiological measures would provide deeper insight into the on-line cognitive mechanisms involved in the perception and lexical access of opaque nominalisations.

Third, systematic corpus-based analyses should be integrated into experimental designs. The inclusion of frequency, dispersion, and exposure metrics would enable more precise evaluation of how lexical entrenchment and usage patterns interact with different types of opacity, thereby strengthening usage-based interpretations.

Fourth, there is a clear need for theoretical model refinement. Hybrid frameworks that combine Stratal Optimality Theory with usage-based or probabilistic approaches should be empirically tested, particularly to improve the modeling of segmental and morphologically idiosyncratic opacity that resists purely constraint-based accounts.

Finally, future research should explore pedagogical applications through longitudinal and intervention-based studies. Investigating how explicit instruction and awareness of phonological opacity influence pronunciation accuracy and derivational morphology learning would offer valuable implications for language teaching and curriculum design.

Final Thought

This study demonstrates that phonological opacity in English nominalisations significantly affects production accuracy, is moderated by gender and academic background, and can be partially predicted by formal phonological models. A combined quantitative and qualitative approach provides a comprehensive framework for understanding how phonology, morphology, and cognition interact, offering both theoretical insights and practical applications for language research and pedagogy.

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