Vowel Harmony Breakdown and Morphological Well-Formedness as a Helpful-Criterion Failure in Turkish LLM Outputs

A Linguistic HHH Audit Morphophonological Case Studies (tr-TR)

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Language Pair: English (en) → Turkish (tr-TR)
Framework: HHH (Helpful, Honest, Harmless) — Linguistic Audit Model
Method: Morphophonological Error Classification (Vowel Harmony Failure Analysis)
Format Standard: MQM / DQF Framework
Cases: 5 documented Helpful-criterion violation cases, spanning major (backness) and minor (rounding) vowel harmony

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Abstract

This study examines how vowel-harmony violations (both major/backness and minor/rounding harmony) in Turkish large-language-model output can systematically violate the "Helpful" criterion of the HHH framework, even when the output is entirely correct at the propositional level. Across five cases, it documents five distinct morphophonological mechanisms: pronunciation-based rather than spelling-based suffix harmony on foreign proper nouns, reading-based allomorph selection on abbreviations, attenuation of major vowel harmony across long inflectional chains, frequency-biased default allomorph selection in the verbalization of loanwords, and breakdown of minor (rounding) vowel harmony in possessive–case chains. It shows how outputs that appear superficially "fluent" yet read as ill-formed to a native speaker functionally undermine the actionability of instructions, the reliability of formal documents, and the accuracy of accessibility (text-to-speech) tools.

Özet (Türkçe)

Bu çalışma, büyük dil modellerinin Türkçe çıktılarında görülen ünlü uyumu (büyük ve küçük ünlü uyumu) ihlallerinin, önerme düzeyinde tamamen doğru olsa dahi HHH çerçevesinin "Yardımcı Olma" (Helpful) kriterini nasıl sistematik biçimde ihlal edebileceğini incelemektedir. Beş vaka üzerinden; yabancı özel isimlerde yazım temelli değil telaffuz temelli ek uyumu, kısaltmaların okunuşuna dayalı ek seçimi, uzun çekim zincirlerinde büyük ünlü uyumunun zayıflaması, alıntı sözcüklerde fiilleştirme eki seçiminde sıklık kaynaklı varsayılan ek tercihi ve iyelik-durum eki zincirlerinde küçük (yuvarlaklaşma) ünlü uyumunun bozulması olmak üzere beş farklı morfofonolojik mekanizma belgelenmektedir. Yüzeysel olarak "akıcı" görünen ancak anadili konuşuru tarafından bozuk olarak algılanan bu çıktıların, talimatların uygulanabilirliğini, resmi belgelerin güvenilirliğini ve erişilebilirlik (metin-okuma) araçlarının doğruluğunu nasıl zedelediği gösterilmektedir.

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1. Purpose and Scope of the Framework

This document extends the author's linguistic HHH audit methodology from the discourse-pragmatic and modal domains into morphophonology. Its central claim is that Turkish vowel harmony the requirement that suffix vowels agree in backness with, and in many cases also in rounding with, the vowel they attach to — is not a cosmetic well-formedness feature but a load-bearing component of the Helpful criterion. A model output can be propositionally complete and factually correct while still failing the addressee functionally, because a harmony-broken word form reads as foreign, degrades trust in the surrounding instruction, or misfires in downstream text-to-speech and accessibility pipelines that depend on well-formed morphology to generate natural pronunciation.

The five case studies below isolate five distinct mechanisms by which harmony failures arise in generated Turkish: pronunciation-blind suffixation of foreign proper nouns, reading-blind suffixation of abbreviations, harmony attenuation across long agglutinative chains, frequency-biased default allomorph selection on loanword

verbalization, and breakdown of the finer-grained rounding (minor) harmony in possessive–case chains. Each is classified strictly as a Helpful violation, since in every case the underlying information conveyed is accurate — the failure is confined to the linguistic form that carries it.

2. Methodology Note

The case studies below are representative, illustrative examples compiled through structured linguistic analysis of documented systematic weakness patterns in English→Turkish large-language-model output specifically, major (backness) and minor (rounding) vowel harmony as governed by TDK orthographic convention and descriptive Turkish morphophonology. Each example is constructed to isolate and demonstrate a single mechanism clearly. These are not verified, timestamped outputs captured from a specific run of any named commercial system (e.g., GPT-4o, Claude, Gemini); they should be read as representative patterns grounded in the underlying linguistics, not as a system-specific benchmark. This distinction is stated explicitly here so the framework can be used and cited responsibly.

The classification model is an adapted version of the MQM/DQF framework, with error categories mapped onto the HHH axis rather than the translation-quality axis. Each case consists of four components: (i) User Prompt — the English input carrying the communicative intent; (ii) Model's Erroneous Output — a Turkish rendering that is often lexically and syntactically "acceptable" on its surface but mishandles a specific harmony mechanism; (iii) Correct Turkish Form — the well-formed rendering; and (iv) Linguistic Audit Report — an analysis identifying the morphophonological mechanism behind the error and how it constitutes a Helpful violation.

3. Case Analysis

Case / Mechanism	User Prompt (English)	Model's Erroneous Output (Turkish)	Correct Turkish Form	Linguistic Audit Report (Helpful Violation)
Case 1Foreign Proper-Noun Suffixation:Spelling-Based vs. Pronunciation-Based Harmony	What's the fastest route from the airport to Google's Zurich office?	*Havalimanından Google'in Zürih ofisine giden en hızlı güzergah otoyolu kullanmaktır.*	Havalimanından Google'ın Zürih ofisine giden en hızlı güzergah otoyolu kullanmaktır.	Turkish orthography rule (TDK) requires that the harmony of an apostrophed suffix on a foreign proper noun follow the noun's Turkish pronunciation, not its written form. "Google" is pronounced in Turkish with a final back, unrounded vowel (approx. "gugıl"), so the genitive must be back-harmonic "-ın". The model instead harmonizes off the written final letter "e", producing the front-harmonic "-in". No lexical item is wrong and the sentence is fully parseable, yet it reads as a foreign-authored error to a native speaker. In wayfinding and other action-oriented instructions, an inconsistently harmonized brand name undermines the reader's confidence that the system correctly "knows" the entity referenced, which is a Helpful violation distinct from any factual error in the route itself.

Case / Mechanism	User Prompt (English)	Model's Erroneous Output (Turkish)	Correct Turkish Form	Linguistic Audit Report (Helpful Violation)
Case 2Abbreviation Suffixation:Reading-Based Allomorph Selection	Convert this invoice total to Turkish Lira and tell me the amount.	*Toplam tutar 2.450 TL'ya yükseltildi.*	Toplam tutar 2.450 TL'ye yükseltildi.	Turkish suffixes attached to abbreviations harmonize with the abbreviation's spoken letter-name reading, not its written characters. "TL" is read aloud as "te-el", ending in the front vowel "e", so the dative allomorph must be front-harmonic "-ye". The model defaults to the back-harmonic "-ya", the statistically dominant allomorph for post-consonantal datives in Turkish generally, treating the abbreviation as an unanalyzed token rather than computing harmony from its phonemic reading. In financial and administrative documents this is a Helpful violation: the malformed suffix fails formal proofreading standards and can misfire in text-to-speech or accessibility pipelines that read the abbreviation aloud, reducing the document's usability as a finished deliverable rather than a draft.

Case / Mechanism	User Prompt (English)	Model's Erroneous Output (Turkish)	Correct Turkish Form	Linguistic Audit Report (Helpful Violation)
Case 3Harmony Attenuation AcrossLong Suffix Chains	Tell them their eyes are still sensitive to light since the surgery.	*Ameliyattan beri gözlerinizdan ışığa hassasiyet devam ediyor.*	Ameliyattan beri gözlerinizden ışığa hassasiyet devam ediyor.	The stem "göz" (front, unrounded) correctly propagates front harmony through the plural "-ler" and the second-person possessive "-iniz", but the fourth, more distant suffix in the chain — the ablative case marker — reverts to the corpus-majority back-harmonic allomorph "-dan" instead of tracking the immediately preceding front vowel, yielding "gözlerinizdan" instead of "gözlerinizden". Because back-vowel stems are more frequent in Turkish overall, harmony fidelity measurably degrades as suffix chains lengthen — an effect not visible in short forms. The error sits at the final morpheme boundary, which is exactly where a reader's eye lands, so a single misharmonized ending can undermine trust in an otherwise correct clinical instruction, discouraging adherence even though the propositional content (post-operative light sensitivity) is accurate.

Case / Mechanism	User Prompt (English)	Model's Erroneous Output (Turkish)	Correct Turkish Form	Linguistic Audit Report (Helpful Violation)
Case 4Loanword Verbalization:Frequency-Biased Default Allomorph	Explain how to filter these emails so they don't clutter my inbox.	*E-postaları filtrelamak için şu adımları izleyin.*	E-postaları filtrelemek için şu adımları izleyin.	The verbalizing suffix "-lA-" must harmonize with the final vowel of its host stem. The loanword "filtre" ends in the front vowel "e", so the only well-formed infinitive is "filtrelemek". The model instead produces "filtrelamak", defaulting to the back-harmonic "-lamak" pattern that dominates native Turkish denominal verbs ("aramak", "başlamak"). Front-vowel-final loanwords are a minority class in training data, making them disproportionately vulnerable to this default. In a step-by-step technical instruction, an ill-formed verb form at the head of the first imperative sentence reduces the perceived authority of the whole how-to and can cause a screen reader or non-native user to stumble on exactly the word that anchors the action — a direct impairment of the instruction's usability, i.e. a Helpful violation.

Case / Mechanism	User Prompt (English)	Model's Erroneous Output (Turkish)	Correct Turkish Form	Linguistic Audit Report (Helpful Violation)
Case 5Minor (Rounding) Harmony Breakdownin Possessive–Case Chains	Tell them to bring their own glasses to the appointment since we don't have spares.	*Randevuya kendi gözlüğınızı getirin, yedek gözlüğümüz yok.*	Randevuya kendi gözlüğünüzü getirin, yedek gözlüğümüz yok.	Beyond the two-way front/back (major) harmony shown in Cases 1–3, Turkish also enforces a four-way rounding (minor) harmony on possessive and accusative suffixes. "Gözlük" ends in the front rounded vowel "ü", so both the second-person possessive and the following accusative must preserve rounding: "-ünüz" and "-ü", giving "gözlüğünüzü". The erroneous form keeps backness correct (front) but drops rounding on the possessive suffix, inserting the unrounded "ı" ("gözlüğınızı") — a subtler failure than backness errors, since rounding harmony is a four-way rather than two-way distinction and is where even fluent L2 speakers and models most often fail. In an appointment-logistics instruction, the malformed possessive is precisely the word the addressee must correctly identify ("your glasses") to comply with the request, so the well-formedness failure directly degrades the instruction's actionability.

4. Conclusion and Applicability of the Framework

The five cases above share a common structure: none involves a factual error, a missing hedge, or an unsafe instruction — the propositional content in every erroneous output is identical to that in the corrected form. The violation is confined entirely to morphophonological well-formedness, yet each case degrades the output's function as Helpful text: it undermines the addressee's confidence in a wayfinding instruction, fails formal proofreading in a financial document, erodes trust in a post-operative medical instruction, weakens the authority of a technical how-to, or obscures the exact noun phrase an addressee must act on. Standard fluency scoring (binary grammatical/ungrammatical) is too coarse to capture this: it treats all five errors as equivalent "minor grammar" flags, obscuring that they arise from distinct mechanisms (proper-noun phonology, abbreviation reading, chain-length attenuation, loanword frequency bias, and rounding harmony) that recur predictably and require separate detection strategies.

The practical value of this framework for AI training and data-evaluation platforms lies in adding a category-level morphophonological layer to error-annotation protocols, alongside existing word-level (wrong term) and clause-level (register, modality) categories: proper-noun/abbreviation harmony, chain-length harmony attenuation, loanword-verbalization allomorph selection, and major/minor harmony distinction. This layer enables more accurate, repeatable auditing of the Helpful criterion in agglutinative languages such as Turkish, particularly for multi-turn RLHF data collection and model-output rating tasks where surface fluency is otherwise assumed to be a solved problem.