# Phonological and phonetic similarity as underlying principles of imperfect rhyme

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## Table of contents

# 1. Introduction

The first linguist to be seriously concerned with the linguistic analysis of poetry was Roman Jakobson, who wrote ‘Linguistics and Poetics’ in 1960 (Holtman, 1996, p.1). Since then, linguistic studies of poetry have made pivotal contributions to various linguistic subfields. Phonology, for instance, has historically looked at poetry as a source of "‘external’ evidence" (Köhnlein & van Oostendorp, 2014, p. 1). Even though poetry is written or performed, as opposed to natural language, the sound patterns employed seem to always adhere to the phonological grammar of human languages (Köhnlein & van Oostendorp, 2014, p. 1). The linguistic principles that regulate reduplication, a phenomenon of natural language, are theorized by Holtman to be the same as those involved in the phenomenon that the current study focuses on (1996, p. 3). That phenomenon is rhyme, a poetic device that has not been extensively studied from the perspective of phonology (Holtman, 1996, p. 4). More specifically, this study will examine the phonological features that govern *imperfect rhyme* within Dutch hip hop.

First, it is useful to explain what imperfect rhyme is, by illuminating the difference between perfect and imperfect rhyme. The type of rhyme that most swiftly comes to mind when conjuring up the concept is usually perfect rhyme. Perfect rhymes are characterized by a Base and a Rhyme (together also denoted as rhyme fellows) with a differing onset but a shared nucleus and coda. A monosyllabic example is the Base *book* and its Rhyme *cook*, in which ‘ook’ [ʊk] is considered the rhyme domain (further explained in section 2.2*)*. Another type of rhyme is imperfect rhyme, also known as near rhyme or half-rhyme, in which the rhyme domains are not completely identical. Consider, for example, *book* and *root*, an imperfect rhyme that contains the consonantal mismatch [k-t].

This type of rhyme is not a new development: already in Middle Dutch (spoken between 1150 and 1500), a relatively high proportion of imperfect rhymes were present in folk songs (Holtman, 1996, p. 23). Renowned poets like Shakespeare and Chaucer also made use of imperfect rhyme, but it is generally marginally used in ‘serious’ poetry as opposed to other genres (Holtman, 1996). In musicals, pop lyrics and nursery rhymes, the device is very popular (Avidan, 2017, p. 1). The genre which makes the most use of imperfect rhymes is probably hip hop, where rhyme ingenuity is pushed to its limits and imperfect rhyme seems to be the norm. Importantly, imperfect rhyme is not a less complex or sophisticated form of rhyme; in fact, it opens up possibilities and enriches the poetic device that rhyme is (Brogan, 2016, p. 220).

In revealing the nature of imperfect rhyme, it will be demonstrated that Dutch rappers, whether knowingly or unknowingly, utilize featural similarity, and thus use rhyme in a systematic way that reflects phonological grammar. Variables that were considered in this research are: the types of imperfect rhyme, the influence of loanwords, perceptibility, genre and phonotactics.

To preface the theoretical background, in which the exact scope of this thesis will be fine-tuned, it seems fitting to provide an example: consider the rhyme pair *crane-same*, and contrast this with *crane-sake*. What probably sticks out is that the first rhyme sounds ‘better.’ This first type of rhyme is indeed also more likely to occur than the second. This is because the mismatching coda consonants involved in the first rhyme are more similar. Instinctively, it makes sense that imperfect rhyme reflects similarity. To what degree this holds true, and what type of similarity is actually at play here is the main question that will be investigated in this thesis. Note that the example that was just given is extremely simple and straightforward; most of the imperfect rhymes in this corpus were more complex but, as we shall see, still beholden to a type of linguistic similarity that can, to a degree, be formalized systematically. In the following section, the different types of imperfect rhyme and the past studies on the phonological and/or phonetic similarity involved in them will be delved into.

## 2. Theoretical background

### 2.1 Types of imperfect rhyme

In the current study, a corpus of Dutch hip hop songs by five different rappers was analyzed for the rappers’ usage of imperfect rhymes and the potential phonological rules involved. One variable that was included is the type of imperfect rhyme, and whether this type influences distribution of the consonantal mismatches. Therefore, it will be useful to establish the different types of imperfect rhyme that appear in the corpus. Poetic theory distinguishes between monosyllabic (*masculine*), disyllabic (*feminine*) and trisyllabic (*triple*) rhyme. Triple rhyme is normally the longest type of rhyme found in Dutch because rhyme boundaries are determined by stress and Dutch does not allow for “main stress further than three syllables away from the right edge of the word” (Holtman, 1996, p. 32). Below, examples of masculine (1), feminine (2), and triple (3) imperfect rhymes are provided from the corpus:

1) *Ik ging dood van het lachen, ik schrok me laatst **dood***
*Elk voorbeeld prikt als een doorn door het **oog***
(Akwasi, “Weet niet waarom ik huil”)

2) *Mensen **haten***

*Konden ons vrij weinig **maken***

(Winne, “Lotgenoot”)

3) *Holtebroek, Assendorp, **Sassenpoort***
*Nog een tijdje gewerkt bij Stork zo**als het hoort***
(Opgezwolle, “Verre Oosten”)

In contemporary hip hop, masculine rhymes do not occur as frequently as they used to in the early stages of the genre; due to rhyme schemes having increased in complexity, multisyllabic rhymes have become the norm for most artists, certainly the ones in this corpus. Example (3) is significant, because it is simultaneously a case of *mosaic rhyme*: rhyme that crosses word boundaries (another example being *rhythm-hit ‘em*). While the three examples above are different types in terms of syllables involved in the rhyme domains, they do all belong to another category of rhyme under analysis in this study: end-rhyme. End-rhymes are those rhymes with two corresponding line-final rhyme fellows. Rhyme pairs that contain a rhyme fellow that is not at the end of a metrical line are known as internal rhymes. An example of an internal rhyme is presented below:

4) *Ik ga **next-level**, van **rap battles** naar HMH*
(Sticks, “Waar wacht je op?”)

So far, the six types of rhyme that were established (masculine, feminine, triple, mosaic, end, internal) have not been categories exclusive to imperfect rhyme, but rather prevalent in perfect rhyme as well. The final two categories that will be considered in this study relate solely to imperfect rhyme: (segmental) *feature rhyme* and s*ubsequence rhyme*. Feature rhyme is imperfect rhyme that contains the same amount of phonemes in both rhyme fellows, but contains one or more mismatching segments; feature does not, in this case, refer to phonological features. The rhyme pair [ha:tən]-[ma:kən] in (2) is an example of feature rhyme in which the segments [t] and [k] mismatch. Subsequence rhyme is characterized by an imperfect rhyme pair that mismatches for number of segments. Zwicky (1976) identified two types of subsequence rhyme. Below, the two types can be observed.

5) *Wervelstorm* ***werkt***

   *De koepel was* ***sterk***

   (Winne, “Lotgenoot”)

6) *Omdat elk feit die ik rap je naar de keel* ***grijpt***

   *We hebben denk ik niet meer lang, er is niet veel* ***tijd***

   (Lijpe, “Barz”)

The example in (5) is peripheral subsequence rhyme, which has the structure XC-X (or X-XC), in which X stands for the part of the Rhyme that is identical to the Base, and C is a consonant being added onto the right edge of the rhyme domain. The example in (6) amounts to the rhyme pair [xrɛipt]-[tɛit], the final phoneme in *tijd* being devoiced, as part of a phonological process in Dutch that will be expounded upon further in section 2.4.2. This is an example of internal subsequence rhyme (internal in this case referring to the type of subsequence rhyme and not to the rhyme fellows’ position within the line), which has the structure CX-X (or X-CX), a consonant being added within the rhyme domain. Lastly, there is of course the possible combination of feature and subsequence rhyme, which also occurs in the corpus. This concludes the discussion of the various types of (imperfect) rhyme that will be relevant in this study.

### 2.2 Rhyme domain

As has been referred to already, rhyme is delineated by boundaries. Within those boundaries exists a rhyme domain. A rhyme domain omits the consonantal onset and starts at a stressed vowel (nucleus), followed by 0 or more unstressed syllables, ending at the end of the word (group) or the next stressed syllable (Katz, 2015, p. 8). In example (7), like in many other imperfect rhymes in the corpus, we see two rhyme domains belonging to two different rhyme pairs. The (imperfect) rhyme domains, represented by different colours, are [ɛks bə]-[ɛxtə], and [ɛitə]-[ɛipə]. As mentioned, the consonantal onsets do not count within rhyme. All four rhyme domains are feminine as they extend over two syllables, the last syllable containing a schwa, which is always unstressed in Dutch (Köhnlein & van Oostendorp, 2014).

7) *Velen zeggen dat ze me tr**acks be**gr**ijpen** , zeggen "Fresku je brengt **echte feiten**"*

(Fresku, "Twijfel")

In both of these rhyme domains, as well as in the examples given before, the vowels correspond, but one or more of the consonants mismatches. The aim of this study is to discern a pattern in the particular consonantal mismatches that are most likely to occur in imperfect rhyme. In the methodology (section 4), more information will be given on how rhyme domains as well as consonantal mismatches are identified, counted, and interpreted. The following section is concerned with the past research that has been done on imperfect rhyme from a phonological and/or phonetic perspective, in order to familiarize the reader with the linguistic literature on imperfect rhyme, which this thesis strives to contribute to.

### 2.3 Past research (phonological and phonetic arguments for imperfect rhyme likelihood)

In this thesis, the two linguistic areas of study phonology and phonetics will often be referred to. Phonology is the study of the structure of sounds in a language, concerned with abstract representations, otherwise known as distinctive features, by which sounds are grouped together. Phonetics, on the other hand, deals with concrete realizations of sounds in the real world, and articulatory, acoustic and auditory information. The distinction between the two fields has been much debated within linguistics. In early generative theory, phonology was thought to be language-specific and representative of a speaker's cognition, whereas phonetic implementations were regarded as universal and "automatic results of speech physiology" (Ernestus, 2011, p. 1). Today, phonetic knowledge is recognized as a part of speakers' cognition, too, but a distinction between phonetics and phonology as separate entities does still exist in most linguistic theories (Sebregts, 2015, p. 9). This distinction is based on the assumption that phonology comprises categorical, unchanging symbols, like phonological features, and phonetics deals with implementation of these symbols into gradient sounds through articulatory and perceptual processes (Ernestus, 2011, p. 2).

Regarding imperfect rhyme, Jakobson, again, is the first scholar to discuss the phenomenon in a linguistic context, and he characterized rhyme as a phonological phenomenon, as opposed to phonetic (Holtman, 1996, p. 37). He studied the Slavic poetic tradition and reported on a pattern in, what he referred to as, the approximate rhymes present in this tradition. In these approximate, or imperfect, rhymes, consonants would mismatch (the example of *boty-boky* is given), but voiced consonants would never mismatch with voiceless ones or vice versa (1960, p. 19). Since Jakobson, other linguists have studied imperfect rhyme and discovered phonological principles to play a role in it. It is disputed, however, if phonology (the study of the structure of sounds in language) is sufficient to fully explain the phenomenon. Besides phonology, linguists have argued that phonetics, too, is an essential factor in imperfect rhyme, if not more so than phonology. These scholars have referred mostly to acoustic and perceptual facts in their analysis of imperfect rhyme; in this thesis, acoustic and perceptual similarity denotes phonetic similarity, whereas phonological similarity is defined by referring to shared distinctive features. In the current section, both viewpoints will be outlined, and past research will be summarized, to introduce the reader to the context in which this study is posited.

### *2.3.1 Phonological similarity as the basis for imperfect rhyme*

In 1976, Zwicky conducted a study on what he called *rock rhymes*: (mostly) masculine, imperfect rhymes that prominently feature in rock lyrics (at the time, hip hop was still a novel genre, in which the exploitation of rhyme was not yet a prominent trait). In the music of Bob Dylan and the Beatles, among others, Zwicky noticed that within feature rhymes, mismatching consonants differed minimally; they were, generally, not more than one distinctive feature apart (p. 686). Frequent consonantal mismatches differed in place or manner features, but rarely in voice. Zwicky's study was limited, however, because he made use of a rather small, homogeneous corpus and did not correct for segmental frequency (the most frequently occurring consonant pair could thus be a result of those phonemes' pervasiveness in the language). Zwicky's research did open up a new field of study for phonologists, however: imperfect rhyme, specifically as it appears in (popular) music and the potential for this phenomenon to help illuminate a language's "phonological space" (p. 677).

Since then, phonological similarity as the basis for imperfect rhyme has been studied by various authors within various languages. In 1994, Golston (as cited in Holtman, 1996, p. 44) found that consonantal mismatches in imperfect rhymes most often involve a difference in place of articulation (*maak-laat* is an example from the corpus), and after that a difference in voice (e.g. *vergeten-reden*). In a study on Japanese imperfect rhymes in hip hop, Kawahara (2007) also found that these rhymes were not randomly paired but contained a hierarchy of likelihood that reflected phonological similarity of the consonants involved (p. 8). Seven phonological features were incorporated in the study and shown to be of significance in determining consonantal mismatches: [sonorant], [consonant], [continuant], [nasal], [voice], [palatal] and [place] (p. 8). As an example: the consonant pair [p-b] was likely to occur in imperfect rhyme, as the phonemes involved only differ in [voice]. Contrastingly, the consonant pair [ʃ-m] was unlikely to occur, as the phonemes contrast in all features but [cons] (p. 8).

Finally, the study that is perhaps most relevant to this thesis is Holtman's Generative Theory of Rhyme (1996). In it, Holtman first provides a framework for modeling perfect rhymes using the constraint-based approach of the Optimality Theory. She identified such constraints as OnsetDis (onsets in Rhyme and Base should be dissimilar) and IDENTITY (Base and Rhyme should be identical) among others. The constraint IDENTITY is violated once in all perfect rhymes because the onsets are dissimilar, unless rich rhyme is employed (for example in *weigh-way*). In imperfect rhymes, the onset can be identical. Within the rhyme domain, however, IDENTITY is violated at least once; the constraint thus ranks lower. The constraint that replaces the high ranking of IDENTITY is then PHONSIM-C, which dictates every consonantal element in the rhyme domain to have a phonologically similar correspondent in the base (p. 264). She derived the ranking from extensive research on English imperfect rhymes in different genres, in which she found phonological similarity between consonants to be the biggest indicator of frequency of occurrence of imperfect rhymes.

Besides this constraint approach, her research also yielded a hierarchy ranking (1996, p. 249) that systematically ranks consonantal mismatches in English imperfect rhyme, based on phonological similarity. She identified a clear parallel between imperfect rhyme and phonological processes like nasal assimilation and, more broadly, reduplication (1996, p. 9). Reduplication is a process found in many languages in which a morpheme, or part of it, (the Base) is repeated to convey a different meaning (Urbanczyk, 2017). An example in English is *phonology-schmonology,* in which the second word is the Reduplicant (the phrase is meant to ridicule or downplay the topic in question). Holtman poses that (partial) reduplication and (imperfect) rhymes share underlying phonological principles (1996, p. 13). Holtman thus does not appeal to phonetics, and asserts phonology to be the principal agent underlying imperfect rhyme. The hierarchical ranking she puts forth can be seen in section 2.4, where it will be explained in greater detail, as its relevance to Dutch hip hop rhymes, and the hypothesis that phonology is the principal determiner of imperfect rhyme likelihood, will be assessed.

### *2.3.2 Phonetic similarity as (additional) basis for imperfect rhyme*

As hinted at before, several linguists have dismissed the notion that imperfect rhyme is governed purely by phonological similarity. In his study on rock rhymes , Zwicky (1976) already speculated that phonetic similarity, too, is an indicator of imperfect rhyme *goodness*. He looked to three types of studies for data on phonetic similarity: studies on mispronunciation (slips of the tongue) and mishearing (slips of the ear), and perceptual experiments, in which participants identify sounds under the influence of noise (p. 688). At the time, however, the experiments were difficult to compare (they focused mainly on syllable-initial consonants and contained a more formal speech register). An important finding was that a difference in place of articulation featured most frequently in perceptual experiments, in accordance with Zwicky's analysis of rock rhymes (p. 689). Despite this finding, he noted that "substantial disparities between feature rhyme and perceptual similarity remain" (p. 690).

Decades after Zwicky first approached the topic of phonetics as a factor in imperfect rhyme within song lyrics, Kawahara (2007) argued, too, that perceptual similarity plays a significant role in the likelihood of imperfect rhymes. While he examined Japanese corresponding consonants for the amount of phonological features and natural classes they shared and found correlation between those and rhyme likelihood, he posited both these findings with the assertion that some features contribute more to similarity than others. Importantly, the likelihood of imperfect rhyme pairs could not be explained adequately by featural similarity alone without taking acoustics into account. Kawahara argued that this could be explained by the fact that detailed similarity is not always captured by features, that "perceptual salience of a feature depends on its context", and that some features are more salient than others (p. 19).

He concluded that speakers possess a rich knowledge of psychoacoustic similarity of which they make use when constructing imperfect rhymes (p. 21). These assertions mirror some of the results gathered in this thesis, and will again be examined in the discussion section. Kawahara's conclusion is in line with the theory put forward by Steriade (2001) in her P-map, in which P stands for perceptibility, of which language users are theorized to possess implicit knowledge that they use to minimize input deformation (2011, p. 3). In a study by Steriade (2003) on Romanian imperfect rhymes, she tested the P-map hypothesis and found that poets share a common similarity hierarchy in constructing imperfect rhymes (p. 364). This hierarchy reflected common phonological processes governed by perceptual similarity, like post-nasal voicing and final devoicing (p. 366). Hence, phonetic information, and not phonology, dictated the structure of the poets' imperfect rhymes. For instance, due to [u] and [ɨ] having the same F3, they were more likely to rhyme than [i] and [ɨ] (p. 364).

Katz (2015), who analyzed imperfect rhyme in an extensive corpus of American hip hop, which is perhaps most comparable with the corpus used in this study, also appealed to phonological processes governed by perceptual similarity and found phonetics to be the most accurate predictor of imperfect rhyme, too. The focus of the study was rhyme pairs which contrast for major place and voicing. Cross-linguistically, these features frequently neutralize, whether through assimilation or final devoicing (p. 15). An example of *place assimilation* in Dutch in the realization of the prefix *on* 'un' is given in (8).

| 8) | **Coronal** | **Labial** | **Velar** | |
|---|---|---|---|---|
| | [ɔnsma:kələk] | *[ɔmsma:kələk] | *[ɔŋsma:kələk] | 'tasteless' |
| | *[ɔnprɛtəx] | [ɔmprɛtəx] | *[ɔŋprɛtəx] | 'unpleasant' |
| | *[ɔnki:s] | *[ɔmki:s] | [ɔŋki:s] | 'inappropriate' |

This example shows that Dutch nasals (often) assimilate to the place feature of the next consonant in a cluster. Katz's hypothesis was that mismatches would occur more frequently for features, like place of articulation for nasals, that neutralize cross-linguistically, as both phenomena reflect perceptual similarity (p. 15). His corpus consisted mostly of rhyme domains which stretched over multiple syllables. Therefore, he could differentiate between mismatches in three different contexts: intervocalic, domain-final and pre-consonantal (p. 8). One of the objectives of the analysis was to measure if the patterns of these mismatches varied in the different contexts. If that was the case, this would be (additional) evidence for rhyme likelihood to be determined by perceptual similarity, and not just phonological features, as English phonological features do not differ in the three contexts but their perceptibility does; his hypothesis was confirmed (p. 41). Differences in likelihood for major place and voice mismatches were predicted according to typological facts about neutralization and perceptual similarity, and confirmed with varying degrees of statistical significance (p. 41).

To sum up, the question of the significance of either phonology or phonetics, or the interplay between the two, as the basis for imperfect rhyme is the source of an ongoing debate within linguistics, and this study aims to contribute to the accumulating knowledge on the subject. In the next section, Holtman's hierarchy ranking of consonantal mismatches in English imperfect rhyme shall be discussed, as it provides a clear frame of reference for this study and an opportunity to compare Dutch and English imperfect rhyme usage.

### 2.4 Holtman's hierarchy ranking of English imperfect rhyme

Differing in place of articulation only ([+ant] nasals)
[m-n]
↓
Differing in place of articulation only (nasals, fricatives, voiceless plosives)
e.g. [p-t] [t-k] [p-k] [n-ŋ] [f-θ] [v-ð] [s-ʃ]
↓
Differing in place of articulation only (voiced plosives)
e.g. [b-d] [g-d] [b-g]
or
Differing in voice only
e.g. [t-d] [p-b] [k-g] [ð-θ] [v-f]
↓
Differing in continuancy only
e.g. [p-f] [t-θ] [k-x]

…………………………………………………………………

↓
Differing in nasality only
e.g. [b-m] [d-n]
or
Differing in laterality only
[l-r]
or
Differing in stridency only
[s-θ] [z-ð]
or
Differing in two features or max. three features
e.g. [f-s], [θ-p] [p-m]
↓
Differing in more than three features (UNGRAMMATICAL)

The above hierarchy was devised based on Holtman's study of English imperfect rhymes within what she deems 'light poetry' (nursery rhyme, pop songs and rap lyrics), which contained more complex, imperfect rhymes than 'serious poetry', for which a different ranking applies. This ranking is copied wholly from Holtman's dissertation (1996), the examples given are hers. From the ranking, it becomes apparent that heterorganic consonants (those that differ in place of articulation) occur most frequently in imperfect rhyme. The highest rank is reserved for [m-n], consonants that only differ in major place. The pair not only shares nasality and voice, but also [+anterior], an articulatory feature which represents the fact that the sound is produced in the front of the mouth, distinguishing between most coronal and all labial consonants on the one hand, and dorsals on the other.

Besides place, voice and continuancy are often manipulated in English imperfect rhyme, as evidenced by their rank. Continuant sounds are produced without closure of the cavity: in this case, it differentiates between fricatives and plosives that otherwise share all features like [p-f] and [k-x]. The inclusion of [k-x] is noteworthy, as /x/ does not exist in the English phonemic inventory. Its inclusion is motivated by the fact that Holtman, herself Dutch, observed this particular mismatch frequently in Middle Dutch imperfect rhymes (p. 249). Other data from Dutch imperfect rhymes did not directly factor in to the structure of this hierarchy. Below the consonants that mismatch for continuancy are more 'distant' rhymes that occur only scarcely, as represented by the dotted line which separates them from the frequent rhymes. Holtman does not explicitly give all the particular features she considered in her study but on inspection of the ranking and her discussion, the following distinctive features can be discerned in order of degree of manipulation ([anterior] is only considered for the highest ranking pair):

9) 1. *Place of articulation*: [labial], [coronal] and [dorsal]
   2. *Laryngeal*: [voice]
   3. *Manner of articulation*: [continuant]
   4. *Manner of articulation*: [nasal], [lateral] and [strident]

As mentioned, major place, voice and continuancy are the most manipulable features in the ranking. Glottal is not considered for place of articulation, which excludes /h/ from the ranking. Aspiration is not considered for the laryngeal feature, because it is not distinctive in English (p. 253). In terms of manner of articulation, nasality, laterality and stridency are more often maintained than continuancy. To explain the preference for the manipulation of one feature over another, Holtman refers to the theory of Feature Geometry, which "attempts to structure the features on several separate tiers in such a way that we can explain certain phonological processes" (p.251). She refers to a Feature Geometry tree by Clements and

Hume (1995), in which the two primary nodes are 'laryngeal' and 'oral cavity' (under which place and continuancy fall) (p. 252). This tree provides the reason why the aforementioned features are most likely to differ in consonantal mismatches in imperfect rhyme.

The hierarchy ranking is thus Holtman's attempt to account for the consonantal mismatches that occur in imperfect rhyme by appealing exclusively to phonological similarity, by way of Feature Geometry, in the same way that other phonological processes can be formalized. The ranking also supposes that certain consonants are too dissimilar to mismatch in imperfect rhyme. In fact, a list of ungrammatical combinations is given, which is longer than the list of possible mismatches and contains 97 pairs (p. 251). The term 'ungrammatical' should in this case not be taken to mean that these mismatches cannot possibly occur; Holtman does not have enough data to conclude that. It does reflect the fact, however, that combinations of consonants that mismatch for more than three features are highly unlikely to occur in English imperfect rhyme. Not included in the list of ungrammatical combinations are those sonorants that mismatch for more than three features, like [m-l], which actually occurs in Holtman's corpus in rap lyrics, possibly meaning that an additional distinction is necessary between sonorants and obstruents (p. 250).

As mentioned, Holtman also looked at imperfect rhyme in Middle Dutch folk songs; she also discusses Dutch poetry briefly in her dissertation. Even though the eventual hierarchy ranking is based on the English data, Holtman claims that this hierarchy will mostly be the same for Dutch, while recognizing more data would have to be assembled to substantiate this claim (p. 246). Therefore, the current study takes Holtman's ranking as a point of departure, to detect differences in the distribution of consonantal mismatches in Dutch and English imperfect rhyme. It is likely that different results will arise in the current analysis of Dutch imperfect rhymes due to differences between the two languages in terms of phonology, and possibly also phonetics. In the next section, the differences that are hypothesized to be of importance will be discussed, after which predictions will be made as to how results from the Dutch hip hop data will differ from Holtman's ranking.

### *2.4.1 Possible deviations from Holtman's ranking*

Holtman's study and subsequent ranking was considered the impetus for the current study on Dutch imperfect rhyme, and an opportunity to compare the usage of the device in both languages. Whereas Holtman refers to phonological similarity and Feature Geometry to explain imperfect rhyme, other authors, as mentioned in section 2.3.2, have argued that perceptual similarity plays a significant role in the distribution of consonantal mismatches in imperfect rhyme, too. In this section, both the differences between English and Dutch phonology, and facts about perceptual similarity of (mainly Dutch) consonants will be summarized. Afterwards, predictions will be made as to which consonantal mismatches may appear frequently in this corpus that do not align directly with Holtman's ranking.

### *2.4.2 Phonological differences between English and Dutch*

Dutch phonology has a lot in common with English phonology, both languages being a part of the West-Germanic branch of the Indo-European language family. The Dutch consonantal inventory (consonants being the focus of this thesis) does feature several deviations from English consonants, though; the most important ones featured in the corpus will be summed up here. First, there are a few consonantal sounds in English for which Dutch has no counterpart. These sounds feature in the corpus only when a loanword is employed. It will be interesting to see how these non-native phonemes are dealt with within imperfect rhyme. The voiced and voiceless dental fricatives /ð/ and /θ/, respectively the first sounds in the words *this* and *thin*, are examples of such phonemes. Similarly, /g/ only occurs in loanwords (excepting occurrence due to voice assimilation) and both /ʃ/ and /tʃ/ occur mostly in loanwords and diminutives.

Vice versa, Dutch also contains some sounds that do not appear in Standard English, like the aforementioned voiceless velar fricative /x/, the initial sound in words like *chloor* 'chlorine' and *goed* 'good' (its voiced counterpart is, by and large, no longer actively used in the Netherlands) (Lindhout, 2016, p. 10). The first sound in the word *water*, spelled the same in both languages, has different realizations. In English, it is the voiced labio-velar approximant [w] and in Dutch, it is the voiced labiodental approximant [ʋ], even though some dialects of Dutch (like Surinamese) do share the 'English' variant. In word-final position, it is usually realized as a bilabial vocoid (Booij, 1995, p. 8). Finally, Dutch /r/ may be realized in a number of ways: the alveolar approximant and tap [ɹ] and [ɾ], and the alveolar and uvular trill [r] and [ʀ] all showed up regularly in this corpus; only the first two are native to the varieties of English that featured in Holtman's corpus.

If we zoom in a bit more, there are also different phonological processes observable in English and Dutch. A common process we find in Dutch is final devoicing, which means that no native Dutch syllable contains a voiced obstruent domain-finally (van Oostendorp, 2003, p. 1). This process leads to words like *eb* 'low tide' and *vloed* 'high tide' to be realized with

[p] and [t] in final position, respectively.. In English, this rule does not apply, as evidenced by words like *have* /hæv/ and *rob* /rɒb/. An additional phonological rule, that might be related to final devoicing, dictates that voiceless fricatives (excluding the velar variant) generally follow short vowels intervocalically, and voiced fricatives follow long vowels (van Oostendorp, 2003, p. 11). Consider some of the examples in (10), and note that English does not know this rule as evidenced by words like *ne*/v/*er* and *loo*/s/*en*.

10) a. After e: *verheven* 'exalted' [vərhe:vən], *lezen* 'to read' [le:zən]
    b. After ɛ: *verheffen* 'to elevate' [vərhɛfən], *lessen* 'lessons' [lɛsən]
    c. After o: *boven* 'upstairs' [bo:vən], *lozen* 'to discharge' [lo:zən]
    d. After ɔ: *boffen* 'to be in luck' [bɔfən], *lossen* 'to unload' [lɔsən]

The above example is given, because this phonological rule is highly relevant to the results of this study, as we shall see in section 5. More generally speaking, Dutch voiced fricatives are systematically devoiced to a great extent, not just in final position (Loo & Smit, 2008, p. 7). The voicing contrasts between [s-z] and [v-f] are not as salient as in English, demonstrated by the small number of minimal pairs involving these consonants (Loo & Smit, 2008, p. 19). From these phonological differences, predictions about potential differences between the consonantal mismatches can be deduced. Those predictions will be outlined below, after the examination of the confusability of consonants in both languages.

### *2.4.3 Phonetic similarity of consonants*

To further illuminate why some phonological features weigh heavier than others in determining the hierarchy of consonantal mismatches in imperfect rhyme, this study will refer to perceptual similarity. Importantly, we saw in 2.3.2 that the scholars suggesting that phonetics plays a crucial role in imperfect rhyme by and large assumed phonetic similarity to be universal; this is not the case, as will become clear here. In a perceptual study by Bradlow et al. (2010), Dutch was identified as most similar to English out of 17 other languages (among which Swedish was the only other Germanic language) by listeners from both language backgrounds. However, differences do exist between the perceptual similarity of consonants in the two languages, which may prove to be of impact to the results of this study. Perceptual similarity has historically been measured by carrying out noise experiments, in which subjects are urged to identify sounds. These experiments yield measures of confusability between items, from which confusion matrices are often set up.

Pols (1983) conducted several experiments in which Dutch listeners were asked to identify consonants “under various conditions of noise and reverberation” (p. 278), and succeeded in setting up a confusion matrix of Dutch consonants on the basis of the results. He found five distinct groups of consonants in regards to perceptual proximity (p. 283):

11) - the sibilants /z, s/
- the nasals /m, n/
- the voiceless plosives /p, t, k/
- the non-sibilant fricatives /v, f, x/
- voiced plosives, liquids and glides /b, d, l, r, w, j, h/

Note that /w/ most likely corresponds to [ʋ]. Pols showed, in accordance with other studies, that a place contrast in nasal consonants is less perceptible than in oral consonants (Kawahara and Garvey, 2014, p. 19). Furthermore, the sibilant fricatives form one group and the non-sibilant fricatives form another group, not separated by voice. Voiced and voiceless plosives do form separate groups. The results of final consonants, which did not contain voiced obstruents and /w/, /j/ and /h/, again yielded five groups of consonants, visualized in a tetrahedron with “/x/, /s/, /l/, and /m, n, ŋ/ at the four corners" and the plosives in the centre (p. 285). Other highly confusable consonant pairs were [x-k], [t-x] and [m-p].

A confusion matrix of English consonants, set up by Cutler et al., based on a phoneme identification experiment conducted with American listeners, reveals several differences between the languages as it pertains to perceptual similarity (2004, p. 3671). In the English matrix, the voiced fricatives [v] and [z] are not grouped together with their voiceless counterparts. This likely has to do with the fricative voicing distinction being stronger in English than in Dutch, as discussed in the last section. Moreover, [b] and [d] were not close to the other plosives, but grouped with other voiced obstruents. From this, we can surmise that the voicing contrast indeed holds more weight in perception in English than in Dutch, both for fricatives and plosives. The voicing distinction between plosives being greater in English reveals something about the perceivability of aspiration as opposed to vocal fold vibration. English voiceless plosives, as opposed to Dutch ones, are aspirated, while Dutch voiced plosives, as opposed to English ones, are realized with vibration of the vocal folds. We can thus conclude, from the differences in perceptibility of voice in plosives between the two languages, that aspiration is more salient than vocal fold vibration.

Importantly, confusion matrices usually do not reflect the fact that sounds are not singularly perceived but in the context of a syllable (Ladefoged & Ferrari Disner, 2001, p. 101). For this reason, a study carried out by Smits et al. (2003) on Dutch consonant perception is interesting, because it measured participants' correct identification of diphones. They found [t] to be the most poorly recognized of the voiceless plosives across contexts; it was more often confused for place and voice than [p] and [k] (p. 10). Another finding was that both voiced stops and fricatives were more often confused for being voiceless than the other way around (p. 11). Again, this reflects the weak voicing distinction in Dutch.

An additional source of information about phonetic similarity is an acoustic study carried out by Wieling et al. (2012). Their main focus was acoustic differences between vowels, because there is no straightforward procedure to compute acoustic differences between consonants. However, using pointwise mutual information (PMI) distance, they did measure acoustic similarity of Dutch consonants, and found sensible groupings, that indicated the validity of the procedure (p. 23). The results showed manner and place of articulation to be most closely related to acoustic similarity: the labials were grouped together, as were the velars, rhotics, alveopalatals and laterals.

Besides the distribution of consonantal mismatches in imperfect rhymes containing Dutch native words, loanwords are also analyzed in this study. In cases where a non-native phoneme appears, speakers and listeners may make use of their native inventory to make sense of the sound (Cutler et al., 2004, p. 3668). This is reflected in the finding by Johnson & Babel (2007) that Dutch listeners rated [s] as more similar to non-native [θ] and partially non-native [ʃ] than American listeners. Another study showed Dutch listeners to identify the non-native dental fricatives more often as labial fricatives (with corresponding voice or voicelessness) than they were actually judged as dental fricatives (Loo & Smit, 2008, p. 34).

### *2.4.4 Predictions about discrepancies*

In this section, an attempt will be made to predict some of the consonantal mismatches that may occur that do not conform to Holtman's ranking, either because they are ungrammatical or they turn up more frequently than expected. Taking into account both the phonological and perceptual differences between Dutch and English, it becomes difficult to make accurate predictions about the mismatches. Perceptually, we have seen that the voicing distinction is stronger in English, which means that Dutch voiced and voiceless consonants are more confusable. As an example: [b] is more confusable with [p] in Dutch due to lack of aspiration. One might thus assume that the [b-p] mismatch will occur more often in this corpus than it did in Holtman's English corpus on which the ranking is based. However, [b] does not exist domain-finally in Dutch, while it does in English. This complicates the prediction that [b-p], and also [d-t], will occur more often than the ranking prescribes, because domain-final mismatches are likely to be the most salient. These mismatches, plosives differing in voice only, are on the third tier of Holtman's ranking. I predict them to occur less frequently in this corpus, despite their perceptual similarity, due to the phonological constraint on voiced obstruents occurring domain-finally in Dutch and the lack of minimal pairs brought forth by the weak voicing distinction (minimal pairs often rhyme).

Mismatches for voice in fricatives will likely be even more infrequent compared to Holtman's ranking, due to the phonotactic rule that states that voiced fricatives always follow long vowels and voiceless fricatives generally follow short vowels intervocalically, which was demonstrated in (10). This rule has as a consequence that few rhyming pairs will be available between [f-v] and [s-z], because imperfect rhyme likelihood depends partially on identical vowels, especially in this study which only considers rhyme pairs with identical vowels (explained in section 2.5).

This begs the question what mismatches will occur with these obstruents. I predict that due to the systematic devoicing of fricatives in Standard Dutch, these phonemes will mismatch more often with phonemes similar to their voiceless counterparts than vice versa, and more than Holtman's ranking predicts. Concretely, this means that I foresee mismatches like [d-k] (derived from [t-k], second tier of Holtman's ranking). Dutch /x/ is interesting because it does not exist in English, and it is the only fricative that regularly occurs after long and short vowels, as well as domain-finally (Lindhout, 2015, p. 15). Holtman foresees [k-x] to be a mismatching pair that will appear often in Dutch imperfect rhyme (1996, p. 249). Additionally, I think [x] will mismatch with [f] and [v] often, because Pols shows these three fricatives to group together perceptually in his confusion matrix, and possibly with [t], also shown to be perceptually similar by Pols (1983, p. 283).

It will be interesting to see the distribution of mismatches of the different Dutch realizations of /r/, and if this will pattern according to their manner and place of articulation. Holtman only includes one /r/ in the ranking, and pairs it with /l/, based on both being approximants; it remains to be seen if the different Dutch rhotic iterations will pattern similarly. Moreover, no distinction is made between /l/ and its dark, velarized variant [ɫ], which is the syllable-final realization in Dutch and will be included here (Booij, 1995, p. 8).

As for the loanwords involved in imperfect rhyme, some predictions can be made. [ʃ] can be expected to mismatch with [s], [θ] with [f], and [ð] with [v] due to perceptual similarity in Dutch. Lastly, it is noteworthy that Holtman does not reserve a high position for rhymes between coronals in the ranking. Coronal consonants (produced with the flexible front part of the tongue) hold a special status in both Dutch and English, where they seem to be easily added onto the edge of a word, and play a role in every consonant cluster that consists of more than two consonants, specifically the voiceless obstruents /s/ and /t/ (van Oostendorp, 2014, p. 53). Not only does this play a role in subsequence rhyme (discussed more in section 2.5), it also means that they often replace each other in imperfect rhyme (Holtman, 1996, p. 230). Therefore, I do foresee imperfect rhyme between these coronals to appear often in the results of the current study.

In Table 1, an overview is given of some of the mismatches that Holtman considers to be on the lowest tier, which are hypothesized to occur more frequently in this corpus. Table 2 displays mismatches that Holtman includes in the highest four tiers that are expected to appear less here. In the end, though, Holtman's ranking is expected to largely align with the results of this study, due to the overlap between Dutch and English phonology and phonetics, and the reported cross-linguistic tendency of imperfect rhyme to reflect similarity.

| | *Position on Holtman's ranking* | *Reason for expected higher frequency of occurrence* |
|---|---|---|
| [s-t] | Lowest tier, differs in continuancy + stridency | Special status of coronals, acoustic similarity |
| [x-f] | Not included (Dutch phoneme), differs in major place + [anterior] | Perceptual similarity |
| [x-v] | Not included, differs in voice + major place + [anterior] | Perceptual similarity |
| [d-k] | Lowest tier, differs in voice + major place + [anterior] | Confusability of /d/ and /t/ |

*Table 1: Consonantal mismatches expected to occur more often than Holtman's ranking prescribes*

| | *Position on Holtman's ranking* | *Reason for expected lower frequency of occurrence* |
|---|---|---|
| [v-f] | Third tier, differ in voice only | Different vocalic environment, final devoicing |
| [s-z] | Third tier, differ in voice only | Different vocalic environment, final devoicing |
| [b-p] | Third tier, differ in voice only | Final devoicing |
| [s-ʃ] [v-ð] [f-θ] | Second tier, differ in major place only | Non-native phonemes |

*Table 2: Consonantal mismatches expected to feature more scarcely than Holtman's ranking prescribes*

An important stipulation to the comparison of the results of this study to Holtman's ranking is that she did not correct for segmental frequency (how often a sound features in a language). In my study, I will look both at the raw numbers and the outcome of the O/E ratio (corrects for segmental frequency, explained in section 4.3) in order to map the structure that underlies imperfect rhyme goodness. If [m] occurs less frequently in Dutch than in English, for example, [m-n] will probably not be the 'best' imperfect rhyme in terms of frequency, but it might still be when taking the O/E ratio into account. Therefore, this study will not merely be a comparison of Holtman's ranking with my results. Holtman's ranking should be regarded as a frame of reference; the actual objective is to reveal the systematic structure of Dutch imperfect rhyme within hip hop by appealing to phonology and phonetics, as well as illuminating the different types of imperfect rhyme and how they pattern comparatively.

Some of the high ranking mismatches in Holtman's hierarchy may be the cause of phoneme frequency. Levitt and Utman (1992) report t, n, r, l, s, d, z, m and k to be the most frequently occurring consonants in English (p. 48). Zuidema (2009) found very similar results for Dutch phonemes, with the exception of /z/ ranking considerably lower, and /x/ ranking among the highest (p. 6). These results may be the root cause for the high ranking of such mismatches as [m-n] and [s-z] in Holtman's hierarchy; the O/E ratios measured in this study will illuminate which mismatches occur frequently relative to the individual phonemes' occurrences in the Dutch language, or at least Dutch rap songs.

One last caveat is that Holtman considered only end-rhymes in her study and overlooked internal rhymes. This may be another source of differing results. In the next section, this variable will be expounded upon. To sum up, I predict that discrepancies between Holtman's ranking and my results may be explained by appealing to language-specific differences in phonology, segmental frequency and phonetic similarity.

### 2.5 Influence of type of imperfect rhyme

An additional source of diverging results may be the type of imperfect rhyme exploited in this corpus. Imperfect rhyme is complex and multifaceted; as discussed in section 2.1, many different categories of imperfect rhyme exist. In this section, the types of imperfect rhyme that were considered in this study will be stated once again, along with the expected effect this will have on the results. First, it is useful to mention that in this thesis, attention will only be paid to those imperfect rhymes with mismatching consonants and identical vowels. The method of only counting rhyme pairs that contain identical vowels as imperfect rhyme assures consonance, a poetic device in which one or more consonants are repeated throughout an utterance, which is technically not rhyme, to not erroneously show up in the data. Besides, vowel mismatches in songs are infrequent, because the vowel, being the most sonorous element of the rhyme and subject to lengthening, becomes crucial in the composition of the rhyme (Holtman, 1996, p. 197). In imperfect rhyme as featured in rap lyrics, the identity of vowels is usually maintained (Holtman, 1996, p. 241).This is why, both for purposes of specification and relevance, consonantal mismatches will be the focus of this study.

In the existing literature on the phonology of imperfect rhyme not a lot has been written about different types of imperfect rhymes and their impact on mismatches. Katz is the only scholar that included internal rhymes in his study, which revealed internal rhyme domains to be imperfect more frequently in hip hop than end-rhyme domains (2015, p. 23). He commented upon the influence of the position of a rhyme domain in hip hop by stating that internal rhyme domains are more dissimilar to their rhyme fellows than rhyme domains at the end of a line, likely due to the rhythmic salience of line-final rhymes (Katz, 2008, p. 6). Unlike internal rhymes, multisyllabic rhymes were included in most of the studies on imperfect rhyme, but they were not examined comparative to their monosyllabic counterparts. Avidan (2017), who studied imperfect rhyme in American musicals, did suggest that multisyllabic rhyme domains are more salient and would thus be allowed less featural difference than monosyllabic rhyme domains (p. 2). This hypothesis will be explored in this thesis, in comparing feminine imperfect rhyme domains to masculine ones.

Zwicky (1976) differentiated between feature and subsequence rhymes as mentioned in section 2.1. The latter were found to appear slightly more often in rock lyrics, alveolar obstruents often being added onto the rhyme domain (p. 680). Other studies on imperfect rhyme (referenced in section 3) did not include subsequence rhymes in their results. Holtman does mention a pervasive type of subsequence rhyme which involves a coronal as a peripheral consonant. Golston calls these 'coronal rhymes', and explains their ubiquitousness by the extrametrical position that coronals often are assumed to inhabit in codas in English (as cited in Holtman, 1996, p. 43). As mentioned in 2.4.4, the same holds true for Dutch coronals. In this study's corpus, many such voiceless coronal rhymes occur. An example is given in (12). Again, note that the 'd' in the second rhyme fellow is realized as a [t] due to final devoicing. This concludes the discussion of the different types of imperfect rhyme involved in this study.

12) *Jong, zwart en losges**lagen***

*Als we kwamen, in en uit, schade achter**latend***
(Winne, "Lotgenoot")

### 2.6 Loanwords in imperfect rhyme

In addition to the more straightforward analysis of the distribution of consonantal mismatches in imperfect rhymes, a sociolinguistic variable will also be examined: namely, the usage of loanwords in Dutch hip hop and the possibly atypical way in which these words pattern in imperfect rhyme due to them containing phonemes that are not present in the Dutch inventory. Several authors have pointed out the prevalence of loanword usage and code switching in hip hop. This is a form of linguistics syncretism in which global and local sources merge together to represent ethnic roots (Alim et al., 2008, p. 54). A case study on the Dutch hip hop group Broederliefde found that the group made use of many different languages, as a marker of ethnic and cultural diversity, among which English, Papiamento, Sranan Tongo and Spanish (Dzjamaljan, 2018). It will be interesting to see which languages the rappers in the current study will use, and whether this will influence their usage of imperfect rhymes as well.

Along with the consonantal mismatch distribution of loanwords in imperfect rhyme, special attention will be paid to the pronunciations of these loanwords in order to investigate loanword adaptation in Dutch hip hop. For this, it will be analyzed whether non-native phonemes are copied faithfully or adapted to fit Dutch phonology. Despite this study's focus on consonants, vowel realizations will also be relevant for this particular analysis of loanwords in imperfect rhyme. A technique that rappers have been shown to utilize is phonemic readjustment, which involves changing a phoneme's realization in order to make it rhyme (Latvaitis, 2017). Phonemic readjustment might play an important role in making loanwords with vowels that diverge from Dutch vowels rhyme with Dutch words.

## 3. Research questions and hypotheses

### *3.1 Research questions*

- What hierarchy of likelihood can be discerned from the distribution of consonantal mismatches in Dutch imperfect rhyme in a corpus of hip hop lyrics?

- Is phonological similarity, as defined by the distinctive features used in Holtman's ranking (1996, p. 249), sufficient to explain the distribution of consonantal mismatches in Dutch imperfect rhyme or is phonetic information also needed to describe the phenomenon?

- How do the various types of imperfect rhyme differ in terms of the distribution of consonantal mismatches?

- What is the relationship between loanwords and imperfect rhyme in Dutch hip hop?

### *3.2 Hypotheses*

- This study's results are expected to contribute to the existing knowledge about imperfect rhyme and its relation to phonological and phonetic similarity. I hypothesize the hierarchy of consonantal mismatches in imperfect rhymes in my corpus to largely reflect phonological similarity, and anticipate that any major discrepancies may be explained by appealing to phoneme frequency, type of rhymes involved, genre and, primarily, language-specific phonotactics and phonetics.

- As for the influence of type of rhyme on the consonantal mismatches, I foresee, in accordance with Avidan (2017), multisyllabic rhyme domains to phonologically be more similar than monosyllabic rhyme domains due to the higher salience of the former. Furthermore, I expect the same to be true for end-rhyme domains as opposed to internal rhyme domains, in line with Katz (2008).

- I expect subsequence rhymes to primarily feature voiceless obstruent coronals due to their exceptional status in Dutch phonotactics.

- Lastly, loanwords involved in imperfect rhyme are anticipated to feature more uncommon consonantal mismatches, as well as phonemic readjustment.

# 4. Methodology

## 4.1 Corpus

For this research, five Dutch rappers from different cities and different ethnic backgrounds were selected for the purpose of heterogeneity. This should not affect their general usage of consonantal mismatches in Dutch imperfect rhyme, because the phonology underlying this phenomenon is assumed to be the same for any speaker of Dutch. Slight dialectal differences may be present, but for consonants this is mostly restricted to the realization of /r/. It will likely influence, however, the variety of loanwords and rhyme styles they employ, which is why they were chosen. The five rappers I have chosen with their respective city of origin and ethnic background are: Fresku (Eindhoven, Dutch Antillean), Sticks (Zwolle, native Dutch), Lijpe (Utrecht, Moroccan), Winne (Rotterdam, Surinamese) and Akwasi (Amsterdam, Ghanaian). Imperfect rhymes were transcribed until 250 consonantal mismatches per artist were obtained. This meant that no fixed number of songs was included in the corpus, because the amount of songs that were necessary to achieve 250 consonantal mismatches was different for each rapper. Intros, bridges, hooks and outros were not considered, as they often contain repetitions of rhymes, which would distort the results. Appendix I gives an overview of all the songs featured in the corpus.

### 4.2 Identification and annotation of rhyme domains

Identifying the imperfect rhymes poses a bit of a problem because there is a danger in missing rhymes. Kawahara simply looked at the last syllable(s) of a line which corresponded to the last syllable(s) of the following line (2007). However, in this study, internal rhyme domains were also included. Because of the possible bias at play when identifying rhymes by hand, Katz used an algorithm that identified as rhymes "any correspondent pair that satisfies a very loose definition of rhyme in terms of rhythmic and phonological properties" (2015, p. 7). This did, however, introduce some false positives into the data. For the current study, the imperfect rhymes were identified by ear, as false positives pose more of a problem than missing rhymes, because the false positives would skew the results by incorporating mismatches that do not adhere to similarity at all, because they are not meant to rhyme.

In transcription, prosodically influenced variations in stress due to hip hop's highly rhythmical nature, as well as phoneme deletion, were taken into account. After the identification of rhyme domains (always containing identical vowels), consonantal mismatches were counted. To illustrate how the consonantal mismatches were counted, I provide several examples below. In the rhyme scheme of (13) the consonantal featural mismatches are [x-k], [k-t] and [t-p]: the consonantal mismatch is thus always counted as relating to the rhyme fellow directly succeeding it, but not further than that. This procedure is maintained because throughout a rhyme scheme, rappers may use linking to transition from one type of featural imperfect rhyme to another (Zwicky, 1976, p. 677).

13) [re:xə]-[re:kə]-[be:tə]-[sle:pə]
14) [bɔrst]-[rɔt]
15) [stɑpə]-[klɑstə]
16) [nits tə] [nit bə]

The other two examples, (14) and (15), are subsequence rhymes. (14) is internal subsequence and (15) peripheral. In (14), [r] and [s] correspond to 0, and in (15), [t] corresponds to 0, which reveals something about how multisyllabic subsequence rhymes were dealt with. Katz argued there is no "theory-neutral way" of deciding which consonants actually mismatch in such rhymes. Though an argument could be made for looking at syllable boundary, which would yield a [p-t] mismatch in (15), it was decided to instead look at segmental alignment, due to the tendency of rappers to manipulate syllable boundaries.

Segmental alignment means that the phonemes' position in relation to the preceding vowel was looked at; [p-s] is therefore the consonantal mismatch involved in (15). Word boundaries were considered to be salient, however, and they were taken into account: (16) thus contains the mismatches [s-0] and [t-b]. Furthermore, for each rhyme domain, I annotated whether it was masculine, feminine or triple by looking at the number of syllables the domain spanned. In order to distinguish internal rhyme domains from end-rhyme domains, a decision had to be made as to where lines ended. This was decided upon by considering both metrical beat and lines as they occurred on *Genius*, where the lyrics were gathered from. Few corrections had to be made, as most lines corresponded to the edge of a metrical beat. Moreover, mismatches were designated as featural or (peripheral or internal) subsequence. In the end, the rhyme domains were phonetically transcribed and the different types of mismatches were analyzed for differences in consonantal distribution.

Lastly, for the sociolinguistic variable of loanwords, I collected all the imperfect rhymes containing loanwords, and labelled them by source language. Unfortunately, not enough loanwords from languages other than English appeared in the corpus to analyze them in a reliable way. A list of the source languages of loanwords in the corpus is given in section 5.6. As for the English loanwords, transcription meant paying close attention to the implementation of both non-native consonants and vowels, and the phonemic readjustments the rappers employed.

### 4.3 Measurement procedures

Two measurement procedures were employed. First, the consonantal mismatches were simply counted, in order to compose a list of frequent mismatches. Besides that, an objective was to find out which mismatches occurred most compared to their expected occurrence based on segmental frequency (how often a phoneme actually occurs in a language or utterance). To this end, I made use of the O/E ratio measurement encountered in Kawahara's study of Japanese half-rhymes (2007, p. 6). The O/E ratio reflects how often an item (in this case a consonant) is observed to be paired with another item (the mismatching consonant) as compared to how much this pairing was expected if all was equally distributed. The formula is: $E(x,y) = P(x) * P(y) * N$ (N being the total number of pairs). If, for example, there are 500 mismatching consonants and 80 of those consonants (16%) are [t] and 30 (6%) are [l] than the expected amount of pairings [t-l] would be: $0.16 * 0.06 * 500 = 4.8$. If the actual observed number of [t-l] pairs is 5 or more, the O/E ratio will be higher than 1, reflecting overrepresentation. If the observed number of pairs is 4 or less, the pair will be underrepresented.

This measurement thus sheds light on the actual tendency of consonants to mismatch with one another under equal circumstances (Kawahara uses the term *rhymability*), which makes it more feasible to draw conclusions about phonological and/or phonetic systematicity in imperfect rhyme. Phonemes that occurred less than 20 times in a mismatch were not considered for this specific measurement, because their O/E values were easily inflated; consider, for example, the mismatch [ɾ-ɹ], which occurred only twice, but its O/E value was an astonishing 8.14, simply due to the infrequent occurrence of both of these allophones. Similarly, mismatches that occurred only once were excluded, because their occurrence being incidental (within a corpus of 1250 mismatches) could not be ruled out, and their O/E values would not reflect an accurate representation of rhymability. Of the remaining 82 mismatches, a hierarchy was devised using distinctive features. This is displayed in section 5.4. An overview of the Dutch consonants involved in the O/E analysis and the relevant features that belong to them can be found in Appendix II.

To compare between types of rhyme domains, O/E values of consonantal mismatches for each type of rhyme domain were measured. Those pairs for which a significant disparity between the O/E values (differing by a factor of 2 or more) was observed, were gathered in the tables in section 5.5, after which analysis could be applied.

## 5. Results

In this section, the results of the various measurements are presented. First, the overall results of the absolute number of featural mismatches, as well as segmental mismatches are shown, after which the O/E values shall be given, in order to answer the most important question this thesis poses, which revolves around whether there is a pattern of phonological similarity observable in consonants that correspond in imperfect rhyme. In 5.4, a closer look is taken at this similarity, and different distinctive features and their importance are identified. Section 5.5 deals with the influence that the type of rhyme has on the results. Lastly, the loanwords involved in imperfect rhyme are examined. The results are accompanied by general observations, and comments about irregularities. The implications of the results, as well as the explanation of some of the inconsistencies will, however, be fully elucidated later, in the discussion.

### 5.1 Subsequence rhyme

In order to measure similarity of consonantal mismatches in imperfect rhyme, a separation first had to be made between featural mismatches and segmental mismatches (those belonging to subsequence rhyme, discussed in section 2.1, in which a consonant mismatches with 0. Of the 1250 mismatches in the corpus, 526 (42%) were segmental. Table 3 gives an overview of the consonants most often involved in subsequence rhyme and their O/E values together with an example from the corpus. As expected, the voiceless coronals [s] and [t] score highest in terms of absolute numbers. Furthermore, rhotics appear very often, as well as consonants that may display vowel-like qualities, such as [ɫ], [j] and [h]. [b] having an O/E value exceeding 1 is unexpected. These results will be interpreted more extensively in section 6.1.

| Consonant | Occurrence in subsequence rhyme | O/E value |
|---|---|---|
| [ʁ] | 4 | 3.17 |
| [t] | 213 | 2.29 |
| [ɹ] | 17 | 2.24 |
| [ɾ] | 14 | 2.15 |
| [r] | 15 | 2.10 |
| [l] | 13 | 2.06 |
| [s] | 76 | 1.74 |
| [h] | 6 | 1.58 |
| [j] | 8 | 1.31 |
| [b] | 8 | 1.02 |
| [k] | 45 | 0.99 |
| [n] | 34 | 0.95 |
| [f] | 15 | 0.94 |
| [ʋ] | 2 | 0.86 |
| [x] | 24 | 0.67 |
| [ʀ] | 1 | 0.59 |
| [d] | 11 | 0.58 |

*Table 3: Consonants mismatching with 0 (absolute occurrence and O/E value)*

### 5.2 Feature rhyme (absolute numbers)

The subsequence rhymes precede the more significant results for the feature rhymes to make the reader aware of the distribution of the consonants between segmental and featural mismatches. The remaining 58% of mismatches were featural, amounting to 724 x 2 = 1448 consonants involved in a consonantal mismatch. These phonemes were of course not distributed equally. Table 4 shows the segmental distribution of the phonemes that were considered in the analysis (again, those that featured less than 20 times were excluded, due to the inflated O/E values). This list of segmental frequency is largely compatible with Zuidema's list of Dutch consonantal frequency that was discussed in section 2.4.4. The major differences are the fact that [k] and [p] rank considerably higher, and [l] lower. This last fact is surely influenced by the inclusion of [ɫ], which Zuidema did not include and likely just treated as a form of [l]. [ɫ] is not included in the table below, as it did not reach the threshold of 20 tokens (it occurred 17 times), but the consonant with which it corresponded most is shown in Table 6.

| **Consonant** | **N=** |
|---|---|
| [t] | 217 |
| [k] | 169 |
| [x] | 146 |
| [n] | 136 |
| [s] | 132 |
| [p] | 95 |
| [m] | 78 |
| [d] | 77 |
| [f] | 61 |
| [l] | 54 |
| [v] | 37 |
| [ŋ] | 35 |
| [b] | 29 |
| [z] | 28 |

*Table 4: Segmental frequency of consonants involved in featural mismatches*

Table 5 lays out the 22 most frequent mismatches, along with an example from the corpus. A more complete table of all the mismatches that occurred can be found in Appendix III. Table 5 shows discrepancies with Holtman's ranking: [m-n] is in fact not the most frequent mismatch in the current corpus; [k-t] is (which is also minimally different phonologically). As expected, the coronal rhyme [s-t] ranks high as well, although it differs in two of the phonological features that Holtman deemed pertinent. Besides this mismatch, the other six most frequent mismatches only differ in one phonological feature. On the whole, most mismatches featured here are phonologically similar in the definition adopted by

Holtman. Some dissimilar mismatches also appear, however, like [x-t], [k-n], [s-k] and [d-x]. Important to keep in mind is that segmental frequency skews the results in favor of those phonemes occurring frequently in the corpus anyway, which both /k/ and /n/ do, for example. Whether these mismatches occur frequently due to the segmental frequency of the consonants involved or they actually tend to be rhymable in imperfect rhyme becomes clear in the next section, where the O/E scores are exhibited.

| Consonantal mismatch (number of occurrences) | Example from corpus |
|---|---|
| [k-t] (54) | *schrikken - zitten* |
| [s-t] (39) | *los - lot* |
| [k-x] (31) | *gek - weg* |
| [p-t] (29) | *open - noten* |
| [m-n] (26) | *raam - gaan* |
| [n-ŋ] (22) | *invoeren - ding loeren* |
| [x-s] (21) | *lachen - lasten* |
| [x-t] (20) | *moet slagen - goed praten* |
| [k-n] (18) | *plek - pen* |
| [t-n] (16) | *gaat het - raak m'n* |
| [p-k] (15) | *nu pas - Lucas* |
| [p-x] (14) | *snapt - nacht* |
| [s-k] (14) | *klus - stuk* |
| [t-f] (12) | *kwijt - lijf* |
| [f-x] (11) | *liften-wichten* |
| [s-f] (10) | *doel af - schoen past* |
| [d-t] (10) | *pedaal - metaal* |
| [d-k] (8) | *ons doven - rondkomen* |
| [d-v] (8) | *steden - dreven* |
| [d-x] (8) | *laden - vragen* |
| [n-l] (8) | *spannen - knallen* |
| [p-f] (8) | *voorloop - voorhoofd* |

*Table 5: 22 most frequent consonantal mismatches in the corpus*

The 14 phonemes in Table 4 do not make up the complete set of consonants that occurred in the corpus. There were 13 other consonants present in feature rhyme, but none of them occurred a minimum of 20 times. Therefore, they are not included in the O/E scores presented in the next section, due to the inevitably inflated O/E values that resulted from their infrequent occurrence. However, it is interesting to see with which consonants these rare phonemes, some of them non-native, mismatched most often. An overview of these mismatches (required to occur at least twice to rule out incidents, which disqualified [θ], [dʒ] and [w]) is given in Table 6, again along with examples from the corpus.

If an infrequent phoneme mismatched an equal number of times with two or more other phonemes, the choice was made to display the mismatch with the more infrequent of the other phonemes, because it more accurately reflects likelihood of mismatching under equal circumstances and thus, hypothetically, similarity. For instance, [tʃ] mismatches twice with [s] as well as /x/. In the Table, [tʃ-s] is listed, because [x] was more segmentally frequent than [s]. Note also that [ɹ-ɫ] is the most frequent mismatch for both consonants involved. A general overview of shared phonological features is provided; this should not be taken as evidence that these specific features are decisive in imperfect rhyme, because too few tokens are present here to conclude anything about phonological similarity yet. What it does suggest is that consonantal mismatches are not totally random, and some type of phonological similarity is involved. The next section reports on the O/E values of all the mismatches containing consonants that were frequent enough to be deemed as valid results, after which it becomes possible to delineate the type of phonological similarity involved in imperfect rhyme more clearly. For now, it is valuable to note that only one of the mismatches in Table 6 differed in voice, namely [ɾ-s]. The results reviewed in the next section will confirm this observation, and delve deeper into which features are most salient in imperfect rhyme.

| Consonantal mismatch (number of occurrences) | Shared phonological features | Example |
|---|---|---|
| [ʃ-s] (6) | [+coronal] [+continuant] [+strident] [-voice] | *bullshit - goed zit* [buɫʃɪt] - [xut sɪt] |
| [j-d] (5) | [+coronal] [+voice] | *draaien - kade* [dra:jə] - [ka:də] |
| [ɾ-s] (5) | [+coronal] | *honger - jongens* [hɔŋəɾ] - [jɔŋəs] |
| [ɹ-ɫ] (4) | [+approximant] [+coronal] [+voice] | *herleef - welnee* [hɛɹle:f] - [ʋɛɫne:] |
| [r-l] (4) | [+approximant] [+coronal] [+voice] | *(sa)laris - falen* [la:rəs] - [fa:lə] |
| [d-ʋ] (4) | [+anterior] [+voice] | *rolmodel - Volvo wel* [ʀɔɫmo:dɛɫ] [fɔɫfo: ʋɛɫ] |
| [x-h] (2) | [+continuant] [-voice] | *doorgeef - doorheeft* [dɔɹxe:f] - [dɔɹhe:ft] |
| [ɫ-ʀ] (2) | [+approximant] [+dorsal] [+voice] | *baal - daar* [ba:ɫ] - [da:ʀ] |
| [tʃ-s] (2) | [+coronal] [+strident] [-voice] | *beetje - wees een* [be:tʃə] - [ʋe:s ən] |

*Table 6: Most frequent mismatches of consonants that occurred less than 20 times*

### 5.3 O/E values

In this section, the main results of this thesis are presented; namely, the O/E values, which provide a valid representation of the manner in which consonantal mismatches are distributed within imperfect rhyme in Dutch hip hop. From these results, judgements can be made regarding the role of phonological similarity in this phenomenon, and whether or not phonological features contribute equally to this similarity. Table 7 shows all the O/E values of the consonantal mismatches that occurred at least twice. Mismatches that occurred only once were excluded, because it could not be ruled out that these were incidental, and their O/E values would not reflect the situation reliably. Mismatches that did not occur were taken into account, however, their O/E values naturally amounting to 0.

| **Mismatch** | **O/E** | **list continued** | **O/E** | **list continued** | **O/E** |
|---|---|---|---|---|---|
| 1) [n-ŋ] (22) | *6.69* | 29) [b-t] (5) | *1.15* | 57) [s-v] (2) | *0.59* |
| 2) [d-v] (8) | *4.06* | 30) [s-b] (2) | *1.14* | 58) [x-ŋ] (2) | *0.57* |
| 3) [m-n] (26) | *3.55* | 31) [k-n] (18) | *1.13* | 59) [s-n] (7) | *0.56* |
| 4) [b-l] (3) | *2.78* | 32) [b-n] (3) | *1.10* | 60) [k-f] (4) | |
| 5) [b-v] (2) | *2.70* | 33) [v-x] (4) | *1.07* | 61) [f-n] (3) | *0.52* |
| 6) [m-ŋ] (5) | *2.65* | 34) [p-b] (2) | *1.05* | 62) [x-n] (7) | *0.51* |
| 7) [m-v] (5) | *2.50* | 35) [d-x] (8) | *1.03* | 63) [k-m] (4) | *0.44* |
| 8) [d-l] (7) | *2.44* | 36) [x-b] (3) | | 64) [t-m] (5) | *0.43* |
| 9) [k-t] (54) | *2.13* | 37) [x-l] (6) | *1.01* | 65) [s-l] (2) | *0.41* |
| 10) [p-t] (29) | *2.04* | 38) [d-n] (7) | *0.97* | 66) [d-p] (2) | *0.40* |
| 11) [p-f] (8) | *2.00* | 39) [m-f] (3) | *0.93* | 67) [t-l] (3) | *0.37* |
| 12) [s-t] (39) | *1.97* | 40) [s-p] (8) | *0.92* | 68) [s-m] (2) | *0.28* |
| 13) [z-l] (2) | *1.92* | 41) [k-v] (4) | | 69) [p-n] (2) | *0.22* |
| 14) [k-x] (31) | *1.82* | 42) [k-z] (3) | | 70) [s-ŋ] | 0 |
| 15) [s-f] (10) | *1.80* | 43) [x-t] (20) | *0.91* | 71) [t-ŋ] | 0 |
| 16) [x-f] (11) | *1.79* | 44) [s-k] (14) | | 72) [d-ŋ] | 0 |
| 17) [m-l] (5) | *1.71* | 45) [d-k] (8) | *0.89* | 73) [p-ŋ] | 0 |
| 18) [z-p] (3) | *1.64* | 46) [d-t] (10) | *0.87* | 74) [b-ŋ] | 0 |
| 19) [s-x] (21) | *1.58* | 47) [d-m] (6) | *0.83* | 75) [f-ŋ] | 0 |
| 20) [n-l] (8) | | 48) [t-n] (16) | *0.79* | 76) [v-ŋ] | 0 |
| 21) [p-x] (14) | *1.46* | 49) [m-p] (4) | *0.78* | 77) [z-ŋ] | 0 |
| 22) [t-z] (6) | *1.43* | 50) [s-z] (2) | | 78) [l-ŋ] | 0 |
| 23) [p-k] (15) | *1.35* | 51) [z-n] (2) | *0.76* | 79) [v-n] | 0 |
| 24) [m-z] (2) | *1.33* | 52) [k-ŋ] (3) | *0.73* | 80) [p-l] | 0 |
| 25) [t-f] (12) | *1.31* | 53) [s-d] (5) | *0.71* | 81) [k-b] | 0 |
| 26) [t-v] (7) | *1.28* | 54) [x-z] (2) | | 82) [z-v] | 0 |
| 27) [v-f] (2) | | 55) [k-l] (4) | *0.64* | | |
| 28) [m-b] (2) | | 56) [d-f] (2) | *0.62* | | |

*Table 7: O/E values of consonantal mismatches*

Table 7 shows that phonological similarity plays a role in the imperfect rhymes under analysis in the current study, too. Strikingly, [voice] is maintained in 23 of the top 25 mismatches in terms of O/E values, the first disagreement occurring only in the consonant pair ranked 18th. Furthermore, the three nasal consonants all have a remarkably high degree of rhymability, mirroring the earlier studies on imperfect rhyme in English and Japanese. Of the 32 mismatches with O/E values lower than 1 (reflecting low rhyme likelihood), the majority of 20 differs in three or more of the phonological features that were salient in Holtman's ranking, notwithstanding the mismatches with O/E values of 0. Of the 37 mismatches with O/E values higher than 1, 25 differ in a maximum of two of those features. As for the mismatches that did not occur even once, it can be observed that they are all highly dissimilar (differing in four or more features, yielding them ungrammatical) when taking into account the distinctive features that Holtman considered to play a role, except for [k-b] and [z-v], which will be discussed in section 6.3. Thus, the results broadly align with Holtman's ranking, but they cannot be said to wholly confirm her hierarchy. Therefore, a closer look is taken at the influence of individual phonological features to get a better sense of the type of phonological similarity that played a role in the imperfect rhymes in this corpus.

### 5.4 Featural significance

After close examination of the distribution of mismatches, it became clear that phonological similarity of consonants does indeed influence imperfect rhyme greatly. To explore what features contribute most to this similarity, the O/E values of all the mismatches that shared a particular feature were collected in order to yield an average O/E value which tells us something about the salience of that feature. All features Holtman uses were measured, as well as some additional features. Whereas Holtman did note the salience of [+anterior] for [m-n], which ensured the pair to be the most frequent mismatch in her research, the feature did not play a role in the rest of her ranking. Here, its influence was measured, along with major class features that were not present in Holtman's hierarchy. [+sonorant] consonants were separated from [-sonorant] consonants, otherwise known as obstruents.

Laterality turned out not to play a role, as also evidenced by the high ranking of of [b-l], [d-l], [z-l], [m-l] and [n-l]. Figure 1 shows the average O/E values per feature in which mismatches agreed. From this, we can conclude that mismatches that agree in voice, major class or nasality are most rhymable, whereas major place, stridency and continuancy are more often manipulated in imperfect rhyme. This is different from what Holtman saw; in her corpus, continuancy and stridency were often maintained. The average O/E value of mismatches that agree in [anterior] is noteworthy, because this place feature is a large category that encompasses all the labial and most of the coronal consonants, which are thus more likely to mismatch with each other than with dorsals.

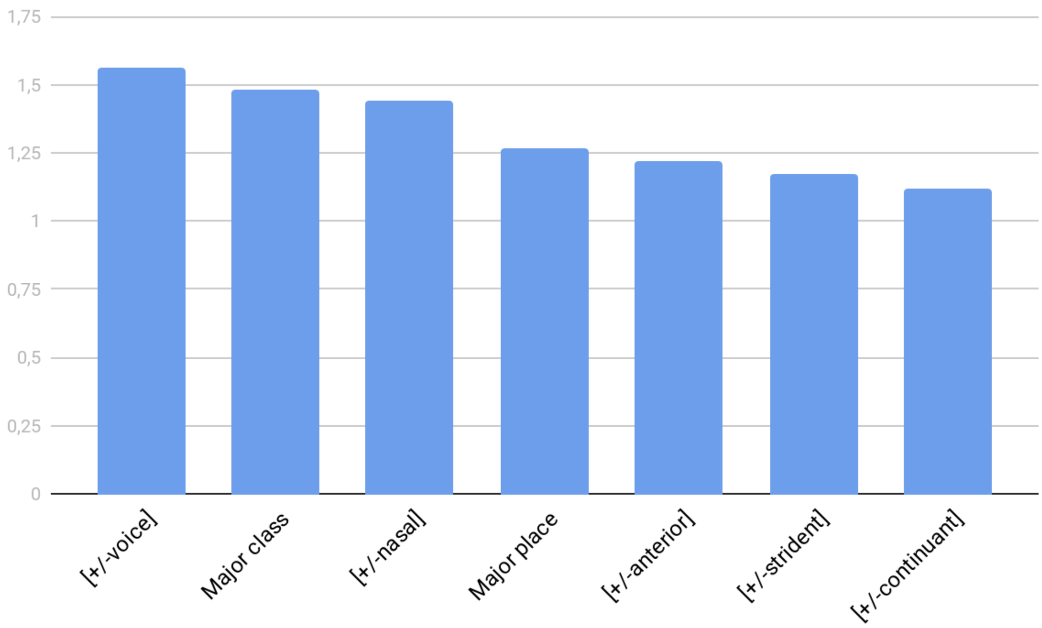


*Figure 1: Influence of shared features on O/E values*

To zoom in a bit more, and provide a more detailed survey of the influence of individual features, Figure 2 was devised. This figure shows, for example, whether consonants sharing [+voice] were more rhymable than consonants sharing [-voice]. The same is demonstrated for nasals and continuants; it becomes clear that nasals are highly rhymable with one another, while continuancy is not a salient feature. Moreover, the difference in influence between individual major place and major class features is exhibited. The figure reveals that sonorants indeed play a special role in imperfect rhyme: they are considerably more rhymable with one another than pairs of [-sonorants] consonants, otherwise known as obstruents, which of course in part has to do with the salience of nasal rhymes. Also, voiced consonants correspond in imperfect rhyme slightly more often than voiceless consonants, as was also apparent in Table 7. As for place, labials are most likely to group together. Again striking is the influence of [+anterior], being that this category covers the majority of Dutch consonants.

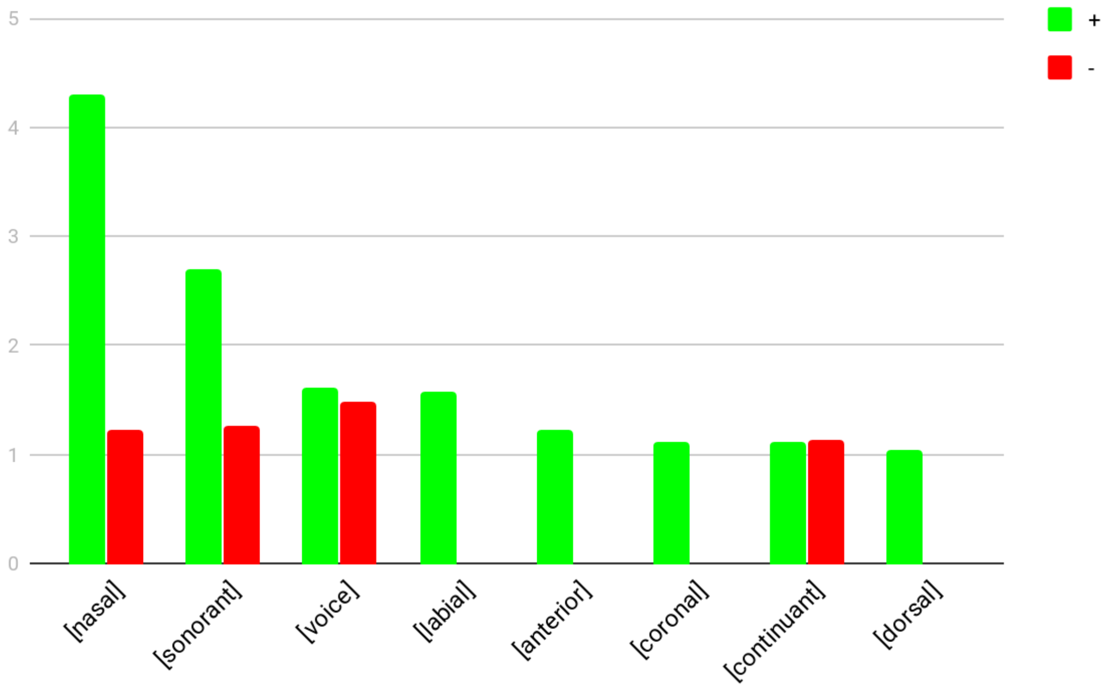


*Figure 2: Detailed look at shared features in descending order of influence on O/E values*

After the analysis of the salience of phonological features in imperfect rhyme, it is useful to construct a hierarchy to reflect phonological similarity and formalize the distribution of consonantal mismatches as related to this similarity. The distinctive features that were incorporated are the same ones pictured in Figure 1; this selection thus differs from Holtman's in the inclusion of major class and [anterior], and the exclusion of laterality. As voice was the least likely to be manipulated, this feature has special status within the hierarchy, presented in Table 8. The hierarchy distinguishes between mismatches in three categories of similarity (tiers); in the first tier, mismatches differ in a maximum of two features that are both not [voice]. In the second tier, mismatches differ in  a maximum of three features, one of which can be [voice]. The third tier features those mismatches that differ in four or more features. The mismatches in the first tier are generally highest in rhymability, before the mismatches in the second tier (on average neutrally rhymable) and the mismatches in the third tier, which are generally too dissimilar to have an O/E value of more than 1, and thus score low in rhymability. Exceptions to this general pattern do exist, and an attempt to interpret them will be made in section 6.3 of the discussion.

| Category of similarity | Mismatches (in descending order of O/E value) | Average O/E |
|---|---|---|
| **Tier 1**: *consonants differ in max. two features (not [voice])* | [n-ŋ] [d-v] [m-n] [b-v] [m-ŋ] [m-v] [d-l] [k-t] [p-t] [p-f] [s-t] [z-l] [k-x] [s-f] [x-f] [n-l] [p-k] [t-f] [m-b] [b-t] [d-n] [z-v] | **2.28** |
| **Tier 2**: *consonants differ in max. three features* | [b-l] [m-l] [s-x] [p-x] [t-z] [v-f] [t-v] [b-n] [v-x] [b-p] [s-p] [x-t] [d-k] [d-t] [d-m] [t-n] [m-p] [s-z] [k-ŋ] [s-d] [d-f] [s-v] [k-f] [s-l] [d-p] [t-l] [k-b] | **0.93** |
| **Tier 3**: *consonants differ in four features or more* | [z-p] [m-z] [s-b] [k-n] [d-x] [x-b] [x-l] [m-f] [k-z] [k-v] [s-k] [z-n] [x-z] [k-l] [x-ŋ] [s-n] [f-n] [x-n] [k-m] [t-m] [s-m] [p-n] [d-ŋ] [b-ŋ] [l-ŋ] [t-ŋ] [p-ŋ] [v-ŋ] [s-ŋ] [b-ŋ] [z-ŋ] [v-n] [p-l] | **0.53** |

*Table 8: Hierarchy of phonological similarity involved in consonantal mismatches*

To visualize this hierarchy more clearly, Figure 3 was created. This figure shows how the three categories of similarity pattern as relating to their O/E values. It aims to validate the hierarchy, and the theory put forth about which phonological features influence consonantal mismatches in Dutch imperfect rhyme. Though three distinct categories can be made out, it is also apparent that there are several mismatches whose O/E values should actually be lower or higher, when taking into account the different tiers. Similarity as pertaining to imperfect rhyme turns out, in fact, to not be a categorical phenomenon as much as it is gradient. In section 6.4, the implications of these results, as well as other factors that played a role, and the complex nature of similarity will be elaborated upon. While keeping in mind the three different tiers, the next section delves into the variable of type of rhyme, and its influence on similarity between corresponding consonants in the corpus.

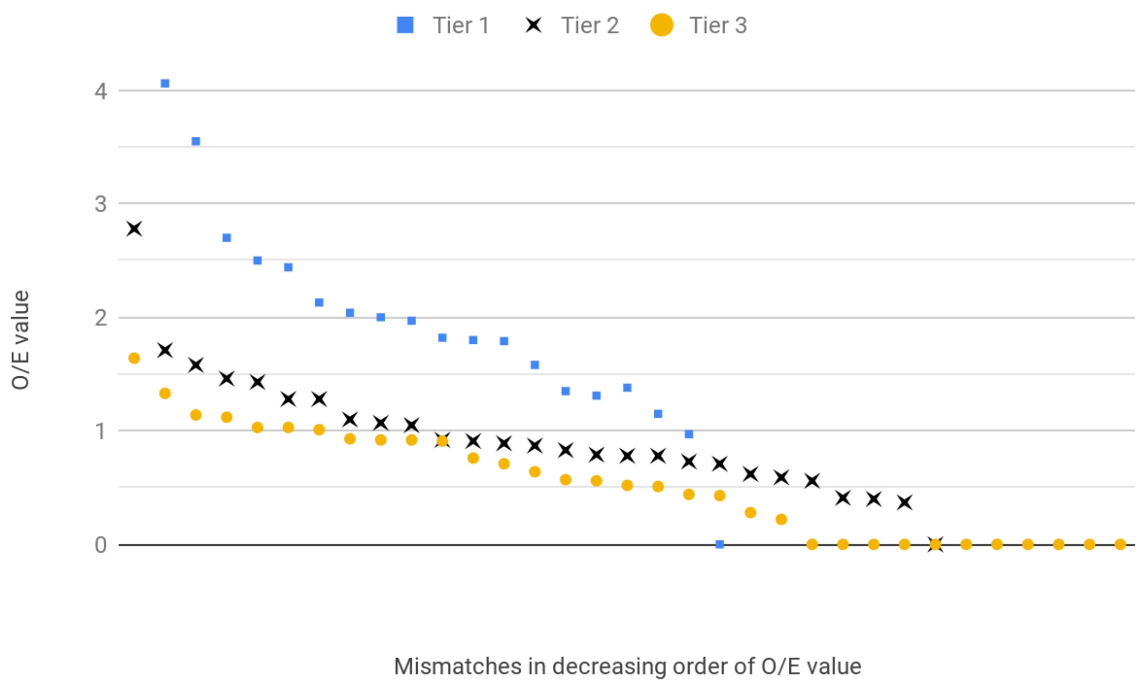


*Figure 3: Patterning of rhyme likelihood according to category of similarity*

### 5.5 Differences between types of rhyme

As hypothesized, the type of imperfect rhyme domain had an influence on the distribution of consonantal mismatches. First, the discrepancies in the results between internal rhymes and end-rhymes shall be addressed, after which the differences that were encountered between masculine and feminine rhyme will be discussed.

#### *5.5.1 Internal and end-rhyme domains*

Mismatches in internal rhyme domains and end-rhyme domains were fairly evenly distributed in the corpus: there were 383 of the former and 341 of the latter. This slight difference in frequency did not matter for the results, because O/E values were calculated again, which corrected for segmental frequency. The biggest divergences in O/E values for mismatches in the two types of domains (those that differed by a factor of 2 or more) were collected, and can be seen in Tables 9 and 10. Table 9 shows the mismatches with an O/E value in end-rhyme domains that was at least twice as large as their O/E value in internal rhyme domains, while Table 10 shows the mismatches with an O/E value in internal rhyme domains that was at least twice as large as their O/E value in end-rhyme domains. For further analysis, the tier to which the mismatch belongs within the hierarchy is added.

These results make it clear that internal and end-rhyme domains in fact do pattern differently when it comes to consonantal mismatches, as perceivable by the 12 mismatches that possess O/E values differing by a factor of >2. Furthermore, the hypothesis that internal rhyme domains require less phonological similarity between corresponding mismatches is affirmed by the fact that most mismatches in Table 9 are from the first tier, and most mismatches from Table 10 are from the third tier. The inconsistencies, as well as the broader conclusions to be drawn from the results below, will be discussed in section 6.5.

| **Mismatch** | **Category of similarity** | **O/E in end-rhyme domains** | **O/E in internal rhyme domains** |
|---|---|---|---|
| [p-f] | Tier 1 | 3.31 | 1.03 |
| [d-l] | Tier 1 | 3.28 | 1.42 |
| [z-p] | Tier 3 | 2.84 | 0 |
| [m-l] | Tier 1 | 2.21 | 0.84 |
| [d-l] | Tier 1 | 1.44 | 0.53 |

*Table 9: Mismatches with O/E value in end-rhyme domains bigger than O/E value in internal rhyme domains by factor of >2*

| **Mismatch** | **Category of similarity** | **O/E in internal rhyme domains** | **O/E in end-rhyme domains** |
|---|---|---|---|
| [d-m] | Tier 2 | 2.25 | 0.84 |
| [s-b] | Tier 3 | 1.56 | 0 |
| [k-v] | Tier 3 | 1.46 | 0 |
| [k-z] | Tier 3 | 1.40 | 0.53 |
| [k-f] | Tier 2 | 0.88 | 0.27 |
| [x-n] | Tier 3 | 0.80 | 0.16 |
| [s-m] | Tier 3 | 0.64 | 0 |

*Table 10: Mismatches with O/E value in internal rhyme domains bigger than O/E value in end-rhyme domains by factor of >2*

### *5.5.2 Masculine and feminine rhyme domains*

The results for masculine and feminine rhyme domains were not as straightforward. First of all, mismatches occurring in feminine rhyme domains (424) were a lot more frequent than those in masculine rhyme domains (198). The remaining 102 mismatches belonged to triple rhyme domains and were not considered because it was decided that this number of tokens was too few, and that a comparison between mono- and multisyllabic rhyme domains by contrasting masculine and feminine was interesting enough in itself. As for the differences between the two types of rhyme domains, they were even larger than the differences between internal and end-rhyme domains. This was mainly due to the simple fact that voiced obstruents did not occur in masculine rhyme domains apart from the occasional incidental case of voice assimilation or hypercorrection (recall that onsets are not counted, and syllable-final obstruents are always devoiced in Dutch). Therefore, all voiced obstruents were excluded from the analysis. From the consonants that were left, a sizable number of, again, 12 mismatches was found that differed by a factor of 2 or more in their O/E values. These mismatches are arranged in Table 11 and 12.

| **Mismatch** | **Category of similarity** | **O/E in masculine rhyme domains** | **O/E in feminine rhyme domains** |
|---|---|---|---|
| [m-n] | Tier 1 | 7.25 | 2.66 |
| [t-f] | Tier 1 | 2.07 | 0.83 |
| [t-n] | Tier 2 | 1.06 | 0.46 |
| [f-n] | Tier 3 | 0.93 | 0.36 |

*Table 11: Mismatches with O/E value in masculine rhyme domains bigger than O/E value in end-rhyme domains by factor of >2*

| Mismatch | Category of similarity | O/E in feminine rhyme domains | O/E in masculine rhyme domains |
|---|---|---|---|
| [p-t] | Tier 1 | 2.41 | 1.20 |
| [x-f] | Tier 1 | 2.41 | 0.58 |
| [k-ŋ] | Tier 2 | 1.81 | 0 |
| [s-n] | Tier 3 | 1.20 | 0 |
| [m-p] | Tier 2 | 0.98 | 0 |
| [x-n] | Tier 3 | 0.89 | 0 |
| [k-f] | Tier 2 | 0.85 | 0 |
| [k-m] | Tier 3 | 0.42 | 0 |

*Table 12: Mismatches with O/E value in feminine rhyme domains bigger than O/E value in end-rhyme domains by factor of >2*

Unlike the data for internal and end-rhyme domains, which made it fairly obvious that consonants in end-rhyme domains tend to be more phonologically similar than internal rhyme domains, the data above do not immediately reveal which type of rhyme more closely follows phonological similarity. A more thorough analysis of the discrepancies will be applied in section 6.5. The next section gives the results of the loanword analysis, after which the discussion commences.

### 5.6 Loanwords

Finally, this study also intended to look at the sociolinguistic variable of loanwords, and the influence this has on imperfect rhyme. Unfortunately, not enough loanwords actually appeared in the corpus to provide a thorough account of their role in imperfect rhyme; instead, a qualitative analysis of the implementation of loanwords by the Dutch rappers in this corpus was carried out. In this section, some of the general tendencies that the rappers displayed in their adaptation of loanwords is given. First, Table 13 lists the different source languages that the loanwords involved in imperfect rhyme originated from. This list is shorter than expected beforehand, though the dominance of English is not surprising. Neither is the fact that Sranan Tongo is the source language in second place as far as loanwords in imperfect rhyme in the corpus. Dutch *straattaal,* or slang, has historically borrowed extensively from this creole language of the former Dutch colony Suriname (Mourigh, 2019). Unfortunately, the low amount of tokens for loanwords from languages other than English, means that this analysis is limited to English. Below Table 13, some of the varying ways in which English loanwords are pronounced within hip hop are outlined.

| **Source language** | **Amount of loanwords** | **Example (translation)** |
| --- | --- | --- |
| English | 69 | *Ik was zo* ***hopeless****, maar jullie geven me kracht elke dag* |
| Sranan Tongo | 6 | *Hoofd in de war maar hoef geen* ***soetoe*** *van je vredespijp*<br>(puff/drag) |
| French | 3 | *Maar ik nam die gok, en nu is me* ***chance*** *groot*<br>(chance) |
| (Moroccan) Arabic | 1 | *Boys die never met me waren willen* ***floes*** *lenen*<br>(money) |

*Table 13: Loanwords involved in imperfect rhyme*

### *5.6.1 Phonemic readjustment*

Phonemic readjustment, a mechanism found in hip hop, in which a word is pronounced differently (usually vocalically) in order to rhyme with another word that traditionally would not rhyme, appeared in this corpus regularly. Especially with loanwords readjustment happened, as they often contained phonemes without equivalent in Dutch. It is difficult to decipher whether rappers intended readjustment or simply were not aware that the vowel deviated. Despite this, the examples in Table 14 were determined to be true instances of phonemic readjustment, because the rapper elsewhere did pronounce the relevant vowel in the ‘English  way’ (one of the examples shows phonemic readjustment for a native word, the others involve at least one loanword from English).

| Word | Native pronunciation | Rapper's pronunciation | To rhyme with |
|---|---|---|---|
| *pedaal* 'pedal' | [pəda:ɫ] | [pe:da:ɫ] | [me:ta:ɫ] *metaal* 'metal' |
| *lauwste* 'coolest' (slang) | [lʌustə] | [laʊstə] | [haʊlə] *howlen* 'to howl' (inflected loanword) |
| *hype* | [haɪp] | [hɛip] | [xəlɛik] *gelijk* 'equal' |
| *fashion* *passion* | [fæʃən] [pæʃən] | [fɛʃən] [pɛʃən] | [lɛsən] *lessen* 'lessons' |

*Table 14: Phonemic readjustment in imperfect rhyme*

### *5.6.2 Dutch loanword adaptation*

In other cases, loanwords were not phonemically readjusted, and similar vowels in English and Dutch rhymed imperfectly, like in the rhyme *mind-mij*, where the diphthongs [aɪ] and [ɛi] corresponded (not included in main O/E analysis due to mismatching vowels). Besides the subtle mechanism of phonemic readjustment, which contributes to rhymability and is more or less a poetic device, loanwords were also often (66% of the time) adapted using Dutch phonemes, unrelated to rhymability. An overview of some of the English sounds that were most frequently realized as Dutch phonemes is given in Table 15. Fricatives were often devoiced and rhotics and vowels were often altered, which makes sense considering the established weaker voicing distinction in Dutch, as well as the differing rhotics and vowels the language possesses. This concludes the overview of the results for loanwords involved in imperfect rhyme.  In section 6.6 some relevant questions to be further explored in future research will be proposed.

| Loanwords | Realization | English to Dutch sound |
|---|---|---|
| *move*<br>*love* | [mu:f]<br>[lʌf] | [v] to [f] |
| *wars* | [ʋɔɹs] | [w] to [ʋ] |
| *tracks*<br>*rematch* | [trɛks]<br><br>[rimɛtʃ] | [ɹ] to [r]<br>[æ] to [ɛ] |
| *rhymes* | [rɛims] | [ɹ] to [r]<br>[aɪ] to [ɛi] |

*Table 15: Examples of English phonemes most often altered in imperfect rhyme*

# 6. Discussion

In this section, the gathered results will be analyzed more deeply in order to be able to answer the research questions and evaluate whether the hypotheses were confirmed or not. Moreover, outliers in the results will be discussed, possible alternate explanations will be explored, and the position of this study in the context of past research on imperfect rhyme will be reiterated. Importantly, the first sections will review the results of the consonantal mismatches in terms of sheer numbers, as well as the segmental mismatches that occurred in the subsequence rhymes, in order to adhere to the sequence in which the results were given. Only after this, the main focus of this thesis will be discussed; namely the degree of phonological and/or phonetic similarity between consonants that correspond in Dutch imperfect rhyme, as reflected by their O/E values, and the implications connected to the type of similarity at play.

## 6.1 Segmental mismatches

This study did not merely look at imperfect featural rhyme in which rhyme fellows contain corresponding consonants that are not alike. Subsequence rhyme, in which rhyme fellows mismatch for segments, was also considered. This phenomenon was first introduced in the context of phonology by Zwicky (1976), but otherwise has never been empirically investigated from this perspective. Table 3 in section 5.1 showed the consonants most often mismatching with 0 under equal circumstances (those with O/E values above 1), in descending order, to be [ʁ], [t], [ɹ], [ɾ], [r], [ɫ], [s], [h], [j] and [b]. Anticipated was the fact that the voiceless coronal obstruents [s] and [t] featured exceptionally frequently, due to their peculiar capacity to always feature in Dutch consonant clusters of three or more segments; referred to by van Oostendorp as being “somehow outside of the phonotactic template” (2014, p. 14). The other results were not anticipated, due to the exploratory nature of this part of the thesis, but they can be accounted for. Table 16 gives examples of subsequence rhymes in which these 10 phonemes mismatch with 0.

| **Mismatch** | **Example** | **Mismatch** | **Example** |
|---|---|---|---|
| [ʁ-0] | *oosten - gozer* [o:stə] - [xo:zəʁ] | [ɫ-0] | *spiegel - liegen* [spi:xəɫ] - [li:xə] |
| [t-0] | *borstkas - los vast* [bɔ:stkɑs] - [lɔs vɑst] | [s-0] | *tegenzit - zegen is* [te:xəsɪt] - [se:xə ɪs] |
| [ɹ-0] | *is er - missen* [ɪs əɹ] - [mɪsə] | [h-0] | *nek aan - trekhaak* [nɛk a:n] - [trɛkha:k] |
| [ɾ-0] | *troosten - over* [tro:stə] - [o:vəɾ] | [j-0] | *stappen - grapjes* [stɑpə] - [xrɑpjəs] |
| [r-0] | *lange ij - (be)langrijk* [lɑŋə ɛi] - [lɑŋərɛik] | [b-0] | *feedback - niet echt* [fitbɛk] - [nit ɛxt] |

*Table 16: Examples from corpus of consonants with highest O/E values in subsequence rhyme*

Rhotics score very high in subsequence rhyme, a fact that may be explained by the tendency for /r/ to be deleted in coda position in Dutch, especially after schwa (Sebregts, 2015, p. 218). In Table 16, all rhotics follow a schwa. They are not deleted, but sufficiently weakened, so that they can correspond to 0 in the rhyme pair. This also explains why [n] is not featured here, even though it is systematically deleted word-finally in Dutch (casual speech) after schwa (van de Velde & van Hout, 1998, p. 137). In the corpus, this was the case too, yielding a word like *spreken,* ‘to speak’, to be pronounced without final -n, which also meant that [n] did not feature in subsequence rhyme as often as the voiceless coronals. Besides the rhotics and the unforeseen [b], three consonants that can be said to possess vowel-like qualities are featured here. When a Dutch or English [l] follows a vowel in syllable-final position, it becomes dark, velarized [ɫ], which is close to a vocoid (think of the last sound in words like *feel* and *pull*).

Dutch [h], too, is a consonant closely related to a vowel. It does not occur in consonant clusters, and is “parasitic” on the following sound, which means it depends on the vowel for its place specifications (Booij, 1995, p. 40). Furthermore, it is easily deleted in casual speech, as evidenced by the Dutch word *haar*, or its English counterpart *her* for that matter, which often is realized as *‘er.* The palatal glide [j] is well known to be a semivowel with properties that are similar to [i] (Booij, 1995, p. 20). Finally, the O/E value of [b] being higher than 1 is illogical considering its phonological features, but a reason may be found in phonetics. In Pols' perceptual similarity study, he found that just behind its voiceless counterpart [p], [b] was most confusable with [h] and the glide [ʋ] (1983, p. 283). To conclude, subsequence rhyme often features coronal obstruents (due to phonotactics), rhotics (due to weakening), vowel-like consonants, and [b], for which a perceptual cause exists.

### 6.2 Absolute occurrences

The results of the absolute number of mismatches per pair were interesting, in that they were the most suited to compare to Holtman's findings. Though various mismatches seen in her hierarchy also occurred frequently in this dataset, differences were also prevalent, which can be ascribed to language-specific differences and the genre's complex exploitation of imperfect rhyme (Holtman only looked at a small corpus of hip hop lyrics), in which many more types of mismatches could occur than those just differing in one or two features. Looking at Table 5, which shows the 22 most frequent mismatches, three mismatches can be noticed that Holtman deemed too dissimilar to rhyme and would belong on the third tier of the hierarchy set forth in this thesis, namely [k-n], [d-x] and [s-k]. All of these occurred frequently as a result of segmental frequency of the consonants involved, except for [k-n], which had an O/E value of more than 1 anyway, and will be discussed together with other outliers in the next section.

As for the predictions that were made about mismatches occurring frequently here that Holtman did not include or rank as high, [d-k] and [f-x] did in fact make the list of 22 most frequent mismatches, and [s-t] was placed second. [k-x], the only prediction Holtman made regarding imperfect rhyme involving a phoneme not found in English, was indeed highly frequent as well, ranking third. The already discussed phonotactic rule of Dutch that states that all voiced [+anterior] fricatives follow long vowels and their voiceless counterparts generally follow short vowels indeed meant that the mismatches [v-f] and [s-z] were very scarce as opposed to Holtman's hierarchy, and did not feature in Table 6. Furthermore, the fact that [ʃ] is not as segmentally frequent in Dutch as in English (not occurring in any native lexical items, except as diminutives), meant that [s-ʃ] was not among the 22 most frequent mismatches either.

It was, however, in Table 6, where the most frequent mismatches of phonemes that appeared sparsely in feature rhymes in the corpus (less than 20 times) are shown. Of these mismatches, [s-ʃ] was the most frequent, which may reflect the pair's perceptual similarity in Dutch, where [ʃ] is infrequent in native words, as discussed in section 2.4.2. While it is not viable to draw any tangible conclusions from the results in Table 6, a brief comment on the featural similarity involved in the mismatches seems appropriate. What becomes clear, at least, is that phonological similarity plays a role in the distribution of these mismatches.

The different types of rhotics and laterals have a clear preference to mismatch with each other, perhaps reflecting the unique phonological status of these liquid consonants and the salience of the [+sonorant] feature that was reported in the general results, too. Pols found [l] and [r] are to be most confusable with each other, so perceptual similarity might play a role too in the matching of these liquids (1983, p. 283). Interestingly, other mismatches are also not explained by phonological similarity alone. [j-d], for example, differs in three of the features that were considered relevant in this thesis (major place, sonority and continuancy), as well as [+consonantal]. The pair's high likelihood of occurrence (its O/E value of 5.53, though probably inflated, was extremely high) is presumably at least in part related to phonetic similarity. Both perceptually and acoustically, [d] and [j] were found to be adjacent (Wielinga et al. 2012, p. 24) (Pols, 1983, p. 283). The pairing is also not surprising in light of the phonological process of d-deletion in Dutch, in which /d/ alternates with /j/ (Pols, 1983, p.91). Consider for example the Dutch word *rode* 'red', which may be realized in casual speech as [ro:jə].

From the results discussed in this section, several conclusions can be extracted. First, the results of consonantal mismatches in imperfect rhyme within Dutch hip hop did not align wholly with Holtman's hierarchy that was set up after reviewing English imperfect rhyme within pop songs, nursery rhyme and a small corpus of hip hop lyrics. Evidently, some of the differences could be explained by language-specific differences in phonotactics, phonemic inventory and segmental frequency. Others are likely the result of a corpus that featured more complex types of imperfect rhyme, or a different type of similarity, namely phonetic. The distinction between phonological and phonetic similarity, and the influence of both on consonantal mismatches in imperfect rhyme, is picked apart more systematically and concretely in the next section on O/E scores and featural significance.

### 6.3 Outliers

This section and the next outline the main results of this study: the O/E values, and their implications for the identification of the type of similarity at play in imperfect rhyme. First, some of the outliers should be addressed: as is often the case in a partially exploratory study (Dutch imperfect rhymes have never been researched at this scale), some outliers that do not correspond to the general results appeared. Among those are mismatches that were too dissimilar to have an O/E value as high as they did, and those mismatches that were too similar to have an O/E value as low as they did. Similarity is in this case defined by the phonological features included in the composition of the hierarchy in 5.4. Table 17 contains outliers that scored too high for rhymability, strictly considering the category of phonological similarity they were grouped in, and, in most cases, a plausible explanation.

| **Mismatch** | **Tier** | **O/E value** | **Explanation** |
|---|---|---|---|
| [b-l] | 2 | *2.78* | [+voice] [+anterior] both can follow short and long vowels |
| [m-l] | 2 | *2.21* | Shares salient features [+voice] [+sonorant] [+anterior] |
| [z-p] | 3 | *1.64* | Error in transcription |
| [m-z] | 3 | *1.33* | Same error in transcription |
| [s-b] | 3 | *1.14* | Features in internal rhyme domains only |
| [k-n] | 3 | *1.13* | - |
| [d-x] | 3 | *1.03* | Possible error in transcription, perceptual adjacency |
| [x-b] | 3 | *1.03* | Possible error in transcription, perceptual adjacency |
| [x-l] | 3 | *1.01* | Error in transcription |

*Table 17: Outliers with higher O/E values than expected*

The pair from the second tier that scored the highest in terms of O/E ratio was [b-l]. Its high degree of rhymability is curious, because the consonants differ in the salient feature [sonorant]. On the other hand, the consonants share [+voice] and [+anterior], also both influential in the distribution of consonantal mismatches. Another possible explanation is the fact that both consonants can follow short and long vowels, unlike the [+anterior] fricatives, as discussed. Still though, the high O/E value of this pair is an irregularity, which may have been smaller if the corpus was larger. The next pair, [m-l], shares [+sonorant] and [+voice], two of the most salient features, and its high value is thus more easily explained.

[z-p] and [m-z] had remarkably high O/E values for mismatches that belong in the third tier. Due to this irregularity, the occurrences of these mismatches were re-examined, and

an error in transcription was found to be at the root of them. A rhyme scheme by rapper Lijpe featured the rhyme fellows *kiespijn-vies zijn-beats pijn-wiep mij*, in which stress was determined to be on the first syllable (usually the case in the word *kiespijn*), rendering the rhyme domains feminine. However, this was a misjudgment, as stress (especially in the rhyme fellows after *kiespijn*) is decidedly on the second syllable upon relistening. This means that the onsets of the second syllables ([p], [z] and [m]) should not be counted, because they are the start of a new rhyme domain. In correcting this error, the O/E values of [z-p] and [m-z] would drop and thus not be irregular anymore.

Another error in transcription was made, which influenced the O/E value of [x-l]. In at least 2 of the 6 times this mismatch occurred, [l] was actually [ɫ], a subtle difference that can be difficult to make out. This would yield a lower O/E value for [x-l], and a higher one for [x-ɫ], which makes sense as they agree for major place. A final note on transcription: voiceless [x] may actually have been voiced [ɣ] in some cases, but this was difficult to tell as the distinction is largely gone in Netherlandic Dutch (if PRAAT would have been used, the distinction could likely have been made). The velar fricative actually being realized as voiced in some cases may have been the reason for the mismatches [d-x] and [x-b] to have as high O/E values as they have. If these mismatches occurred part of the time with the voiced dorsal fricatives, the O/E values would change, and the pairing would make more sense as the consonants would share [+voice]. Simultaneously, Pols showed that the dorsal fricative is most confusable with plosives after fricatives, and not just the homorganic [k] (1983, p. 283). Thus, the pairing of [x] with the voiced plosives [b] and [d] may not be so out of the ordinary if we take into account perception and possible voicedness of the fricative in some cases.

The last mismatch that occurred more often than would be expected is [k-n]. For this pair, no perceptual or phonological explanation was found. The only possible form of similarity between the consonants seems to be that the pair is [coronal-dorsal], which may be a distinction between such consonants and those that are [labial-dorsal], in a similar way that [+anterior] distinguishes between [coronal-labial] and [coronal-dorsal], for example, though undoubtedly less strongly. An argument for this theory is the constraint that exists in Dutch on consonant clusters that combine labials and dorsals, whereas every other combination with the three place features is possible. This is speculative, though, and it remains a fact that [k-n] appeared unexpectedly often.

| Mismatch | Tier | O/E value | Explanation |
|---|---|---|---|
| [d-n] | 1 | *0.97* | Salience of [+/-nasal] and [+/-sonorant] |
| [z-v] | 1 | *0* | Perceptual and acoustic dissimilarity |
| [k-f] | 2 | *0.56* | Perceptual dissimilarity |
| [s-l] | 2 | *0.41* | Salience of [+/-sonorant] [+/-voice] |
| [d-p] | 2 | *0.40* | Perceptual dissimilarity |
| [t-l] | 2 | *0.37* | Salience of [+/-sonorant] [+/-voice] |
| [k-b] | 2 | *0* | Salience of [+/-voice], [dorsal-labial] |

*Table 18: Outliers with lower O/E values than expected*

Table 18 lists the mismatches that scored higher for rhymability than would be assumed for their tier, or category of similarity, as constructed by the author. From the first tier, there were two mismatches scoring below the boundary of 1, which represents a degree of rhymability greater than random. One scored only slightly lower than 1, [d-n], and this is most likely the result of the difference in nasality and sonority, the two most salient features, as established in Figure 1 and 2. [z-v] is more curious, because both are voiced [+anterior] obstruents. A glance at the literature on phonetic similarity of Dutch consonants reveals that the consonants are far apart, both acoustically and perceptually (Wielinga et al. 2012, p. 24; Pols, 1983, p. 283). Perceptual dissimilarity is also likely the reason for the low score of [k-f]. Note also that this pair is [dorsal-labial], which might be a worthy distinction from [+anterior] and [coronal-dorsal], as was just indicated.

[s-l] owes its low O/E value to the difference in sonority and voice; the two items are also significantly dissimilar perceptually, but [s] is actually dissimilar to all non-strident phonemes in the Dutch inventory (Pols, 1983, p. 283). [d-p] is surprisingly low, both being [+anterior] plosives. They differ, of course, in voice and are also remarkably dissimilar phonetically, being the least confusable plosives in Dutch (Pols, 1983, p. 283). The reason for [t-l] being low can again be ascribed to a difference in the salient features voice and sonority; the pair is also perceptually dissimilar. It may be that a difference in phonological features like sonority and voice contributes to phonetic dissimilarity. This will be explored in the next section. Lastly, [k-b] occurred 0 times. The pair differs in voice and is also [dorsal-labial]. The distinction between [dorsal-labial] and [dorsal-coronal] may also be the reason why, for example, [k-t] scores substantially higher on the O/E ratio than [p-k] (2.13 versus 1.35), even though both are combinations of voiceless plosives.

### 6.4 Phonological or phonetic similarity as the basis for imperfect rhyme?

As we have seen, similarity is instrumental in determining the distribution of consonantal mismatches in Dutch imperfect rhyme. This is in line with earlier studies on the phenomenon in different languages, summarized in section 2.3. The type of similarity that is involved, or that contributes the most, is still a matter of debate. In section 5.4, the distinctive features' individual influence on consonantal mismatches was demonstrated. Certainly, it has been proven that phonological similarity is an important factor in the mechanism of imperfect rhyme. Through distinction between three categories of similarity, we saw a clear pattern in Figure 3, in which the different categories scored differently in terms of O/E values, and thus exhibited different degrees of rhymability. In the last section, some of the outliers were discussed. Note that 16 outliers, consonant pairs that did not score according to their phonological similarity as defined in 5.4, out of a total of 82 consonant pairs (only counting those that were included in the O/E measurement) is not necessarily a lot (especially when taking into account the possible errors in transcription). However, it is still too much to conclusively state that the phonological similarity employed in this study is sufficient to explain the correspondence of consonants in Dutch imperfect rhyme. In the last section, phonetic similarity (both perceptual and acoustic) was appealed to in order to account for some of the discrepancies. It is useful to zoom in a bit further on this variable here.

For instance, while it has been established that some features are more salient than others, the question remains why this is the case. Kawahara (2007, p. 17) found certain features to be more influential within Japanese imperfect rhyme in hip hop than others; he explained this by positing that the perceptual salience of a feature depends on its context. In Kawahara's study, nasals scored highest in terms of O/E ratio, which was explained by citing perceptual studies that concluded "place information to be less distinctive for nasals than for plosives" (p. 19*)*. The consonants that grouped together most reliably in this study were the nasals as well. Besides being nasals, they are also sonorant and voiced, which renders them highly phonologically similar in the context of this thesis. Perceptually, nasals are also similar, being most confusable with each other in both the confusion matrices referred to in 2.4.3, for Dutch and for English (word-finally, because word-initial ŋ is not allowed in these languages) (Pols, 1983, p. 284; Cutler et al., 2004, p. 3672). Moreover, the other sonorant [l] was most confusable with [n] in the Dutch experiment, and with [m] in the English experiment (word-initially, word-finally it becomes velarized, as discussed) (Pols, 1983, p.

283; Cutler et al., 2004, p. 3671). Thus, sonorants and nasals (a subdivision of sonorants) being the most striking, least manipulable distinctive features in imperfect rhyme can be said to have a phonetic basis.

However, the other phonological feature that was shown to be highly salient was voice, meaning that it was mostly maintained in rhyme. This contradicts the phonetic basis of imperfect rhyme, if we take into account the findings of Pols (1983) and others that the voicing distinction is perceptually weak, especially in Dutch. Interestingly, Holtman reported a difference in voice to not happen as often as a difference in place in nursery rhyme as opposed to 'serious' poetry (1996, p. 245). This is probably due to nursery rhyme being a genre that is spoken, whereas poetry is not always. Hip hop, too, is spoken of course, and the voicing distinction is apparently often maintained in spoken rhyme. Another finding of Holtman was that fricatives mismatched more often for voice than plosives (1996, p. 245). The phonotactic reason why fricatives that differed only in voice were not frequent in this corpus was foreshadowed in section 2.4.2. [v-f] and [s-z] had O/E values lower than 1 due to the phonotactic rule of the length of the vowel they usually follow, as well as final devoicing. This last process also caused [d-t] and [p-b] to score low: they could not contrast word-finally, which is the only position that matters in masculine rhyme.

Interestingly, though, sonorants (by default voiced in Dutch) also were more likely to mismatch with voiced obstruents than voiceless ones, as evidenced by the high O/E values of [m-v], [b-l] and [d-l], among others. In Japanese imperfect rhymes, this was also the case. In Japanese, voicing in sonorants is phonologically inert, but phonetically still present. Thus, Kawahara related that this finding reflected speakers' inherent psychoacoustic knowledge, which ensures them to pair sonorants with voiced obstruents more frequently than voiceless obstruents in imperfect rhyme, despite there being no real phonological basis for it (2007, p. 13). The same may be the case here, but there are also some mismatches with high O/E values that cannot be explained by acoustic or perceptual knowledge alone. [d-v], for example, which has a staggering O/E value of 4.06, suggests that the phonological feature of voice does indeed contribute greatly to similarity in imperfect rhyme. A hypothesis to be further explored in a later research is that voicing of consonants (not just fricatives) influences the quality of the preceding vowel in Dutch, which of course has an effect on the mismatches in imperfect rhyme in hip hop, in which vowels usually correspond. Additionally, the pairings of [s-f], [s-t] and [z-l] could not be explained by phonetics alone, as the sibilant fricatives are perceptually very dissimilar to any other Dutch consonants (Pols, 1983, p. 283).

A larger discussion on the exact distinction between phonetics and phonology as it pertains to similarity of sounds is outside the scope of this thesis, but it is clear that one cannot go without the other. Hamann (2011), discussing the often referred to interface between phonetics and phonology, posed that there is not one such interface, but many different ones, "depending on the aim of the studies and the assumptions following from it" (p. 203). In this thesis, this has certainly been the case; the specific approach taken colored the interface between phonetics and phonology that was in the end identified. Similarly, Zhang states that the dichotomy between the two types of linguistic inquiry is "neither valid nor necessary" as both depend on each other (2002, p. 136).

For now, it is relevant to remark that both phonetic and phonological information play a role in the type of similarity involved in imperfect rhyme. Whereas Holtman strictly considered phonological features to explain the phenomenon, this categorical approach did not suffice in this study. She found a dissimilarity threshold of consonantal pairs in imperfect rhyme (they could differ in three features at the most, sonorants notwithstanding); the dissimilarity threshold, if there can be said to be one, in this study was a difference in six features. Kawahara also did not find such a clear threshold, and related this to the assertion that “similarity is inherently a gradient notion” (2007, p. 9). The fact that various mismatches between consonants that differed in four features or more actually took place, can thus in part be attributed to the phonetic similarity discussed above. Furthermore, the types of rhyme employed by the rappers in this corpus were more complex than the rhymes Holtman measured. The next section will assess the results of those different types of rhyme, and attempt to provide an explanation for them.

### 6.5 Review of the different results for type of rhyme domain

In this section, it will be reviewed whether the hypotheses posed in this thesis about the influence of different types of imperfect rhyme domains were confirmed, and why this was or was not the case. First, let us turn to the results of internal and end-rhyme domains. As we saw in Table 9 and 10, internal rhyme domains were less restricted by phonological similarity than end-rhyme domains. Table 9 showed that all but one of the mismatches with an O/E value that was at least twice as large in end-rhyme domains, compared to that value in internal rhyme domains, were mismatches designated to be in the first tier of phonological similarity. The exception was [z-p]; this mismatch was, however, the result of a misjudgment in stress, as discussed in 6.3, and can therefore be ignored. Table 10, then, showed those mismatches with O/E values at least twice as high in internal rhyme domains as opposed to end-rhyme domains. It is appropriate to account for the two pairs that were in the second tier of similarity (reflecting an average degree of rhymability). [d-m] differs in the crucial features [+/- sonorant] and [+/-nasal], thus decreasing the pair's rhymability; [k-f] was already established to be a perceptually dissimilar pair, and, on top of that, a combination of [dorsal-labial], which possibly contributes to phonological dissimilarity. All in all, the hypothesis that internal rhyme domains in hip hop feature more dissimilarity, as put forth in section 3.2 in accordance with Katz (2008), was definitively confirmed.

The difference between masculine and feminine rhyme domains as they relate to phonological similarity was more ambiguous. Table 11 and 12, again, displayed those O/E values that differed by a factor of >2 for the two types of rhyme domains. As for the mismatches in Table 11 (mismatches with O/E value twice as great in masculine rhyme domains), two are highly similar, one is fairly similar, and a third is highly dissimilar: [f-n]. The O/E value of [f-n] does not exceed 1 within masculine rhyme domains, though, and is thus still not overly rhymable. In Table 12, two highly similar mismatches [p-t] and [x-f] are twice as likely in feminine rhyme domains as in masculine rhyme domains. However, [p-t] still has an O/E value of more than 1 in masculine rhyme domains, and is thus still more rhymable than the average pair. The two mismatches from the second tier featured in this table both differ in the three most salient features: voice, nasality and sonority.

Thus, even though the picture painted by these data is not so clear, it can cautiously be concluded that masculine rhymes tend to be more phonologically similar than feminine rhymes, as three of the remaining mismatches with higher O/E scores in feminine rhyme domains are from the third tier, and one is [k-f], a perceptually dissimilar pair of the [dorsal-labial] type. This is not in line with the hypothesis put forth in this thesis which stated that feminine rhyme domains are more salient and therefore more phonologically similar, in accordance with Avidan's findings of imperfect rhymes in musicals (2007). Upon reflection, this result is not an anomaly. It is very likely that corresponding consonants in feminine rhyme domains are allowed to be more dissimilar because the rhyme domains by definition contain two vowels, whereas masculine rhyme domains only contain one. Identical vowels in rhyme serve as the most important cue to the listener that a rhyme is being said, rapped, or sung. As a feminine rhyme domain contains two vowels, this cue is clearer than in masculine rhyme domains which contain only one vowel. Thus, the consonants are allowed to diverge more phonologically in the former. This may well be different in musicals than in hip hop, though both are musical genres; contemporary hip hop arguably allows for more dissimilarity and complex rhymes than any other poetic genre.

### 6.6 Loanwords

As for the loanword analysis, it is unfortunate that not more tokens (involved in imperfect rhyme) could be collected. The results are very few, and general statements can only be speculative at this point. The most often adapted phonemes in the production of English loanword were fricatives, rhotics and diphthongs. A significant effect for the distribution of consonantal mismatches differing for loanwords in imperfect rhyme compared to native words could not be discerned. A future research in this area may have this issue as its focal point; in this thesis, the variable was considered purely out of exploratory interest. Further study would have to include more loanwords from different languages with different phonemic inventories. Another interesting feature of loanword implementation in Dutch hip hop that was encountered in the corpus and may be worthy of more thorough examination (from a phonological viewpoint, but perhaps more so in the context of morphology) is Dutch affixation of English loanwords. Table 19 shows some examples of this. A hypothesis that may be posed regarding this phenomenon is that words that receive a Dutch affix have become commonplace in hip hop and are thus not loanwords anymore, being realized in a manner that decidedly adheres to Dutch phonology. Other suggestions for future research, pertaining to imperfect rhyme, will be discussed in 6.8.

| **Loanword** | **Affixed realization** | **New meaning** |
|---|---|---|
| *smack* | *gesmackt* | Past participle 'smacked' |
| *hook up* | *up hooken* | Infinitive 'to hook up' |
| *beef* | *beefje* | Diminutive of 'beef' (slang for conflict) |
| *move* | *moven* | Infinitive 'to move' |

*Table 19: Dutch affixation of English loanwords*

### 6.7 Possible limitations of the study

To return to the discussion of this thesis' main results, it is important to stipulate that some inconsistencies in the results may have been caused by limitations of the study or specific choices made in the data collection and transcription process. The error made in judging stress and possible errors in transcription have already been addressed in section 6.3. As for the methodological approach, some decisions that were made likely impacted the results. The choice was made, for instance, to count as a rhyme pair only those rhyme fellows that immediately followed each other in a rhyme scheme, due to the phenomenon of linking rhyme, as explained in section 4.2. Hip hop being a highly rhythmical art form, however, rhyme schemes can also be manipulated to the point were the first and third rhyme fellows in a rhyme scheme are meant to correspond strongly (occurring on the rhythmical beat), while the middle rhyme fellow holds less weight. An example from the corpus is the rhyme scheme spanning the words *ben-plek-pen.* The methodology that was chosen in this thesis prescribes two mismatches of [k-n] to be counted here, even though *plek* may really not have been so significant.

This happened rarely, but it touches on the important point that choices made in the specific approach of counting and annotating imperfect rhyme will inevitably influence the outcomes of the study. I believe that this influence was minor in this study, however, and that the results hold weight for imperfect rhyme in Dutch hip hop.

### 6.8 Future research

Future research would ideally feature a larger corpus, in order to verify the results obtained here, as well as to include the phonemes that occurred too infrequently to be considered for the general analysis. As mentioned, it would be interesting to test the hypothesis that the voicing of Dutch consonants has such an effect on the preceding vowel, that they are indeed more likely to correspond to other voiced consonants in imperfect rhyme. Other linguistic studies of imperfect rhyme may range from phonology to other areas. As for phonology, Köhnlein and van Oostendorp theorized, and tested on a small scale, that imperfect rhymability for feminine rhymes increases when the second syllable is able to carry secondary word stress, reflecting metrical differences between open and closed syllables in Dutch (2004, n.p.). Further study between the relation of metricality to rhyme in Dutch hip hop would certainly be interesting. Another possible approach to rhyme is semantic; it is perfectly possible, for example, that some dissimilar imperfect rhymes occur due to a semantic relation between the words involved.

## 7. Conclusion

This thesis has researched the type of similarity involved in imperfect rhyme or, more specifically, the consonantal mismatches in imperfect rhyme within a corpus of Dutch hip hop. The results have shown that phonological similarity between the consonants is of major importance, as formalized in the hierarchy ranking of Holtman (1996, p. 249). However, in line with Katz (2015), Kawahara (2007) and Steriade (2003), phonetic information (in the form of perceptual and acoustic similarity) was also relevant. Rappers can be said to possess implicit phonological and perceptual knowledge of similarity that they use when constructing their rhymes. In the end, similarity in this study was a mixture between categorical and gradient. The phonological features that were most easily manipulated were stridency, continuancy and major place, while sonority, voice, nasality, and [anterior] were most frequently maintained.

The discrepancies that were found in the results of Dutch imperfect rhyme and in earlier research on English imperfect rhyme, were caused by language-specific differences in phonotactics, general phonology, phonetic similarity, and type of rhyme. Subsequence rhymes (containing one or more segmental mismatches) occurred most often with voiceless coronal obstruents, and consonants that are easily weakened or vowel-like. Internal rhyme domains, being less salient in a musical genre like hip hop, were allowed more dissimilarity than end-rhyme domains. Feminine rhyme domains were in turn allowed more dissimilarity than masculine rhyme domains (though the difference was less considerable), most likely due to the extra vowel that they contain, which serves as an additional cue for rhyme. A last variable, loanwords, did not yield a sufficient amount of data to be analyzed quantitatively.

To sum up, imperfect rhyme, specifically as it occurs within Dutch contemporary hip hop, is an intricate, multi-dimensional phenomenon, which is interesting linguistically for a variety of reasons. This thesis has attempted to address some of the linguistic components that play a role in the composition of imperfect rhyme. The result is a comprehensive analysis of the phonology and phonetics involved, and the interplay between the two.

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**Appendix I: Songs per rapper**

| **Artist** | **Songs** |
|---|---|
| Fresku | *Twijfel*<br>*101 Barz Studiosessie 272* |
| Akwasi | *Een wedstrijd*<br>*Weet niet waarom ik huil vandaag*<br>*Back up staat klaar* *<br>*Koningsdag* * ft. Winne<br>*Je bent nodig*<br>*We komen eraan*<br>*1 goede reden*<br>*Binnenvetter remix* ft. Fresku, Winne, Typhoon |
| Sticks | *Verre Oosten* **<br>*Regendans* **<br>*Waar wacht je op* ft. Big 2<br>*Beter dan goed* ft. Hef, Spanker<br>*101 Barz Studiosessie* ft. Rico, Typhoon<br>*Spaanse vlieg* ft. Delic<br>*Maslow* |
| Winne | *Lotgenoot*<br>*ODZ*<br>*101 Barz Studiosessie* ft. Feis<br>*Koningsdag* ft. Zwart Licht<br>*Winne zonder strijd*<br>*Schoonheid*<br>*W.I.N.N.E.* |
| Lijpe | *Eng*<br>*Geen stress*<br>*Lijpe barz* |

* As part of the group Zwart Licht.

** As part of the group Opgezwolle

## Appendix II: Dutch consonants involved in O/E analysis with relevant phonological features

| | b | d | p | k | t | f | v | x | s | z | l | n | m | ŋ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [sonorant] | - | - | - | - | - | - | - | - | - | - | + | + | + | + |
| [nasal] | - | - | - | - | - | - | - | - | - | - | - | + | + | + |
| [continuant] | - | - | - | - | - | + | + | + | + | + | + | - | - | - |
| [voice] | + | + | - | - | - | - | + | - | - | + | + | + | + | + |
| [labial] | + | - | + | - | - | + | + | - | - | - | - | - | + | - |
| [coronal] | - | + | - | - | + | - | - | - | + | + | + | + | - | - |
| [dorsal] | - | - | - | + | - | - | - | + | - | - | - | - | - | + |
| [anterior] | + | + | + | - | + | + | + | - | + | + | + | + | + | - |

## Appendix III: Complete overview of all consonantal mismatches in the corpus

| | t | s | d | m | n | p | k | x | b | f | v | z | l | r | h | j | ʀ | ł | ŋ | tʃ | ʃ | ɹ | ɾ | ʁ | ʋ | w | θ | dʒ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| t | -- | 39 | 10 | 5 | 16 | 29 | 54 | 20 | 5 | 12 | 7 | 6 | 3 | 2 | 0 | 2 | 0 | 1 | 0 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 1 | 0 |
| s | 39 | -- | 5 | 2 | 7 | 8 | 14 | 21 | 3 | 10 | 2 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 6 | 0 | 5 | 0 | 1 | 0 | 0 | 0 |
| d | 10 | 5 | -- | 6 | 7 | 2 | 8 | 8 | 1 | 2 | 8 | 1 | 7 | 1 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 0 |
| m | 5 | 2 | 6 | -- | 26 | 4 | 4 | 1 | 2 | 3 | 5 | 2 | 5 | 0 | 2 | 3 | 0 | 0 | 5 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| n | 16 | 7 | 7 | 26 | -- | 2 | 18 | 7 | 3 | 3 | 0 | 2 | 8 | 3 | 1 | 1 | 1 | 4 | 22 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| p | 29 | 8 | 2 | 4 | 2 | -- | 15 | 14 | 2 | 8 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 |
| k | 54 | 14 | 8 | 4 | 18 | 15 | -- | 31 | 0 | 4 | 4 | 3 | 4 | 0 | 0 | 2 | 0 | 1 | 3 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| x | 20 | 21 | 8 | 1 | 7 | 14 | 31 | -- | 3 | 11 | 4 | 2 | 6 | 3 | 2 | 2 | 1 | 0 | 2 | 2 | 2 | 0 | 3 | 0 | | 0 | 0 | 1 |
| b | 5 | 3 | 1 | 2 | 3 | 2 | 0 | 3 | -- | 1 | 2 | 1 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| f | 12 | 10 | 2 | 3 | 3 | 8 | 4 | 11 | 1 | -- | 2 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| v | 7 | 2 | 8 | 5 | 0 | 1 | 4 | 4 | 2 | 2 | -- | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| z | 6 | 2 | 0 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 0 | -- | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| l | 3 | 2 | 7 | 5 | 8 | 0 | 4 | 6 | 3 | 1 | 1 | 2 | -- | 4 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 1 | 0 | 1 | 0 | 0 | 0 |
| r | 2 | 2 | 1 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 4 | -- | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 |
| h | 0 | 1 | **1** | 2 | 1 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | -- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| j | 3 | 0 | 5 | 3 | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -- | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ʀ | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | -- | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| ł | 1 | 0 | 0 | 0 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | -- | 2 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 |
| ŋ | 0 | 0 | 0 | 5 | 22 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | -- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| tʃ | 1 | 2 | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | -- | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ʃ | 1 | 6 | 0 | 0 | 1 | 0 | 1 | 2 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | -- | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ɹ | 3 | 0 | 0 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | -- | 2 | 1 | 1 | 0 | 0 | 0 |
| ɾ | 1 | 5 | 1 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | -- | 0 | 0 | 0 | 0 | 0 |
| ʁ | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | -- | 0 | 0 | 0 | 0 |
| ʋ | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| w | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| θ | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| dʒ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -- |