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The Emergence of Rhymed Meters in the Indo-Aryan Prosody

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Abstract Indo-Aryan poetry began to incorporate the end rhyme as an obligatory metrical rule from Apabhraṃśa literature in the eighth century, although the precise reasons for this development remain uncertain. The emergence of the end rhyme is a multifactorial event, influenced by not only phonological but also sociolinguistic factors, such as the impact of more prestigious literary traditions. From a morphophonological perspective, Arjunwadkar suggests that the simpler variations in word endings in later languages facilitated the end rhyme. This paper evaluates his hypothesis by calculating the actual difficulty of rhyming with textual data of Sanskrit, Middle Indo-Aryan, and New Indo-Aryan and argues that less difficulty of rhyming in later languages contributed to the adoption of the end rhyme.

Keywords Middle Indo-Aryan. Apabhraṃśa. End Rhyme. Phonology. Prosody.

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1 Introduction

Peust (2014, 343) defines the concept of 'rhyme' as "the phonological identity of substrings of lines". This feature is prevalent in poetic texts across various literary traditions. Among different types of rhyme, one notable type is the 'end rhyme'. In this study, the term 'end rhyme' is used to refer to the phonological identity of the final (typically more than one) substrings of metrical units.

New Indo-Aryan poetical traditions generally employ the end rhyme as a mandatory metrical rule. Typically, the final two syllables or four morae (*mātrā*s) of pādas are matched as the end rhyme. (1) is an example of Braj Bhāṣā poetry.

(1) *caraṇa kamala, baṃdauṃ hari rāi*
jākī kṛpā paṃgu giri laṃghai, aṃdhe kauṃ saba kachu darasāi
bahirau sunau gūṁga puni bolai, raṃka calai sira chitra dharāi
sūradāsa svāmī karunāmaya, bāra bāra baṃdau tihiṃ pāi
(Sūrdas, *Sūr-sāgar*, 1, ed. Vājpeyī 1949, 1)

I salute the lotus feet of Hari, the king,
through whose mercy the lame will cross a mountain, the blind [may all things see.
the deaf hear, the dumb speak again, the pauper go with a [canopy held above his head;
Sūrdās' lord is composed of compassion, again and again I [salute his feet.
(Snell 1991, 85)

However, in the early verse literature of Indo-Aryan languages, that is, in most of the Sanskrit verse literature following the *Ṛgveda*, the end rhyme is not a metrical rule.[1] Furthermore, the end rhyme is not used in early Middle Indo-Aryan (Prakrit) texts such as the Pāli Buddhist canons.

It is from the second half of the first millennium AD that Indo-Aryan prosody began to use the end rhyme as a metrical rule. According to Ollett (2017, 102), meters using the end rhyme called

1 Indeed, the end rhyme is used as an optional stylistic device already in the early Indo-Aryan literature, too. Klein (2002, 221) indicates that a rhyme-matching rhetorical figure called homoioteleuton serves phonetic and grammatical functions in *Ṛgveda*. The end rhyme is also used as one of the *alaṃkāras* in classical Sanskrit poetry. However, such rhetorical uses of the end rhyme should be distinguished from the end rhyme as an obligatory metrical rule. As a metrical rule indivisibly connected with the prosody, the end rhyme is not found in early Indo-Aryan literature.

khañjaka appeared partially in the Sanskrit-Prakrit mixed drama of the seventh century, such as Harṣa's *Ratnāvalī*. Furthermore, in the verse literature of Apabhraṃśa from the eighth century onwards, rhymed metrical patterns dominated the entire body of literature. (2) is an example of the *khañjaka* verse from Harṣa's *Ratnāvalī*. (3) is an example of the Apabhraṃśa verse.

(2) kusumāuhapiadūao maulāiabahucūao |
siḍhiliamāṇaggahaṇao vāai dāhiṇapavaṇao
(Harṣa, *Ratnāvalī* 13, ed. Kale 1921, 14)

The southern breeze is here, bringing buds to
the mango, the dear messenger of the God of Love,
slackening anger and quarrels,
(Ollett 2017, 101, ed. Bhayani 1953, 1)

(3) paṇaveppiṇu āibhaḍārāhŏ | saṃsārasamudduttārāhŏ
(*Paümacariu* I, 1, 1)

Bowing before Rishabha, the first lord,
who escaped from the ocean of samsara;
(De Clerq 2018, 9)

As described above, the end rhyme was not systematically used in the early Indo-Aryan languages. Still, from the seventh century, it emerged as a rule of metrical composition, then prevailed in the entire Late Middle Indo-Aryan literature in the eighth to tenth centuries, and has continued to be used up to the present day.

The reason for the emergence of the end rhyme is an important yet unsolved problem in many languages that have rhymed poetry. In particular, the development of the end rhyme in Indo-Aryan, which we cannot explain solely by language contact, has not been thoroughly studied.

The emergence of rhyme is a multifactorial phenomenon. Aside from language-internal factors such as sound change, there are factors like a cultural, musical, or stylistic factor to consider. This study examines one of the factors behind the emergence from a morphophonological point of view.

In this paper, I argue that the diversity of word-final syllables diminished in the language changes from Sanskrit to later languages, which reduced the difficulty of matching the end rhyme in Sanskrit and created the environment more suitable for the emergence of the end rhyme in later languages. I would like to argue that the simplification of the word-final patterns contributed to the emergence of the end rhyme in Indo-Aryan prosody.

2 Background

In this section, we organize the types of languages and the periods of verse texts in the Indo-Aryan languages. Thereafter, we will review previous research and examine the hypotheses on the emergence of the end rhyme.

The earliest verse literature in Indo-Aryan languages is the Vedic literature, including the *Ṛgveda*. The language of the Vedic literature is Old Indo-Aryan (OIA), and the later Classical Sanskrit is the standardized Old Indo-Aryan. As for verse literature in Sanskrit, the two epics, *Mahābhārata* and *Rāmāyaṇa*, were composed around the beginning of the Common Era, and *Kāvya* literature flourished from the fourth century AD onwards.

From around the third century BC, verse literature in the Middle Indo-Aryan (MIA, Prakrit) began to emerge. Middle Indo-Aryan languages are divided into three stages. The oldest stage includes Pāli with Buddhist canon. The middle stage (Middle Middle Indo-Aryan) consists of Prakrits used in Jain texts, such as Ardhamāgadhī, and Prakrits used in drama and lyrical poetry, such as Māhārāṣṭrī and Śaurasenī, with works influenced by the Sanskrit *Kāvya* literary tradition. The newest stage is Apabhraṃśa (Late Middle Indo-Aryan), with verse para-canonical works by Jain authors.

From the thirteenth century onwards, verse literature began to emerge in the New Indo-Aryan languages (NIA), including Bengali, Marathi, Braj Bhāṣā, Awadhi, and others. In addition, Urdu verse literature, exemplified by works such as *Kadam Rāo Padam Rāo*, which was heavily influenced by Islamic Persian poetry, also developed around the fourteenth to fifteenth centuries.

The history of Indo-Aryan poetries, as described so far, is summarized in Table 1.

Table 1 Indo-Aryan verse literature and the use of the end rhyme

Period	OIA	Early MIA	Middle MIA	Late MIA	NIA
BC 1600-500	Vedic Literature	-	-	-	-
BC 500- AD 700	Epic Literature Kāvya Literature	Pāli Canonical Texts	Prakrit Drama(hybrid with Sanskrit) Lyric Poetry Jain Canonical Texts	-	-
AD 700-1200	-	-	-	Apabhraṃśa Tantric Literature Apabhraṃśa Jain Paracanonical Literature	-
AD 1200-	*Gīta Govinda*	-	-	-	NIA literature

As shown in section 1, literature with the end rhyme throughout the entire composition as a metrical rule in Indo-Aryan languages spread from the eighth century AD onwards, namely in Late Middle Indo-Aryan verse literature and subsequent modern Indo-Aryan verse literature.[2] Meanwhile, even works created after the eighth century AD in older languages such as Sanskrit and Pali did not use rhyme, probably because of the literary tradition. The exception is Sanskrit lyrical poetry in the twelfth century, *Gīta Govinda*, which features rhymed verses, presumably influenced by the Middle Indo-Aryan and New Indo-Aryan poetic traditions that used the end rhyme.[3]

Then the question naturally arises: why did the end rhyme emerge in Indo-Aryan languages? This phenomenon can be attributed to multiple factors. The influence of other literary traditions, particularly the Perso-Arabic prosody, which uses the end rhyme, is one possible factor. However, the use of the end rhyme in Apabhraṃśa was from the eighth century, a period when works composed in the Persian language and with the Persian metrical system were not prevalent.[4] In addition, contact with languages whose poetry use the end rhyme does not necessarily lead to the adoption of the end rhyme. For example, despite the extensive contact with Classical Chinese poetry, which uses elaborate end rhyme, Classical Japanese poetry never introduced the end rhyme. Therefore, the influence of Perso-Arabic poetry alone does not provide a convincing explanation, unless some poets deliberately imported Perso-Arabic styles.

Mahesh (1964, 182) suggests that "the common folk, who continuously use rhymes in everyday life, are the originators of this [rhyme]". A stylistic reason such as Mahesh's theory could be one factor behind the adoption of the end rhyme. It is possible that Indian poets gradually came to appreciate the aesthetic appeal of end rhyme from folk songs and began to use it, but we cannot prove or refuse this theory.

From linguists' point of view, as stated by Fabb and Sykäri (2022, 6), "There is a widespread view that a language offers 'affordances' which make rhyme, or a particular kind of rhyme, possible in its verbal arts, and that languages differ in their affordances". This concept is referred to as the 'development hypothesis' in Fabb 2010. From this perspective,

2 However, the earliest meters of Apabhraṃśa poetry do not use the end rhyme as a mandatory rule. One example is *gāhā* meter, whose origin is the earlier Prakrit prosody.

3 Cf. Kurkarni 1965, xii-xiii. Therefore, I do not consider rhyming verses in the *Gīta Govinda* as a counterevidence of the primary assertion that language change promoted the emergence of the end rhyme.

4 Nagasaki (2012) also discusses the origin of the end rhyme in *Savaiyā* meters in Hindi prosody and states: "Perso-Arabic metre as applied to New Indo-Aryan was not yet in widespread use except among the court poets of the Mughal Dynasty during the Bhakti period in which Savaiyā gained popularity" (Nagasaki 2012, 123).

it is plausible that the affordances of rhyme evolve alongside language change. Consequently, it is reasonable to consider language change as a factor in the emergence of the end rhyme.

In relation to the development hypothesis, some scholars argue that stress accent facilitates the development of rhyming poetry with rhyme typically including a stressed syllable. For example, Sedgwick (1924, 335) states in his paper on the origins of Medieval Greek and Latin rhyme: "As long as stress was ignored in verse, modern rhyme, which depends on it, was obviously impossible; it is recurrence of stress, not of verse-ictus which causes rhyme".

Certainly, there is a possibility that the Late Middle Indo-Aryan language had a stress system. A long vowel before or after an accented syllable in Old Indo-Aryan is reduced to a short vowel in Apabhraṃśa (De Clercq 2005, 2099),[5] suggesting that Apabhraṃśa may have inherited a stress system from the Old Indo-Aryan pitch accent system. However, this reduction is already found in the Middle Middle Indo-Aryan languages[6] and is inconclusive evidence for a synchronic stress accent system in Late Middle Indo-Aryan. Furthermore, even if such a stress system did exist, Late Middle Indo-Aryan end rhyme sometimes lacks a syllable that would be considered stressed if it had a stress system.[7]

Fabb and Sykäri (2022, 7) also note that "the vocabulary of a language can make certain kinds of rhyme more easy, or less easy". Some might attribute the origin of the end rhyme to this, but they oppose this view in the same work.

> It is worth noting that the development hypothesis also makes a possibly incorrect assumption about aesthetics, which is that a verbal art should be constrained so that it is easy to produce poetry relative to the resources of the language. But we should also remember that verbal arts often gain their value by their difficulty, and by the skill of the composer in overcoming those difficulties. (Fabb, Sykäri 2022, 7)

I fully accept that the difficulty of rhyming can be overcome by poets' creativity; but in traditions like Indo-Aryan poetry where

5 For example, OIA *úlūka* 'owl' > Late MIA *uluhaṃ* and OIA *pravāhá-* 'stream' > Late MIA *pavaha-*

6 Using the examples above, Māhārāṣṭrī has such forms with short vowels as *uluga-*, and *pavaha-*.

7 Using the example of OIA *úlūka* 'owl', the initial syllable of Late MIA *uluhaṃ* would be stressed. However, *Paümacariu* has a verse whose rhyme (*-uhaṃ*) lacks the stressed syllable.

(4)*ṇāẏa-ṇaülaẏaṃ kāẏaloluhaṃ | hatthi-ajaẏaraṃ dava-mahīruhaṃ ||*
(PC LXXXI, X, 3, ed. Bhayani 1960, 206)

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the end rhyme became pervasive, the development hypothesis is convincing, and I would like to pursue that possibility by analyzing actual language data to determine whether the easiness of the end rhyme correlates with its occurrence.

As for Indic languages, Arjunwadkar (1985, 197-8) argues that the simplification of the morphology of later languages is a factor behind the development of the end rhyme. According to him, Sanskrit has a more complex inflectional system than Marathi, resulting in a vast number of combinations of phonemes in the word-final environment, making it unsuitable for rhyming. Unlike the theories of Mahesh (1964) I mentioned above, it is possible to verify this theory with linguistic data, which Arjunwadkar has not done, however.

It is highly likely that the difficulty of rhyme, which is inseparably linked to the end rhyme, plays a role in its emergence. I would like to pursue the line of Arjunwadkar's hypothesis that the phonological variation at the end of words decreased over time in Indo-Aryan languages, resulting in ready rhymability and the emergence of the end rhyme.

3 Test Design

This section presents the methods and results of the data survey.[8] The survey utilizes seven texts as shown in Table 2 below.

Table 2 Materials used

Abbreviation	Title	Author/Editor	Language	Attested period
RV	*Ṛgveda Saṃhitā*	-	OIA	twelfth-tenth century BC
SS	*Gāhā Sattasaī*	Hāla	Māhārāṣṭrī (Middle MIA)	first-second century
SB	*Setubandha*	Pravarsena		fifth century
GV	*Gaüḍavaho*	Vākpatirāja		eighth century
PC	*Paümacariu*	Svayambhūdeva	Late MIA (Apabhraṃśa)	seventh-tenth century?
PD	*Pāhuḍadohā*	Rāmasiṃha		tenth century
DV	*Dohāvalī*	Tulsīdāsa	NIA (Braj Bhāṣā)	sixteenth century

These texts are significant and representative of the poetical traditions in each language. *Ṛgveda Saṃhitā* marks the beginning of the Old Indo-Aryan poetry. *Gāhā Sattasaī* is the starting point of the Middle Middle Indo-Aryan literary tradition (Ollett 2017, 7).

8 Codes and result data are published in GitHub. `https://github.com/ryosuke-masaoka/The-Emergence-of-Rhymed-Meters-in-the-Indo-Aryan-Prosody`.

Setubandha and *Gaüḍavaho* are prominent works among Māhārāṣṭrī court epics. *Paümacariu* is one of the earliest examples of Late Middle Indo-Aryan literature. Although *Pāhuḍadohā* is not as important as *Paümacariu*, it remains one of the main Apabhraṃśa works identified by Tagare (1987, 16-20). *Dohāvalī* is an influential work in the NIA poetry.

Furthermore, all these texts are available in electronic form, except for *Pāhuḍadohā*. As for the *Ṛ̊gveda Saṃhitā*, the Lubotsky's (1997) text[9] is available for download from VedaWeb.[10] Electronic texts of *Gāhā Sattasaī*, *Paümacariu*,[11] and *Dohāvali* are accessible on GRETIL.[12] Electronic texts of *Setubandha* and *Gaüḍavaho*[13] can be obtained from Prakrit Digital Text Project.[14] As for *Pāhuḍadohā*, I created text data based on Śāstrī's edition (1998).

As shown in section 2, Old Indo-Aryan texts do not match the end rhyme. Some Middle Middle Indo-Aryan texts use the end rhyme as Ollett (2017, 102) reports, but *Gāhā Sattasaī* doesn't seem to employ

9 Lubotsky's (1997) text presents each word with sandhi effects eliminated, resembling the *padapāṭha*, but in the underlying representation. Final /-r/ is retained in its original form to distinguish it from final /-s/. However, for the purpose of this study, I changed the final /-r/ into -ḥ because the distinction is unnecessary in *pausa*, which corresponds to the rhymed position in later texts. Metrically lengthened forms, such as vedā+, were replaced by short forms, such as veda, in this analysis. From a philosophical perspective, the *Ṛ̊gveda Saṃhitā* text we have now is not entirely identical to the original composition in the earliest stage of Old Indo-Aryan because of the editing process which replaced older forms with younger, more familiar forms similar to those in Classical Sanskrit. For example, the oldest text contained at least two genitive plural endings (Arnold 1905, 104), *-ām* and **-$_a$am* (< PIIr. **-aHam* < PIE **-oHom*), but the later editing process replaced **-$_a$am* forms into *-ām*, which became standard in Classical Sanskrit. To access the text before the editing process, one can use restored text by van Nooten and Holland (1994). However, in this analysis, I used Lubotsky's (1997) text as it approximates the Old Indo-Aryan text closely enough and the language of the text after the editing process is more closely related to the fundamental language of later Old Indo-Aryan and Sanskrit poetic traditions.

10 VedaWeb. `https://vedaweb.uni-koeln.de`.

11 *Ya-śruti* was eliminated from the text of *Paümacariu* in this survey. In *Paümacariu*, *ĕ* and *ŏ* in open syllables are orthographical variants of *i* and *u*, respectively, and are thus replaced by *i* and *u*.

12 GRETIL – Göttingen Register of Electronic Texts in Indian Languages. `https://gretil.sub.uni-goettingen.de/gretil.html`.

13 Orthographical irregularities sometimes pose challengings when working with Middle Middle Indo-Aryan texts. Vowels *e* and *o* in closed syllables are sometimes written as *i* and *u*. I was unable to fully correct these irregularities, so I conducted a survey using the text with the original orthography, and these results are presented as the main findings. Also, I conducted a survey using the text where all instances of *e* and *o* in close syllables were replaced with *i* and *u*, and these results are provided in the footnotes. The true values likely lie between the values obtained from these two surveys. External sandhi in the Middle Middle Indo-Aryan texts was unapplied by the author.

14 Ollett, A. *Prakrit Digital Text Project*. `https://github.com/aso2101/prakrit_texts`.

rhyme because this text is from the earliest stage of Middle Middle Indo-Aryan. *Setubandha* and *Gaüḍavaho* have a few rhyming verses, but they do not match the end rhyme for the most part. *Paümacariu, Pāhuḍadohā*, and *Dohāvalī* show the use of the end rhyme in the entire text.

The purpose of this survey is to compare the diversity of word-ending patterns in each text. First, let us clarify the definition of the 'word-ending pattern' (hereafter referred to as the 'rhyme pattern'). This definition can only be established when the definition of the end rhyme in Late Middle-Aryan texts is clearly defined.

According to Yamahata (2009, 854), there were several kinds of end rhymes in Late Middle Indo-Aryan poetries. These included end rhymes with only one syllable, called *puruṣatuk*, and end rhymes with two or three syllables, called *komalatuk*. Given the variety of rhyming schemes in Late Middle Indo-Aryan poetry,[15] I conducted a preliminary survey to identify the predominant rhyming structures. Among rhyming couplets of *Paümacariu*, 94.56% matched pāda-final -VC_0VC_0#, 56.24% matched pāda-final -$C_0VC_0VC_0$#, 50.13% matched pāda-final -$VC_0VC_0VC_0$# and 12.61% matched pāda-final -CVC0VC0VC0#. These results indicate -VC_0VC_0# and -$VC_0VC_0VC_0$# as the main rhyming schemes. Therefore, I conducted separate surveys targeting -VC_0VC_0# as the rhyme pattern and targeting -$VC_0VC_0VC_0$# as the rhyme pattern. As for imperfect rhymes, several patterns are observed (for example, /nt/ rhymes with /nd/); however, only the perfect matches are considered for this study. Monosyllabic words were excluded from this investigation.

The second question concerns how we should compare diversity. There are several diversity indices available, one of which is Gini-Simpson's Diversity Index. This is used in biology to calculate ecological diversity and is considered the most independent diversity index from the sample size (Kunakh et al. 2023, 136-8). According to Kunakh et al. (2023, 134), the definition of Gini-Simpson's Diversity

15 In introducing the rhyme pattern, I describe how rhyme in Late Middle Indo-Aryan works. According to Tagare (1987, 39), Late Middle Indo-Aryan had 9 vowels (*a*, *ā*, *i*, *ī*, *u*, *ū*, *ṛ*, *e*, *o*) and 31 consonants (*k*, *kh*, *g*, *gh*, *c*, *ch*, *j*, *jh*, *ñ*, *ṭ*, *ṭh*, *ḍ*, *ḍh*, *ṇ*, *t*, *th*, *d*, *dh*, *n*, *p*, *ph*, *b*, *bh*, *m*, *r*, *l*, *v*, *ś*, *s*, *h*, *ḷ*). The vowel *ṛ* appeared only in loanwords from Sanskrit, and *ś* was found only in eastern Apabhraṃśa, a different variety from the language of *Paümacariu* and *Pāhuḍadohā*. All vowels except for *ṛ* could be nasalized. Unlike Sanskrit, Apabhraṃśa did not have diphthongs such as *ai* and *au*. According to De Clercq (2018, xx), the metrical structure of *Paümacariu* is as follows:"The *Paümacariu* is divided into five books (*kāṇḍa*s), totaling ninety chapters (*sandhi*s), each consisting of on average sections (*kaḍavaka*s). A section is made up of a body of rhyming couplets (*yamaka*s) followed by a stanza (*ghattā*) of two, four, or six quarter-verses with complex rhyming scheme. […]. Each chapter opens with a stanza usually in the same meter as the closing stanzas of the sections of that chapter. Sometimes the sections commence with a longer stanza of two or four quarter-verses before the body of rhyming couplets". For further details on the complex rhyming scheme of *ghattā*s, see Bhayani 1953, 78-92.

Index is as follows:

$$Gini - Simpson's\ Diversity\ Index, D_{S1} = 1 - \sum_{i=1}^{S} {P_i}^2$$

(P_i = proportion for the *i*th species, S = total number of species in the community)

The complement of Gini-Simpson's Diversity Index (that is, ∑i=1SPi2) can be interpreted as the probability that two randomly selected tokens happen to belong to the same type. If we apply this idea, we can get the probability of a coincidental rhyme match in each text.

The frequency of a given rhyme pattern (r_i) can be considered as the probability {P(r_i)} of (r_i) occurring at any given word-final location in the text. This {P(r_i)} is acquired by dividing the frequency of (r_i) by the total number of rhymes in the text. Then, the probability of (r_i) occurring at another location is {P(r_i)}, too. Hence, the probability of the same (r_i) happening to occur at any two-given word-final locations is {P(r_i)}^{2}. By calculating this probability for all rhyme patterns and summing them, we obtain the probability that any given rhyme pattern will match at the two locations. Let us call this Rhyme Match Probability (RhMP).

$$(RhMP) = \sum_{i=1}^{S} \{P(r_i)\}^2$$

(S = the total number of rhyme pattern types)

The Rhyme Match Probability calculated in this way does not serve only as an indicator of diversity in word-endings, but also as an indicator of how easy it is to match the end rhyme in a language. If it is high, it is easier to match the end rhyme.

To avoid overrepresentation of rhyme patterns in rhyming texts such as *Paümacariu, Pāhuḍadohā*, and *Dohāvalī,* multiple identical rhyme patterns that arise due to the metrical rhyming rule are counted only once.[16] For example, two occurrences of -VC_0VC_0# rhyme patterns (iṇu, āhŏ) are extracted from (3), not three (iṇu, āhŏ, āhŏ), because the second āhŏ in 'saṃsārasamudduttārāhŏ' is present due to its rhyming position with āhŏ in 'āibhaḍārāhŏ'.

16 If rhyme patterns do not match at the rhyming positions, I counted all patterns because they do not appear because of the rhyming rule.

(3) paṇaveppiṇu āibhaḍārāhŏ | saṃsārasamudduttārāhŏ
(*Paümacariu* I, 1, 1 reappeared)

4 Results

As for the results of the survey targeting -VC_0VC_0#, Table 3 shows the token count, the number of rhyme pattern types, and the Rhyme Match Probability.

Table 3 Rhyme Match Probability of -VC_0VC_0#

Language	**Vedic Skt.**	**Māhārāṣṭrī Prakrit**[17]			**Late Middle Indo-Aryan**		**NIA(Braj)**
Text	RV	SS	SB	GV	PC	PD	DV
Token count	134,443	9,399	10,024	8,496	72,730	2,456	7,754
Types	5,506	837	659	644	1,184	359	852
Average Frequency	24.42	11.23	15.21	13.19	61.43	6.84	9.10
RhMP	0.321 %	1.212%	1.183%	1.464%	2.079%	2.572%	1.163%

According to the data, it is considered that as time progressed, the variation in rhyme pattern types decreased, and the diversity of rhyme patterns increased, making it progressively easier to follow a rhyming rule.

In the *Ṛgveda*, 80% of the cumulative total of all rhyme patterns are covered by 707 patterns, 160 in the *Sattasaī,* 140 in the *Setubandha*, 125 in the *Gaüḍavaho*, 95 in the *Paümacariu,* 77 in the *Pāhuḍadohā,* and 173 in the *Dohāvalī.* Fewer rhyme patterns account for the 80% in newer texts except for the *Dohāvalī*.

Interestingly, *Dohāvalī*, the newest text of the materials used, exhibited its Rhyme Match Probability close to those of the Middle MIA texts, yet lower than those of the Apabhramśa texts. This observation suggests that the emergence of the end rhyme is a one-way, irreversible phenomenon. Despite the increasing difficulty in the end rhyme, they continued to compose rhymed poetry due to the rhyming tradition.

17 The results of the survey replacing *e* and *o* in closed syllables with *i* and *u* are as follows:

Texts	SS	SB	GV
Token count	9,399	10,024	8,496
Types	809	634	631
Average Frequency	11.51	15.81	13.46
RhMP	1.213 %	1.186%	1.465%

As for the results of the survey targeting -$VC_0VC_0VC_0$#, Table 4 shows the token count, the number of rhyme pattern types, and the Rhyme Match Probability.

Table 4 Rhyme Match Probability of -$VC_0VC_0VC_0$#

Language	**Vedic Skt.**	**Māhārāṣṭrī Prakrit**[18]			**Late Middle Indo-Aryan**		**NIA (Braj)**
Text	RV	SS	SB	GV	PC	PD	DV
Token count	70,058	6,500	8,245	6,724	54,947	1488	3,638
Types	15,201	3,116	2,984	3,058	8,316	811	1,492
Average Frequency	4.61	2.09	2.76	2.20	6.61	1.83	2.44
RhMP	0.0483%	0.101%	0.109 %	0.109%	0.121%	0.312%	0.673%

These results are similar to those of the survey targeting -VC_0VC_0# in that later rhyming texts show higher values of the Rhyme Match Probability. It is noteworthy that the Rhyme Match Probability of *Paümacariu* is close to those of *Sattasaī, Setubandha,* and *Gaüḍavaho*. One possible explanation is that the end rhyme of the final two syllables (-VC_0VC_0#) was established first, and more complex -$VC_0VC_0VC_0$# end rhyme developed later.

In order to compare the data above with those of other languages, I conducted the same survey in Italic languages. The materials are the first volume of *Aeneis* in Classical Latin (non-rhyming text) and *Yvain ou le Chevalier au Lion* in Old French (rhyming text). In this survey, rhyme pattern was defined as the part after the stressed or accented vowel in each word, which is the French rhyming scheme (Peust 2014, 371). Table 5 shows the results:

18 The results of the survey replacing *e* and *o* in closed syllables with *i* and *u* are as follows:

Text	SS	SB	GV
Token	6,500	8,245	6,724
Types	2,882	2,835	2,830
Average Frequency	2.56	2.91	2.38
RhMP	1.118%	0.115%	0.110%

Table 5 Rhyme Match Probability in Italic Languages

Languages	**Classical Latin**	**Old French**
Texts	the 1st volume of *Aeneis*	*Yvain ou le Chevalier au Lion*
Token counts	2,285	28,401
Types	1,334	820
Average Frequency	1.71	34.64
RhMP	0.141%	2.620%

This data on Italic languages supports the main claim of this paper that the development of the end rhyme is influenced by the increase of the Rhyme Match Probability. Other factors are said to contribute to the emergence of the end rhyme in Italic languages, and I am not claiming that the increase of the Rhyme Match Probability is the sole factor. However, from a comparative perspective, it is probable that an environment conducive to rhymed poetry is a necessary condition for the acceptance of the end rhyme in prosody.

Based on the data of Indo-Aryan languages (especially those with rhyme patterns of -VC_0VC_0#) and Italic languages, I propose 1.5 ~ 2.0 % as a hypothetical threshold of rhyme emergence. In future research, this threshold should be refined with the data of more languages. Theoretically speaking, the more language data we examine, the closer we will inductively get to the 'true' threshold. In fact, non-linguistic factors play important roles in the rhyme emergence of every language, so it may be impossible to reach a unique threshold.

The survey conducted thus far has assumed only the language model, disregarding the meters. However, the end rhyme is a part of the metrical schemes and several major rhyming meters match the bisyllabic end rhyme in the Guru-Laghu (heavy-light, henceforth GL) rhythm. Therefore, I also extracted only the GL rhyme patterns and calculated the Rhyme Match Probability in each text. The results are as follows:

Table 6 Rhyme Match Probability of GL rhyme patterns[19]

Language	**Vedic Skt.**	**Māhārāṣṭrī Prakrit**			**Late Middle Indo-Aryan**		**NIA(Braj)**
Text	RV	SS	SB	GV	PC	PD	DV
Token count	56,016	3,847	3,407	3,487	22,309	742	2,669
Types	2,117	345	235	224	563	179	329
Average Frequency	26.46	11.15	14.50	15.57	39.63	4.07	8.11
RhMP	0.962%	3.28%	2.94%	4.32%	1.68%	1.73%	1.95%

Interestingly, the values of the Rhyme Match Probability in Middle Middle Indo-Aryan texts are significantly higher than those of the later rhyming texts. This observation suggests two possibilities. One possibility is that the end rhyme has a different origin from meters, which is unlikely given their inseparability. The second possibility is that the end rhyme may not be adopted if rhyming is too easy. Thus, there may not be only a minimal threshold for the rhyme emergence but also a maximal one.

As the factors of the increase of the Rhyme Match Probability, we can name mainly two factors: morphological simplification and syllable structure simplification. The latter is more important. Because of phonological changes, the restrictions on consonants that can appear in the coda of the syllables became stricter in MIA. For example, there are 161 different consonant clusters that appear in the middle of words 10 times or more in *Ṛgveda* according to Kobayashi (2004, 185-91), while there are only 44 clusters that appear 10 times or more in *Paümacariu*. Less contrasted phonemes in the coda led to a reduction in the variety and deviation of rhyme patterns.

5 Conclusion

This paper examined the factors contributing to the emergence of the end rhyme in the Indo-Aryan prosody by a morphophonological approach. The results in section 4 revealed that the number of rhyme

19 The results of the survey replacing *e* and *o* in closed syllables with *i* and *u* are as follows:

Text	SS	SB	GV
Token	3,847	3,407	3,487
Types	325	222	219
Average Frequency	11.84	15.35	15.92
RhMP	3.28%	2.96%	4.32%

pattern types decreased over time and the diversity in their frequency increased, making it easier for poets to use the end rhyme. With the Rhyme Match Probability, we can observe distinct differences between older languages and Late Middle Indo-Aryan; it became easy enough to rhyme in Late Middle Indo-Aryan, while it was too difficult in Old Indo-Aryan. The Rhyme Match Probability increased in later languages and exceeded a certain threshold (here hypothetically 1.5 ~ 2.0%) in Late Middle Indo-Aryan. It is highly likely that the increased rhymability of literary languages, a factor closely related to the end rhyme, contributed to the development of the end rhyme.[20]

As a reason for the absence of the systematic end rhyme (especially in classical Greek and Latin), it is sometimes claimed that it is too easy to match word-endings because many words share the same inflectional endings. While the main claim of this paper might appear to contradict this line of argumentation, in fact it aligns with it, although we need a detailed survey into Greek and Latin. In section 4, I suggested the possibility that both excessive ease (too high Rhyme Match Probability) and excessive difficulty (too low Rhyme Match Probability) can prevent the adoption of the end rhyme. As for Indo-Aryan languages, however, the minimal threshold is the primary concern.

As I stated in sections 1 and 2, the emergence of the end rhyme is a phenomenon that might have been triggered by multiple factors. Various elements, such as the cultural influence from Perso-Arabic poetry or purely stylistic reasons, also played roles in the end rhyme development. It is not easy to clarify the entire process by which the end rhyme became an obligatory element of Indo-Aryan poetry.

A culture-sensitive phenomenon, such as the emergence of the end rhyme, cannot be completely analyzed by a simple linguistic model. However, there is a correlation between the morphophonological difficulty and the presence of the end rhyme in each language, which may be identified as a contributing factor in its emergence. An increase in the Rhyme Match Probability means relaxing the verbal restriction to the end rhyme and therefore may be one of the necessary conditions for the emergence of the end rhyme. The development of the end rhyme is influenced not only by traditional and cultural factors but also by changes in the language, which form the basis of poetic composition. This study, which correlates the ease of the end rhyme with its emergence, provides an argument in favor of the development hypothesis.

20 An alternative hypothesis is also possible: the reduction in word endings made 'interesting' end rhyme more difficult due to the oversimplicity of word endings, thereby making the end rhyme a more fascinating ornament. However, this paper does not adopt this hypothesis because rhyming words with the same suffixes are frequently used and probably not considered 'less interesting' in Late Middle Indo-Aryan rhymed poetry.

Appendix: Rhyme Patterns (-VC$_0$VC$_0$#) with High Frequencies

Text	RV	SS	SB	GV	PC	PD	DV
Most frequent RP	asya	ai	ai	ai	ai	ai	ana
Frequency rate (%)	2.62	5.01	5.48	5.47	6.28	9.52	4.66
2nd frequent RP	āya	eṇa	iaṃ	anti	au	au	ata
Frequency rate (%)	1.25	4.13	3.02	4.11	6.21	8.35	3.74
3rd frequent RP	ate	aha	aaṃ	ēṇa	ahu(ahŏ)	ahaṁ	āma
Frequency rate (%)	1.22	3.23	2.89	3.73	5.02	3.83	3.43
4th frequent RP	ati	assa	ēṇa	āṇa	iu	aṇu	asī
Frequency rate (%)	0.97	3.10	2.80	3.55	5.01	3.26	3.29
5th frequent RP	ayaḥ	āi	assa	āō	aṇu	ahiṁ	ala
Frequency rate (%)	0.91	3.03	2.31	3.11	3.30	3.01	2.91
6th frequent RP	ataḥ	ammi	ammi	ammi	aĩ	aiṁ	ara
Frequency rate (%)	0.87	2.02	2.11	2.79	2.90	2.57	2.91
7th frequent RP	avaḥ	ia	aha	ia	ia	iu	ati
Frequency rate (%)	0.87	2.01	2.03	2.45	2.53	2.48	1.97
8th frequent RP	āsaḥ	iaṃ	anti	assa	eṇa	iy̆a	ita
Frequency rate (%)	0.85	1.98	1.88	2.42	2.51	2.38	1.70
9th frequent RP	asaḥ	iō	iō	iha	ihĩ(ĕhĩ)	ahi	ahiṁ
Frequency rate (%)	0.83	1.55	1.71	1.90	2.24	2.36	1.69
10th frequent RP	ānaḥ	āṇa	aṇaṁ	ēsu	ivi(ĕvi)	avi	ama
Frequency rate (%)	0.82	1.54	1.70	1.81	2.08	1.87	1.52

Abbreviations

Abbreviations	Corresponding Names
DV	*Dohāvalī*
GV	*Gaüḍavaho*
MIA	Middle Indo-Aryan
NIA	New Indo-Aryan
OIA	Old Indo-Aryan
PC	*Paümacariu*
PD	*Pāhuḍadohā*
PIE	Proto-Indo-European
PIIr	Proto-Indo-Iranian
RhMP	Rhyme Match Probability
RV	*Ṛgveda Saṃhitā*
SB	*Setubandha*
	Gāhāsattasaī

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