Referential Density in Japanese: Diachronic Study*

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1 Introduction to Referential Density

In this article, I will discuss referential density (henceforth RD) in the history of the Japanese language. The seminal study in the field of referential density is Bickel (2003), who defines RD as 'the average ratio of overt argument NPs (nouns or pronouns) to available argument positions in the clause'. Bickel compares RD in three prodrop languages in the Himalayas and relates the differences between them to the degree to which morphosyntactic features of NPs, especially case features, are relevant for syntactic processing. Bickel's methodology was refined by Noonan (2003), who introduced three additional indices: RD1+, the ratio of all overt references to available arguments (including verbal agreement markers); RD2, the ratio of overt arguments to verbs in the clause; and RD2+, the ratio of all overt arguments to available arguments. So far, there has been no extensive study on the diachrony of referential structure in any given language. The only attempt in this direction has been undertaken by Song (2021), who applied Bickel's (2003) and Noonan's (2003) methodology to three stages of the English language (Old, Middle, and Modern) and demonstrated that the stable increase of 'referential density' reflects significant changes in argument structure. In this study, I applied their methodology to compare referential density in Old Japanese (OJ) and Modern Japanese (cNJ). The structure of this paper is as follows: Sources, Methodology, Data and Discussion, and Conclusion.

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2 Sources

Since studying referential density requires parsing longer narratives, I excluded short poetic forms like *tanka*, despite their prevalence in the OJ corpus. Instead, I analyzed the *Shoku-Nihongi Senmyō* (697–791) and the *Engi-Shiki Norito* (completed 927), the only available prose texts in OJ, as well as *chōka* (*nagauta*) from the *Man'yōshū* (MYS). The *kōhon* (variorum) editions consulted were Kitagawa (1982) and the *Nihon Koten Bungaku Taikei* (Iwanami 1957–69, henceforth NKBT). OJ originals were compared to cNJ translations by Ujitani (1992) for the *Senmyō* and Aoki (2000) for the *Norito*. In total, **320 clauses** were analyzed. Additionally, I consulted the *Oxford-NINJAL Corpus of Old Japanese* (ONCOJ) and the *Kainoki Treebank* of Modern Japanese. I also cite a few sentences from the Balanced Corpus of Contemporary Written Japanese (BCCWJ).

Texts Analysed:

1. *Senmyō* (*Shoku-Nihongi*): SM 1 (39 clauses), SM 2 (23 clauses), SM 3 (52 clauses)
2. *Norito* (*Engi-Shiki*): *Nakatomi Saimon* (80 clauses)
3. *Man'yōshū chōka*: MYS 18.4094 (53 clauses), MYS 2.199 (73 clauses)

3 Methodology

3.1 Annotation procedure

The principles of annotation are based on Noonan (2003).[1] Given the limited scope of this publication, I will mostly highlight the modifications to Noonan's original protocol that were necessary for its application to the Japanese material.

3.1.1 Predicates

a) Both 'main' and 'subordinate' predicates are counted.
b) Following Aoki and Frellesvig (2021: 45), the structures below are considered monocausal and therefore counted as single units: (i) deverbal prefix attached to verbs (PRX-V); (ii) auxiliary verb constructions ($V+V_{(aux)}$); (iii) lexicalised (fixed or univerbated) compounds (VV); (iv) complex verbal predicates. The latter are conceived of as 'a predicate of a single surface-level clause consisting of two verbs that both contribute semantically to the predication'. This encompasses coordinate complexes (V1+V2), thematic complexes ($V1_{(manner)}$+V2), and Aktionsart complexes ($V1+V2_{aktionsart}$ or $V1_{aktionsart}$ +V2).
c) Null (i.e. elliptical) predicates are counted as zero. Thus, the first clause in the example below has two arguments (*Tarō* and *ringo*) but a zero predicate since *tabeta* is omitted:

(1) *Tarō wa ringo o ___, Ken wa banana o tabeta.*
Taro TOP apple ACC 0_{pred} Ken TOP banana ACC eat.PST
'Taro ate an apple, and Ken ate a banana.'

Note that cases like this do not pose any challenge to determining RD2 because the index is calculated for an entire text rather than for each clause separately. Suppose (1) is the whole

[1] Since, to the best of my knowledge, the article is not available online, please contact me if you would like to obtain an electronic copy.

text we need to analyze: In the first clause, we have two arguments (*Tarō* and *ringo*) and a zero predicate, whereas, in the second clause, we have two arguments (*Ken* and *banana*) and one predicate (*tabeta*). Since dividing by zero is mathematically impossible, instead of calculating RD2 for each clause one by one and finding the average, we sum up the overall number of arguments and divide it by the overall number of overt predicates. Thus, RD2 for (1) is (2+2)/1 = 4.

3.1.2 Nominals

a) Overt nouns and pronouns possess the same referential power.
b) Coordinated NPs are counted as one since there is no reason to assume that languages differ in the number of coordinated NPs they allow. What languages do vary in are the syntactic positions in which NPs can be omitted.
c) Exaltation morphology on verbs (i.e. *sonkei* and *kenjō* markers) is not counted as an overt reference, even when there is no explicit argument signaling the same referent; this being said, it is counted as referentially significant exaltation morphology (see section 3.2).

3.1.3 Arguments[2]

a) Argument arrays (i.e. available NP slots) are determined notionally and verified on corpus data. For premodern Japanese, unless an argument is attested with a verb, it will not be included in the array, even if it is notionally possible. If a predicate has three arguments notionally (e.g. verbs of transfer), there must be at least one token of this predicate governing three arguments in the corpus. However, we cannot sum up the number of argument slots attested in different tokens since these might be different lexemes. Compare the two uses of *hanasu* in the following examples:

(2)

Sōiū	*koto*	*o*	(ok *sukina*	*josei*	*ni*)
such	things	ACC	beloved	woman	DAT
hanashita	*koto*	*ga*	*arimasen*	*ka?*	
tell.PST	thing	NOM	be.POL.NEG	Q	

'Haven't [you] told (ok [your] beloved woman) about such things?' (BCCWJ)

(3)

Sukina	*josei*	*to*	(? *Sōiū*	*koto*	*o*)
beloved	woman	COM	such	things	ACC
hanashite	*iru*	*sakkaku*	*o*	*okoshite*	*imasu.*
talk.GER	STAT	illusion	ACC	cause.GER	STAT.POL

'[She] creates the illusion of talking (? about such things) to your beloved woman.' (BCCWJ)

The verb *hanasu* can have both direct objects encoded with an accusative marker (2) and indirect objects (3) encoded with a comitative marker. However, these arguments can hardly be combined in the same clause because the verb's lexical meaning changes depending on the argument it takes: In (2), *hanasu* means 'to tell' and does not have an available slot for a

[2] Repetitions (i.e. identical predicates with identical argument arrays) are disregarded; however, this does not apply to identical predicates whose argument arrays differ at least by one slot.

comitative participant,[3] whereas in (3), the same verb means 'to talk' and prototypically lacks a slot for a direct object.[4]

b) All predicate nominal constructions have one argument, the subject.

c) Raised arguments are counted only once with their source clause. Thus, in the example below, the raised direct object *ametuti no kokoro wo* is counted only once with the subordinate predicate *itapasi mi* but not with the matrix predicate *nori-tamapu.*

(4) *ame-tuti* *no* *kokoro* *wo*
heaven-earth GEN will ACC
itapasimi […] *to* *nori-tamapu*
painful.ACOP.INF COP proclaim-RESP.CONC
'I proclaim the will of heaven and earth painful and …' (SM3.13-14)[5]

d) Shared arguments in conjoined predicate constructions, converbal constructions, and so forth, are counted only once:

(5) ***Nihongakusha*** ***ga*** *Berugī* *de* *atsumatte*
Japanologist **NOM** Belgium INS gather.GER
kenkyū *kekka* *o* *happyō* *shita.*
research results ACC present do.PST
'Japanologists gathered in Belgium and presented [their] research results.'

Here, the subject argument *nihongakusha* is counted only once with *happyō shita*, the main verb.

e) Arguments of null (elliptical) predicates are counted, though the predicates are not.

(6) *Boku* *wa* *ringo* *o* ***Ø,*** *Tarō* *wa* *mikan* *o* *tabeta*.
I TOP apple ACC Taro TOP mandarin ACC eat.PST
'I had an apple, and Taro [had] a mandarin.'

f) Incorporated arguments are not counted, but the verb into which they are incorporated is considered to have a reduced value due to the incorporation of the argument (e.g., *kumogakur-* 'hide behind clouds' has a slot for only one argument, the subject, because the locative argument is already incorporated into the verb).

g) Conversational ellipsis is treated in the same manner as any other sort of ellipsis:

(7) a. *Kore* *wa* *nan* *desu* *ka?*
this TOP what COP Q
'What is this?'
b. *Tsukue.*
table
'A table.'

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[3] That said, this type of *hanasu* can have an indirect object encoded by the dative *ni* alongside the direct object.

[4] In both examples (2) and (3), the additions in brackets are not part of the original sentences. The grammaticality of these additions was assessed by native Japanese speakers.

[5] When citing the *Senmyo*, the numbers before and after the dot refer to the edict and the line therein, respectively, as per Kitagawa (1982). Thus, SM1.2 refers to edict 1 line 2.

The response in (7b) is understood to be an elliptical version of *Kore wa tsukue desu,* which is a true nominal predicate containing one argument, *kore wa*. (7b), therefore, has a nonovert predicate, one possible argument, and zero overt arguments.

h) Emphatics (e.g. *kare jishin* 'he himself') are not counted independently of other manifestations of the same NP referent.

i) Overt subjects of imperatives are counted as arguments:

(8) *opo-mikoto* *wo* *moromoro* *kiki-tamapeyo*
great-imperial.edict ACC everyone listen-HUM.IMP
'Everyone, listen to the great imperial edict!' (SM1.14)

Thus, there are two overt arguments in (10), including the subject *moromoro* and the direct object *opo-mikoto*.

3.2 Exaltation morphology

Japanese exaltation markers have referential functions and, therefore, can be conceived of as a variety of verbal agreement. The term exaltation encompasses two phenomena known as **respect** (*sonkei*) and **humility** (*kenjō*). These markers are considered referentially significant if the argument they refer to is not overtly expressed (9); otherwise, they are annotated as referentially insignificant (10).

(9) *sumyera* *ga* *opo-mikoto-rama* *to* *nori-tamapaku*
emperor GEN great-imperial.edict-as COP proclaim-RESP.NMNL
'What the Emperor deigns to proclaim as a great imperial edict …' (SM1)

(10) *sumyera* *ga* *mikadwo* *no* *siki-tamapi*
emperor GEN emperor GEN rule-RESP
'The emperor deigns to rule, and …' (SM1)

3.3 Relative clauses

Contrary to Noonan (2003), all relative clauses are counted, and gapped arguments appearing as their heads are counted as overt arguments of the relative clauses; moreover, the same head NP can be counted as an argument of a higher clause (11).

(11) *sumyera* *ga* *opo-mikoto-rama* *to*
emperor GEN great-imperial.edict-as COP
nori-tamapu *opo-mikoto* […] ***kiki-tamapeyo***
proclaim-RESP.ADN great-imperial.edict listen-HUM.IMP
'Hear the great edict, which the Emperor deigns to proclaim as his great edict!' (SM1)

3.4 Syntax vs. Discourse

Since we count gapped arguments in relative clauses, it is tempting to count elliptical shared arguments in sentences like (12).

(12) *ame no sita wo* ***nade-tamapi*** ***Ø*** ***utukusibwi-tamapu*** [...]
heaven GEN beneath ACC care-RESP.INF bless-RESP
'[I] care for my realm and bless [it].' (SM1)

However, we ought to distinguish between syntax and discourse. In relative clauses, the gap is conditioned by syntactic rules. It is, therefore, mandatory, whereas the ellipsis in (12) is conditioned by the discourse and is optional. Let us have a look at a short dialogue in cNJ and its translation:

(13) a. *Anata mo Tarō o mita no?*
you FOC Taro ACC see.PST Q
'Have you also seen Tarō?'
b. *(Boku mo) (kare o) mita yo!*
I FOC he ACC see.PST PRT
'*(I) have also seen *(him).'

As in relative clauses, in (13b), both arguments are easily recoverable, so it is tempting to count them as well. However, by ignoring the difference between gaps conditioned by discourse and syntactic rules, we risk lumping together languages like Japanese and English, with English prohibiting prodrop in (13b) *syntactically*.

This might appear a minor issue, but it is crucial since 24% of the clauses in the data are sentences like (11), that is, relative clauses with gapped arguments as their heads, so the results of our calculations differ significantly depending on whether we count such gapped arguments once or twice.

3.5 Indices

The following indices are adopted from Noonan (2003):

a) RD1 (overt arguments/possible arguments)
b) RD1+ (overt arguments + exaltation/possible arguments)
c) RD2 (overt arguments/predicates)
d) RD2+ (overt arguments + exaltation/predicates)

Additionally, I introduced four indices which reflect the referential power of gapped arguments as well as exaltation morphology:

e) RD1++ (overt arguments + gapped arguments/possible arguments)
f) RD2++ (overt arguments + gapped arguments/number of predicates)
g) RD1- (exaltation/possible arguments)
h) RD2- (exaltation/predicates)

4 Data and Discussion

4.1 Manually Annotated Data[6]

Table 1 presents the average RD values for all Old Japanese prose, its translations into contemporary Japanese, and the difference between the two (DIF). The most notable change is observed in

[6] The annotated data can be accessed on GitHub via the following link: https://github.com/artemiyk83/RD_Pilot_Study.git

the RD1- and RD2- indices, representing the ratio of referentially significant exaltation markers to possible arguments or predicates, respectively. Another significant shift is in RD2++, which assesses the ratio of explicit and gapped arguments relative to the number of predicates. However, none of the remaining indices show a substantial diachronic difference.

	OJ	cNJ	DIF
RD1	.39	.4	0.01
RD1-	.2	.11	-0.09
RD1+	.54	.51	-0.03
RD1++	.49	.52	.03
RD2	.8	.86	.06
RD2-	.41	.23	-0.18
RD2+	1.12	1.09	-0.03
RD2++	1.01	1.11	.1

Paired t-test = 0.6194 (t = 0.5195; df = 7)

Table 1: Changes in SM and NT

	OJ	cNJ	DIF
RD1	.36	.37	.01
RD1-	.09	.12	.03
RD1+	.46	.48	.02
RD1++	.47	.45	-0.02
RD2	.75	.79	.04
RD2-	.21	.23	.02
RD2+	.96	1.03	.07
RD++	0.96	1.01	.05

Paired t-test = 0.0241 (t = 2.8676; df = 7)

Table 2: Changes in MYS

Table 2 provides average RD values for the longest songs in the *Man'yōshū* (MYS 18.4094 and MYS 2.199). Unlike the diachronic trends observed in Table 1, which showed a significant decrease in RD1- and RD2- as well as a significant increase in RD2++, Table 2 does not exhibit such trends. Two nonmutually exclusive factors can explain this. First, poetry is inherently more prone to argument omission (Baker 2007: 144–152), which might affect the frequency of exaltation markers. Consequently, the relatively low RD1- and RD2- values are already evident in the OJ originals. Second, the contemporary Japanese translations of the OJ songs appear more faithful to the original text than the translations of the *Senmyō* and the *Norito*, particularly regarding referential devices. Thus, when an exaltation marker is present in an OJ song, it is usually not replaced by an overt noun phrase (NP) in the cNJ translation but is instead replicated using a cNJ equivalent (e.g. *tamapu* > *irassharu*). These factors collectively contribute to the distinct patterns observed in Table 2 compared to Table 1. To sum up, below are three observations based on the data above:

i) RD1 and RD1++ have not changed significantly in any of the texts
ii) The number of explicit arguments increased
iii) The proportion of exaltation morphology has decreased.

Could (ii) and (iii) be related? Is the increase in the number of explicit arguments a result of the decrease in the amount of exaltation morphology? Suppose there is a causal relationship between the two tendencies. In that case, the increase in explicit arguments should have affected subjects more than any other arguments because exaltation morphology usually refers to subjects.

However, the ratios of either subjects or objects have not changed significantly, which means there is no direct causal relation between these tendencies. Indeed, there are no cases in my database wherein a referentially significant exaltation marker is *replaced* by an overt subject in the translation referring to the same participant. However, there are a couple of cases wherein a referentially significant exaltation marker is *supplemented* by an overt subject referring to the same participant.

There is one more way to find out if there is a direct correlation between tendencies (ii) and (iii) outlined above. If the reduction in exaltation morphology were linked to reference, we would not expect the same tendency from referentially insignificant exaltation markers. Indeed, the data reveals that the proportion of referentially insignificant exaltation markers has remained relatively stable and has not exhibited significant changes across all analysed texts. This starkly contrasts with the noticeable upward trajectory observed in the frequency of referentially significant exaltation markers across these texts.

	OJ	cNJ
SUB	39%	36%
OBJ	44%	46%
IO	16%	18%

X^2 (2, N = 600) = 0.2771, p = .870631

Table 3: Arguments by syntactic position

	OJ	cNJ
SM1	29% (8/28)	37% (7/19)
SM2	27% (4/15)	38% (3/8)
SM3	16% (6/37)	19% (5/27)
NT10	28% (8/29)	16% (4/25)
Average	**25%**	**27.5%**

Table 4: Ratio of referentially insignificant exaltation markers to all exaltation markers

The slight increases we do observe in SM 1–3 can be attributed to overly descriptive cNJ translations. To confirm that the correlation between the increase in overt arguments and the decrease in exaltation morphology is not a data artefact (e.g. a peculiarity of the cNJ translations used in this study), it is necessary to conduct a verification corpus analysis.

4.2 Corpus Data

To validate the trends observed in the manually annotated data, I analyzed data from the *Oxford-NINJAL Corpus of Old Japanese* and the *Kainoki Treebank* of Modern Japanese regarding RD2 as the index most prone to diachronic change. As for RD1 indices, applying them to corpus data would have been impossible since the latter are not annotated with information about the valency of different verbs. In Table 5, I compare RD2 values in the corpora and manually annotated data (MAD). Where possible, subcorpora with (+ADJ) and without (-ADJ) adjectival predicates, as well as with (+REL) and without (-REL) predicates in relative clauses were formed to see how these contribute to the overall referential density. It is also crucial to note the difference in genre between prose (the manually annotated SM and NT and automatically analyzed texts in *Kainoki Treebank*) and poetry presented in ONCOJ. In all cases, RD2 values are lower in poetry, which is also confirmed by the manually annotated data in Table 2. This can be easily explained by a higher frequency of omissions in poetry due to formal limitations (5-7-5 syllable structure) and higher contextuality (often, poems are preceded by introductions in prose explaining their background).

As seen in Table 5, the primary trend for RD2 values to increase in cNJ also holds for the corpus data. Thus, RD2 (excluding relative clauses and adjectival predicates) changed from 0.69 in OJ to 1.26 in cNJ, whereas RD2 (including adjectival predicates but excluding relative clauses) changed from 0.58 to 0.12. Compare this to the much more modest change in the manually annotated data from 0.8 in OJ to 0.86 in cNJ.

	-ADJ, -REL	+ADJ, -REL	-ADJ, +REL	+ADJ, +REL
MAD OJ	N/A	N/A	N/A	.8
ONCOJ	.69	.58	N/A	N/A
Kainoki	1.26	1.12	1.24	1.14
MAD cNJ	N/A	N/A	N/A	.86

Table 5: Comparison of RD2 in ONCOJ, *Kainoki*, and manually annotated data

Since argument traces in gapped relative clauses are still to be annotated in the ONCOJ, I excluded both from my search query (hence 'N/A' in the '+REL' cells in the table). However, there is a solid reason to assume that this did not significantly affect RD2 values: In the *Kainoki Treebank*, there is almost no difference between the respective values (1.12 for '+ADJ, -REL' vs. 1.14 for '+ADJ, +REL').

5 Conclusion

The contradictory results of the two tests, which we used to check for causality between the increase in overt arguments and the decrease in exaltation morphology, warrant a more detailed investigation. To understand the morphosyntactic mechanics behind the diachronic trends observed in the data, it is helpful to consider all factors that have a bearing on RD typologically. Bickel (2003) suggests the following:

Verbal agreement. As discussed above, Japanese exaltation markers have some referential functions and, therefore, can be conceived as a variety of verbal agreement, but as we have seen, there seems to be no direct causation between the increase in RD2 and the decrease in the ratio of referentially significant exaltation markers.

Switch-reference morphology. This factor is not applicable to Japanese since there are no dedicated switch-reference markers at any attested stage of the language; see McAuley (2002) for an analysis of possible noncanonical switch-reference markers in EMJ, and Watanabe (1994) for those in cNJ.

The ratio of transitive vs intransitive verbs. There are no reasons to assume any significant change has happened in this domain. That said, noun incorporation seems more widespread in OJ than in cNJ, which could lead to a higher transitivity rate in the latter.

The ratio of the so-called 'rich verbs' versus 'poor verbs'. Poor verbs have a generic meaning and are compatible with many different referents and situations (e.g. *put*, *do*, etc.), whereas rich verbs have particular meanings and strongly restrict the kind of referents compatible with them (e.g. *carry-by-handle*, *grasp*, etc.); Brown (2020) is an empirical study showing that dropping NPs tends to be more common with semantically rich verbs than with semantically poor ones.

It is also possible that the diachronic trends observed in the data are purely discourse-driven, as demonstrated in Section 3.4. While the line between syntax and discourse can be rather subtle, these are two separate domains, each of which goes through its own diachronic development.

Abbreviations

ACC = accusative; ACOP = adnominal copula; ADJ = adjectival predicate; ADN = adnominal; BCCWJ = *Balanced Corpus of Contemporary Written Japanese*; cNJ = contemporary Japanese; COM = comitative; CONC = conclusive; DAT = dative; EMJ = Early Middle Japanese; FOC = focus; GEN = genitive; GER =

gerund; HUM = humility; IMP = imperative; INS = instrumental case; INF = infinitive; MAD = manually annotated data; MYS = *Manyōshū*; NEG = negative; NKBT = *Nihon Koten Bungaku Taikei*; NMNL = nominal form; NOM = nominative; NP = noun phrase; NT = *Norito*; OBJ = object; OJ = Old Japanese; ONCOJ = *Oxford-NINJAL Corpus of Old Japanese*; POL = politeness; PRT = particle; PST = past tense; Q = interrogative; RD = referential density; REL = relative clause; RESP = respect; SM = *Senmyō*; STAT = stative; SUB = subject; TOP = topic.

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