

Frequencies of the Spatial Prepositions AT, ON and IN in Native and Non-native Corpora

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Abstract: This paper investigates the nature of frequencies in the Nagoya Interlanguage Corpus English of spatial prepositions of AT, ON and IN. The proportions and ratios of these three prepositions, because of their grammatical characteristic, are to an extent fixed not only for native speakers but also advanced non-native speakers. The analysis is divided into three parts: a general examination of overusage and underusage of these forms, an examination of the most distinctive words in contrast to AT, ON and IN, and an examination of the distinctiveness in native speaker and non-native speaker corpora separately. The results show that 1) while there is a general tendency to underuse these forms by non-native speakers their overall proportions and ratios remain stable; 2) fluctuations occur mainly with lexical words; 3) fluctuations in AT, ON and IN may be topic driven but a minor factor as their fixed nature is governed by grammatical and communicative needs. Proportional usages of AT, ON and IN though stable show internal variations (polysemy). Non-native speakers are inclined to produce native-like proportions but miscue in their literal and metaphorical usages. The findings suggest further research into the ratios of literal to metaphorical usages is required.

Key words: spatial prepositions, frequency, literal meaning, metaphor.

1. Introduction

Research into the prepositions of AT, ON and IN have been until last decade preoccupied with their literal meaning. Herskovits (1986) for example from the perspective of computational linguistics looked at their ideal meanings or prototypes. As recent as 2006, studies have continued to focus on literal usages, examining them with respect to how they are conceptualized differently in different linguistic cultures (Levinson, 2003; Levinson & Wilkins, 2006). While the preoccupation with literal meaning is justified by the fact that secondary abstract meaning are extended from prototypical (usually literal) usages it is still necessary to attend to the other meanings. Since 1980, starting with Lakoff and Johnson's landmark work *Metaphors We Live By* (1980) studies into meaning derived from metaphorical constructions have come to the fore. The polysemic nature of words – lexical and grammatical – have marked a major shift in how we perceive vocabulary and grammar. Brugman explained in Lakoff (1987) has shown how the various meanings of 'over' stem from its basic minimal literal meaning in a logical and coherent way.

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However, the above works mentioned have the two problems of 1) not combining its findings with quantitative data, and 2) not being able to tell us the quantities or ratios of literal to metaphorical usages. Early studies, of course, did not have the benefit of corpus linguistic techniques but later studies did and chose to ignore this possibility. The first problem, however, is often not seen as a problem. Studies of word forms often look at what are called *lexical* or *content* words and as such they are *context dependent*. By this it is meant that the topic of a text or corpus will dictate the content and therefore the words which are discussed. *In general* this is not the case with *grammatical* or *structure* words which are *context independent* as in the prepositions in the present study. I shall argue that AT, ON and IN have fixed proportions overall and ratios relative to each other. Here I combine both a cognitive linguistic perspective with corpus linguistic technique in order to clarify this phenomenon.

The remainder of the paper consists of five sections. Section 2 is a review of the literature. Section 3 will describe the research objectives. Section 4 will explain the statistical method and data used. Section 5 presents the results from the data and Section 6 is a discussion of the findings and its implications.

2. Literature Review

This section is divided into three sub-sections reviewing 1) the general characteristics of AT, ON and IN, 2) the importance of frequency in input and usage, and 3) the problems faced by learners.

2.1. Linguistic perspectives of AT, ON, and IN.

AT, ON and IN can be divided into two general perspectives (or periods) – *traditional* and *contemporary* for a lack of a better name. The traditional perspective through historical development (metaphors were seen as a literary device and not part of the domain of linguistics) focused exclusively upon the literal meaning, seeing metaphorical meaning as ‘deviant’ or ‘mundane’. In perceiving language in this manner traditional grammarians have therefore focused upon such examples as (1)~(3) while ignoring other instances (metaphorical instances) altogether:

- (1) Harry is *at* the station.
- (2) The cat is *on* the roof.
- (3) Jane is *in* the kitchen.

These sentences are worthy of study in their own right because metaphorical extensions based on these forms derive their meaning from these ‘literal’ basic usages or conceptualizations, which can be schematically represented by the diagrams in Figure 1. Taking our cue from Brugman’s formulation (Lakoff, 1987) all extensions can be seen to be based on these image schemata with appropriate accommodations.

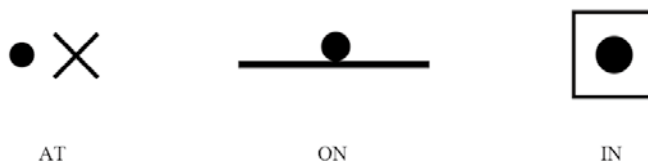


Figure 1 – Image schema for AT, ON and IN

2.2. Frequency in language acquisition and use

In research done before the advent of corpus linguistic evidence it has already been noted that native speaker informants may be relied upon for word frequency information (Shapiro, 1969). Hasher and Zacks (1979) suggested that this is because first language learners seem to automatically monitor frequency of language input forms. Later research and studies also back this view (Balota, Pilotti, & Cortese, 2001; McGee, 2008). Schmitt and Dunham (1999) found also that non-native speakers with ample exposure and experience can judge accurately the frequency of words in a second language. The evidence implies that exposure to the target language is the key acquiring this knowledge. It is in this sense that a large amount of input is necessary (Krashen, 1985). But without guidance the high frequency of input can become “noise” (Larsen-Freeman, 2002, p. 280) at least for lexical words. Some kind of attention is necessary for acquisition to occur. See also Ellis (2002a, 2002b) for an in-depth discussion of the role of frequency in language acquisition.

The frequency (or lack thereof) is unproblematic for grammatical words since they (as a group of approximately 300 forms) are mostly high frequency words in the English language. If we take the British National Corpus as our reference then AT, ON and IN constitute 0.5%, 0.7% and 2.0%¹ respectively of all language used (*BNCweb*, 2012). And in a larger, more balanced reference corpus like the *Bank of English* the proportions constitute 0.4%, 0.6% and 1.5% respectively (*Bank of English*, 2012). If we accept these figures as representative then the three prepositions can reasonably be assumed to make up approximately 3% of usage. It seems reasonable to also assume that AT, ON and IN should follow a general ratio of 1 to 1.3 to 3.5. If grammar is indeed ‘a response to discourse needs’ (Bybee & Hopper, 2001, p. 2) then the relatively inalterable nature of these proportions and ratios make sense. Unlike content words, because grammatical words *refer not to objects but to the relationship of objects* within a clause, I shall argue that these proportions and ratios are relatively fixed due to their role as spatial prepositions to explicate these relationships, whether of physical or abstract since a certain amount of our speech must be spent to describe how things relate to each other. If the proportion of 3% is reasonable then one in three or four sentences must utilize the forms AT, ON or IN to relate objects to each other. This phenomenon has not been fully investigated. My concern here is that of quantity of output by native and non-native speakers in the production of opinion writing without regard for the exact content (in this study at least) of the output. To reiterate it is possible to do this because of the grammatical nature of these forms as described.

2.3. Learners’ difficulties of AT, ON, and IN

It has been noted (小寺 & 小延, 2001) that English prepositions are inherently difficult to learn and teach in the Japanese context. Reasons for this difficulty (高木, 2005; 高木, 2006) include 1) its relatively lower representation in Japanese textbooks compared to other parts-of-speech; 2) apathy towards the role of prepositions in communicative meaning; 3) the phonologically unstressed nature of prepositions in listening (and speaking); and 4) the emphasis and focus upon content words in reading comprehension. AT, ON and IN, however, are not equally problematic to Japanese learners of English. According to Hayashi (Hayashi, 2001) IN is the least problematic, ON increases in difficulty as its meaning becomes more abstract. A similar observation was made for AT (Bong, 2012) although the easiest sense of the preposition was *temporal* rather than the prototypical *spatial* meaning of coincidence of place. This inversion is probably due to the former’s salient or frequent nature.

The problem may partly also stem from the fact that textbooks in general do not reflect the realities of actual native speaker usage (Anderson, 2007). Ideally textbooks should also mirror the

proportion of meaning usage (Biber and Reppen, 2002). But given the time constraints of teaching courses and the available space within teaching material this is a tall order. Minimally teaching material should at least loosely emphasize proportions of usage or difficulty (高木, 2006).

3. Research objectives

Although the importance of frequency in language has been well established no studies, as far as I am aware, have looked at the frequency nature of grammatical words. If grammatical words are different to content words then the nature of their frequencies – particularly their immutability – must also be different.

The first objective is to examine *whether NNS underuse, overuse or do not differ from NS in their overall usages of AT, ON and IN*. The prediction is that they will overuse all three forms. It has already been noted that NNS have less vocabulary breadth than the NS and therefore by extension will, in general, need overuse the utilized vocabulary to compensate for the difference in token size.

The second objective is to examine *which individual forms are most distinctive between NNS and NS*. The cut-off rank at thirty is arbitrary and was selected because sufficient instances will give some indication of the nature of the vocabulary. Identical to the case in the third objective instances of five or less are numerous. However, this does not affect the distinctiveness scores.

The third objective is to examine *whether NNS and NS differ in terms of their usage of AT, ON and IN*. The analysis will compare distinctiveness between topics within NNS and NS separately. Some differences will be expected. However, these differences will not affect the overall frequencies. Despite NNS and NS having different vocabulary breadth they are expected to produce similar quantities (proportions and ratios) because of the nature grammatical words. Significance from the chi-squared will be disregarded because the accuracy of the statistical results is affected by cells containing five or less instances. However, as in the second objective this does not affect the distinctive scores.

4. Method

Four contingency tables shall be made. The first table shall be of AT, ON, IN and “OTHER” cross-tabulated against the two sub-corpora. The second table cross-tabulates all unique forms (that is, types) against the NNS and NS corpora. The third and fourth tables shall be of the two sub-corpora dealt with separately with AT, ON and IN cross-tabulated against the eleven topics. It should be noted that despite the size difference between the first and second contingency tables the frequencies of AT, ON and IN in relation to the two whole sub-corpora do not change. Therefore, the expected and distinctiveness values in these cells do not change. In changing the number of cells only the chi-squared test values, that is the χ^2 , degrees of freedom and p-value, change. Because the third and fourth tables are isolated the analyses of NNS and NS are not directly comparable but represent their internal distinctivenesses.

4.1. The data

The corpus used in this study, the Nagoya Interlanguage Corpus of English (Sugiura, 2011), consists of a native speaker (NS) and non-native (NNS) corpora of opinion writing produced by adult writers at university. The NNS component contains writing by Japanese learners of English while the English native speaker component contains writing by exchange students from various countries. Subjects were limited to one hour and a choice of eleven general topics. All writing

was done under supervision with the use of dictionaries prohibited. The two corpora were intentionally designed to be of equal size each containing roughly 100,000 tokens. In order to balance two corpora, however, a greater number of samples was required because NNS wrote considerably less than the NS. While the NS produced 118,560 tokens from 200 samples NNS required 342 samples to produce 115,918 tokens. In other words each NNS sample was on average 40% shorter than the NS samples. NNS produced approximately 339 tokens to the native speakers' 593 tokens in identical time conditions.

Table 1 – Distribution of Essays and Tokens by Topic in NS and NNS

TOPIC	Files NS	Files NNS	Total NS	Total NNS	% of Token (NNS)
<i>School education</i>	20	122	12,646	41,525	35.8%
<i>Money</i>	18	82	10,580	28,592	24.7%
<i>Sports</i>	17	62	9,959	19,370	16.7%
<i>Violence on TV</i>	18	14	10,740	4,226	3.6%
<i>Death Penalty</i>	19	13	10,504	4,105	3.5%
<i>Recycling</i>	18	13	10,752	5,009	4.3%
<i>Suicide</i>	19	10	11,963	3,856	3.3%
<i>Divorce</i>	19	8	11,865	3,017	2.6%
<i>Crime</i>	17	7	9,541	2,597	2.2%
<i>Teenagers</i>	18	5	10,368	1,650	1.4%
<i>Water Pollution</i>	17	5	9,642	1,663	1.4%
<i>(Unknown)</i>	-	1	-	308	0.3%
Total	200	342	118,560	115,918	100%

*The intended topic of this essay could not be discerned from the content of this text sample.

After the creators balanced the size of the corpora they were faced with a second problem: the uneven distribution of topic samples in the NNS corpus. It would seem that the sample number revolved around the 200-sample output by the native speakers with the NNS corpus “filled” to match its token output. Furthermore, the NS had a relatively even distribution of samples among the eleven files ranging between 17 and 20 files whereas the NNS had a distribution ranging from 122 samples in the *School Education* topic to 5 samples in the *Teenagers* and *Water Pollution* topics (see Table 1). It would seem then that the NNS subjects were not assigned their topics while the NS subjects were. This “inconsistency” resulted possibly because the creators were concerned that NNS subjects may not be able to produce useable samples because of a lack of vocabulary, a concern not unfounded as we have already noted that NNS subjects produced noticeably less than the NS subjects. The foresight to give free reign of topic choice to NNS subjects was therefore a sensible decision.

It should also be noted that despite the equalized size of the two corpora the NNS had less variety in terms of vocabulary. Wordlists constructed from the corpora revealed that the NS had 9,029 types² while the NNS had 5,003 types. As noted each NNS subject wrote less and therefore more samples were required. This means the NNS corpus is also more fragmented than the NS corpus. Although it is likely that NNS subjects will have had a smaller vocabulary size even if they had wrote the same amount. While per-sample size may have contributed to this vocabulary size discrepancy it will not considered an important factor here.

5. Results

Section 5.1 will look at the overall significance, overuse and underuse of AT, ON and IN to answer the first research objective. Section 5.2 will look at the most distinctive forms through a cross-tabulation of NNS and NS corpora. Section 5.3 will look at the distinctiveness of AT, ON and IN between topic in the NNS and NS corpora.

5.1. AT, ON, IN and OTHER

Overall, the chi-squared test of AT, ON, IN and OTHER has shown the frequencies of these types to be highly significant ($\chi^2=40.6$, $df=3$, $p=8.1e^{-9}$). In terms of distinctiveness ON (rank 169th) was the most distinctive of the three types followed by IN (352nd) and then AT (9,843rd). While the differences between the frequencies of NS and NNS for ON and IN near the top of the rankings AT was near the bottom, from a total of 10,434 tokens. According to ranking, then, both ON and IN are within the top five percent of distinctiveness while AT was just outside the lowest 5 percentile, indicating AT is indistinctive. The summary of the results is shown in Table 2.

Table 2 – Rank, Observed Frequencies and Distinctiveness Scores (χ^2) of AT, ON, IN and (OTHER)

Rank	TYPE	Observed		(O-E) ² /E (NNS)
		NS	NNS	
:	:	:	:	:
169	ON	750	552	13.1
:	:	:	:	:
352	IN	2,525	2,215	7.0
:	:	:	:	:
9,843	AT	454	446	0.003
:	:	:	:	:
-	(OTHER)	114,831	112,705	0.43
		118,560	115,918	

The exact nature of the distinctiveness of ON and IN is that they are substantially underused.

5.2. Distinctive types in NS and NNS

It was found in Section 5.1 that NNS significantly underused two of three prepositions. ON was found to be most underused with IN next. AT, on the other hand, was close to their expected frequencies. My prediction was that these forms should be overused to compensate for the lack of vocabulary breadth. However, this was not the case.

In looking at the most distinctive types between NS and NNS it was observed that the most distinct types were lexical words. Table 3 shows a list of the 30 most distinctive types in the NICE, of which 20 of these were lexical words. Of these twenty only one ('was') was underused in the NNS. Of the 10 function words 6 were overused and 4 underused. In other words, function word usage is eclectic and unpredictable while overusage of lexical words is the observed norm.

5.3. Distinctiveness in topics

When we look at the distinctiveness scores in NNS against each topic we find three cells – IN in *School Education*, IN in *Money* and ON in *Violence on TV* – which stand out from the rest as shown in Table 4 (left). It was found that IN in *School Education* and ON in *Violence on TV* was overused, and IN in *Money* was underused. Distinctiveness was also found in two of the three same cells in NS – *School Education* and *Violence on TV* (Table 4 (right)). And like the NNS these were also found to be overused.

Table 3 – 30 Most Distinctive Types in the Nagoya Interlanguage Corpus of English

Rank	Type	Observed		(NNS)	Function Word?	NNS Underused?
		NS	NNS	(O-E) ² /E		
1	english	39	822	369.1		
2	money	241	1048	264.8		
3	school	320	1108	229.0		
4	think	254	962	216.6		
5	students	138	733	212.4		
6	we	550	1409	200.4	Function	
7	study	27	438	188.4		
8	so	354	966	150.5	Function	
9	a	2749	1580	146.6	Function	Underused
10	the	5795	4054	136.4	Function	Underused
11	can	435	1037	131.5	Function	
12	sports	138	523	117.8		
13	was	993	415	113.5		Underused
14	japanese	116	429	94.5		
15	job	44	289	94.0		
16	good	155	490	91.8		
17	university	35	265	91.8		
18	education	153	480	89.2		
19	high	110	397	85.5		
20	elementary	26	229	84.1		
21	important	93	361	83.1		
22	as	971	471	82.1	Function	Underused
23	i	2110	2957	81.6	Function	
24	they	811	1376	80.4	Function	
25	want	101	360	76.6		
26	should	162	462	76.4	Function	
27	play	40	241	75.0		
28	learn	55	261	70.3		
29	into	225	34	69.1	Function	Underused
30	is	1894	2617	67.1		

Table 4 – Three Highest Distinctiveness Scores for NNS and NS against Topics

(NNS)	School Education	Money	Violence on TV	(NS)	School Education	Sports	Violence on TV
AT				AT		9.3 (+)	
ON			278.6 (+)	ON			85.1 (+)
IN	58.0 (+)*	73.5 (-)		IN	14.1 (+)		

* (+) denotes overusage and (-) denotes underusage.

However, because *Violence on TV* represents only 3.6% of the NNS sub-corpus (see Table 1) the raw difference is small. As shown in Table 5, 95 instances were observed while only 20 whole instances were expected of ON in *Violence on TV* topic. In contrast the next most distinctive overusage was IN in *School Education* with 1,008 and 793 instances of observed and expected frequencies respectively. Since the file size of *School Education* was almost ten times larger than *Violence on TV* (which was expected to have 74 instances less) it was expected to have 214 instances less even though its distinctiveness was substantially smaller than *Violence on TV*.

Table 5 – Observed and Expected Frequencies in NNS of most Distinct Types

Word	File (NNS)	Observed	Expected	Observed-Expected
ON	<i>Violence on TV</i>	95	20.1	74.9
IN	<i>School Education</i>	1,008	793.5	214.5
IN	<i>Money</i>	346	546.3	-200.3

Remaining to be discussed from the data in Table 5 is IN in *Money*. In terms of distinctiveness it was next after *Violence on TV*. However, in this instance IN was substantially underused. In fact, its underuse almost equalled to that of IN in *School Education*, thus this alone cancelled out the overall expected differences in IN.

Overall the distinctiveness in NS is that of overusage. The three most distinctive cells – ON in *Violence on TV*, IN in *School Education* and AT in *Sports* – are substantial overusages (see Table 3 (right)). The two most distinctive cells were identical to those in NNS. This suggests that the topic could be affecting the usages of these prepositions in these files. It should be noted the level of distinctiveness in NS is less dramatic than those in NNS.

6. Discussion

It was found in Section 5.1 that quantitatively the differences are significant. NNS tended to underuse prepositions of AT, ON and IN. Specifically, the underusage is with ON and IN. In spite of this the ratios of AT, ON and IN remained fixed at 1 to 1.3 to 3.5. In other words deviation was small. Even with irregularities as in the *Violence on TV* topic it was not enough to affect the overall frequencies and ratios. If the *Violence on TV* topic were to be taken as an outlier then all the more pronounced is the underusage by NNS. So where are the overusages occurring then? The answer lies within the content words as Table 3 in Section 5.2 seems to suggest. The summation of all content words in Table 3 shows that NS produced 4,972 tokens while NNS produced 12,468 tokens. In contrast, grammatical words were even with 14,162 and 14,346 tokens produced by NS and NNS respectively. This result came not from frequency equivalence but rather overall equivalence. In other words content words showed a lopsided tendency with NNS relying heavily upon them and function words showing greater variability depending on the type. While our three prepositions did not appear to be highly distinctive other function words in Table 3 did. Only one of these function words was a preposition – ‘into’ – with 34 and 225 instances in the NNS and NS respectively. It should be noted that ‘into’ (a grammaticalized version of ‘in’ and ‘to’ and sometimes is also written in this way³) is related to IN in that at times they can be used interchangeably but more often than not are not interchangeable (Lindstromberg, 2010, pp. 32–34). As IN was marginally overused by NNS this underusage cannot be explained by frequency alone. Furthermore, ‘to’ was overused by NNS (4,029 instances vs. 3,714 instances in NS). In other words the usages of IN, ‘to’ and ‘into’ all exhibit differing behaviours and require further analysis.

In the study of distinctiveness in Section 5.3 of individual topics we find that ON in the *Violence on TV* most distinct in the NNS. It was overused comparatively more than any other preposition. More than likely this was influenced by the title – *Violence on TV* – which included the target form ON. Table 5 reveals that there were almost 75 more instances than had been expected. A search for ‘on TV’ showed that this file alone had 64 instances. While ON overall was the most distinctly underused of the three prepositions its sample token size in the *Violence on TV* topic was small and therefore did not greatly impact on frequency. This cannot be said of IN in *School Education*. Although much less distinctive (see Table 3, right) than ON in *Violence on TV* because of the proportion of the topic (more than one-third of the entire NNS corpus) the raw contribution is far greater. Two facts should be borne in mind: 1) Table 5 shows that there are at least 214 instances more of IN than were expected in this topic, and 2) in Table 3 we can see that within the list of most distinctive words are included ‘school’ and ‘university’. Intuitively, these words collocate with IN often. A search of these terms up to five position right of the IN node revealed that IN collocated with ‘school’ 236 and 66 times in the NNS and NS respectively. This is despite the fact IN is underused overall. In other words IN in the remaining two-thirds of the NNS

corpus must be even more underused – as with ON – than the statistics suggest. Our NNS data also shows us that IN is underused most in *Money* where the frequency of underusage is roughly equal to the overusage in IN in *School Education* thereby nullifying the frequency effect. These overusages dependent on specific topics in NNS are further strengthened by the fact that NS also mirror this tendency. We see the same pattern with ON in *Violence on TV* and *School Education* in NS but less pronounced. The effect of the topics (or title) is likely an important factor here but this cannot explain the anomaly with *Sport* in NS. Again further analysis of required here as well.

Frequencies of AT, ON and IN have been shown to follow the fixed pattern for AT, ON and IN. The brief look at some collocations above helped explain some frequency anomalies but had not helped explain all differences. Such an analysis is beyond the scope of this preliminary study and requires a separate analysis. A preliminary informal study indicates that articles – ‘a’, ‘an’ and ‘the’ – after the immediately after the preposition is shown to be acutely underused even though they are usually the most frequency collocates with prepositions. The presence of articles after prepositions generally announces two types of connections – with *nouns* and with general *abstractions*. And because they are underused such connections must be underdeveloped within the non-native speakers’ minds. Further research is therefore necessary in the area of literal-metaphorical usages of prepositions which is again beyond the scope of this paper. Again my preliminary studies in this area indicate that non-native speakers seem to use metaphorical constructions more than native speakers. One would expect the opposite that NNS would stay with safer more “concrete” usages as seen in Cameron’s study (2003) because of their limited vocabulary size and grammar. And Takagi (2006) suggests the lack of examples of the teaching of abstract usages of AT, ON and IN in textbooks may be the reason for incorrect usage. Why material developers are avoiding metaphorical usages needs to be addressed since learners by age 10 are more than ready for these abstract concepts (Graf, 2010). But the results here suggest learners want to use more complex more abstract usages but are held back by their lack of knowledge. It can be said that these learners are at an interlanguage stage when it comes to their metaphorical usages. Further research into this area is required.

Notes

- ¹ The even distribution (Juillard’s D 98, 97 and 98 for AT, ON and IN respectively (Leech, Rayson, & Wilson, 2001)) of these prepositions is further evidence of their grammaticity. This grammaticity is *conceptual* and not *formal* because of its polysemic network in the Brugman (1981) sense, and form and meaning are not arbitrary but developed from the need for linguistic economy in the Zipf (1965) sense.
- ² The basic definition of a ‘token’ is taken to be following: a *character* is any letter of the English alphabet, upper- or lowercase, from A to Z. A *non-character* is any letter or sign that is not a *character*. A *token* in a text is one or more *characters* delimited by at least one *non-character*. A *type* is a unique token after all *characters* have been treated as lowercase. *Frequency* is the number of occurrences of the same *type*.
- ³ In NICE there were only 2 and 5 instances of ‘in to’ in the NNS and NS respectively.

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