

# Directional evidence revisited: End weight bias and templating in conjoined phrase postmodification

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## Abstract

The tendency of speakers and writers to place larger constructions at the end of sentences, whether consciously or unconsciously, is well established. Often this question of ‘end weight’ is usually discussed in relation to grammatical transformations. In this short paper we demonstrate a simple method for investigating a similar phenomenon in coordination patterns where conjoins are either noun phrases, e.g. *the X of Y or Z*, or prepositional phrases, e.g. *the X of Y or of Z*. We then investigate whether the coordinated noun phrases (*Y, Z*) are themselves postmodified, either by another prepositional phrase or by a clause. As postmodifying phrases and clauses are potentially expansive, they are grammatically complex and we operationalise them as signifiers of ‘weight’. We find that both sets of coordination patterns are end-sequence biased by weight.

We also find an elevated frequency for patterns where both first and last conjoins in the sequence are greater than would be expected were they independently selected. Setting aside potential explanations of directional influence, which cannot be decided inductively, we focus instead on the content of these doubly-postmodified constructions and examine them for evidence of templating, i.e. lexical-syntactic repetition.

We also show that these results are not explicable by semantic ordering in coordination, and contrast evidence from prepositional and clausal postmodification with that from premodifying adjective phrases, where scope ambiguity may also be a factor.

Keywords: end weight, templating, coordination, interaction, directionality

## 1. Introduction

Are phrases at the end of a *coordination sequence* of conjoined phrases larger, more complex or ‘heavier’ than those at the start?

The principle of ‘end weight’ is often discussed in the context of empirical evidence of *information structuring* (see e.g. Kaltenböck 2020): moreover, students of English are taught to position larger constructions at the end of utterances (Cowan 2008). Similarly, studies of the dative alternation with the double object construction – *Aden gave the prize to Beth* (dative) vs. *Aden gave Beth the prize* (double object) – have observed that the size of the movable object (*the prize*) appears to be a factor in its position (Bresnan, Cueni, Nikitina and Baayen 2005).

However a freer structure for investigation – one that requires no additional transformative device such as extraposition or double-object constructions – is the coordination of like phrases.

If there is a general cognitive or communicative principle engaged in extraposition and other broadly semantically neutral transformations such as the dative alternation, it seems likely that *coordination* is also final end-weighted, i.e. the hypothesis is that the final conjoin would tend to be ‘heavier’ than earlier ones. Cognitively, such a method would minimise interruptions to the producer’s attention, and allow them to concentrate on the coordinated phrase sequence itself. Communicatively, end-weight strategies package information to the recipient without large potentially distracting diversions, a principle also termed ‘end focus’. Whereas explicit teaching tends to prioritise conscious communicative purposes, as linguists we are usually more interested in evidence of spontaneous biases.

Since planning is more difficult to employ in spontaneous speech than edited writing, observing differences between speech and writing may help us distinguish explanations.

An important method that adds ‘weight’ to phrases is *noun phrase postmodification*, typically by clauses and preposition(al) phrases (PPs). This is not the only method for adding weight: alternatives include introduction of premodifying adjective and determinative phrases, adjuncts,

'floating' postmodifiers, or the use of compound nouns. However, since a clause or PP may themselves be expanded, their introduction opens the door to potentially unlimited constructions.

In a sequence of like conjoins, the same structures could be added to any conjoin, but on the principle of end weight, we hypothesize they tend to be found at the end of a sequence rather than at the start.

Such a pattern could arise in at least two ways. A speaker may plan ahead to place weightier conjoins at the end of a sequence. Alternatively, it is also possible that, having introduced a particularly lengthy construction, a speaker might *then* decide to stop the coordination sequence.

One potential reason for postmodification end-weighting in conjoins concerns *ambiguity of scope*. Adjective premodification of nouns is well known to exhibit this phenomenon, c.f. *the old men and women*.

Let us consider a simple example. Example (1) consists of a noun phrase with conjoined postmodifying (NPPO) prepositional phrases (PPs) identified by brackets:

- (1) ...a systematic adoption [of the ideals [of Bildung]] and [of the German middle class way [of life]] [S2B-042 #47]

It would be entirely possible to rewrite this noun phrase as Example (1').

- (1') ...a systematic adoption [of the German middle class way [of life]] and [of the ideals [of Bildung]]

However (1') is slightly ambiguous. Are the 'ideals' systematically adopted, or are they part of 'the German middle class way'? Arguably, the original example (1) is ambiguous for the same reason! In speech, intonation may help. The positioning of constructions can aid in resolving ambiguity, provided that the speaker plans ahead.

However a more substantive issue concerns *ordering*. Some coordination patterns are semantically sequenced by the conjunctions used. Consider (2) and (3) below.

- (2) ...having a degree in say English Literature or <,> uh Greek and Latin whatever ...only says something about *your ability [in that area] and not [in the wider areas [of life]]*...[S1B-029 #153]
- (3) ...the consequences of these proposals for *the movement of traffic [outside the areas immediately affected], and particularly [in the direction [of the A3]]*.

Example (2) is exclusionary, (3) is specificatory. Reversing the conjoins is quite difficult.

- (2') ...having a degree in say English Literature or <,> uh Greek and Latin whatever ...only says something about *your ability not [in the wider areas [of life]] but [in that area]*...
- (3') ...the consequences of these proposals for *the movement of traffic particularly [in the direction [of the A3]], and also [outside the areas immediately affected]*.

Rewritten examples seem quite strained, especially the specificatory ones. It seems more straightforward in English to start with a broader concept and then narrow it, than to present a narrow concept and widen it.

This might affect a result otherwise attributed to 'end weight'. In these ordered examples there may be logical-semantic reasons why the second conjoin, *because it represents a subset of the first* (whether excluded or specified), might tend to be more complex and grammatically 'heavier'.

This type of reasoning does not apply to (4), which is ordered logically. There is no particular reason why the consequent (the second conjoin) would be heavier than the antecedent (the first).

- (4) *In the fixed dunes, [with their much higher organic content], **and therefore** [with a greater proportion [of fine particles]]...* [W2A-022 #75]

For the purposes of the present study we will first pool ordered and unordered examples alike. In Section 3.3 we review our data by repeating our experiments, requiring *and* or *or* to immediately precede the last conjoin, and thereby obtain a dataset of unordered cases.

## 2. Experiments

### 2.1 Conjoined prepositional phrases containing noun phrases postmodified by PPs

We obtain data from the fully-parsed *British Component of the International Corpus of English* (ICE-GB, Nelson, Wallis and Aarts 2002).

All of the experiments obtain data by the following approach. We construct four *Fuzzy Tree Fragments* (FTFs) according to a single schema, and extract data using ICECUP. The yellow nodes are optional, so we have four versions of this FTF (neither, initial, final, both).

In our first experiment we will use the schema in Figure 1. We relax the constraint that the PP must immediately follow the noun phrase head (indicated by a white ‘After’ arrow, rather than a black ‘Immediately after’ arrow). Should any other element fall between the head and PP, the FTF will still find it. However, this relaxation has a drawback. The FTF matches cases with multiple postmodifiers more than once, creating duplicate matches, so we should review all our results and subtract any duplicates manually.

The conjoined PP nodes are marked as being at the start and end of the sequence. Any element may fall between the two, hence the white next ‘After’ arrow between them.

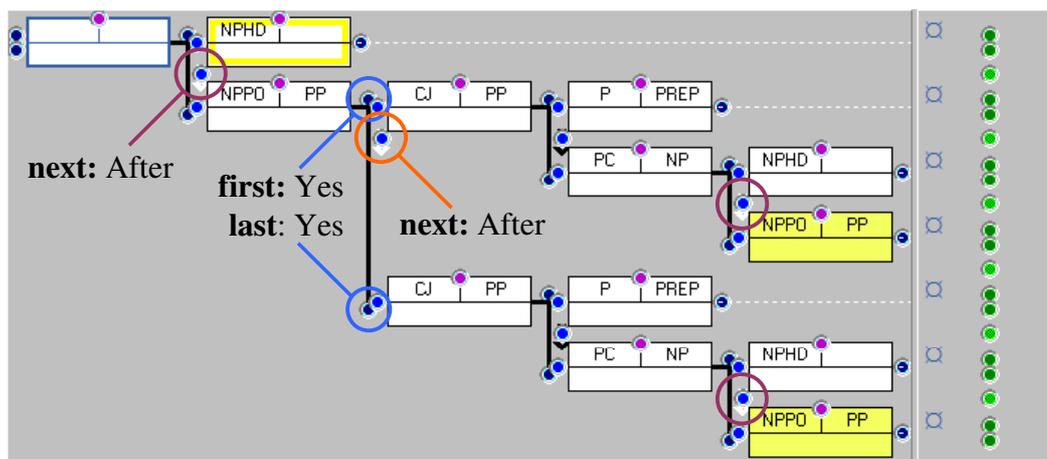


Figure 1. FTF schema: optional NP postmodification in conjoined prepositional phrases (ordered or unordered sequences). Four FTFs are constructed, with the right-most NPPO, PP nodes present or removed.<sup>1</sup>

Using this schema, for all ICE-GB data, we obtain values for the highlighted cells and construct a contingency table by subtraction (Table 1). The FTF with both ‘NPPO, PP’ nodes yields 13 cases, the FTF with a postmodifying PP node in the first position matches all of these plus another 8.

Note that this search method ignores intervening conjoins. It pools data from coordination sequences of any number. A pattern that only postmodifies a *medial* conjoin would therefore register as ‘neither’. However longer conjoin sequences are relatively low in frequency.

We extract the following proportions with 95% Wilson score intervals (see Table 1):

<sup>1</sup> The tree is drawn from left to right for reasons of space rather than top-down. Word order is from the top, down, on the right hand side. Gloss: NPHD = noun phrase head, NPPO = noun phrase postmodifier, PP = prepositional phrase, CJ = conjoin, P = prepositional (function), PREP = preposition, PC = prepositional complement, NP = noun phrase. Black arrows = immediately after, white arrows = (eventually) after.

$$p(\text{first}) = 21/186 = 0.1129 \in (0.0750, 0.1664),$$

$$p(\text{last}) = 47/186 = 0.2527 \in (0.1957, 0.3197).$$

| CJ, PP +PP        | - last | + last | total  | $p(\text{last})$ |
|-------------------|--------|--------|--------|------------------|
| - first           | 135    | 34     | 165    |                  |
| + first           | 8      | 13     | 21     | 0.6190           |
| total             | 139    | 47     | 186    | 0.2527           |
| $p(\text{first})$ |        | 0.2766 | 0.1129 |                  |

Table 1. Contingency table for independent decisions to have a postmodifying PP in first or last place for conjoined PPs ('+ first' means the first conjoin is postmodified by a PP), all ICE-GB data.  $\chi^2 = 16.83$  (Yates's  $\chi^2 = 14.71$ ).

If we compute confidence intervals on  $p(\text{first})$  and  $p(\text{last})$ , we find that the intervals do not overlap, and we can report that  $p(\text{last})$  is significantly greater than  $p(\text{first})$ , i.e. it is more likely that a later conjoin is postmodified than an earlier one. In other words, we find a potential end-weight bias.

## 2.2 Interaction and patterning

We could stop at this point. However comparing  $p(\text{first})$  and  $p(\text{last})$  evaluates their *independent rates*. It does not address their *interaction*.

Note that the probability of choosing the cell (+first, +last) in Table 1, which we might write as  $p(\text{both}) = 13/186 = 0.0699$ . This is nearly *two and a half times* the independent intersection probability,  $p(\text{first}) \times p(\text{last}) = 0.0285$ . The ratio has the scaled 95% Wilson score interval for  $p/P$ , where  $P$  is simply a constant.

$$p/P = 0.0699/0.0285 = 2.45 \in (1.45, 4.06),$$

where  $p$  is the observed proportion,  $p(\text{both})$ , and  $P = p(\text{first}) \times p(\text{last})$ . There are between 1.5 and 4 times (with a best estimate of 2.45) more 'double postmodification' cases than would be expected were the two postmodification acts independent.

We can compute Cramér's  $2 \times 2 \phi = 0.3008 \in (0.1385, 0.4646)$ .<sup>2</sup> This tells us that there is a sizeable effect size, which is 95% sure to be within this range.

This effect size can be used to compare the *degree of association* between decisions. However, since  $\phi$  is associative, it is bidirectional, and does not distinguish between axes (directions).

Using these proportions, we could examine how the rate of postmodification on one conjoin changes if we know the other is postmodified. But as we shall discuss in Section 3.1, making a claim of *directionality* of influence would be doubly misguided.

In the meantime, consider Figure 2, which plots the changing rate of each decision point as separate trends.<sup>3</sup> We compute these second, conditional proportions like this:

$$p(\text{first} \mid \text{last}) = 17/47 = 0.2766 \in (0.1694, 0.4176),$$

$$p(\text{last} \mid \text{first}) = 17/21 = 0.6190 \in (0.4080, 0.7925).$$

We plot spoken and written rates, alongside the pooled 'all ICE-GB' rate, both in order to identify whether mode of delivery makes a difference to the outcome, and as a kind of weak replication check (see Wallis 2021: 201). Note that although we might perceive differences between speech and writing in Figure 2, they are not significantly different (note how the intervals overlap points).

<sup>2</sup> These are 95% intervals computed using the method outlined in (Wallis 2021: 225).

<sup>3</sup> This is not an additive probability chart. The equivalent additive probability chart would link  $p(\text{last})$  with  $p(\text{first} \mid \text{last})$  as a chain of additive decisions.

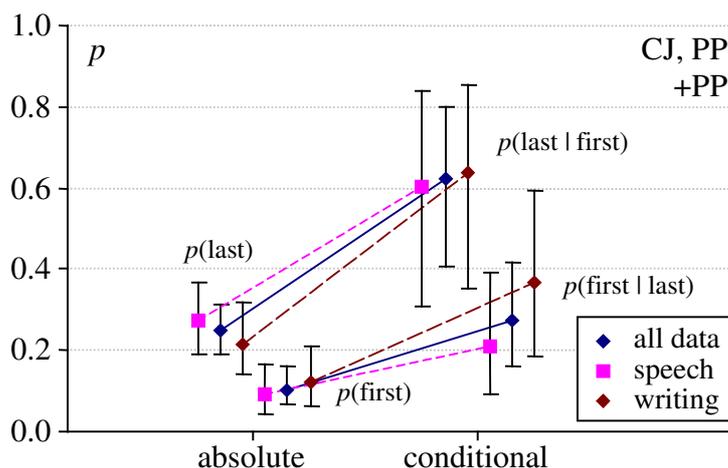


Figure 2. Changing rate of postmodifying a noun phrase head with a PP in the last position of a series of conjoined PPs,  $p(\text{last})$ , vs. the changing rate of  $p(\text{first})$ , if the other conjoin is postmodified.

The graph draws attention to Church’s *gradients*, i.e.  $p(\text{last} \mid \text{first}) - p(\text{last})$ , etc. This gradient represents the tendency for the rate of postmodification at a particular conjoin to increase if we know that the first is postmodified. Examining the difference between conditional and absolute probabilities is an idea due to Ken Church (2000). We might also compare this gradient with the equivalent gradient for the opposite direction, i.e.  $p(\text{first} \mid \text{last}) - p(\text{first})$ . If there was an influence in a particular direction, one could expect a steeper gradient on the influenced term.

However, such an interpretation would be incorrect. We should be careful in not over-interpreting the increased gradient for  $p(\text{last})$  over  $p(\text{first})$ . *The two gradients are not independent observations*, but differences extracted from a contingency table with a single degree of freedom.

We already know that  $p(\text{last}) > p(\text{first})$  (‘absolute’ values, left). And we know that there are additional cases of double-postmodification. The steeper gradient is entirely due to these two facts. In other words, it is a mathematical artifact of Table 1!<sup>4</sup>

Indeed, in each set of data we examined in this paper,  $p(\text{last} \mid \text{first})$  exceeds 0.5 numerically, or, to put it another way, more than half the cases that are postmodified in the first position have a postmodified final conjoin.

However this does *not* permit us to assume a directional influence, a claim we might codify as ‘+postmodify(first) → +postmodify(last)’, i.e. choosing to postmodify the first conjoin encourages, or primes, postmodification of the final conjoin. We will return to questions of directional influence and templating in Sections 3.1 and 3.2.

With the above in mind, a simpler way to present this data is shown in Figure 3. This representation places the emphasis on *particular patterns* (‘initial’ = ‘first only’; ‘final’ = ‘last only’) rather than on the probability of *an item being found*. Thus  $p(\text{first})$  is the probability that  $x$  exists in the initial position, which could be in either ‘initial’ or ‘both’ patterns.

For ICE-GB and spoken data, the intervals for  $p(\text{initial})$  and  $p(\text{final})$  do not overlap. All three differences are significant at  $\alpha = 0.05$ , confirmed by a paired-frequency  $z$  test (Wallis 2021: 168).

A meaningful statistic is the *end weight odds*, for which we can also estimate 95% confidence intervals (Wallis 2022a, c). An odds score is simply the ratio of two competing proportions, in this case  $p(\text{final})/p(\text{initial})$ . This statistic ignores ‘both’ or ‘neither’, only considering ‘first only’ and ‘last only’. For all ICE-GB data, we observe 4.25 times as many conjoin final cases as initial ones (34:8 or 4.25:1), with a 95% interval of 2.00 to 9.01 times. In other words, we are 95% confident that in the population from which our data is sampled there are between twice and 9 times as many conjoin-final as conjoin-initial cases, and our best estimate of their ratio is 4.25.

<sup>4</sup> The elevated double-postmodification rate is why  $\chi^2$  was significant. To demonstrate this, the expected value is  $21 \times 47 / 186 = 5.31$ . Set out Table 1 with cells in the ‘known totals’ tab on the  $2 \times 2$   $\chi^2$  spreadsheet, [www.ucl.ac.uk/english-usage/statspapers/2x2chisq.xls](http://www.ucl.ac.uk/english-usage/statspapers/2x2chisq.xls). Then substitute 5.31 for 13.  $\chi^2$ ,  $\phi$  and  $\phi_p$  tend to zero.

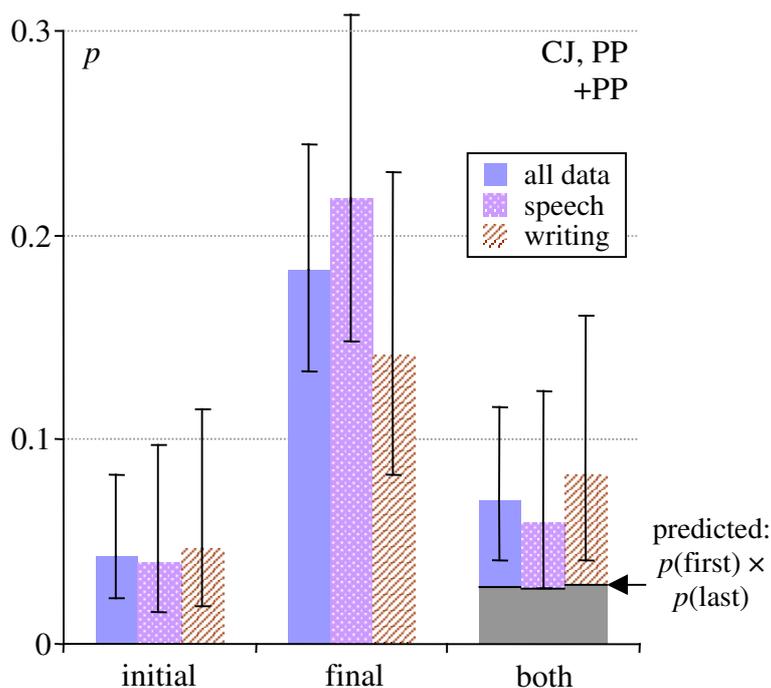


Figure 3. Probability distribution for the position of ‘heavy’ (postmodified) conjoined prepositional phrases. The final column identifies ‘excess’ double-postmodified patterns.

### 2.3 Conjoined noun phrases, postmodified by PPs

We have considered conjoined PPs (e.g. *of X and of Y*). An even simpler conjoin pattern is conjoined noun phrases (*of X and Y*). The FTF schema for this is shown in Figure 4, and data obtained from ICE-GB is summarised in Table 2.

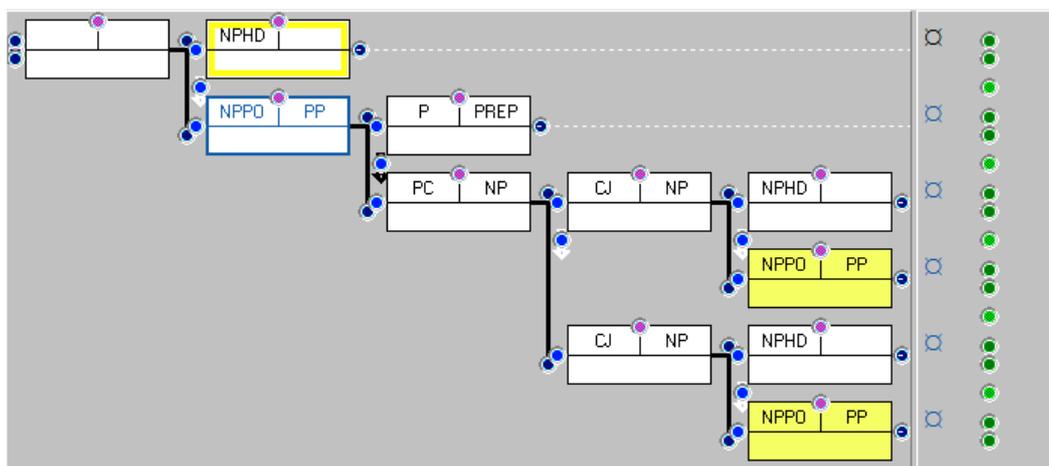


Figure 4. FTF schema for optional NP postmodification in conjoined noun phrases.

| CJ, NP +PP        | - last | + last | total  | $p(\text{last})$ |
|-------------------|--------|--------|--------|------------------|
| - first           | 1,830  | 283    | 2,113  |                  |
| + first           | 46     | 60     | 106    | 0.5660           |
| total             | 1,876  | 343    | 2,219  | 0.1546           |
| $p(\text{first})$ |        | 0.1749 | 0.0478 |                  |

Table 2. Contingency table for comparing rates of postmodification in first and last place for conjoined NPs, all ICE-GB data,  $\phi = 0.2549$  (0.1948, 0.3192).

This obtains Figure 5.

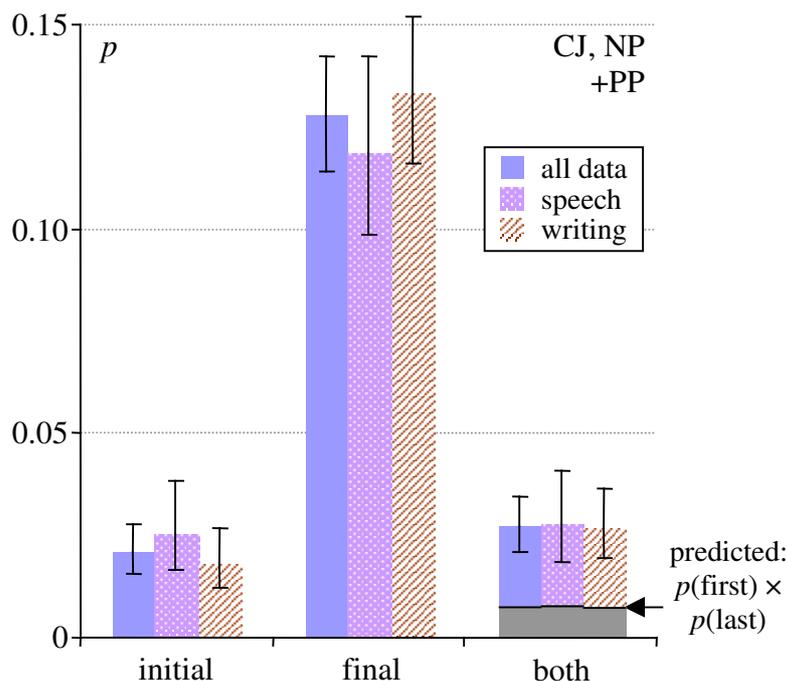


Figure 5. Probability distribution for postmodified conjoined noun phrase patterns, within the schema of Figure 4.

Here the result is dramatic. The most common pattern by far is end-weighted. With more conjoined NP sequences in our sample, the intervals are narrower and the end weight ratio,  $p(\text{final})/p(\text{initial})$ , is  $6.15 \in (4.51, 8.39)$  for a 95% interval.

#### 2.4 Clausal postmodification

As well as postmodification by PPs, postmodification with relative clauses is quite common. These are of lower frequency, however, with only 4 examples of double-postmodified conjoined PPs, and 27 double-postmodified conjoined NPs.

We construct FTFs like Figures 1 and 3, with postmodifying clauses instead of PPs, and repeat the search procedure with ICE-GB. Following de-duplication we obtain Tables 3 and 4, and we plot graphs for ICE-GB, plus speech and writing separately, in Figure 6.

We see a familiar pattern,  $p(\text{last}) > p(\text{first})$ , and  $p(\text{final}) > p(\text{initial})$ . A higher proportion of postmodified clauses are observed in the final position in the sequence of conjoins. We also have evidence of an increased ‘both’ pattern.

| CJ, PP +CL | - last            | + last | total  | $p(\text{last})$ |
|------------|-------------------|--------|--------|------------------|
| - first    | 157               | 21     | 178    |                  |
| + first    | 4                 | 4      | 8      | 0.5000           |
| total      | 161               | 25     | 186    | 0.1344           |
|            | $p(\text{first})$ | 0.1600 | 0.0430 |                  |

Table 3. Contingency table for independent decisions to have a postmodifying clause in first or last place for conjoined PPs, all ICE-GB data,  $\phi = 0.2272$  (0.0544, 0.4645).

| CJ, NP +CL        | - last | + last | total  | $p(\text{last})$ |
|-------------------|--------|--------|--------|------------------|
| - first           | 2,031  | 152    | 2,183  |                  |
| + first           | 9      | 27     | 36     | 0.7500           |
| total             | 2,040  | 179    | 2,219  | 0.0807           |
| $p(\text{first})$ |        | 0.1508 | 0.0162 |                  |

Table 4. Contingency table for independent decisions to have a postmodifying clause in first or last place for conjoined PPs, all ICE-GB data,  $\phi = 0.3156$  (0.2292, 0.4044).

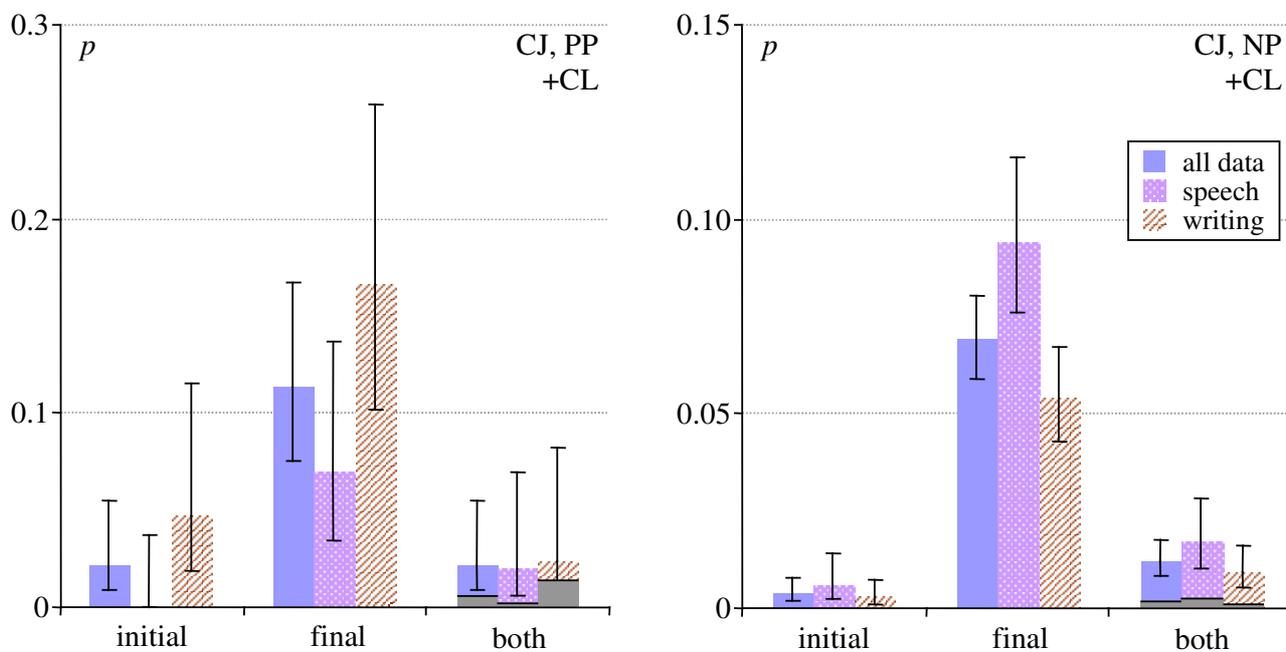


Figure 6. Probability distributions for clausal postmodification – left, conjoined prepositional phrases, and right, noun phrases.

With conjoined noun phrases, we have nearly ten times the data and obtain a more reliable result. Figure 6 (right) is very similar to Figure 5, indicating that prepositional phrases and clauses both share the same tendency to end-weight, and both may involve templating.

End-weight odds for all ICE-GB data are  $5.25 \in (1.88, 14.62)$  for the clausal postmodification of prepositional phrases, and  $16.89 \in (8.72, 32.69)$  for noun phrases.

With noun phrases, we can report that not only are the final end-weighted cases the most common, but double-postmodified cases exceed those where only the first noun phrase is postmodified by a clause, i.e.  $p(\text{both}) > p(\text{initial})$ .

There is also evidence of a significant difference between speech and writing for  $p(\text{final})$ , but we should be wary of making claims on the basis of a single datapoint.

### 3. Discussion

#### 3.1 The (directional) causality trap

Haunting this article is the spectre of *directional explanations*. Observing a high number of conjoined-final ‘heavy’ phrases, we are tempted to infer directionality of decision making and thus influence. If we plot graphs like Figure 2, this temptation becomes even greater. The gradient for  $p(\text{last})$  tends to be steeper than that for the opposite inference. In the case of postmodified noun phrases we can obtain a *significantly* steeper result.

But what does this mean? We could claim that where a gradient in one direction is found to be significantly greater than another, this gradient is likely to be seen in future data. This means that

we might say *the prediction* is reproducible, but it does not mean that the reason this pattern is observed is due to a particular underlying *process*.

But as we have seen, this result can also be explained as a mathematical artifact of two other facts: that conjoins are end-weighted ( $p(\text{last}) > p(\text{first})$ , and  $p(\text{final}) > p(\text{initial})$ ) and that the intersection (the doubly-postmodified ‘both’ pattern) is greater than expected.

In fact, any observed pattern like this is the aggregate result of *multiple* patterns and tendencies, idiomatic expressions and schema, as well as genuinely independent decisions which influence one another.

As with any correlation, great care should be taken not to interpret a directional correlation as evidence of causality. We cannot know for certain that a decision regarding adding a postmodifier to the first conjoin is made prior to a decision to add one to the last, however intuitive or seductive this reasoning might be. Human mental processing is highly parallelised, and conjoins might be constructed internally in parallel, and only *articulated* in a single order.

Finally, although we see an elevated rate for cases where both first and last conjoin is postmodified, this might be due to a specific set of cases, such as idiomatic patterns or templating.

There are some circumstances in corpus linguistics where direction might be deduced, for example where one speaker primes another. But greater care must be applied when dealing with linguistic interaction research within an utterance by the same speaker. For a start, direction does not automatically accord with word order. We have previously discovered interactions between decisions that are only credibly explained by planning ahead, such as attributive adjective phrases conditioned by the semantics of the head that follows. When I say *the large grey cat*, I have a mental picture of the cat I am describing to you, and I am constrained by the eventual noun I might possibly eventually utter – *cat, feline, animal, creature*, etc.

Similarly, objective *who/whom* alternation is shown to interact with a following subject (Wallis (2021: 39). The choice of subject, like the choice of noun phrase head, necessarily concerns the overarching intended meaning of the clause or phrase.

In some processes, we might advance an argument that some decisions are likely to be made in a particular order because the option to add a second term only arises should the first be made, such as in *embedded* constructions (Wallis 2019). However, even embedding may involve a degree of look-ahead. Wallis (2022b) finds evidence that proper nouns postmodified by PPs found in titles appear to defy the expectation of a declining additive probability. Although analysed grammatically as multi-level embedding, the rise in probability observed appears to be only explicable by ‘chunking’ (the construction is introduced as a single unit), or the application of a title ‘formula’, such as *the X of Y*, e.g. *the Duke of York*.

In our case, a plausible cognitive model *could* hypothesise that the memory and attention demands of introducing an additional PP mitigates against it being added in the initial position, but this pattern in the data might be explained as a result of some other (possibly as yet unknown) phenomenon.

### 3.2 Templating evidence

Doubly or multiply-postmodified compounds may also be examples of *templating*, which can only be properly determined by a close reading of cases. Templating is a type of *lexical-syntactic repetition*, where a language producer re-uses a structure (a template) that they had recently used.

Templating could have cognitive or communicative origins. A producer-centred cognitive explanation would assume that it is easier to produce an utterance when re-using recently activated structures, i.e. we engage in ‘self-priming’. Alternatively a hearer-centred communicative explanation might emphasise how we accommodate to our audience by producing utterances that they are more likely to follow because we repeat structures our audience anticipate. Socially and historically, the latter may also be conscious performance: rhetoric, emphasis, and poetics (Tannen 1987).

The following examples could be evidence of this phenomenon. Example (5) is an example of conjoined PPs, and (6) is one of conjoined NPs.

- (5) ...*a lot of respect* [*for some* [*of them*]] *and not* [*for a lot* [*of them*]] [S2A-050 #32]
- (6) ... *information* [*about chemical companies* [*in Dorset*]] *and other companies* [*in West Sussex*]]... [S1B-064 #175]

Templating may also involve numbers and ranges, as in (7) and (8).

- (7) ...*Prime Minister* [*in twenty-three* [*to twenty-four*]]] *and* [*from twenty-nine* [[*to thirty-five*]]] [S2B-035 #106]
- (8) ...*improvements* [*to some six hundred miles* [*of motorways*]] <,> *and nine hundred miles* [*of trunk roads*]] <,> [S2A-023 #91]

Finally, there are examples of clear evidence of forward planning.

- (9) But is all *the talk* [*about change* [*of attitudes*]] <,> *and specifically* [*of switch* [*of priorities* [*to community policing*]]] <,> too complacent <,> [S2B-037 #35]
- (10) *The recent experience* [*of the Soviet Union* [*in Afghanistan*]]] *and* [*of Argentina* [*in the Falkland Islands*]]]... [W2E-001 #39]

The final PP *to community policing* in Example (9) is analysed by the ICE-GB annotators as embedded within the final PP postmodifying *priorities*, but it might also arguably be attached to *attitudes* (or *switch*).

Like our premodified noun phrase head *cat*, the speaker presumably has the concept of *community policing* in their head at the time of utterance. Had they not uttered the second conjoin, the sentence would have been something like Example (9').

- (9') But is all *the talk* [*about change* [*of attitudes* [*to community policing*]]] <,> too complacent <,> [S2B-037 #35]

Likewise, the entire expression *the recent experience...* in (10) is the subject of a clause.

In short, even in spontaneous speech, speakers plan constructions ahead. Although prepositional phrases and clauses are embedded, they appear to have limited processing cost for the speaker.

In Appendix 1 we review all cases of prepositional phrase double PP-postmodification, finding at least 7 out of 13 with features that suggest templating. Even with a strict identical-preposition criterion, these are more than sufficient to explain the excess numbers identified in Section 2.2.

### 3.3 *The effect of order*

Are our results due to order effects? We previously noted a distinction between unordered and ordered conjunctions, including exclusionary (e.g. *and not*), specificatory (*or precisely*) and logical (*and therefore*) conjunctions. The alternate hypothesis is that we are seeing an effect of ordering on end weight.

To test this, we repeat the entire exercise, but require that the conjunction is *and* or *or*, and that it immediately precedes the last conjoin. A close reading of the resulting set reveals that conjoins may still be ordered, however. Consider Example (11), where the final conjoin has an anaphoric reference to the first, *in some other part*.

- (11) The mechanisms responsible for such adaptation ...may be due to *changes* [*in the receptors themselves*]] *or* [*in some other part* [*of the receptor-response system*]]]. [W2A-025 #70]

Although these cases are rare, this illustrates the difficulty of ensuring that conjoins are genuinely unordered. The conjoins are not simply reversible.

A second weakness is that the restriction to *and* and *or* conjunctions rules out asyndetic cases (those without conjunctions), and some cases, such as *as well as*, that are also unordered. Despite these objections, it is a robust method, and concords well with a manual evaluation of cases for semantic reversal.

What is the result? Overall, limiting cases to *or* and *and* reduces the dataset by between 25 and 50% for PP modification and 10 to 20% for NP postmodification. But the results are not significantly different from before, and the graphs are similar. We apply separability tests to evaluate this. In all cases (including subdivisions of data into speech and writing), we obtain initial-final differences,  $d = p(\text{final}) - p(\text{initial})$ . If we apply a Newcombe-Wilson gradient separability test (Wallis 2021: 245) to compare these difference scores, we find no significant difference between scores with or without the ordering restriction applied. Comparing odds and  $\phi$  scores also fails to detect a significant difference.

We are unable to reject the null hypothesis that the data are similar, and there is no evidence that conjunction ordering effects explain our results.

### 3.4 Adjective phrase, PP and clausal distributions

As a final step, and to round off this paper, we will compare the relative proportions of elements across the three patterns, initial, final and both. In addition to postmodifiers we also include adjective phrases, as the most common premodifier, in our analysis.

Considering distributions across all ICE-GB data (Figure 7), we might summarise our results as showing a tendency for more prepositional phrases than clauses in each position, that both patterns consistently show more ‘both’ cases than are predicted by an independence assumption, indicating templating as a possible cause, and we see evidence of end weight,  $p(\text{final}) > p(\text{initial})$ .

Premodifying adjective phrases also add to the ‘weight’ of a conjoin, but these results are more inconsistent.

We suspect that this is because another factor is in play, namely ambiguity of scope.

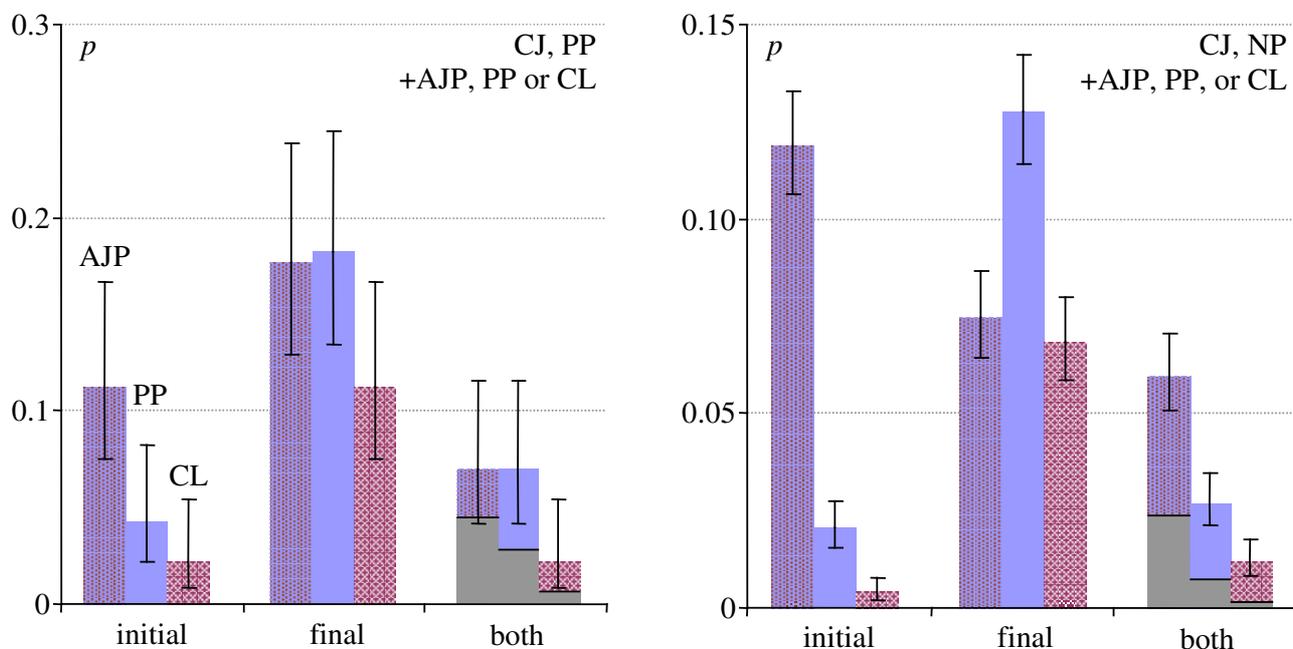


Figure 7. End-weight and templating analysis, comparing adjective phrase premodifiers (first column) with prepositional phrase and clause postmodifiers, all ICE-GB data.

Although a close reading of cases reveals few cases of scope ambiguity with postmodifying clauses and phrases (cf. Example (1) in the introduction), adjectives are infamous for this problem,

especially with small phrases (e.g., *young gay men and women* (S1B-045 #57)). This is a possible explanation for the high numbers of first-only adjective phrase examples for conjoined noun phrases (Figure 7, right). A close reading of these examples might inform.

## 5. Conclusions

In each of the four patterns of coordination and postmodification we have examined, the consistent tendency is to postmodify the last conjoin over the first, i.e.  $p(\text{last}) > p(\text{first})$ , and  $p(\text{final}) > p(\text{initial})$ , in each case. This phenomenon can be reliably found for both speech and writing.

We also see an elevated rate of the intersection, i.e. cases where conjoins are postmodified in *both* first and last position occur in greater numbers than would be expected by chance. In other words, the intersection probability,  $p(\text{first} \wedge \text{last})$ , is greater than the independent product  $p(\text{first}) \times p(\text{last})$ . In each pattern, more than half of the cases with a postmodified conjoin in the initial position have a postmodified conjoin in the final position.

In cases of conjoined NPs, we might also observe a statistically significant difference in Church's gradient ( $p(\text{first} | \text{last}) - p(\text{first})$ ). However, this is a mathematical consequence of these first two observations, and should not imply a greater *influence* in one direction than another.

Rather than infer that this is evidence of direction of decision making, it makes more sense to pay attention to possible explanations for the increased prevalence of double postmodification. One possible reason concerns 'templating', a tendency to reuse a construction. This might have cognitive efficiency benefits, or be motivated by communicative reasons, such as for rhetoric or emphasis. To illustrate this we identify plausible templates for PP-postmodified conjoined PPs. Once those cases are subtracted from the total, the observed significant difference disappears.

There are, of course, a range of additional ways one might extend this research, such as estimating complexity and interpreting the linguistic strategies of speakers and writers.

We might also more rigorously determine criteria for identifying potential instances of templating. On an exploratory basis we opted for *like prepositions* (both prepositions should be essentially the same) and *semantically comparable NP heads* (the two heads should be semantically of the same class). However the latter criterion is not very well-defined. Thus in Appendix 1, I suggested that *range of different groups* and *functioning of the organisation* are referring to different dimensions of disparate items, whereas *purposes of the school* and *Code of Practice* were semantically comparable. Others might employ a more restrictive definition of templating.

We briefly explored the role of *specific conjunctions* in the sequence. The semantics of conjunctions could matter for two potential reasons. The first is ordering, for which we obtained data. An ordered coordination like *X but not Y* might be reworded as *not Y but X*, but this seems awkward. In such cases, what we called the 'free' decision to postmodify the first or final conjoin seems to be more constrained. Examples of ordered constructions were noted in the introduction, and are highlighted in Appendix 1. We therefore investigated if this was a possible explanation for our results. We restricted data to cases with only *and* or *or* conjunctions, and repeated our experiments for these unordered (syndetic) examples. Statistically similar results were found, albeit based on less data.

The second reason to examine conjunctions is *syndeticity*, which becomes potentially interesting for coordination patterns consisting of three or more conjoins. We might wish to distinguish between *asyndetic* (no conjunctions), *syndetic* (a single conjunction prior to the final conjoin) and *polysyndetic* coordination (conjunctions prior to each conjoin). In particular, syndetic coordination would appear to indicate foresight that the final case was in fact the final one, a signal of planned ordering that – in speech at least – would belie a post-expression 'on the fly' interpretation of evidence of end-weight bias. However, coordination with greater than two conjoins are relatively infrequent in our data, and we are likely to need a larger corpus to examine this question properly.

## References

- Bresnan, J., A. Cueni, T. Nikitina & R.H. Baayen 2007. Predicting the Dative Alternation. In G. Bouma, I. Kraemer, & J. Zwarts (eds.), *Cognitive Foundations of Interpretation*. Amsterdam: KNAW. 69-94.
- Church, K. 2000. Empirical Estimates of Adaptation: The chance of Two *Noriegas* is closer to  $p/2$  than  $p^2$ , *Coling*, 173-179.
- Cowan, R. 2008. *The Teacher's Grammar of English with Answers*. Cambridge: CUP.
- Kaltenböck, G. 2020. Chapter 22 in Aarts, B., Popova, G. and Bowie, J. (eds.) *The Oxford Handbook of English Grammar*. Oxford University Press.
- Nelson, G., B. Aarts & S.A. Wallis 2002. *Exploring Natural Language: Working with the British Component of the International Corpus of English*. Varieties of English Around the World series. Amsterdam: John Benjamins.
- Tannen, D. 1987. Repetition in Conversation: Toward a Poetics of Talk. *Language* 63(3), 574-605.
- Wallis, S.A. 2019. Investigating the additive probability of repeated language production decisions, *International Journal of Corpus Linguistics*, 24(4), 492-525.
- Wallis, S.A. 2021. *Statistics in Corpus Linguistics Research: A new approach*. Routledge: New York.
- Wallis, S.A. 2022a. *Accurate confidence intervals on Binomial proportions, functions of proportions, algebraic formulae and effect sizes*. London: Survey of English Usage.
- Wallis, S.A. 2022b. *Are embedding decisions independent? Evidence from preposition(al) phrases*. London: Survey of English Usage.
- Wallis, S.A. 2022c. *Confidence intervals for the ratio of competing dependent proportions*. London: Survey of English Usage. <https://corplingstats.wordpress.com/2022/06/27/confidence-intervals>.

## Appendix 1: Templating in double-postmodified prepositional phrases

The table below lists the 13 cases found in ICE-GB where conjoined prepositional phrase were themselves postmodified by a preposition. We may consider two criteria for evidence of templating: whether the prepositions are alike and whether NP head semantics are comparable.

Both criteria hold for instances 2, 4, 8, 9, 10, 12 and 13, i.e. 7 out of the 13. Instance 3 repeats the initial *as regards* and 11, *of*. Instance 5 concerns numbers, but the initial prepositions (*in, from*) differ. Instance 1 seems wrongly classified as coordination. Nevertheless, even were we to take a strict interpretation of templating as requiring identical prepositions and semantically comparable nouns, we would be left with 6 out of 13 cases that were not necessarily paradigmatic.

We may also consider the conjunction. We can see several cases (highlighted) where the order of conjoins is mandated by the conjunction, e.g. exclusionary (*and not*), or specificatory (*that is to say, and specifically, not just...but also*, etc).

Examples in the top half of the table are found in speech (1-6), the remainder are written.

| Example  | prepositions              | head nouns            |
|--|---------------------------|-----------------------|
| 1. Well there is <i>reference to the leader of Her Majesty's opposition to one of the salaries uhm legislation</i> but it doesn't refer to a party [S1B-011 #62]   | ✓ to...of...              | ✗ leader/one          |
| 2. ...even though I got the you know <i>a lot of respect for some of them and not for a lot of them</i> was a reporter <,> [S2A-050 #32]   | ✓ for...of...             | ✓ some... a lot       |
| 3. ...the arbitrators did not give the charterers a proper opportunity to present <i>their case as regards the scope of the arbitrators' jurisdiction or as regards their the charterers' liability for these further instalments</i> <,> [S2A-065 #10]  | 1 as regards... of/for... | ✓ scope/liability     |
| 4. I assume here <,> uh that the arbitrators have <i>jurisdiction only in respect of an accrued causes of action that is to say in respect of those instalments of hire uh which have already become due</i> and as I've already said that there is a separate cause of action in respect of each instalment [S2A-065 #54] | ✓ in respect of... of...  | ✓ causes/ instalments |

| Example   | prepositions          | head nouns                 |
|---|-----------------------|----------------------------|
| 5. Ramsay Macdonald the illegitimate son of a fishwife <i>Prime Minister in twenty-three to twenty-four and from twenty-five to two twenty-nine to thirty-five</i> [S2B-035 #106]   | 1 in/from... to...    | ✓ (number ranges)          |
| 6. But is <i>all the talk about change of attitudes &lt;,&gt; and specifically of switch of priorities to community policing &lt;,&gt; too complacent &lt;,&gt;</i> [S2B-037 #35]   | ✗ about/of... of...   | ✓ change/switch            |
| 7. ...decisions were identifiably of political importance because they were seen to imply <i>major changes for a wide range of different groups and for the functioning of the organisation as a whole</i> . [W2A-011 #77]  | ✓ for...of...         | ✗ range/functioning        |
| 8. It is <i>a call for discretion towards the international environment and for an end to appropriating apparent conflicts with stereotyped enemies for the domestic political game</i> . [W2A-017 #84]   | ✓ for... to(wards)... | ✗ discretion/end           |
| 9. there is evidence of a similar type to suggest that VIP mediates <i>the effect of vagal stimulation on the flow of pancreatic juice in some species, and on the inhibition of gastric motility in the presence of atropine</i> . [W2A-027 #100]  | ✓ on... of... in...   | ✓ stimulation/inhibition   |
| 10. What the British listener will immediately register is <i>the powerful underlying influence of Gilbert and Sullivan, not just in the plot – with Gilbertian situations exploited – but also in the music, with patter-songs and choral descants used in a very Sullivan-like manner</i> . [W2B-008 #163]  | ✓ in... with...       | ✓ plot/music               |
| 11. Designated courses are those leading to: • <i>a first degree of a university in the United Kingdom or of the CNAA, including courses provided jointly by an establishment in the UK and an overseas establishment...</i> [W2D-003 #25]  | 1 of... in/including  | ✓ university/CNAA          |
| 12. The Regulations exist to maintain these conditions, in <i>accordance with the purposes of the School as set out in paragraph 3 (a) of its Memorandum and Articles of Association, and with the Code of Practice on Free Speech</i> , and to protect the School from actions which would damage its reputation or the standing of the School and its members. [W2D-007 #130] | ✓ with... of...       | ✓ purposes/Code            |
| 13. <i>The recent experience of the Soviet Union in Afghanistan and of Argentina in the Falkland Islands ought to have warned him...</i> [W2E-001 #39]  | ✓ of... in...         | ✓ (countries... conflicts) |