

The sequencing of adverbial clauses of time in academic English: Random forest modelling of conditional inference trees

Abbas Ali Rezaee and Seyyed Ehsan Golparvar
University of Tehran, Tehran, Islamic Republic of Iran

ABSTRACT

Adverbial clauses of time are positioned either before or after their associated main clauses. This study aims to assess the importance of discourse-pragmatics and processing-related constraints on the positioning of adverbial clauses of time in research articles of applied linguistics written by authors for whom English is considered a native language. Previous research has revealed that the ordering is co-determined by various factors from the domains of semantics and discourse-pragmatics (bridging, iconicity, and subordinator) and language processing (deranking, length, and complexity). This research conducts a multifactorial analysis on the motivators of the positioning of adverbial clauses of time in 100 research articles of applied linguistics. The study will use a random forest of conditional inference trees as the statistical technique to measure the weights of the aforementioned variables. It was found that iconicity and bridging, which are factors associated with discourse and semantics, are the two most salient predictors of clause ordering.

Keywords:
positioning,
discourse,
semantics,
processing,
iconicity

1

INTRODUCTION

Previous research on subordinate adverbial clauses has revealed that the majority of these clauses are mainly put in initial and final posi-

tions (Aarts 1988; Kirk 1997; Diessel 1996, 2001; Givón 2011). These two clause positions serve different discourse functions.

Adverbial clauses that are sentence-final usually play a local function. They illustrate the conditions of their matrix clause by specifying reason, temporal circumstances, result, etc. Further, such adverbial clauses are usually unidirectional; they are linked to their main clauses as already stated. Post-posed adverbial clauses offer information which is more integrated with the matrix clause at the local level (Thompson *et al.* 2007). Moreover, such adverbial clauses are mostly placed in the middle position of a paragraph; that is, adverbial clauses in final position are usually in the middle of a firmly coherent thematic chain (Givón 2001). In terms of semantics, the information encoded in sentence-final clauses tends to be in line with the information expressed in clauses that are in coordination (Ford 1993; Givón 2001).

On the other hand, sentence-initial adverbial clauses play a stringently local function, but have broader discourse-organizing functions by dint of enumerating a new frame for the coming discourse or connecting it to the preceding discourse. Furthermore, the cohesive function of pre-posed clauses may occur at different levels, from the whole discourse to inter-paragraph and inter-sentential levels. The inter-sentential function may be deemed as a local back-referencing function yielding a close connection between two sentences, “while the higher-level function marks the episode boundary or thematic discontinuity” (Thompson *et al.* 2007, p. 289). It should be observed that whether local or global, initial adverbial clauses play a bidirectional function, connecting what has been stated before to what is to be expressed. In addition, semantic information offered by pre-posed clauses is less significant due to the fact that they often repeat or give predictable information from what has already been stated (Thompson *et al.* 2007).

Thus, the two ordering patterns of adverbial clauses are not necessarily interchangeable in the academic discourse and writers of research articles should be cognizant of when to employ each of these positions in their texts.

The present study intends to examine the constraints on the positioning of temporal adverbial clauses in research articles of applied linguistics. Further, this research seeks to measure the weight of processing-based and discourse-pragmatics constraints on the po-

sitioning of finite, temporal adverbial clauses by means of a random forest of conditional inference trees, which has proved to be more efficient than ordinary regression models (Tagliamonte and Baayen 2012; Wiechmann and Kerz 2013).

2

BACKGROUND

Two approaches have attempted to account for the positioning tendency of adverbial clauses in English. The first approach is grounded upon the fact that the order of linguistic items, including finite adverbial clauses, is primarily influenced by the information structure of the string. Proponents of this discourse-based account (e.g., Chafe 1984; Birner and Ward 1998) have put forward the argument that users of a language tend to produce new, inaccessible information, which is reflected in the main clause, after given, accessible information that is expressed by the subordinate clause.

Two factors encourage speakers and writers to place adverbial clauses in the initial position, namely the ‘bridging’ function and the ‘setting the stage’ function. Sentence-final adverbial clauses serve local functions, whereas sentence-initial adverbial clauses play discourse-organizing functions. Two instances of discourse-organizing functions are connecting the sentence to the preceding discourse and introducing new frames for upcoming discourse (Ford 1993; Verstraete 2004; Thompson *et al.* 2007; Givón 2011).

The current study, like Wiechmann and Kerz (2013), only focuses on one discourse-pragmatic factor: bridging. It refers to a context in which an initial adverbial clause acts like a bridge between the previous and the upcoming discourse. The presence of an anaphoric item in an adverbial clause marks the bridging function of that clause. In example (1), the underlined part is a sentence-initial temporal clause and the anaphoric item THEIR plays a bridging function, connecting the previous sentence to the upcoming discourse.

- (1) This article explores the citing behaviours of 16 undergraduates in a North American university. After completing a research paper for their disciplinary courses, each participating student was interviewed to identify in his/her writing words and ideas borrowed from source texts and to explain why and how the relevant texts were appropriated with or without citations. (Shi, 2010)

The semantic nature of the subordinate clauses is the other factor examined in the discourse-based approach. To put it differently, the semantic difference observed among different types of adverbial clauses (such as adverbial clauses of time, condition, concession, etc.) cause them to occupy different positions within a complex sentence (Quirk *et al.* 1985; Biber *et al.* 1999; Diessel 2005, 2008; Wiechmann and Kerz 2013). For example, Diessel (2001) showed that conditional clauses usually precede their associated matrix clauses, causal clauses are usually sentence-final, and there is a roughly even distribution between initial and final temporal adverbial clauses. Diessel (2001) also revealed that adverbial clauses of reason and purpose are predominantly placed in the final slot. Moreover, concessive clauses show a slight preference for the final position (Biber *et al.* 1999; Diessel 2001; Wiechmann and Kerz 2013). Clauses headed by different subordinators display slight differences in meaning. Thus, any subordinator selected for adverbial clauses is deemed as a predictor of the positioning of these clauses (Wiechmann and Kerz 2013). For example, IF and UNLESS are the most common subordinators for adverbial clauses; however, IF is the most versatile conditional subordinator. According to Quirk *et al.* (1985), WHEN, AFTER, and BEFORE are the most frequent temporal subordinators in academic English, which will be the focus of this study.

Iconicity is another factor that affects the order of temporal adverbial clauses. According to Croft (2003), the main idea underlying iconicity is that the structure of language is a reflection of the structure of experience. Haiman (2015) has asserted that some of the most basic principles and rules of language tend to be ironically motivated. “The meaning of a complex expression is in some way the sum of the meanings of its parts”, “Conceptual closeness of ideas is reflected in physical closeness of their expression”, “The same form is used for same meaning”, and “More form reflects more meaning” (Haiman 2015, p. 512) are some of the iconic principles of language.

It has been suggested that the order of clauses in complex sentences often corresponds to the order of events they describe (Diessel 2008; Haiman 2015). Previous studies have demonstrated that this tendency is able to account for the positioning of some types of subordinate clauses. For instance, Haiman (1983) showed that conditional clauses are usually placed in the sentence-initial position since the

event they describe is conceptually prior to the one denoted by the matrix clause. Similarly, Greenberg (1963) has argued that purpose clauses follow their associated matrix clause because they express the upshot of the action denoted in the main clause. In a similar vein, it has been suggested that AFTER clauses are put in initial position more frequently than BEFORE clauses, because the former denote an event that takes place prior to the one in the matrix clause, while BEFORE clauses describe a posterior event (Clark 1971).

The other approach attempting to account for the ordering of dependent clauses considers processing-related factors. These accounts expound the positioning of an adverbial clause on the grounds of constraints like the relative length of the clause, complexity, and deranking. The most prominent supporter of this account is John Hawkins (Hawkins 1994, 2004), claiming that the constituent order is basically determined by processing difficulty. Hawkins has explained that information structure comes to the scene only when two alternative orders are equally demanding with regard to processing.

The first processing-related factor co-determining the order of temporal adverbial clauses is the length of the constituents. Past research has clearly demonstrated that in languages like English longer constituents usually come after shorter ones (Quirk *et al.* 1985). This tendency can be explained based on the notion that the processing of the whole construction (complex sentence) appears to be more smooth with this order (Hawkins 1994, 2004; Gibson 1998, 2000). In line with Hawkins' performance-based theory of constituent ordering (Hawkins 2004), constituents deemed to be heavy tend to appear in the final slot, because this ordering is cognitively more efficient in languages which are head-initial, rendering both production and parsing easier.

In a similar vein, the dependency locality theory propounded by Gibson (2000) assumes that the processing complexity of a linguistic string rests on the length of its syntactic dependencies. The complexity effects on ordering follow from the integration cost component determining that longer distance attachments are more demanding to produce in comparison with shorter distance ones (Hawkins 1994). Temporal adverbial clauses that are placed in the initial slot yield longer dependencies and are hence more burdensome to process.

We may also resort to a pragmatics, information-structural account to shed light on the tendency of 'lighter' constituents to precede

'heavier' ones in accordance with the 'given-new' principle (Arnold *et al.* 2000), paying attention to the fact that new information requires more linguistic materials to be encoded compared to given information. The discourse-pragmatics account has also revealed that the informativeness increases towards the end of each grammatical unit, for both clauses and multi-clause expressions. Thus, length is a salient predictor of the positioning of adverbial clauses.

The second predictor of clause positioning that is related to processing difficulty is complexity. There are a number of definitions and accounts of complexity such as relative complexity (Vulanovic 2007), absolute complexity (Miestamo 2004), language complexity (Hawkins 1994, 2004), and complexity in terms of informativeness (Li and Vitányi 1997). Adverbial clauses of time may show different degrees of complexity. It may be expected that pre-posed adverbial clauses are structurally less complex. Following Diessel (2008) and Wiechmann and Kerz (2013), in this study we consider only those dependent clauses as complex that contain at least another dependent clause of any kind. We should bear in mind that linguistic complexity and the length of adverbial clause are closely tied to each other. Adverbial clauses containing another subordinate clause – complex adverbial clauses – tend to be longer and hence are more demanding to process. Consequently, it can be assumed that complex adverbial clauses of time are usually post-posed.

Wiechmann and Kerz (2013) have noted that deranking is another processing-related factor affecting the ordering of temporal adverbial clauses. Based on Stassen (1985), languages may apply two basic strategies in coding two linked clauses coming in a fixed temporal order. In the first strategy, called *balancing*, the two clauses have verb forms that are structurally equivalent, each of them occurring in one independent clause. Example (2) is an illustration of this strategy.

(2) His father died before he was born.

In the second strategy, *deranking*, a verb form that cannot come in an independent clause is used in the dependent clause. A deranked verb form is different from its balanced counterpart in two ways: (1) the categorical distinctions usually associated with verbs in language, like tense, aspect, mood, or person distinctions, are totally or partially absent, (2) particular markings that are not allowed to be used in in-

dependent clauses are used in dependent clauses (Cristofaro 2003). Consider example (3):

(3) Coming home, he directly went to bed.

In other words, an adverbial clause in English is ‘balanced’ if it is tensed, whereas it is perceived as ‘deranked’ provided that it is not tensed but reduced in some way. Deranked adverbial clauses consist of a non-finite verb form or are used as a verbless construction (Wiechmann and Kerz 2013). Consider Example (4):

(4) The findings indicate that a significant percentage of the subjects experience difficulties *when studying content subjects through the medium of English.* (Evans and Green 2007)

In Example (4), the italic part is a deranked temporal adverbial clause in which ‘studying’ is a verb without tense. It might be assumed that balanced adverbial clauses tend to be longer than deranked ones and consequently their processing can be more difficult. However, this is not always true; as Cristofaro (2003) and Wiechmann and Kerz (2013) have noted, non-finite or verbless adverbial clauses present information in a more condensed format. Therefore, reduced or deranked adverbial clauses involve greater syntactic integration and more informational compactness and can be much more demanding in processing, which can move them to the final slot.

Recent inquiries on clause positioning have demonstrated that a variety of constraints, the effects of which may be in conflict, condition the ordering of finite adverbial clauses. They have revealed that the ordering of main and adverbial clauses is determined by the interaction between processing, discourse, pragmatics, and semantics (Wasow 2002; Diessel 2005, 2008; Wiechmann and Kerz 2013).

Diessel (1996) examined the processing factors of initial and final adverbial clauses. Particularly, Diessel examined the ordering of finite adverbial clauses (such as adverbial clauses of condition, concession, time, reason, and manner) in light of Hawkins’ processing principles (Hawkins 1994). Diessel (2008) also explored the impact of several factors (including: length, complexity, pragmatic import, and the principle of iconicity) on the ordering of adverbial clauses of time, and demonstrated that iconicity of sequence is the most powerful predictor of the positioning of temporal adverbial clauses. Finally, Wiech-

mann and Kerz (2013) made an assessment of the weight of discourse-pragmatics and processing-based constraints on the ordering of concessive adverbial clauses. They revealed that discourse-pragmatics factors, namely bridging and subordinator choice, are the stronger factors predicting the positioning of concessive adverbial clauses.

3 METHOD

3.1 *Corpus*

A corpus of 100 research articles written by native speakers of English was compiled for this experiment.

The articles were randomly sampled¹ from a set of articles published in each of ten applied linguistics/language learning/language teaching journals.² Ten articles were selected from each journal. All these articles were filtered so that only those with the standard IMRD (Introduction, Methods, Results, and Discussion) format were included.

3.2 *Data annotation*

In this study, the position of temporal adverbial clauses (POS) is the dependent variable which is measured as a binary factor having two levels that are final (POS 1) and initial (POS 0). In addition, the predictors of clause ordering are bridging, subordinator, iconicity, length, complexity, and deranking. Bridging (BRG) is measured on a binary basis with two levels that are containing an anaphoric item indicating a bridging context (BRG 1) and absence of such an item (BRG 0). Subordinator is a categorical variable with three levels, namely WHEN (SUB 0), AFTER (SUB 1), and BEFORE (SUB 2). According to Quirk

¹We enumerated all articles published in all ten journals between 2001 and 2014, then performed stratified random sampling using random number tables from Stat Trek (<http://stattrek.com/Tables/Random.aspx>).

²The ten journals from which we sampled articles are: Annual Review of Applied Linguistics; Applied Linguistics; ESP Journal; EAP Journal; Language Learning; Language Teaching Research; System; Second Language Research; Second Language Writing; and TESOL Quarterly. These journals may contain different types of articles (research articles, reviews, editorials); only research articles were included in the corpus compiled.

et al. (1985), these three subordinators are the most frequent temporal subordinators in the academic register. Iconicity is also measured on a categorical basis with three levels that are clauses referring to a prior event (ICN 0), clauses denoting a simultaneous event (ICN 1), and clauses expressing a posterior event (ICN 2).

As in Wiechmann and Kerz (2013), the relative length of dependent clauses (LNG) is measured as a continuous variable, which is defined as the proportion of the number of words in the adverbial clause to that of the whole complex sentence containing that clause. Complexity (COM) is binary variable with two categories: simple (COM 0) and complex (COM 1). Finally, deranking (DRK) is similarly a binary variable encoding balanced (DRK 0) and deranked (DRK 1).

3.3 *Data analysis*

The present research uses a *random forest of conditional inference trees*. Each forest is a large number of decision trees used for variable selection. Each decision tree is able to cope with missing values; nonetheless, use of one single tree may be unreliable due to the fact that minor changes in the input variables may bring about significant changes in the output. Therefore, selecting variables by means of a random forest of such trees is a far more efficient tool (Breiman 2001).

The preference for random forest modelling with conditional inference trees is rooted in the fact that it provides an unbiased tool for variable selection in the individual classification trees, enabling us to reliably assess the relative importance of variables coded on different scales or different with regard to the number of their factor levels. This is a salient deficiency of traditional tree-based models. In addition, the coefficients of logistic regression models are far more complex to interpret (Hothorn *et al.* 2006; Strobl *et al.* 2007).

Classification trees generally try to predict a binary outcome on the basis of a group of predictors. The algorithms by which classification trees operate work through the data and determine a number of if-then logical (split) conditions yielding definite classification of cases. To put it another way, in the initial step, the algorithm will split the data based on the most significant predictor. The algorithm will go on separating each resulting subset of the data until it can no longer find significant associations between the dependent variable and any of the predicting variables (Wiechmann and Kerz 2013).

By contrast, mixed effects models are grounded upon various assumptions concerning the distribution of the data and require the data to satisfy given requirements in order that such models' parameters be estimable: whereas random forests are non-parametric, rendering them a more flexible tool allowing the researcher to incorporate all potential predictors in the analysis concurrently, even if there exist severe interactions among these factors, there are highly unequal cell counts or even empty cells, or are collinear. If, instead, a linear modelling framework were to be used, it could result in potentially unsolvable computational problems (Strobl *et al.* 2007).

4

RESULTS

The findings of this study demonstrate that the majority of adverbial clauses of time (64.8%) are in final position. In addition, a considerable proportion of them are simple (88.4%), balanced (72.8%), have no anaphoric item suggesting a bridging context (91.6%), and begin with WHEN as the subordinator (80.8%). Moreover, their average length relative to the size of the whole complex sentence is 0.43. In addition, more than half of the adverbial clauses of time in this corpus (52.9%) denote a simultaneous event. Furthermore, temporal clauses expressing a prior event (37.8%) are far more frequent than those referring to a posterior event (9.3%). Table 1 reports some descriptive statistics with regard to the sample.

Figure 1 illustrates the distribution of these predictors across the two clause positions in this corpus of adverbial clauses of time. Figure 1 depicts that there is a significant distribution difference between initial and final adverbial clauses with regard to iconicity and bridging, and to a lesser extent, length. In addition, Figure 1 suggests that temporal adverbial clauses without a bridging function are mostly in final position, whereas those involving a bridging context are mainly sentence-initial. With regard to complexity, it is observed that in both simple and complex clauses, post-posed adverbial clauses outnumber pre-posed ones. Likewise, in both balanced and deranked clauses, temporal clauses in final position are more frequent than those in initial position. Further, in the three subordinators, sentence-final clauses are more frequent than sentence-initial ones. Finally, Figure 1 shows that temporal adverbial clauses expressing a prior event are

Sequencing of adverbial clauses of time in English

| Dependent variable | POS | Initial | Final |
|--------------------|--------------|---------------------------|---------------------|
| | | 35.2% | 64.8% |
| Predictors | BRG | Bridging | Non-bridging |
| | | 91.6% | 8.4% |
| | COM | Simple | Complex |
| | | 88.4% | 11.6% |
| | DRK | Balanced | Deranked |
| | | 72.8% | 27.2% |
| | SUB | When | After |
| | 80.8% | 11.9% | 7.3% |
| ICN | Prior | Simultaneous | Posterior |
| | 37.8% | 52.9% | 9.3% |
| LNG | Mean | Standard Deviation | |
| | 0.43 | 0.16 | |

Table 1:
Descriptive
statistics

more often in sentence-initial position, while temporal clauses referring to a simultaneous or posterior event usually follow their associated main clauses.

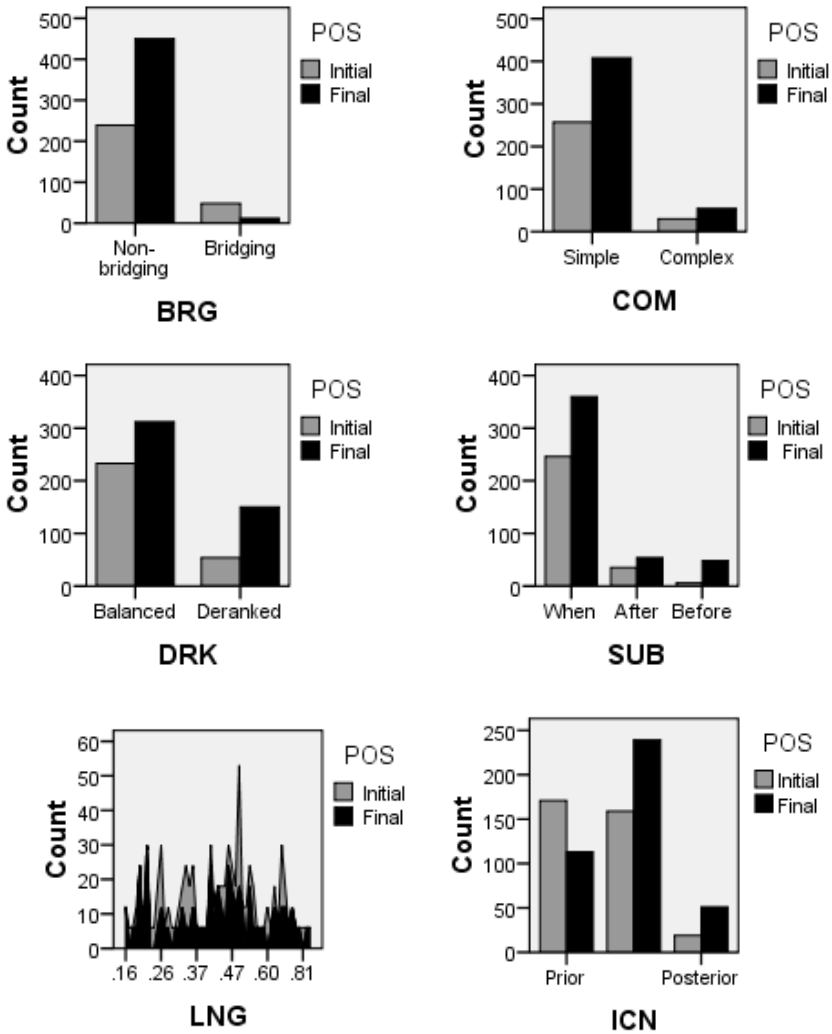
Figure 2 depicts the conditional inference tree. The analysis of this tree reveals that three of the predictors of the positioning of temporal clauses (subordinator, bridging, and iconicity) turn out to be significant predictors. Each oval denotes a split variable and the corresponding *p* value estimating the significance level. Moreover, the numbers on the lines linking the nodes of the tree show the particular categories of the nominal predictors or the value range of the numerical predictors.³

In order to interpret the tree, we should examine it from top to bottom. At the top of the tree representing all data in the first subset, the first split is made based on iconicity. Temporal adverbial clauses that are prior ($ICN \leq 0$) are split based on bridging (Node 2), whereas adverbial clauses of time that are simultaneous or posterior ($ICN > 0$) are further split based on their subordinator (SUB, Node 5).

The conditional inference tree clearly demonstrates that among the prior adverbials that lack a bridging context ($BRG \leq 0$), sentence-

³ It should be noted that the only numerical variable in this research is length.

Figure 1:
The distribution
of the six
predictors across
the two positions



initial clauses slightly outnumber sentence-final ones (Node 3, 468 cases), whereas those with a bridging context are mostly in the initial position (Node 4, 40 cases). On the other hand, among temporal clauses that are simultaneous or posterior ($ICN > 0$), those that are headed by WHEN or AFTER ($SUB \leq 1$) are predominantly in final position. This is observed in Node 6 with 128 cases. Moreover, adverbial clauses of time that are introduced by BEFORE are all post-posed (Node 7, 20 cases).

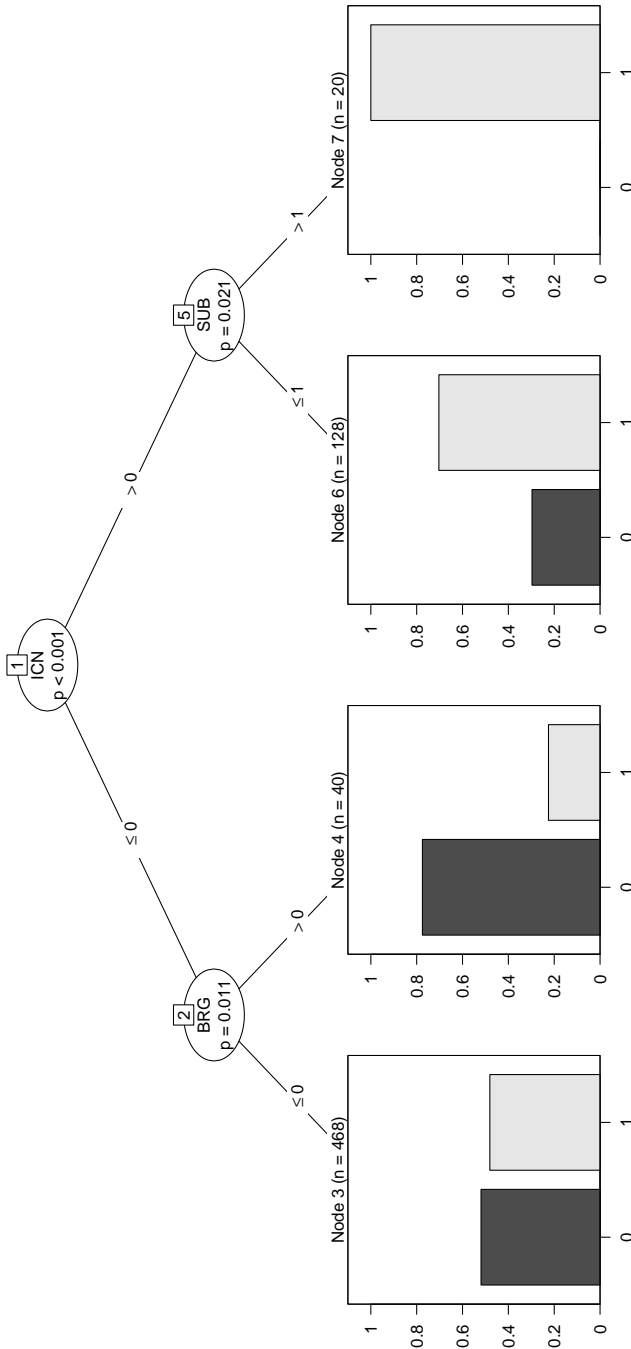


Figure 2: Conditional inference tree for clause positioning

A salient point with regard to a single-tree model is that such a model can yield problematic results. In order to solve this problem, a forest of such trees – rather than a single one – is built. This will produce more robust and generalizable findings (Breiman 2001). In this study a total set of 500 trees is built by means of a bootstrapping technique, in which 500 different random subsamples are taken from the original data.

In order to measure how salient each variable is for predicting the ordering of concessive clauses, a permutation variable importance measure is calculated. We used the conditional variable importance measure implemented in the `cforest` function of the `Party` package in R. In this estimation, the original values of the predictor are permuted to decouple the original association of the predictor and the response. This will demonstrate how much the overall classification accuracy of the model drops. The greater the decrease in classification accuracy is, the more useful that predictor is for modelling clause positioning. The superiority of the conditional variable importance measure over alternatives (e.g., Gini importance) lies in the fact that it is not biased in cases where explanatory variables are different in terms of their number of categories or scale of measurement (Breiman 2001). Figure 3 illustrates the variable importance plot for the six predictors measured by the random forest model.

Figure 3 demonstrates that iconicity is by far the most important variable for predicting the ordering of adverbial clauses of time in

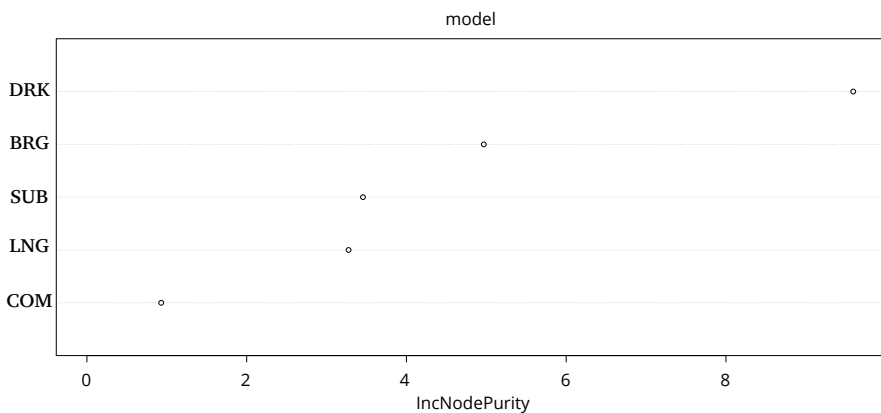


Figure 3: The variable importance plot

academic English. To put it differently, whether a temporal adverbial clause refers to a prior, simultaneous, or posterior event is the most significant factor determining the ordering of these constructions. Initial clauses mostly suggest a prior event and final clauses usually denote a simultaneous or posterior event. As depicted in Figure 3, bridging (whether temporal adverbial clauses contain an anaphoric item indicating a bridging context or not) is the second most important predictor of the positioning of adverbial clauses of time. Initial clauses mostly suggest a bridging context and final clauses usually do not have such a function. The conditional variable importance plot (Figure 3) also revealed that discourse-pragmatics motivators play a more important role in sequencing adverbial clauses of time.

5

DISCUSSION

The results of this research revealed that sentence-final adverbial clauses of time are more frequent than sentence-initial ones. In addition, the random forest of conditional inference trees demonstrated that iconicity of sequence is the most powerful predictor of the positioning of temporal clauses. Further, bridging turns out to be the second most important variable for predicting the position of these clauses. Consequently, factors associated with discourse and pragmatics can offer a better explanation for the ordering of adverbial clauses of time. Finally, among the motivators of clause order that are related to processing, length is a more powerful predictor of clause positioning in research articles of applied linguistics.

On the descriptive side, the findings of this research indicated that in adverbial clauses of time produced by native writers, sentence-final clauses (64.8%) outnumber sentence-initial ones (38.2%). This is supported by previous research (Chafe 1984; Quirk *et al.* 1985; Diessel 1996; Biber *et al.* 1999; Diessel 2001, 2005, 2008; Wiechmann and Kerz 2013). The descriptive analysis also revealed that in both balanced and simple clauses post-posed temporal clauses are more frequent than pre-posed ones. In addition, in all of the three temporal subordinators, final constructions are more frequently observed than initial ones. Therefore, adverbial clauses of time mostly follow their matrix clauses in the academic corpus of this study.

The findings of this study revealed that iconicity of sequence has a strong impact on the linear ordering of adverbial clauses of time. Temporal clauses expressing a prior event are more often in sentence-initial position, while temporal clauses referring to a simultaneous or posterior event usually follow their associated main clauses. This is in line with Diessel (2008) who has claimed that iconicity of sequence, in spite of being semantic by nature, can be regarded as a processing principle affecting the overall processing load of a complex sentence since a clause order that is not iconic is more demanding to process. This is also supported by Ohtsuka and Brewer (1992) who demonstrated that temporal clauses headed by NEXT are easier to store and retrieve than non-iconic clauses headed by BEFORE.

Random forest modelling of the competing motivators of the ordering of adverbial clauses of time also indicated that the presence of an anaphoric item with a bridging context is the second most powerful predictor of clause ordering in this corpus of temporal clauses written by researchers of applied linguistics for whom English is deemed as a native language. This is supported by Wiechmann and Kerz (2013) in which bridging emerged as the first predictor of positioning in adverbial clauses of concession. This finding corroborates the idea that adverbial clauses of time are mostly put in the initial position when their function is to organize the flow of information in the ongoing discourse, and their use is affected by factors related to information structuring and cohesion (Givón 2001; Verstraete 2004; Diessel 2005, 2008; Wiechmann and Kerz 2013). Consider Example (5):

- (5) This second rater reviewed 15% of the data and then results were compared with those obtained by the researcher. A minimum of an 80% coincidence was needed. When this 80% was not achieved, which only happened in one case, the case was discussed until both raters agreed on the mark.

(Llanes and Muñoz 2009)

In Example (5), the underlined part is a temporal adverbial clause in which 'this 80%' is an anaphoric item indicating a bridging context. The anaphoric item and the adverbial clause of time in which it is embedded establish a link between the main clause and the previous discourse. The results of this research demonstrated that the majority of these bridging-functioning clauses precede their main clauses.

The relative length of the adverbial clauses of time investigated in this study was the most closely associated variable among those motivated by processing-based theories. It only emerged as the third predictor of the ordering of these constructions. This is in line with Diessel (2008) and Wiechmann and Kerz (2013) who also found that length plays a marginal role in predicting temporal ordering. According to Hawkins' parsing theory, it can be assumed that post-posed adverbial clauses are easier to process than pre-posed ones since complex sentences containing final adverbial clauses enjoy a shorter recognition domain than complex sentences involving initial adverbial clauses (Hawkins 2004). This offers a cogent explanation for the predominance of sentence-final adverbial clauses of time in English (Diessel 2008). This also provides further support for the fact that the ordering of adverbial clauses of time is first and foremost determined by discourse-pragmatic and semantic constraints rather than processing-based explanations.

6

CONCLUSION

The findings of this research demonstrated that in a corpus of 100 research articles in the field of applied linguistics written by those for whom English is considered as a native language, post-posed temporal clauses outnumber pre-posed ones. In addition, this study provided further support for previous research on clause positioning (Diessel 2005; Wasow 2002; Diessel 2008; Wiechmann and Kerz 2013) suggesting that the ordering of adverbial clauses is co-determined by constraints of cognitive processing and discourse-pragmatics. Moreover, discourse-pragmatics motivators (iconicity and bridging) are significantly better predictors of the position of temporal adverbial clauses than processing-related constraints. Further, the length of these clauses, as a processing-related factor, emerged as the third significant predictor of the positioning of temporal clauses in this corpus. Finally, the random forest of conditional inference trees technique was found to be a robust statistical means for assessing the relative weight of these constraints.

REFERENCES

- Bas AARTS (1988), Clauses of concession in written present-day British English, *Journal of English Linguistics*, 21(1):39–58.
- Jennifer E. ARNOLD, Anthony LOSONGCO, Thomas WASOW, and Ryan GINSTROM (2000), Heaviness vs. newness: The effects of structural complexity and discourse status on constituent ordering, *Language*, 76(1):28–55.
- Douglas. BIBER, Stig JOHANSSON, Geoffrey LEECH, Susan CONRAD, and Edward FINEGAN (1999), *Longman Grammar of Spoken and Written English*, Longman, London, <http://eprints.lancs.ac.uk/1275/>.
- Betty J. BIRNER and Gregory WARD (1998), *Information Status and Noncanonical Word Order in English*, number 40 in Studies in Language Companion Series, John Benjamins Publishing Company.
- Leo BREIMAN (2001), Random forests, *Machine Learning*, 45(1):5–32.
- Wallace CHAFE (1984), How people use adverbial clauses, in *Proceedings of the Tenth Annual Meeting of the Berkeley Linguistics*, pp. 437–449, Linguistic Society of America.
- Eve V. CLARK (1971), On the acquisition of the meaning of before and after, *Journal of Verbal Learning and Verbal Behavior*, 10(3):266–275, <http://www.sciencedirect.com/science/article/pii/S0022537171800543>.
- Sonia CRISTOFARO (2003), *Subordination*, Oxford Studies in Typology and Linguistic Theory, Oxford University Press, Oxford.
- William CROFT (2003), *Radical Construction Theory: Syntactic Theory in Typological Perspective*, Cambridge University Press, 2nd edition.
- Holger DIESSEL (1996), Processing factors of pre-and postposed adverbial clauses, in *Proceedings of the 22th Annual Meeting of the Berkeley Linguistics Society*, pp. 71–82, Linguistic Society of America.
- Holger DIESSEL (2001), The ordering distribution of main and adverbial clauses: A typological study, *Language*, 77(3):433–455.
- Holger DIESSEL (2005), Competing motivations for the ordering of main and adverbial clauses, *Linguistics*, 43(3):449–470.
- Holger DIESSEL (2008), Iconicity of sequence: A corpus-based analysis of the positioning of temporal adverbial clauses in English, *Cognitive Linguistics*, 19(3):465–490.
- Stephen EVANS and Christopher GREEN (2007), Why EAP is necessary: A survey of Hong Kong tertiary students, *Journal of English for Academic Purposes*, 6(1):3–17.
- Cecilia E. FORD (1993), *Grammar in Interaction: Adverbial Clauses in American English Conversations*, Cambridge University Press, Cambridge.

Sequencing of adverbial clauses of time in English

- Edward GIBSON (1998), Linguistic complexity: Locality of syntactic dependencies, *Cognition*, 68(1):1–76, [http://dx.doi.org/10.1016/S0010-0277\(98\)00034-1](http://dx.doi.org/10.1016/S0010-0277(98)00034-1).
- Edward GIBSON (2000), The Dependency Locality Theory : A distance-based theory of linguistic complexity, in Alec P. MARANTZ, Yasushi MIYASHITA, and Wayne O'NEIL, editors, *Image, Language, Brain*, pp. 95–126, MIT Press.
- Talmy GIVÓN (2001), *Syntax: Introduction*, volume 2, John Benjamins Publishing Company, Amsterdam and Philadelphia.
- Talmy GIVÓN (2011), *Ute Reference Grammar*, volume 3 of *Culture and Language Use*, John Benjamins Publishing.
- Joseph H. GREENBERG (1963), Some universals of grammar with particular reference to the order of meaningful elements, in Joseph H. GREENBERG, editor, *Universals of language*, volume 2, pp. 73–113, MIT Press.
- John HAIMAN (1983), Iconic and economic motivation, *Language*, 59(4):781–819, <http://www.jstor.org/stable/413373>.
- John HAIMAN (2015), Iconicity in linguistics, in James D. WRIGHT, editor, *International Encyclopedia of the Social & Behavioral Sciences*, Elsevier, Oxford, second edition.
- John A. HAWKINS (1994), *A Performance Theory of Order and Constituency*, volume 73 of *Cambridge Studies in Linguistics*, Cambridge University Press.
- John A. HAWKINS (2004), *Efficiency and Complexity in Grammars*, Oxford University Press, <http://tocs.ub.uni-mainz.de/pdfs/125604661.pdf>.
- Torsten HOTHORN, Kurt HORNIK, and Achim ZEILEIS (2006), Unbiased recursive partitioning: A conditional inference framework, *Journal of Computational and Graphical Statistics*, 15(3):651–674.
- John M. KIRK (1997), Subordinate clauses in English, *Journal of English Linguistics*, 25(4):349–364.
- Ming LI and Paul VITÁNYI (1997), *An Introduction to Kolmogorov Complexity and its Applications*, Graduate Texts in Computer Science, Springer Verlag, 2nd edition.
- Àngels LLANES and Carmen MUÑOZ (2009), A short stay abroad: Does it make a difference?, *System*, 37(3):353–365.
- Matti MIESTAMO (2004), On the feasibility of complexity metrics, in *FinEst Linguistics: Proceedings of the Annual Finnish and Estonian Conference of Linguistics*, pp. 11–26, Tallinn University Press.
- Keisuke OHTSUKA and William F. BREWER (1992), Discourse organization in the comprehension of temporal order in narrative texts, *Discourse Processes*, 15(3):317–336.

Randolph QUIRK, Sidney GREENBAUM, Geoffrey LEECH, and Jan SVARTVIK (1985), *A Comprehensive Grammar of the English Language*, Longman, London.
Leon STASSEN (1985), *Comparison and Universal Grammar*, Basil Blackwell, Oxford.

Caroline STROBL, Anne-Laure BOULESTEIX, Achim ZEILEIS, and Torsten HOTHORN (2007), Bias in random forest variable importance measures: Illustrations, sources and a solution, *BMC Bioinformatics*, 8(1), <http://www.biomedcentral.com/1471-2105/8/25>.

Sali A. TAGLIAMONTE and R. Harald BAAYEN (2012), Models, forests, and trees of York English: Was/were variation as a case study for statistical practice, *Language Variation and Change*, 24(02):135–178.

Sandra A. THOMPSON, Robert A. LONGACRE, and Shin Ja J. HWANG (2007), Adverbial clauses, in Timothy SHOPEN, editor, *Language Typology and Syntactic Description*, pp. 237–300, Cambridge University Press, Cambridge.

Jean-Christophe VERSTRAETE (2004), Initial and final position for adverbial clauses in English: The constructional basis of the discursive and syntactic differences, *Linguistics*, 42(4):819–853.

Relja VULANOVIC (2007), On measuring language complexity as relative to the conveyed linguistic information, *SKY Journal of Linguistics*, 20:399–427.

Thomas WASOW (2002), *Postverbal Behavior*, CSLI Publications, Stanford, CA.

Daniel WIECHMANN and Elma KERZ (2013), The positioning of concessive adverbial clauses in English: Assessing the importance of discourse-pragmatic and processing-based constraints, *English Language and Linguistics*, 17(01):1–23.

This work is licensed under the Creative Commons Attribution 3.0 Unported License.

<http://creativecommons.org/licenses/by/3.0/>

