Applicative Structures and Immediate Discourse in the Turkish Discourse Bank

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Abstract

Various discourse theories have argued for data structures ranging from the simplest trees to the most complex chain graphs. This paper investigates the structure represented by the explicit connectives annotated in the multiple-genre Turkish Discourse Bank (TDB). The dependencies that violate tree-constraints are analyzed. The effects of information structure in the surface form, which result in seemingly complex configurations with underlying simple dependencies, are introduced; and the structural implications are discussed. The results indicate that our current approach to local discourse structure needs to accommodate properly contained arguments and relations, and partially overlapping as well as shared arguments; deviating further from simple trees, but not as drastically as a chain graph structure would imply, since no genuine cases of structural crossing dependencies are attested in TDB.

1 Introduction

A variety of structures for discourse representation has been proposed, including successive trees of varying sizes connected and occasionally intertwined at the peripheries (Hobbs, 1985), a single tree structure (Rhetorical Structure Theory, RST, Mann & Thompson, 1988), entity chains (Knott *et al.* 2001), tree-adjoining grammars (Discourse-Lexicalized Tree Adjoining Grammar, D-LTAG, Webber, 2004), directed acyclic graphs (Lee *et al.*, 2006, 2008) and chain graphs (Wolf & Gibson, 2005).

The simplest of these structures is a tree, which treats discourse structure simpler than sentence-level syntax. The most complex representation, chain graphs that allow for crossing dependencies and other tree-violations, treats discourse as more complex than sentence level. We know since the work of Shieber (1985) and Joshi (1985) that sentence-level structures require more than context-free power, but not to the extent of dealing with general graphs, or with strings that grow out of constant control. It is of general interest to discover whether such complexity occurs in natural discourses, because we would like to know how far discourse structures deviate from applicative semantics. (Applicative structures are binary operations on data; for example a connective's meaning depending only on two arguments. A system is applicative if it only makes use of function application, but not e.g. graph reduction or general function composition. The concepts are distinct but related: function application can be linked to applicative structures by currying.) If more complex structures are found, we must go above applicative semantics, and we must worry about function compositions and graph reductions, which are known to require more computational power.

2 Turkish Discourse Bank

Turkish Discourse Bank (TDB) is the first large-scale publicly available language resource with discourse level annotations for Turkish built on a ~ 400,000-word sub-corpus of METU Turkish Corpus (MTC) (Say *et al.*, 2002), annotated in the style of Penn Discourse Tree Bank (PDTB) (Prasad *et al.*, 2008). The TDB Relations are annotated for explicit discourse connectives, which link two spans of text that can be interpreted as Abstract Objects (Asher, 1993). Connectives are annotated together with their modifiers and arguments,and with supplementary materials for the arguments (Zeyrek & Webber, 2008; Zeyrek et al., 2010). The first release of TDB is available at http://medid.ii.metu.edu.tr/.

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As in PDTB, the connectives in TDB come from a variety of syntactic classes (Zeyrek & Webber, *ibid*). The coordinating and subordinating conjunctions such as *ve* 'and' and *için* 'for' and 'in order to', respectively, are considered structural connectives, meaning that they take both arguments structurally. Discourse adverbials and phrasal expressions that are built by combining a discourse-anaphoric element with a subordinating conjunction are considered to be anaphoric connectives, meaning that they only take the argument that is syntactically related, and the other argument is interpreted anaphorically. In PDTB and TDB style, the syntactically related argument is called the second argument (Arg2), and the other argument is called the first argument (Arg1), for both structural and anaphoric connectives. The syntactic class of the discourse connective will be included in the further releases of TDB along with the sense of the discourse relations, and some morphological features for the arguments of subordinating conjunctions (Demirşahin *et al.*, 2012).

3 Discourse Relation Configurations in Turkish

Lee *et al.* (2006) identified *independent relations* and *fully embedded relations* as conforming to the tree structure, and *shared arguments*, *properly contained arguments*, *pure crossing,* and *partially overlapping arguments* as departures from the tree structure in PDTB. Although most departures from the tree structure can be accounted for by non-structural explanations, such as anaphora and attribution, Lee *et al.* (2006, 2008) state that shared arguments may have to be accepted in discourse structure.

Aktaş *et al.* (2010) identified similar structures in TDB, adding *nested relations* that do not violate tree structure constraints, as well as *properly contained relations* that introduce further deviations from trees. Following their terminology, we will reserve the word *relation* to discourse relations (or coherence relations), and use the term *configuration* to refer to relations between discourse relations.

1.1 Independent, Fully Embedded and Nested Relations

The first release of TDB consists of 8,484 explicit relations. The argument spans of some discourse connectives do not overlap with those of any other connectives in the corpus. We call them *independent relations*. All others are called *non-independent relations*. We have identified 2,548 non-independent configurations consisting of 3,474 unique relations, meaning that 5,010 relations (59.05%) are independent. Table 1 shows the distribution of 2,548 non-independent configurations.

Configuration	**#**	**%**
Full Embedding	695	27.28
Nested Relations	138	5.42
Total Non-violating Configurations	**833**	**32.69**
Shared Argument	489	19.19
Prop. Cont. Argument	194	7.61
Prop. Cont. Relation	1018	39.95
Pure Crossing	2	0.08
Partial Overlap	12	0.47
Total Violating Configurations	**1715**	**67.31**
Total	**2548**	**100.00**

Table 1: Distribution of non-independent configurations

Since full embedding and nested relations conform to tree structure, these configurations will not be discussed further. The following subsections discuss the suitability of explanations involving anaphora and attribution to tree-violating configurations. Those that cannot be completely explained away must be accommodated by the discourse structure.

1.2 Shared Arguments

Lee *et al.* (2006, 2008) state that *shared argument* is one of the configurations that cannot be explained away, and should be accommodated by discourse structure. Similarly, Egg & Redeker (2008) admit that even in a corpus annotated within RST Framework, which enforces tree structure by annotation guidelines, there is a genre-specific structure that is similar to the shared arguments in Lee *et al.* (2006).

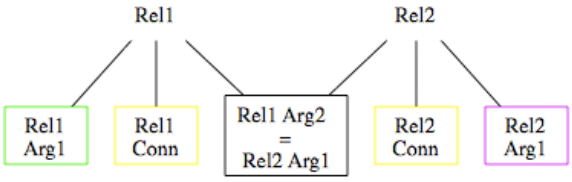


Figure 1 - Shared Argument

Of the 489 shared arguments in TDB, 331 belong to anaphoric discourse relations (i.e. relations in which at least one of the connectives involved is either a discourse adverbial or a phrasal expression) (67.69%). In the remaining 158 relations (32.31%), arguments are shared by structural connectives. (1) is an example of a shared argument.

(1) 00001131-2&3
(a) *Vazgeçmek kolaydı, ertelemek de.* Ama **tırmanmaya başlandı mı bitirilmeli!** Çünkü her seferinde acımasız bir geriye dönüş vardı.
"*It was easy to give up, so was to postpone*. But **once you start climbing you have to go all the way!** Because there was a cruel comeback everytime."
(b) Vazgeçmek kolaydı, ertelemek de. Ama *tırmanmaya başlandı mı bitirilmeli!* Çünkü **her seferinde acımasız bir geriye dönüş vardı.**
"It was easy to give up, so was to postpone. But *once you start climbing you have to go all the way!* Because **there was a cruel comeback everytime**."

All examples are from TDB; the first line indicates the file name (00077211 in (1)), and the browser index of the connectives involved in the configuration (2 & 3 in (1)). The first arguments (Arg1) of the connectives are in *italic,* the second arguments (Arg2) are in **bold.** The connectives themselves are underlined. For the sake of simplicity, the modifiers of the connectives are displayed as part of the connective, and the shared tags are omitted when they are immaterial to the configuration being discussed.

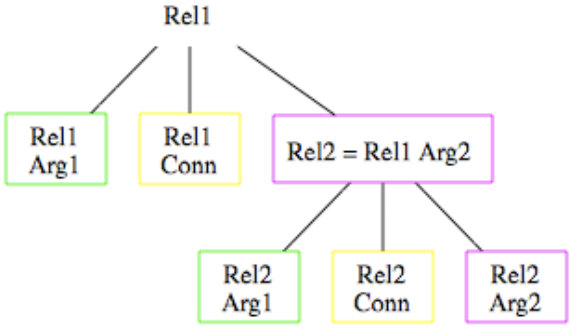
In (1), the first argument of *but* (relation 2) annotated in (a) completely overlaps with the first argument of *because* (relation 3), annotated in (b) on the same text for comparison. The result is a shared argument configuration.

1.3 Properly Contained Relations and Arguments

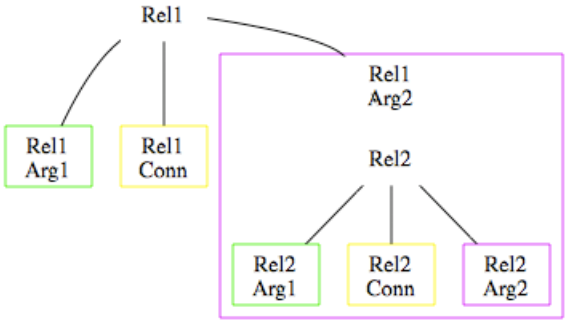
In TDB there are 1,018 properly contained relations, almost half of which (471 relations; 46.27%) are caused by anaphoric relations.

Properly contained relations where anaphoric connectives are not involved can be caused by attribution, complement clauses, and relative clauses. (2) is a relation within a relative clause (a), which is part of another relation in the matrix clause (b). The result is a properly contained relation.

(2) 00001131-27&28
(a) Sabah çok erken saatte **bir önceki akşam gün batmadan** hemen önce *astığı* çamaşırları toplamaya çıkıyordu ve doğal olarak da gün batmadan o günkü çamaşırları asmak için geliyordu.
"She used to go out to gather the clean laundry *she had hung to dry* right before **the sun went down the previous evening**, and naturally she came before sunset to hang the laundry of the day."
(b) *Sabah çok erken saatte bir önceki akşam gün batmadan hemen önce astığı çamaşırları toplamaya çıkıyordu* ve **doğal olarak da gün batmadan o günkü çamaşırları asmak için geliyordu.**
"*She used to go out to gather the clean laundry she had hung to dry the previous evening right before the sun went down*, and **naturally she came before sunset to hang the laundry of the day.**"



a. Full Embedding



b. Properly Contained Relation

Figure 2 - Properly Contained Relation vs. Full Embedding

Sometimes a verb of attribution is the only element that causes proper containment. Lee *et al.* (2006) argue that since the relation between the verb of attribution and the owner of the attribution is between an abstract object and an entity, and not between two abstract objects, it is not a

relation on the discourse level. Therefore, those stranded verbs of attribution should not be regarded as tree-structure violations. In (3) the properly contained relations occur in a quote, but the intervening materials are more than just verbs of attribution. Because the intervening materials in (3) are whole sentences that participate in complex discourse structures, we believe that (3) is different than the case proposed by Lee *et al.* (2006) and should be considered a genuine case of properly contained relation.

(3) 00003121-10, 11&13
(a) "Evet, küçük amcamdı o, nur içinde yatsın, yetmişlik bir rakıyı devirip ipi sek sek geçmeye kalkmış; kaptan olan amcam ise kocaman bir gemiyi sulara gömdü. Aylardan kasımdı, ben çocuktum, çok iyi anımsıyorum, fırtınalı bir gecede, Karadeniz'in batısında batmışlardı. *Kaptandı*, ama **yüzme bilmezdi amcam**. Bir namaz tahtasına sarılmış olarak kıyıya vurduğunda kollarını zor açmışlar, yarı yarıya donmuş. *Belki de o anda Tanrı'ya yakarıp yardım istiyordu*, çünkü **çok dindar bir adamdı**. Ama artık değil; küp gibi içip meyhanelerde keman çalıyor." Sonra da Nesli'nin ilgiyle çatılmış alnına bakıp gülüyor: "Çok istavritsin!"
"Yes, he was my younger uncle, may he rest in peace, he tried to hop on the tightrope after quaffing down a bottle of raki; my other uncle who was a captain, on the other hand, sank a whole ship. It was October, I was a child, I remember it vividly, in a stormy night, they sank by the west of the Black Sea. *He was a captain*, but **he couldn't swim**, my uncle. When he washed ashore holding onto a piece of driftwood, they pried open his arms with great difficulty, he was half frozen. *Maybe at that moment he was begging God for help*, because **he was a very religious man**. But not anymore, now he hits the bottle and plays the violin in taverns." Then he sees Nesli's interested frown and laughs: "You're so gullible!"
(b) *"Evet, [...] Ama artık değil; küp gibi içip meyhanelerde keman çalıyor."* Sonra da **Nesli'nin ilgiyle çatılmış alnına bakıp gülüyor: "Çok istavritsin!"**
"Yes, [...]But not anymore, now he hits the bottle and plays the violin in taverns." Then **he sees Nesli's interested frown and laughs: "You're so gullible!"**

Whereas attribution can be discarded as a non-discourse relation, a discourse model based on discourse connectives should be able to accommodate partially contained relations resulting from relations within complements of verbs and relative clauses.

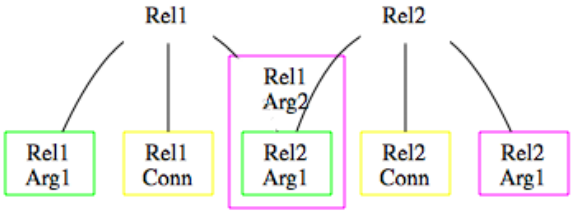


Figure 3 - Properly Contained Argument

As in properly contained relations, properly contained arguments may arise when an abstract object that is external to a quote is in a relation with an abstract object in a quote. Likewise, a discourse relation within the complement of a verb or a relative clause can cause properly contained arguments. Anaphoric connectives account for the 129 (66.49%) of the 194 properly contained arguments in TDB.

1.4 Partial Overlap

There are only 12 partial overlaps in TDB, and 3 of them involve anaphoric relations.

Figure 4 - Partial Overlap

In (4), the argument span of *in order to* partially overlaps with the argument span of *to*. This is a partial overlap of the arguments of two structural connectives.

(4) 20630000-44&45
(a) *Hükümetin, 1998'de kapatılan kumarhaneleri,* **kaynak sorununa çözüm bulmak** amacıyla *yeniden açmak için harekete geçmesi,* tartışma yarattı.
"The fact that *the goverrntment took action in order to reopen the casinos that were closed down in 1998* in order to **come up with a solution to the resource problem** caused arguments."
(b) *Hükümetin*, **1998'de kapatılan kumarhaneleri, kaynak sorununa çözüm bulmak amacıyla yeniden açmak** için *harekete geçmesi*, tartışma yarattı.

"The fact that *the goverentment took action* in order to **reopen the casinos that were closed down in 1998 in order to come up with a solution to the resource problem** caused arguments."

The first argument of relation 44 (a) properly contains the first argument of 45 (b), whereas the second argument of (b) properly contains the second argument of (a). This double containment results in a complicated structure that will be analyzed in detail in §3.5.

In (5) the second argument of *but* (relation 42 (a)) contains only one of the two conjoined clauses, whereas the first argument of *after* (relation 43 (b)) contains both of them. The most probable cause for this difference in annotations is the combination of "blind annotation" with the "minimality principle." This principle guides the participants to annotate the minimum text span required to interpret the relation. Since the annotators cannot see previous annotations, they have to assess the minimum span of an argument again when they annotate the second relation. Sometimes the minimal span for one relation is annotated differently than the minimal span required for the other, resulting in partial overlaps.

(5) 00001131-42&43
(a) *Yine istediği kişiyi bir türlü görememişti*, ama **aylarca sabrettikten sonra gözetlediği bir kadın soluğunu daralttı**, tüyleri diken diken oldu.
"Once again he couldn't see the person he wanted to see, but **after waiting patiently for months, a woman he peeped at took his breath away,** gave him goose bumps".
(b) Yine istediği kişiyi bir türlü görememişti, ama **aylarca sabrettikten** sonra *gözetlediği bir kadın soluğunu daralttı, tüyleri diken diken oldu.*
"Once again he couldn't see the person he wanted to see, but after **waiting patiently for months**, *a woman he peeped at took his breath away, gave him goose bumps."*

1.5 Pure Crossing

There are only 2 pure crossing examples in the current release of TDB, a number so small that it is tempting to treat them as negligible. However, the inclusion of pure crossing would result in the most dramatic change in discourse structure, raising the complexity level to chain graph and making discourse structure markedly more complex than sentence level grammar. Therefore, we would like to discuss both examples in detail.

(6) 00010111-54&55
(a) Sonra *ansızın sesler gelir*. Ayak sesleri. Birilerinin ya işi vardır, aceleyle yürürler, ya koşarlar. O zaman **kız katılaşır ansızın**. Oğlan da katılaşır ve her koşunun gizli bir isteği var.
"And then *suddenly there is a sound*. Footsteps. Someone has an errand to run, they walk hurriedly or run. Then **the girl stiffens suddenly.** The boy stiffens, too; and every run has a hidden wish."
(b) Sonra ansızın sesler gelir. Ayak sesleri. *Birilerinin ya işi vardır, aceleyle yürürler, ya koşarlar.* O zaman kız katılaşır ansızın. Oğlan da katılaşır ve **her koşunun gizli bir isteği var.**
"And then suddenly there is a sound. Footsteps. *Someone has an errand to run, they walk hurriedly or run*. Then the girl stiffens suddenly. The boy stiffens, too; and **every run has a hidden wish."**

In (6), the discourse relation encoded by *then* is not only anaphoric -and therefore not determinant in terms of discourse structure- but also the crossing annotation does not necessarily arise from the coherence relation of the connective's arguments. It is more likely imposed by lexical cohesive elements (Halliday & Hasan, 1976), as the annotators apparently made use of the repetitions of *ansızın* 'suddenly' and *koş* 'run' in the text when they could not interpret the intended meaning.

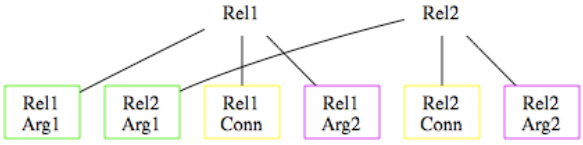


Figure 5 - Pure Crossing

The other example, given in (7), is not anaphoric. It is more interesting as it points to a peculiar structure similar to (4) in §3.4, a surface crossing which is frequent in the subordinating conjunctions of Turkish.

(7) 20510000-31,32&34
(a) *Ceza*, **Telekom'un iki farklı internet alt yapısı pazarında tekel konumunu kötüye kullandığı** için ve uydu istasyonu işletmeciliği pazarında artık tekel hakkı kalmadığı halde rakiplerinin faaliyetlerini zorlaştırdığı için *verildi*.

"The penalty was given because **Telekom abused its monopoly status in the two different internet infrastructure markets** and because it caused difficulties with its rivals' activities although it did not have a monopoly status in the satellite management market anymore."

(b) Ceza, Telekom'un *iki farklı internet alt yapısı pazarında tekel konumunu kötüye kullandığı* için ve **uydu istasyonu işletmeciliği pazarında artık tekel hakkı kalmadığı halde rakiplerinin faaliyetlerini zorlaştırdığı** için verildi.

"The penalty was given because *Telekom abused its monopoly status in the two different internet infrastructure markets* and because **it caused difficulties with its rivals' activities although it did not have a monopoly status in the satellite management market anymore**."

(c) *Ceza*, Telekom'un iki farklı internet alt yapısı pazarında tekel konumunu kötüye kullandığı için ve **uydu istasyonu işletmeciliği pazarında artık tekel hakkı kalmadığı halde rakiplerinin faaliyetlerini zorlaştırdığı** için *verildi*.

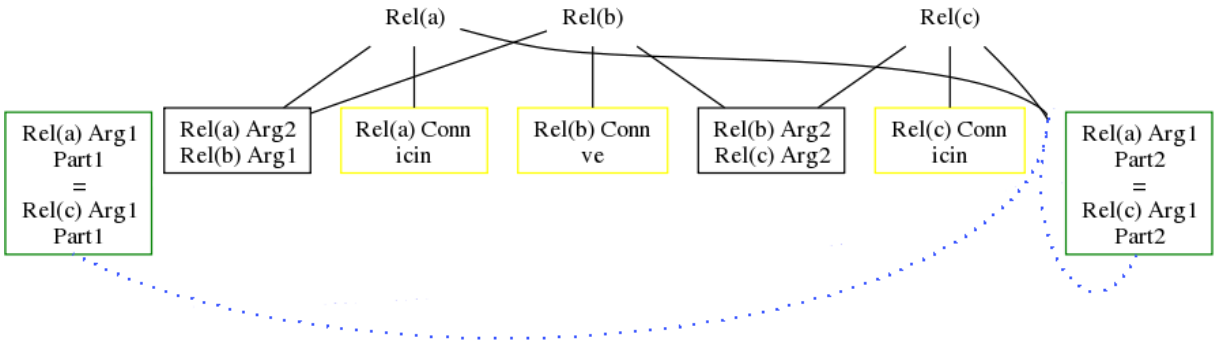
"The penalty was given because Telekom abused its monopoly status in the two different internet infrastructure markets and because **it caused difficulties with its rivals' activities although it did not have a monopoly status in the satellite management market anymore."**

A closer inspection reveals that the pure crossings in (7) are caused by two distinct reasons.

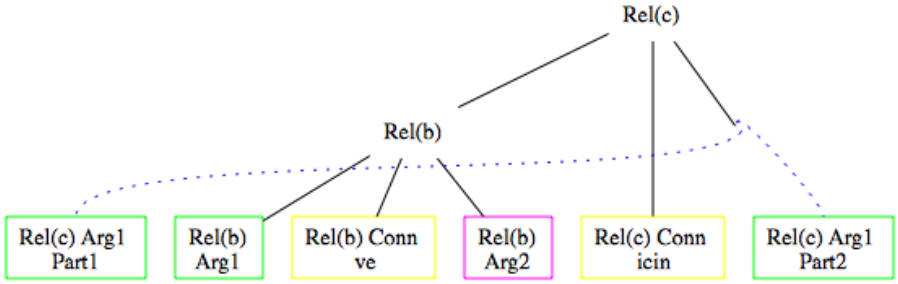
The first reason is the repetition of the subordinator *için* 'because'. Had there been only the rightmost subordinator, the relation would be a simple case of Full Embedding, where *ve* 'and' in (b) connects the two reasons for the penalty, while the rightmost subordinator connects the combined reasons to the matrix clause (see Figure 6). However, since both subordinators were present, they were annotated separately. They share their first arguments, and take different spans as their second arguments, which are also connected by *ve* 'and', resulting in an apparent pure crossing.

Our alternative analysis is that *ve* 'and' actually takes the subordinators *için* 'because' in its scope, and it should be analyzed similar to an assumed single-subordinator case. This kind of annotation was not available in TDB because the annotation guidelines state that the discourse connectives at the peripheries of the arguments should be left out. Machine Learning can help us spot these instances.

The second reason for crossing is the *wrapping* of the first arguments of (a) and (c) around the subordinate clause. This crossing is in fact not a configuration-level dependency, but a relation-level surface phenomenon confined within the relation anchored by *için* 'because', without underlying complex discourse semantics. Example (8) is a simpler case where the surface crossing within the relation can be observed.



a. Double-subordinator (as-is)



b. Single-subordinator (hypothetical)

Figure 6 - Configuration for (7) as is, and the hypothetical single-subordinator version

(8) 10380000-3
1882'de İstanbul Ticaret Odası, **bir zahire ve ticaret borsası kurulması** için *girişimde bulunuyor* ama sonuç alamıyor.
"In 1882, İstanbul Chamber of Commerce makes an attempt for **founding a Provisions and Commodity Exchange Market** but cannot obtain a result."

Subordinators in Turkish form adverbial clauses (Kornfilt, 1997), so they can occupy any position that is legitimate for a sentential adverb.

Wrapping in discourse seems to be motivated information-structurally. In the unmarked position, the subordinate clause comes before the matrix clause and introduces a theme. However, the discourse constituents can occupy different positions or carry non-neutral prosodic features to express different information structures (Demirşahin, 2008). In (7), wrapping takes *ceza* 'penalty' away from the rheme and makes it part of the theme, at the same time bringing the causal discourse relation into the rheme.

As is clear from the gloss in (7) and its stringset, this is function application, where *ceza verildi* 'penalty was given' wraps in the first argument as a whole. Double occurrence of the "connective" within the wrapped-in argument is causing the apparent crossing, but there is in fact one discourse relation.

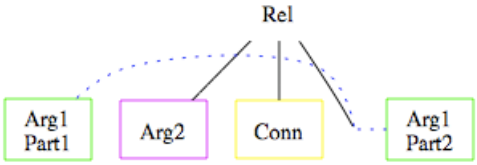


Figure 7 - Wrapping

Wrapping in discourse is almost exclusive to subordinating conjunctions, possibly due to their adverbial freedom in sentence-level syntax. The subordinators make up 468 of the total of 479 wrapping cases identified in TDB. However, there are also four cases of coordinating conjunctions with wrapping. Two of them result in surface crossing as in (9), and the other two build a nested-like structure, as in (10) and (11). The latter two are both parentheticals.

(9) 10690000-32
Bezirci'nin *sonradan elimize geçen* ve **1985'lerde yaptığı** antoloji hazırlığında, […]
"In the preparation for an anthology **which Bezirci made during 1985's** and *which came into our possession later*[…]"

In (9) *ve* 'and' links two relative clauses, one of which seems to be embedded in the other. It should be noted that the first part of Arg1 (*Bezirci-nin*) has an ambiguous suffix. The suffix could be the agreement marker of the relative clause, as reflected in the annotation, or it could be the genitive marked complement of the genitive-possessive construction *Bezirci'nin antoloji hazırlığı* 'Bezirci's anthology preparation'. The latter analysis does not cause wrapping.

(10) 00003121-26
Biz yasalar karşısında evli sayılacak, ama *gerçekte evli iki insan gibi değil de* (**evlilikler sıradanlaşıyordu** çünkü**, tekdüze ve sıkıcıydı**; biz farklı olacaktık), *aynı evi paylaşan iki öğrenci gibi yaşayacaktık.*
"We would be married under the law, but *in reality we would live like two students sharing the same house rather than two married people* (because **marriages were getting ordinary**, **(they were) monotonous and boring**; we would be different)."

(11) 00008113-10
Masa ya da duvar saatleri bulunmayan, ezan seslerini her zaman duyamayıp zamanı öğrenmek için *erkeklerin (***evde oldukları** zaman**, tabii***) cep saatiyle doğanın ışık saatine ve kendi içgüdüleriyle tahminlerine bel bağlayan* birçok aile, yaşamlarını bu top sesine göre ayarlardı.
"Lots of families who didn't have a table clock or a wall clock and couldn't always hear the prayer calls, who *relied upon the men's pocket watch (*when **they were home, of course***) and their instincts and guesses* to learn the time adjusted their lives according to this cannon shot."

Both (10) and (11) are parentheticals, resulting in a double-wrapping-like construction (Figure 8). However, parentheticals move freely in the clause and occupy various positions, so we believe that this construction should be taken as a peculiarity of the parenthetical, rather than the structural connectives involved in the relation.

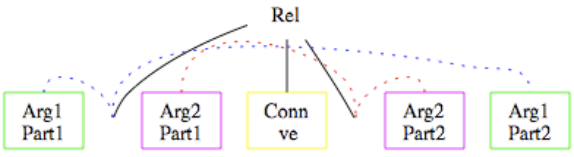


Figure 8 - Double-wrap-like Parenthetical Construction for (10)

4 Conclusion

In this paper we presented possible deviations from the tree structure in the first release of TDB. Following Lee *et al.* (2006, 2008) and Aktaş *et al.* (2010). We have scanned the corpus for shared arguments, properly contained relations and arguments, partial overlaps, and pure crossings. Overall, about half of these configurations can be accounted for by anaphoric relations, i.e. they are not applicative structures (see Table 2). Note that if one of the relations in a configuration is anaphoric, we treat the configuration as anaphoric.

Configuration	Structural	Anaphoric	Total
Shared Argument	158	331	489
	32.31%	67.69%	100.00%
Prop. Cont. Arg.	65	129	194
	33.51%	66.49%	100.00%
Prop. Cont. Rel.	547	471	1018
	53.73%	46.27%	100.00%
Pure Crossing	1	1	2
	50.00%	50.00%	100.00%
Partial Overlap	9	3	12
	75.00%	25.00%	100.00%
Total	780	935	1715
	45.48%	54.52%	100.00%

Table 2: Distribution of anaphoric relations among tree-violating configurations

In addition to the shared arguments that were accepted in discourse structure by Lee *et al.*, we have also come up with partially contained relations arising from verbal complements and relative clauses. These structures can be treated differently in other frameworks; for instance in RST, they are treated as discourse constituents taking part in coherence relations. However, for the connective-based approach adopted in this study, they need to be accommodated as deviations from tree structure.

The few partial overlaps we have encountered could mostly be explained away by wrapping and by different interpretations of annotation guidelines by the annotators, especially the minimality principle. Recall that wrap has applicative semantics. Of the two pure crossing examples we have found, one was also anaphoric, whereas the other could be explained in terms of information-structurally motivated relation-level surface crossing, rather than configuration-level crossing dependency. In other words, if we leave the processing of information structure to other processes, the need for more elaborate annotation disappears. In Joshi's (2011) terminology, immediate discourse in the TDB appears to be an applicative structure, which, unlike syntax, seems to be in no need of currying.

As a result, we can state that pure crossing (i.e. crossing of the arguments of structural connectives) is not genuinely attested in the current release of TDB. The annotation scheme need not be enriched to allow more complex algorithms to deal with unlimited use of crossing. There seems to be a reason in every contested case to go back to the annotation, and revise it in ways to keep the applicative semantics, without losing much of the connective's meaning.

In summary, our preliminary analysis shows that discourse structure may have to accommodate partial containment and wrap in addition to shared arguments. TDB has an applicative structure.

Taking into account that *independent relations*, *fully embedded relations* and *nested relations* are frequent in discourse structure, and that the discourse structure should accommodate shared arguments and partial containments; we are currently inclined to think of discourse structure as Hobbs (1985) does: local trees of various sizes connected and occasionally intertwined at the edges. Further complications within trees are an open field for further studies.

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