

## Explicitness and implicitness of discourse relations in a multilingual discourse bank

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### Abstract

Proposals such as continuity and causality-by-default relate the level of expectedness of a relation to its linguistic marking as an explicit or implicit relation. We investigate these two proposals with regard to the English transcripts of six TED Talks and their Lithuanian, Portuguese and Turkish translations in the TED-Multilingual Discourse Bank (TED-MDB), annotated for discourse relations, following the Penn Discourse Treebank style of annotation. Our data shows that the discontinuous relations Contrast and Concession are indeed frequently explicit in all languages. But continuous relations show differences per relation and language. For instance, Cause is frequently conveyed implicitly in English and Portuguese, but not in Lithuanian and Turkish. We explore temporal continuity by analysing whether the forward-order sense Result is more frequently implicit than the backward-order Reason. The hypothesis is confirmed by English and Portuguese, but not Lithuanian and Turkish. However, in Turkish, the arguments of the backward-order relation Reason are frequently presented by the reversed order of arguments, retaining the linear order of events even in the presence of the connective. The causality-by-default hypothesis is not confirmed, as Cause is not the most frequent implicit relation in the four languages.

Keywords: discourse relations, continuity, explicitness

### 1 Introduction

Discourse relations (DRs) ensure coherence between discourse units (DUs) and may be explicitly marked by connectives or left implicit and inferred through linguistic context. The work of Murray (1997) and Segal *et al.* (1991) explore the concept of continuity and put forward the hypothesis that continuous relations such as Cause are typically implicit, while discontinuous ones such as Contrast are typically explicit. Another consequence of continuity would be that non-linearity in presenting events, for instance presenting a consequence before its effect or presenting a sequence of events in backward temporal order, would be less expected than a linear (forward) transition of events. Another proposal, the causality-by-default hypothesis, suggests that readers tend to interpret contiguous clauses as involving a causal relation by default (Sanders 2005), and this expectedness would predict that causal relations are more frequently implicit than other relations.

We propose to explore the relation between such proposals and the explicit or implicit marking of DRs in English and in the translations of three less-studied languages (Lithuanian, Portuguese, Turkish) by analysing the relevant parts of the TED-Multilingual Discourse Bank

(TED-MDB), reliably annotated for DRs and their constitutive DUs in six TED talks in seven languages, following the Penn Discourse Treebank principles (Zeyrek *et al.* 2020). We focus on two languages in the TED-MDB, Turkish and Portuguese, and a third language recently added to the corpus, Lithuanian. Several factors guided our choice of these languages besides English. Firstly, in our earlier work (on all languages but Lithuanian) over two texts of the TED-MDB, we found that the percentage of implicit DRs among the language sets placed English and Turkish at one end of the spectrum, and Portuguese at the other end (with a higher frequency of implicit DRs), a result that is directly relevant for the purpose of this paper. Secondly, we know that Turkish is different from other languages since it involves a set of specific subordinator connectives (converbial suffixes and postpositions), where the canonical order of the subordinate clause is always sentence-initial. Thus, Turkish is directly relevant to the linearity issue (presenting events in forward or backward order) explored in this work. Thirdly, since Lithuanian was not part of the corpus in our earlier work, it was not analysed and we wanted to include it in our analysis as a third language to understand how it behaves with respect to the hypotheses and in comparison to the other languages dealt with here. We explore several research questions: Do proposals such as continuity and causality-by-default explain the linguistic marking of DRs as explicit or implicit in English? Are these patterns found cross-linguistically in the other three languages? Do linearity and non-linearity have an effect on the explicitness/implicitness of DRs? We base our study on a corpus of original English texts and their translations into three target languages (TLs).

We believe that parallel corpora are a fundamental resource for contrastive studies that “should be recognised as the normal part of a natural language that they are” (Mauranen 1999: 161), bringing to light differences in form and meaning across languages (Mauranen 1999, 2016; Noel 2003). However, translation may also have an impact on the linguistic marking of DRs in TLs. One such consequence is related to possible interference from the source text (e.g., the DRs may be kept as explicit or implicit as in the source text) independently of what would be considered the most appropriate rendering of the construction in the TLs (Mauranen 1999).

Another possible effect of translation is related to the proposal of translation universals, such as explicitation, the process of making the implicit source text information explicit in translated texts (Blum-Kulka 1986). However, universals might be a concept too high in generality (Toury 2016) and the conclusions of some studies do not confirm explicitation as a universal of translation, rather revealing a more complex situation where connectives may be omitted, inserted or changed in the translations to be in line with the patterns of the TL, the source text, or the text type (Puurtinen 2016; Zeyrek *et al.* 2022). While analysing the properties that affect the linguistic marking of DRs, we will keep in mind the possible consequences of translation on our data.

We start by reviewing previous work on the topic under investigation in section 2. We present our data and the methodology in section 3. In section 4, we first present our research questions and then discuss the results, before concluding in section 5.

## **2. Continuity, causality-by-default and cognitive complexity**

Murray (1997) and Segal *et al.* (1991) explore the concept of continuity in experimental settings and define the principle of continuity, which states that “readers have a bias toward interpreting sentences in a narrative as following one another in a continuous manner. As readers progress through a narrative, they assume that the events will follow in a linear fashion” (Murray 1997: 228). Also, continuity in the sense of Segal *et al.* (1991) means that the same frame of reference is maintained, considering dimensions like time, space, character or perspective. Experiments reported in Murray (1997) showed a contrast between additive, causal, and adversative connectives in terms of their effect on the textual progression: for instance, when the participants were presented with an additive or causal connective as the first word of an upcoming sentence, they generated sentences that denoted a continuous textual progression, while an adversative connective led to sentences with discontinuous text events. The dimension “perspective” of the continuity hypothesis was explored by Zufferey & Gyax (2016) who analyse translations of the French connective *en effet* (indeed, in fact): when the connective is used with a Confirmation

meaning (which involves a perspective shift and is discontinuous), it is kept in the translation but when used with a causal meaning, it is frequently omitted in the target languages.

Another proposal is the causality-by-default hypothesis (Sanders 2005) that suggests that when establishing discourse coherence, users tend to interpret contiguous clauses as involving a causal relation by default, and, consequently, it predicts causal relations to be expected in the flow of discourse and to be more frequently expressed implicitly than other relations. The factors affecting the explicit vs. implicit encoding of DRs across languages are explored in Hoek & Zufferey (2015) through the Europarl corpus using the Cognitive Approach to Coherence Relations (CCR) (Sanders *et al.* 1992). They found that in all languages positive additive relations are translated implicitly significantly more often than negative and conditional relations.<sup>1</sup> The causality-by-default hypothesis does not fully explain the results obtained in the study because additives are more frequently implicit than causals, nor does the continuity hypothesis provide a satisfactory answer (i.e., it does not explain the case of conditionals because they cannot be categorized as continuous nor discontinuous). The authors suggest that the data can be explained in terms of cognitive complexity: for instance, relations with negative polarity (such as Contrast) are more complex than relations with positive polarity (see also Evers-Vermeul & Sanders 2009).

Hoek *et al.* (2017) confirm that an expected discourse relation is cognitively less complex and tends to be implicit, while a complex discourse relation is unexpected and marked explicitly, which is valid cross-linguistically in their corpus. Positive causal relations are not more often implicit than positive additive relations, contrary to what the causality-by-default hypothesis would suggest, and the authors propose that “people's causal expectations may be more specific, potentially driven by contextual features, and possibly limited to certain type of causal relations” (Hoek *et al.* 2017: 128).

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<sup>1</sup> The CCR defines several dimensions that characterize DRs. A relation has a positive polarity if the relation holds between P and Q, expressed in S1 and S2, and a relation has a negative polarity if the relation holds between a negated version of either P or Q, not-P or not-Q. A relation is additive if the segments cannot be connected by an implication operation, but rather in a logical conjunction (P & Q). A relation is objective if the discourse segments are connected at the level of their propositional content and subjective if they express the speaker's opinion, argument, claim or conclusion (Sanders *et al.* 2021).

Previous research presented so far focus on specific connectives considered as representatives of a set of DRs (typically, additive, causal, adversative and conditional) explored in corpus or experimental data. Asr & Demberg (2012) examine the validity of the continuity hypothesis and the causality-by-default hypothesis over the entire set of senses of the PDTB 2.0,<sup>2</sup> a discourse bank of news articles from the Wall Street Journal. They explore the idea that DRs tend to be explicit when unexpected but may be implicit when they can be anticipated, arguing that this is related to the Uniform Information Density hypothesis (Frank & Jaeger 2008), according to which information is spread evenly across a text or utterance, and that highly predictable linguistic material is reduced or even omitted. They label the senses as continuous or as discontinuous, excluding the sense Condition, which they consider unclassifiable in terms of continuity. Their results show that (i) relations that denote continuous events have implicitness values larger than average; (ii) causal relations are not the only ones that are often expressed without an explicit connective but causal relations are the most frequent implicit DRs in the PDTB; therefore, a causal relation tends to be expected between neighbouring clauses; (iii) relations with forward order (e.g., Result) are more often implicit than backward order relations (e.g., Reason).

The work reported in Asr & Demberg (2012) is highly relevant to our goals in the current paper as we also intend to explore a corpus annotated in the PDTB style. Asr & Demberg (2012) are conscious of the difficulty of applying a strict categorization of continuity to some DRs; for instance, the sense Expansion:Conjunction is considered difficult to classify because it sometimes involves a deictic shift in entity. The issue of strict categorization is also discussed in Das & Egg (2023) who define continuity in terms of the seven coherence strands in Givón (1993): time, space, reference, action, perspective, modality, speech act, and annotate the presence or absence of these properties on a set of relations from the RST Discourse Bank (Carlson *et al.* 2002). The results show that DRs are seldom homogeneously continuous or discontinuous; for instance, a

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<sup>2</sup> The PDTB list of senses is organized under four top-level senses that have second-level, and in some cases, third-level senses.

causal relation may be continuous regarding the time dimension but discontinuous in terms of the perspective dimension. Nevertheless, in spite of this lack of total homogeneity, most DRs can be classified as being mainly continuous or discontinuous, as the studies referred to in this section have shown.

### 3. Methodology

The TED-MDB encompasses six TED talks transcripts annotated for DRs, in the PDTB style, in the original English transcripts and translations in six other languages (Zeyrek *et al.* 2018, 2020). The list of TED Talks is provided in Table 1. The data for the present paper includes all six talks in four languages: English, Lithuanian, Portuguese and Turkish.

**Table 1.** List of TED Talks included in the TED-MDB corpus

ID	Author	Title <sup>3</sup>
1927	Chris Mc Knett	The investment of logic for sustainability
1971	David Sengeh	The sore problem of prosthetic limbs
1976	Jeremy Kasdin	The flower-shaped starshade that might help us detect Earth-like planets
1978	Sarah Lewis	Embrace the near win
2009	Kitra Cahana	A glimpse of life on the road
2150	David Troy	Social maps that reveal a city's intersections and separations

TED talks are prepared speeches, delivered to a live audience in English by different speakers, on a variety of topics, and have become a very popular form of public speech and an “emergent genre” (Ludewig 2017). They are published online and subtitled in English, and the transcripts are then translated to a large set of languages, which makes them an excellent source

<sup>3</sup> [https://www.ted.com/talks/chris\\_mcknett\\_the\\_investment\\_logic\\_for\\_sustainability/](https://www.ted.com/talks/chris_mcknett_the_investment_logic_for_sustainability/)  
[https://www.ted.com/talks/david\\_sengeh\\_the\\_sore\\_problem\\_of\\_prosthetic\\_limbs](https://www.ted.com/talks/david_sengeh_the_sore_problem_of_prosthetic_limbs)  
[https://www.ted.com/talks/jeremy\\_kasdin\\_the\\_flower\\_shaped\\_starshade\\_that\\_might\\_help\\_us\\_detect\\_earth\\_like\\_planets](https://www.ted.com/talks/jeremy_kasdin_the_flower_shaped_starshade_that_might_help_us_detect_earth_like_planets)  
[https://www.ted.com/talks/sarah\\_lewis\\_embrace\\_the\\_near\\_win](https://www.ted.com/talks/sarah_lewis_embrace_the_near_win)  
[https://www.ted.com/talks/kitra\\_cahana\\_a\\_glimpse\\_of\\_life\\_on\\_the\\_road](https://www.ted.com/talks/kitra_cahana_a_glimpse_of_life_on_the_road)  
[https://www.ted.com/talks/dave\\_troy\\_social\\_maps\\_that\\_reveal\\_a\\_city\\_s\\_intersections\\_and\\_separations](https://www.ted.com/talks/dave_troy_social_maps_that_reveal_a_city_s_intersections_and_separations)

of parallel data for contrastive studies. The translations of the transcripts are done by volunteers, and the result is revised by experts.

The annotation follows the principles of the PDTB (Prasad *et al.* 2008). DRs are considered to hold between two DUs called “arguments” in the PDTB framework, where *argument2* is always the DU introduced by the discourse connective. DUs have an abstract object interpretation, in the sense that they denote eventualities, propositions, facts (Asher 1993) and are typically clauses and sentences, but may also be nominalizations.

We annotated the following types of relations: Explicit, Implicit, Alternative Lexicalization (at inter- and intra-sentential levels), Entity Relation, and No Relation (annotated at the inter-sentential level). DRs are considered Explicit when two DUs are related by a discourse connective, which can be coordinating and subordinating conjunctions (*and, because, if, although*, and equivalent conjunctions in the other languages); adverbials (*indeed, additionally, consequently, for example, in fact*); adpositions (prepositions *para* ‘in order to’ and *devido a* ‘due to’ in Portuguese or postpositions in Turkish, such as *için* ‘since/because’).<sup>4</sup> When there is no connective that anchors the DR, the DR is considered implicit and the annotator has to supply a connective that expresses the sense that holds between the DUs. However, when the insertion of a connective creates a redundancy due to the presence of a non-connective expression that alternatively expresses the relation that holds between two DUs (see, for instance, Altenberg (1984) for causal relations; and Prasad *et al.* (2008) for the PDTB), the relation is labelled as an Alternative Lexicalization (AltLex). AltLexes are typically multiword expressions, such as *a razão é que* ‘the reason is that’ (in Portuguese) denoting a causal relation. We illustrate in (1) a case of explicit relation in English and its Turkish translation in the corpus, where the discourse connective is a postposition in Turkish (*için* in 1b)), and in (2) an implicit relation in English and its Portuguese translation in the corpus (in the examples, *argument1* is in italics, *argument2* in bold, the discourse connective is underlined).

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<sup>4</sup> The annotation scheme doesn’t require that discourse connectives are labelled for their part-of-speech category.

- (1) a. *Her neighbour had taken it because she saw its value.*
- b. **Komşusu da değerini anladığı için onu almıştı.**  
 Neighbour also its value understands because it took  
 Back translation: Because her neighbour understands its value, she took it.
- (2) a. *he wanted all of his diaries, manuscripts, letters and even sketches burned upon his death. (Implicit = however) His friend refused to honor the request (Talk 1978, English)*
- b. [ele] *queria que todos os seus diários, manuscritos, cartas e até mesmo rascunhos fossem queimados depois de ele morrer. (Implicit = mas) O seu amigo recusou-se a cumprir esse pedido (Talk 1978, Portuguese)*

Two other types of DRs are considered in our annotation procedure: Entity Relation (EntRel), when the second argument provides additional information on an entity that is introduced in the first argument, and No Relation (NoRel), when no relation can be inferred between two adjacent sentences (typically in cases of topic change). Explicit, Implicit and AltLex relations are further labelled with a sense selected from the PDTB 3.0 sense hierarchy (Webber *et al.* 2019) (Tables in Appendix 1 list the set of second-level senses). The annotations on all six talks were performed by monolingual teams, which comprised minimally an expert on discourse and a trained annotator. Each monolingual annotator went over the data file by file, annotating relations in each adjacent clause and sentence. In order to avoid the effect of the source language (SL) on the TL texts, annotations were performed independently by each monolingual expert, then discussed in multilingual group meetings for consistency.

Table 2 provides the frequencies of the DRs for all languages amounting to 2,976 DRs in total. In English, Lithuanian and Turkish, explicit relations outnumber implicit ones. Portuguese behaves as an exception in this regard, as we find more cases of implicit relations. These general numbers provide an overview of the distribution of DRs and a broad tendency per language

**Commented [A1]:** Add a gloss in English, e.g.

'S/he wanted all his/her diaries, manuscripts, letters and even drafts to be burned after his/her death. His/her friend refused to fulfil this request.'

Choose the correct gender.

**Commented [A2R1]:** We've added between brackets the null pronoun missing in the Portuguese corpus (translation of the English TED Talk). But we didn't add a gloss. We only use glosses in specific cases where the order or type of connective is different from the source language to the target language. Please, see if this is acceptable.



towards explicitness or implicitness. The table also provides the total number of words and sentences across languages.

**Table 2.** Frequency of discourse relations and number of words and sentences in the corpus across languages

	<b>EN</b>	<b>LT</b>	<b>PT</b>	<b>TR</b>	<b>Total</b>
AltLex	46	18	29	60	153
EntRel	78	79	38	70	265
Explicit	289	376	269	315	1,249
Implicit	254	315	311	264	1,144
NoRel	49	32	33	51	165
Total	716	820	680	760	2,976
Number of words	6,981	5,173	8,180 <sup>5</sup>	5,159	25,493
Number of sentences	385	414	412	421	1,632

There are several aspects of our work that differ from Asr & Demberg (2012): while their data is a written corpus (news articles), ours is prepared speeches delivered orally and transcribed; we use the PDTB 3.0 sense hierarchy, while their analysis is based on the PDTB 2.0; and, contrary to the PDTB 2.0, in our corpus, both inter- and intra-sentential implicit relations are annotated for explicit, implicit and AltLexes.

We exclude from our data the two types of relations that are not labelled with a sense: Entity Relation, No Relation. We also exclude cases of Alternative Lexicalizations due to the low number of occurrences found in our corpus. For the same reason, we do not consider senses with the feature Speech-Act (e.g., the sense Result+Speech Act) and the top-level sense Hypophora, used in the TED-MDB to label question-answer sequences that are often used to capture the attention of the audience.

<sup>5</sup> The Portuguese corpus was tokenized prior to the annotation to expand cases where prepositions are contracted with the following determiner (for instance, the last element of the multiword preposition *com vista a* ‘with a view to’ may be contracted with the determiner *a* ‘the’: *com vista à*). As punctuation is tokenized, this has the effect of increasing the number of counted words in the Portuguese corpus.

In what follows, we characterize the second-level senses of the PDTB 3.0 in terms of the continuity hypothesis presented under the top-level senses whose semantics they refine: Temporal, Contingency, Comparison, Expansion.

### **Temporal**

*Synchronous and Asynchronous.* In Asr & Demberg (2012), asynchronous relations are categorized as discontinuous, following Segal *et al.* (1991), and synchronous relations are also categorized as discontinuous because they introduce new events. Synchronous and asynchronous temporal relations hold between DUs with different temporal locations, but other dimensions of continuity might be kept constant, so it is not clear whether all instances of temporal DRs are discontinuous. Nevertheless, we take as criterion the fact that Temporal relations introduce new events and consider both synchronous and asynchronous senses as discontinuous.

### **Contingency**

*Cause.* The continuity hypothesis considers Cause as continuous due to its level of expectedness, and we label it as continuous. Additionally, the causality-by-default hypothesis suggests that causal relations are expected in the flow of discourse, supporting the continuous nature of Cause.

*Cause+Belief.* Asr & Demberg (2012) include it among the continuous values. However, cases of Cause+Belief frequently involve a shift of perspective, so we consider this sense discontinuous.

*Purpose.* This sense was introduced in the PDTB 3.0 and has no correspondence in Asr & Demberg (2012)'s classification. The Purpose relation is considered to be semantically close to the Result relation (Purpose is labelled as Result in the PDTB 2.0 (Prasad *et al.* 2007: 39)), and sometimes defined as an intended result (Schmidtke-Bode 2009); so, we label it as continuous.

*Condition, Negative Condition.* For Asr & Demberg (2012), these relations cannot be classified as continuous or discontinuous and fall outside the scope of the principle of continuity, nor is there a predictive value for continuity for them in Das & Egg (2023). For this reason, we

consider these senses as neither continuous nor discontinuous and leave them out of scope of our analysis.

### **Comparison**

*Contrast, Concession.* Both senses are treated as discontinuous in Asr & Demberg (2012) and Murray (1997); similarly, we label them as discontinuous.

*Similarity.* This sense is new in the PDTB 3.0, and not considered in Asr & Demberg (2012). It involves different events, time and participants, so we label it as discontinuous.

### **Expansion**

*Conjunction.* Conjunction falls into the additive relations that are continuous in Murray (1997). However, Asr & Demberg (2012) point to the fact that this is not a homogeneous class, partly due to its vague definition in the PDTB, and because some of its instances involve deictic shift. We consider prototypical instances of Conjunction to be continuous, but will pay special attention to the results of this DR in terms of the distribution between explicit and implicit cases.

*Disjunction, Exception, Substitution.* These senses involve negative polarity and are labelled as discontinuous.

*Level-of-detail.* It is labelled as continuous by Asr & Demberg (2012). We also consider it as continuous, although an inspection of the cases of specification in our data shows that some instances may involve a shift of perspective.

*Equivalence, Instantiation.* Both senses are positive additive, and we label them as continuous (as in Asr & Demberg (2012)).

*Manner.* This is also a new sense in the PDTB 3.0. We characterize it as continuous because the arguments (or DUs) refer to the same event.

## **4. Research questions and discussion of results**

In this section we start by presenting our research questions and working hypotheses in 4.1, and discuss our results in 4.2 and 4.3.

#### 4.1 Research questions and hypotheses

We pose three research questions (RQ) and four hypotheses:

**RQ1.** Are continuous relations more frequently implicit and discontinuous ones more frequently explicit in the four languages?

We expect, in accordance with the literature on the topic, that DRs labelled as discontinuous for their second-level sense are less expected and consequently frequently realized with an explicit connective guiding the interpretation of the relation. We put forward the hypothesis that these principles hold across the languages considered in our corpus, even though they are typologically different, because the bias towards continuity could be a general principle of text interpretation. Our results will be compared with other studies for English, and will also allow us to test whether these constraints hold cross-linguistically. Our Hypothesis 1 is that the frequency of continuous DRs left implicit will tend to be higher than those conveyed explicitly in all languages; our Hypothesis 2 is that the frequency of explicitly conveyed discontinuous DRs will tend to be higher than those left implicit in all languages.

**RQ2:** How does the temporal ordering of events affect the explicitness / implicitness of the DRs?

Previous studies have shown that backward order affects linearity and is less expected than forward order; so, our Hypothesis 3 is that backward order relations are more frequently conveyed explicitly than forward order relations. We test our hypothesis with the third-level senses Result (forward order) and Reason (backward order). We do not include the third-level senses of Asynchronous relations due to their low frequency in our corpus.

**RQ3.** Does the causality-by-default hypothesis hold cross-linguistically? Our Hypothesis 4 is that Cause tends to be left implicit, and that it is the most frequent implicit sense among the language sets in the TED-MDB that we are concerned with.

We will address RQ1 in 4.2, RQ2 in 4.3 and RQ3 in 4.4.

## 4.2 Results for the continuity hypothesis

Although we are aware that discourse senses do not behave homogeneously, previous studies have shown that they show prototypical patterns. So, we labelled all second-level senses of a DR in the corpus with the same feature (continuous/discontinuous), without making a distinction for individual tokens or individual languages, e.g., all Reason relations are labelled as continuous. We will first present the results of this categorization in 4.2.1. We will then proceed to evaluate specific continuous and discontinuous second-level senses in 4.2.2.

### 4.2.1 Overall analysis of continuous and discontinuous senses

We present the distribution of continuous/discontinuous senses to explicit (expl.) and implicit (impl.) DR types in Table 3. We applied the chi-squared test to each language, using the software Jasp (Jasp Team 2022), and the results show that, for each language, the distribution of the continuous/discontinuous relations per DR type is statistically significant ( $p < .001$ ), except in Turkish.

**Table 3.** Distribution of (dis)continuous senses per relation type

	EN		LT		PT		TR	
	Expl.	Impl.	Expl.	Impl.	Expl.	Impl.	Expl.	Impl.
<b>conti- nuous</b>	177 46.58%	203 53.42%	239 48.78%	251 51.22%	156 38.33%	251 61.67%	188 48.08%	203 51.92%
<b>disconti- nuous</b>	85 63.91%	48 36.09%	94 64.38%	52 35.62%	89 63.57%	51 36.43%	90 63.38%	52 36.62%

The data in Table 3 shows that in all languages, continuous DRs tend to be left implicit i.e., conveyed with no overt connective. However, in English, Lithuanian and Turkish, the percentage of implicit continuous relations is close to the percentage of explicit continuous relations (46.58% vs. 53.42% in English; 48.78% vs. 51.22% in Lithuanian; 48.08% vs. 51.92% in Turkish). Only in Portuguese is the percentage of implicit continuous relations considerably higher than the

explicit ones (38.33 vs. 61.67%). So, when we take continuous senses globally, Hypothesis 1 is confirmed for Portuguese and partially confirmed for English, Lithuanian and Turkish.

Regarding discontinuous DRs, the numbers in Table 3 confirm Hypothesis 2: discontinuous DRs are expressed with a discourse connective more often than being left implicit in all languages (ranging between 63.38% in Turkish and 64.38% in Lithuanian).

#### 4.2.2 *Analysis of second-level senses*

We will investigate in this section whether Hypotheses 1 and 2 hold for the second-level senses, taken individually. We exclude from our discussion those senses that have less than 10 occurrences in each language because it is difficult to propose generalizations for individual senses with so few numbers: Disjunction, Equivalence, Exception, Manner, Negative condition, Similarity, Substitution, and senses with the feature Belief. We will examine the distribution of the remaining second-level senses to explicit and implicit DRs in the four languages. The percentages of this distribution are shown in Figure 1. The full numbers and percentages are provided in Table A of Appendix 1.

Additionally, we calculate the ratio of implicit DRs by the implicitness measure presented in Asr & Demberg (2012): number of implicit relations of a sense divided by the total number of relations (explicit and implicit) of that sense. Implicitness values are provided in Figure 2. The average implicitness value (number of implicit relations of all senses divided by the total number of explicit and implicit relations of all senses) is marked with a horizontal line for each language in Figure 2 (0.48 in English; 0,47 in Lithuanian; 0,55 in Portuguese; and 0,48 in Turkish).

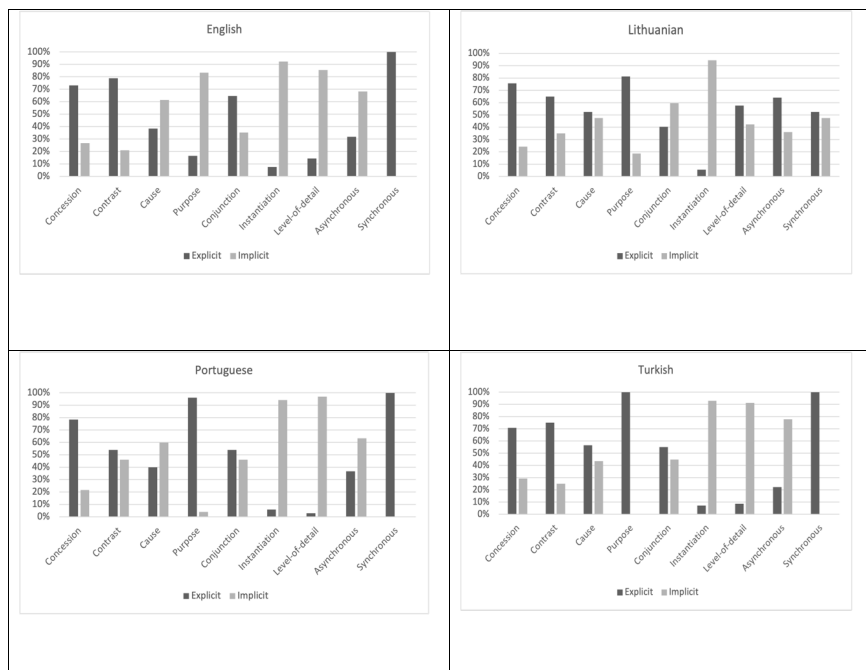


Figure 1. Distribution of second-level senses per DR in four languages

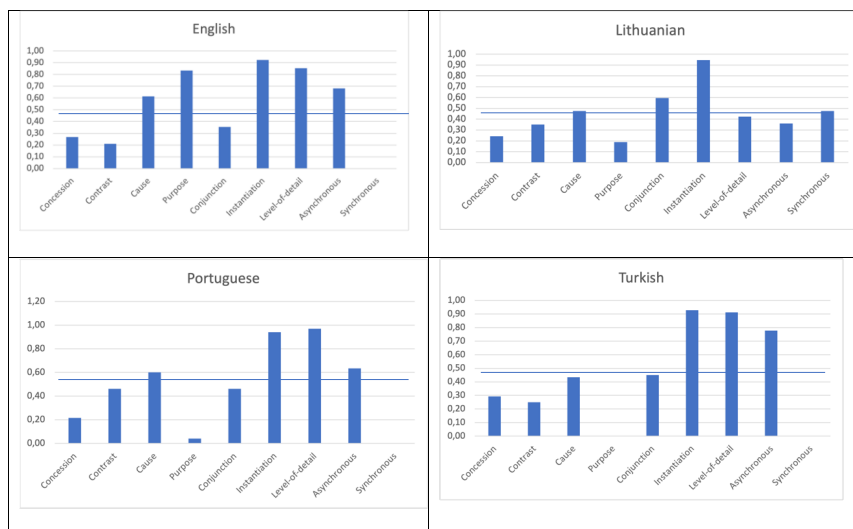


Figure 2. Level of implicitness of second-level senses per DR in four languages

- *Continuous senses*

According to Hypothesis 1, we expect continuous DRs in Figure 1 (Cause, Purpose, Conjunction, Instantiation and Level-of-detail) to be frequently implicit because these relations are expected.

Of these relations, only Instantiation seems to exhibit a consistent behaviour across four languages, where it is frequently implicit as we hypothesized (92.31% of the Instantiation senses are implicit in English, 94.44% in Lithuanian, 94.12% in Portuguese and 92.86% in Turkish). Its implicitness value is also higher than average in the four languages. Although Level-of-detail is more frequently labelled as an implicit relation in English, Portuguese and Turkish (85.48% of Level-of-detail is implicit in English, 97% in Portuguese and 91.25% in Turkish), and it has a value of implicitness higher than average in those languages, Lithuanian displays a different picture, with 57.56% explicit vs. 42.44% implicit Level-of-detail relations, and an implicitness value below average.

Cause occurs mostly as an implicit relation in English, with 61.43% of Cause relations assigned the implicit tag, and in Portuguese, where 60% of Cause relations is implicit, and in both languages, the implicitness value of Cause is higher than average. But in Lithuanian, Cause is often explicit (occurring in 52.48% of all Cause relations) and the implicitness value is only slightly over average. Finally, in Turkish, the percentage of explicit Cause relations is higher than implicit ones, with 56.52% of Cause relations labelled as explicit, and with an implicitness value under average.

Conjunction is frequently implicit only in Lithuanian (with 59.52% of Conjunctions being implicit, against 35.32% in English, 46.02% in Portuguese and 44.95% in Turkish), and its implicitness value is higher than average also only in Lithuanian. In fact, Asr & Demberg (2012) have already found higher numbers of explicitly conveyed Conjunction relations in the PDTB 2.0. It is possible that the sense covers a large set of different types of instances, possibly with



discontinuous properties, such as the introduction of new events in a non-linear order and a shift of perspective.

Finally, Purpose occurs frequently as an explicit relation in all languages (81.25% of Purpose relations is explicit in Lithuanian, 96% in Portuguese and 100% in Turkish), which go against English, which has 83.33% of Purpose relations labelled as implicit. Concomitantly, the implicitness value of Purpose is higher than average only in English. Where a Purpose relation is inferred in English, the implicit connective *in order* is supplied, as in (3a). In other languages, a close equivalent such as an adposition is annotated as an explicit marker, such as the postposition *için* (a subordinator) in Turkish, or the conjunction *kad* in Lithuanian (3b). The results are in line with the findings from previous studies on Purpose relations (Andersson & Spenader 2014). The fact that Purpose is typically an intra-sentential relation, and in our data it is always the case in all four languages (100%), might be a factor that influences its explicitness.

- (3) a. *I used magnetic resonance imaging (implicit = in order) to capture the actual shape of the patient's anatomy* (Talk 1971, English)
- b. *Pasitelkiau magnetinio rezonanso tomografiją kad pamatyčiau, kokia yra paciento anatomija* (Talk 1971, Lithuanian)

The results show that Hypothesis 1 does not seem to hold for all continuous senses cross-linguistically, except the sense Instantiation. Based on the distribution of senses to explicit and implicit relations, and the values of implicitness, we find that Cause, Instantiation, Level-of-detail and Purpose confirm Hypothesis 1 in English, Cause, Instantiation and Level-of-detail in Portuguese, and Instantiation and Level-of-detail in Turkish. In Lithuanian, only Instantiation confirms Hypothesis 1.

- *Discontinuous senses*

We now examine the discontinuous senses (Contrast, Concession, Asynchronous, Synchronous) to see if they support Hypothesis 2, i.e., whether they tend to be expressed explicitly rather than being left implicit in all languages.<sup>6</sup>

Three of these senses are frequently explicit in all languages: Concession (with explicits ranging between 70.73% in Turkish and 78.38% in Portuguese), Contrast (with explicits ranging between 53.85% in Portuguese and 78.95% in English) and Synchronous (with explicits ranging between 52.38% in Lithuanian and 100% in English and Turkish). The implicitness values of all three senses are lower than average, except Synchronous in Lithuanian, which has a value of 0,48 (average = 0,47). These results support our Hypothesis 2 in the case of Concession and Contrast.

The sense Asynchronous is frequently implicit in English, Portuguese and Turkish (with implicits ranging between 63.33% in Portuguese and 78.78% in Turkish), but not in Lithuanian, where 54% of Asynchronous relations is explicit. In those three languages, the implicitness value is higher than average, contrary to what Hypothesis 2 predicts. This result appears to be in contradiction with the findings of Asr and Demberg (2012) who report that the Asynchronous sense is more frequently explicit in the PDTB 2.0. When inspecting the corpus data, we find that in English, eight cases of Asynchronous:Precedence (where the event in argument1 precedes the event in argument2) appear in a sequence of juxtaposed clauses describing the steps of a process. In these cases, there is no explicit connective, and an implicit temporal connective is supplied, as in (4).

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<sup>6</sup> Although we haven't considered conditional relations in the analysis because they are not categorized as continuous nor discontinuous, we observed their distribution to explicit and implicit relations in our data. When comparing additive, causal and conditional relations, Hoek et al. (2017:118) consider conditionals to be the most complex type: "Since they not only involve the addition of information, but also signal an implication relation, causal and conditional relations are logically more complicated than additive relations. Conditional relations, unlike causal and additive relations, always involve a mental space shift, namely shifting to a conditional mental space". In our data, we see that all languages express this relation more frequently as an explicit relation (ranging between 92.59% explicit in Lithuanian and 100% in English and Turkish), as suggested by the cognitive complexity hypothesis. We present the frequency of conditionals in Table B of Appendix 1.

- (4) We build a big screen (implicit = then) we fly it in space (implicit = then) we put it up in front of the star (implicit = then) we block out most of the light (implicit = then) we fly a space telescope in that shadow that's created (Talk 1976 EN).

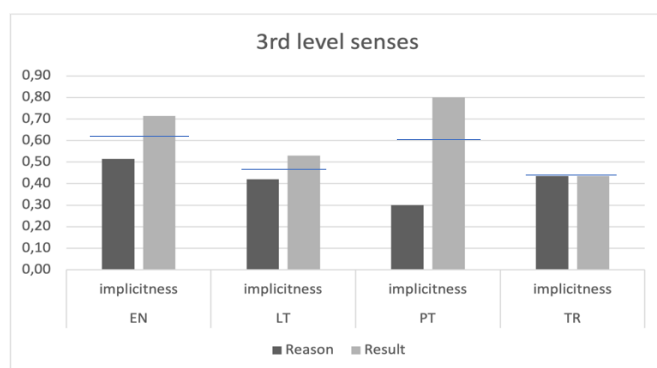
Such a sequence of syntactically juxtaposed sentences is frequently found in spoken language (Cresti 2014), and indeed TED Talks are an instance of prepared speech. While we need more data and research on this issue, one possible explanation for the implicitness of this sense in our corpus could be the spoken modality and the specific genre of our data. In Lithuanian, on the other hand, Asynchronous relations are often conveyed explicitly. The annotated instances show that the Lithuanian translation of the transcripts favours the use of an explicit connective where English is implicit, possibly bringing the transcript closer to the standards of written language, and possibly as a response to the discontinuous nature of this relation. This could be a rare case of explicitation in our data and would suggest that explicitation needs to be related to specific senses, contexts or languages.

#### 4.3 Results for temporal continuity

We now turn to RQ2, the effect of temporal continuity on the explicitness and implicitness of DRs, and our Hypothesis 3, where we expect backward order relations to be more frequently explicit than forward order relations. We will test our hypothesis on causal relations, namely Reason, a backward order relation, and Result, a forward order relation. This topic is especially interesting due to the results obtained for the sense Cause in section 4.2.2. The effect of temporal continuity might provide some explanation for the fact that Lithuanian and Turkish do not seem to validate the continuity hypothesis for causal DRs. Table 4 provides the counts and percentages of the 3<sup>rd</sup> level senses Reason and Result per relation type and per language. In Figure 3, we provide the value of implicitness per third-level sense and per language (the line marks the average value of implicitness calculated by dividing the total of implicit third-level causals by the total of third-level causals).

**Table 4.** Distribution of 3<sup>rd</sup> level senses Reason and Result per relation type and per language

	EN		LT		PT		TR	
	Expl.	Impl.	Expl.	Impl.	Expl.	Impl.	Expl.	Impl.
Reason (backward)	17	18	29	21	21	9	13	10
	48.57 %	51.43 %	58%	42%	70 %	30 %	56.52 %	43.48 %
Result (forward)	10	25	24	27	9	36	13	10
	28.57 %	71.43 %	47.06%	52.94%	20 %	80 %	56.52%	43.48%



**Figure 3.** Implicitness value for Reason and Result per language

The data in Table 4 shows that in English, no contrast is found between forward and backward order, as both Result and Reason are frequently implicit. Nevertheless, the counts and the percentage of implicit Result relations are much higher than those of Reason relations; also, the implicitness value of Result in Figure 3 is higher than that of Reason, and it is higher than average (as expected). Portuguese shows the expected pattern: Reason is more frequently an explicit relation and Result an implicit one, and the implicitness value of Result is much higher than that of Reason and it is higher than average. Section 4.2.2 showed that Lithuanian and Turkish had a higher number of explicit Cause relations than implicit ones, contrary to what Hypothesis 1 would suggest. A closer look at the 3<sup>rd</sup> level Causal senses shows that in Lithuanian, Reason is frequently explicit while Result is frequently implicit, and the implicitness value of

Result is slightly above average. But the implicitness values of Reason and Result are close, preventing us to reach a clear-cut effect of the forward/backward order on the explicit vs. implicit coding of Causal relations in Lithuanian. In Turkish, we see no effect of the order of the events in explicit versus implicit coding of Causal relations, as the number of explicit and implicit Reason and Result relations are equal, and they have the same implicitness value. Finally, Asr & Demberg (2012: 2679) note that “forward/backwardness of the relation (or the connective) in some cases does not correspond with the order in which the arguments of the relation appear”. For instance, in Turkish, the textual order of arguments of the Reason relation can be reversed (e.g., in relations conveyed by *için* as in example (1b) above, the backward relation Reason is expressed linearly by the argument2-argument1 ordering, similar to a Result relation). Taking this fact into consideration, we find that in Turkish, 26.08% of the explicit Reason relations is expressed by the reversed order of arguments. The reversed occurrences of the backward relation Reason show that Turkish has a tendency to present the events in a linear temporal order, even in the presence of an explicit cue. In English, Lithuanian and Portuguese, we find no tendency to reverse the order of the arguments of the backward order relation Reason.

#### 4.4 Results for the Causality-by-default hypothesis

The causality-by-default hypothesis suggests that causal relations would often be left implicit, as readers would tend to interpret contiguous clauses as involving a causal relation by default. So, our Hypothesis 4 suggests that the sense Cause, because it is expected, (i) would frequently occur as an implicit relation; and (ii) it would be the sense that occurs more frequently as an implicit relation in the corpus. So, the hypothesis does not seem to hold across the board. Although in English and Portuguese, Cause (i) is frequently implicit and has an implicitness value above average; (ii) Cause is not the sense with the highest number of implicit relations, nor is it the sense with the highest implicitness value in those two languages. In both languages, the senses Instantiation, Level-of-detail and Asynchronous have higher implicitness values than Cause. In Lithuanian and in Turkish, Cause is frequently explicit, and its implicitness value is slightly above

average in Lithuanian and under average in Turkish. The senses Level-of-detail and Asynchronous show higher values of implicitness in both Lithuanian and Turkish. Comparing our results to Asr & Demberg (2012), we see that in the PDTB 2.0, Cause is the sense with the highest number of implicit relations, but this is not the case in our data. Similar to their finding, the sense Restatement (renamed as Level-of-Detail in the PDTB 3.0) and Instantiation also have a higher implicitness value than Cause.

## 5. Conclusion

We have explored the factors that affect the explicitness or implicitness of the DRs in a corpus of six TED Talks in four languages. One such factor is the continuity of DRs. We found that the discontinuous senses Contrast and Concession are frequently conveyed explicitly cross-linguistically in our data, and that the continuous sense Instantiation is frequently left implicit in the four languages. But continuity does not apply consistently to all senses and languages of our corpus. For instance, implicit causal relations do not occur more frequently than explicit ones across the corpus, as the continuity hypothesis would predict. Temporal continuity of events in a DR is another factor that we explored in the corpus: forward and backward causal relations seem to affect the implicit or explicit marking of DRs in English and Portuguese, but not in Lithuanian and Turkish. Turkish tended to keep the textual order of the arguments of the backward order relation Reason the same as the associated temporal order, retaining the linearity of the events even in the presence of a connective.

We discussed the possible effect of the TED Talk genre in our data: the relation Asynchronous is frequently implicit in English, Portuguese and Turkish, contrary to what the continuity hypothesis would suggest, and this could be related to the spoken properties of the TED talks. The intra- or inter-sentential encoding of DRs appears to be another factor that may affect their linguistic marking, as we mentioned while discussing the relation Purpose.

Our results do not support the causality-by-default hypothesis cross-linguistically, as we see that causal relations are not the most frequent implicit relations across languages in the corpus,

suggesting that contiguous sentences do not necessarily tend to be interpreted first as causal relations. Our findings also suggest that we need to consider the possible lack of homogeneity of certain DRs in terms of continuity. A manual inspection of the features of continuity of the relations labelled as Conjunction could provide some insight into the diversity of the relations tagged with this sense.

Our corpus is a translational corpus, and this could influence the linguistic marking of DRs. We find no evidence that the set of TLs follows or differs consistently from the pattern of the SL (except the potential case of exploitation of the Asynchronous relation in Lithuanian).

Our findings are based on a small set of data (six TED Talks annotated for DRs), which makes it difficult to generalize over the languages under analysis. Our findings would need to be explored over a larger set of data, and compared with non-translated texts. Also, the size of our corpus did not allow us to consider the degree of variation in implicitness across texts of individual languages, which has been observed to occur (Zeyrek *et al.* 2020) and could be linked to the choices made by different translators. This is also an issue to explore in the future.

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## Appendix 1

**Table A.** Distribution of continuous and discontinuous senses per relation type and per language

	EN		LT		PT		TR	
	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit
Cause	27	43	53	48	30	45	26	20
	38.57 %	61.43 %	52.48 %	47.52 %	40 %	60 %	56.52 %	43.48 %
Conjunction	130	71	68	100	95	81	109	89

	64.68 %	35.32 %	40.48 %	59.52 %	53.98 %	46.02 %	55.05 %	44.95 %
Equivalence	0	9	0	6	1	6	4	7
	0%	100%	0%	100%	14.29%	85.71%	36.36%	63.64%
Instantiation	1	12	1	17	1	16	1	13
	7.69 %	92.31 %	5.56 %	94.44 %	5.88 %	94.12 %	7.14 %	92.86 %
Level-of-detail	9	53	99	73	3	97	7	73
	14.52 %	85.48 %	57.56 %	42.44 %	3 %	97 %	8.75 %	91.25 %
Manner	7	0	5	4	2	5	10	1
	100%	0%	55.56%	44.44%	28.57%	71.43%	90.91%	9.09%
Purpose	3	15	13	3	24	1	31	0
	16.67 %	83.33 %	81.25 %	18.75 %	96.00 %	4.00 %	100 %	0 %

#### Discontinuous

	EN		LT		PT		TR	
	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit
Asynchronous	7	15	16	9	11	19	4	14
	31.82%	68.18 %	64 %	36 %	36.67%	63.33%	22.22%	77.78%
Cause+Belief	4	6	3	2	3	5	5	2
	40 %	60 %	60 %	40 %	37.50%	62.50%	71.43%	28.57%
Concession	30	11	28	9	29	8	29	12
	73.17%	26.83 %	75.68%	24.32%	78.38%	21.62%	70.73%	29.27%
Contrast	15	4	26	14	14	12	12	4
	78.95%	21.05 %	65 %	35 %	53.85%	46.15%	75 %	25 %
Disjunction	6	0	6	0	5	0	10	0
	100%	0%	100%	0%	100%	0%	100%	0%
Exception	0	1	1	0	0	0	1	1
	0%	100%	100%	0%	0 %	0 %	50 %	50 %
Similarity	2	5	0	5	1	3	5	4
	28.57%	71.43%	0%	100%	25%	75%	55.56%	44.44%
Substitution	5	6	3	3	1	4	4	15
	45.45%	54.55%	50%	50%	20%	80%	21.05%	78.95%
Synchronous	16	0	11	10	25	0	20	0
	100 %	0 %	52.38%	47.62%	100 %	0 %	100 %	0 %

**Table B.** Distribution of the conditional senses per relation type and per language

	EN		LT		PT		TR	
	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit	Explicit	Implicit
Condition	19	0	25	2	19	1	30	0
	100 %	0 %	92.59 %	7.41 %	95 %	5 %	100 %	0 %
Negative-condition	0	0	2	0	0	0	1	0
	0 %	0 %	100 %	0 %	0 %	0 %	100 %	0 %