

# Annotation and Visualization of Reporting Events in Textual Narratives

Purificação Silvano<sup>1,\*</sup>, Evelin Amorim<sup>2</sup>, António Leal<sup>1</sup>, Inês Cantante<sup>1</sup>, Fátima Silva<sup>1</sup>, Alípio Jorge<sup>3,2</sup>, Ricardo Campos<sup>4,2</sup> and Sérgio Nunes<sup>3,2</sup>

<sup>1</sup>University of Porto/ CLUP, Porto, Portugal

<sup>2</sup>INESC TEC, Porto, Portugal

<sup>3</sup>University of Porto, Porto, Portugal

<sup>4</sup>Polytechnic Institute of Tomar, Ci2 – Smart Cities Research Center, Tomar, Portugal

## Abstract

News articles typically include reporting events to inform on what happened. These reporting events are not part of the story being told but are nonetheless a relevant part of the news and can pose a challenge to the computational processing of news narratives. They compose a reporting narrative, which is the present study's focus. This paper aims to demonstrate through selected use cases how a comprehensive annotation scheme with suitable tags and links can properly represent the reporting events and the way they relate to the events that make the story. In addition, we put forward a proposal for their visual representation that enables a systematic and detailed analysis of the importance of reporting events in the news structure. Finally, we describe some lexico-grammatical features of reporting events, which can contribute to their automatic detection.

## Keywords

News narratives, reporting events, annotation, visualization

## 1. Introduction

News articles are frequently characterized by their narrative form. This involves recounting recent events of public interest [1] affecting one or more participants at a specific time and place. Such narrative flow is frequently blended with reported speech, as in “The police authority said that the suspect did not accept the money”. The reported speech includes the sources of the author (journalist) in the news, such as event participants, witnesses or authority figures. The reference to these sources provides authenticity, veracity or explanation, among other aspects

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\*Corresponding author.

✉ msilvano@letras.up.pt (P. Silvano); evelin.f.amorim@inesctec.pt (E. Amorim); aleal@letras.up.pt (A. Leal);

cantante.ines@gmail.com (I. Cantante); mhenri@letras.up.pt (F. Silva); amjorge@fc.up.pt (A. Jorge);

ricardo.campos@inesctec.pt (R. Campos); sergio.nunes@fe.up.pt (S. Nunes)

🌐 <https://www.purisilvano.pt> (P. Silvano); <https://github.com/evelinamorim> (E. Amorim);

<http://www.ccc.ipt.pt/~ricardo/> (R. Campos)

🆔 0000-0001-8057-5338 (P. Silvano); 3C18-B766-4A42 (E. Amorim); 0000-0002-6198-2496 (A. Leal);

0009-0002-3866-4550 (I. Cantante); 0000-0003-2360-5136 (F. Silva); 0000-0002-5475-1382 (A. Jorge);

0000-0002-8767-8126 (R. Campos); 0000-0002-2693-988X (S. Nunes)



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([2]). Such strategy is essential, as reporters do not usually write about what they saw but about what their sources of information have to say regarding what they actually saw or know.

When looking at a news article, one can thus be offered two intertwined levels of discourse: the level of the (reported) events that constitute the story and the level of the (reporting) events, which connect the information conveyed in the news with the source(s) behind that information. Both represent different layers that have to be adequately identified so that during the extraction and representation of the news content, one can clearly separate the two narratives, that is, the reporting sequence and the (reported) story (cf. [2]). This separation is of the utmost importance to extract narratives and generate visualizations in a large-scale fashion because without it the outcome would be a representation of a collection of miscellaneous events and not a representation of related, causal events as it should be. However, as noticed by Gervás (2021) [3] when analyzing embedded stories in narratives, the great majority of computational models that aim at formalizing narratives disregard the existence of two storylines, which, according to the author, leads to insufficient formalisms to model embedded stories and the relations between the narratives levels. Although embedded stories in narratives referred to by Gervás (2021) [3] are somewhat different from those introduced by reporting events in news articles, the same observations are valid regarding the scarcity of computational approaches to model these two levels and the relations between them.

The study presented in this paper is a first step towards the distinction between these two lines of narratives found in news articles. Our purpose is threefold: (i) demonstrate how the reporting events that build the reporting narrative can be properly integrated into a multilayer annotation scheme designed initially to extract the story narrative from news articles (Section 3.1); (ii) put forward a proposal of building a visualization format for the reporting narrative (Section 3.2); (iii) describe some lexico-grammatical features of reporting events (Section 3.3), which can contribute to their automatic detection.

## 2. Key concepts

In this section, we present some key concepts of our study. Section 2.1 is dedicated to reporting events and some proposals for their analysis. Section 2.2 refers to the concept of visual representation of events, to some formats it can assume and to its usefulness when dealing with large quantities of data.

### 2.1. Reporting events

Reported speech and quotation have been treated, in the context of Natural Language Processing (NLP) tasks, mainly as specific forms of attribution relations, that is, relations between pieces of information and the sources expressing them. Pareti (2009) ([4] and [5]), delving into previous work, proposed an analysis of attribution relations grounded in three central notions: content, source and cue. The content corresponds to the linguistic material that someone, usually other than the speaker, said. Typically, it corresponds to a clause (as the that-clause in "John said that the shop is closed") or a series of clauses, but it can go from a single word to an entire paragraph. In the latter case, the source is explicitly attributed only in the first sentence. Additionally, content sometimes arises discontinuously in discourse (cf. [2] for an in-depth

analysis of different types of content and the distinction between speech, writing, and thought presentation). The source is the original producer of the content, which usually receives the thematic role of experiencer or of agent and can correspond to human entities, social institutions, or even inanimate entities (such as ‘newspaper’ or ‘report’) lexically linked to human referents by metonymic relations [5]. Finally, the cue, usually a verb, is the linguistic element that explicitly links source and content, and it functions as an ‘attribution signal’ [5]. In some annotation schemes, cue and source are annotated together [6], whereas in others cues are not annotated at all [7]. However, if we were to annotate all three in the sentence “The police said that the suspect resisted arrest”, the annotation would be as follows: source-”police”, cue-”said” and content-”the suspect resisted arrest”.

Attribution relations have been annotated in dedicated schemes (cf. [5] and references therein). Still, they have also been merged into the annotation schemes of other linguistic aspects, namely temporal relations and discourse relations. As for the former case (temporal relations), TimeML annotation framework [8] includes labels, such as REPORTING, concerning the annotation of eventualities that correspond to reporting events, which were used in the TimeBank and FactBank corpora. As for the latter (discourse relations), different frameworks like Rhetorical Structure Theory [9], the Segmented Discourse Representation Theory [10] or the Penn Discourse TreeBank [11] treat attribution as a discourse relation, but mainly not to leave any part of text loose, and to represent the connections between attributions and other discourse relations. However, ISO-8 [12] does not treat attribution as a discourse relation, and ISO-6 [13] recommends that it should be annotated in a separate layer, being the interactions between the attribution and other relations captured by merging the two layers.

Attribution relations in the news have been extensively studied for English, but simply identifying these meaning units is still difficult. The identification of attribution raises, for example, problems of dealing with different linguistic formats and nested constructions. For low-resource languages, such as Portuguese, the work on attribution relations is scarce (e.g., [14]; [15]), and the same applies to work on reported speech (e.g., [16]; [15]; [17]).

In this paper, we adopt the terminology and theoretical framework proposed by ISO 24617-1 [18] to describe the events that introduce the facts of the news. Therefore, from now onward, we will use the term ‘reporting events’ instead of attribution, a concept that is part of other theoretical approaches. The ISO-based approach that we take regarding the analysis of the reporting narrative has not yet been explored to the best of our knowledge.

## 2.2. Visual representation of events in narratives

To allow for a more accessible investigation of relations between the events that are represented in different types of discourse, visual representations of events are often used in [19, 20]. One advantage of visualizations is to speed up the skimming of texts since it summarizes the relevant information in one picture [21]. Other leaner visual models can also be used to represent narratives and provide a fast way for experts to investigate the story’s structure in the case of narratives, among other characteristics. One example of such models is the Knowledge Graphs (KG) [22, 23, 24], which are a ubiquitous visual representation of events. However, despite their widespread use, KG can be sometimes hard to read. Another example of a more plain visual scheme is the Message Sequence Chart (MSC), which is useful to represent events in a temporal

timeline and the relations between them [25, 26, 24]. Nevertheless, both KG and MSC lack mechanisms to represent events that belong to different layers, as is the case of the reporting and reported events in news articles. In fact, despite adopting a few visualization schemes to represent narratives, current visualization proposals do not present any solution for a deeper study of the narrative layers of a text. To fill this gap, we propose a new visual representation of events that separates the two types of events: the reporting from the reported events, enabling the distinction between the two narrative layers. Furthermore, our proposal includes other pertinent information about the participants that report the story, namely their semantic role and the relation to the other sources of the reporting events. Such a visual representation constitutes a valuable tool both for experts and non-experts because it produces a considerable bulk of information in a more convenient, productive, less-time consuming format, allowing, for instance, researchers to determine, in a large amount of data, predominant lexico-grammatical features of both reporting and reported events, which can be used for creating models of automatic extraction.

### 3. The study

The study described in this section addresses two main problems: (1) integrating the annotation of reporting events that belong to the reporting narrative layer of news articles into an annotation scheme initially designed to extract the story narrative (Section 3.1); and (2) representing visually the reporting and reported events, in other words, the reporting narrative and the story narrative (Section 3.2). The section ends with a description of some lexico-grammatical properties of reporting events (Section 3.3).

#### 3.1. Data and annotation

To conduct the present study we resorted to 120 news articles in European Portuguese from the Lusa News Agency, which were fully annotated according to a multilayer annotation scheme, named Text2Story annotation scheme, designed by Silvano et al. (2021) [27] and Leal et al. (2022) [28]. The Text2Story annotation scheme is a comprehensive annotation scheme for annotating relevant temporal, referential, spatial and thematic (semantic role labelling) information in news texts with a narrative nature. This bootstrapping annotation scheme is the result of the harmonization of four parts of ISO-24617 Language resource management, representing each of the four abovementioned linguistic levels: Part 1 – Time and Events [18]; Part 4 – Semantic roles [29]; Part 7 – Spatial Information [30]; Part 9 – Reference annotation framework [31]. It comprises two types of structures: entity structures and link structures (Appendix A). The former includes the following entities: events, times, participants, measures and spatial relations, whereas the latter includes the following links: temporal, aspectual, spatial, subordination, objectal and semantic role links. For each type of entity and link, several tags with different values can be assigned depending on their grammatical features (Appendix B and Appendix C). Nonetheless, due to the harmonization of the four different layers, described in separate parts of ISO, and bearing in mind the goals for which the annotation scheme was designed (extraction of narratives), we selected only the tags and attributes that were necessary to represent the story depicted in the narratives of news texts.

For this particular study, the relevant information concerns the entity structure event and the temporal and semantic role link structures. Following ISO 24617-1 [18], an event is a situation that happens, a state or circumstance that is temporally relevant, typically marked by a verb, a noun or an adjective. Events are annotated with tags and values for class, type, part of speech, tense, aspect, verb form, mood, modality and polarity. An event belongs to the class 'reporting' when it consists of an action of a person/ organization declaring something, narrating a situation, or informing about a situation. So, cases such as *informou*, *declarou*, *afirmou*, *disse* ('informed', 'declared', 'stated', 'said') are markables of reporting events. In addition to these, during the annotation process, we came across several instances of expressions such as *segundo* ('according to')+ noun phrase or *de acordo com* ('according to')+ noun phrase, which are considered in some works as markers of reporting events (cf. e.g. [32] and references therein). For these, we annotated the markable as *segundo* and *acordo* as reporting events.

The different markables identifying the reporting source were also annotated in the participant layer. The participants are linked by the objectal link, which establishes the connection between referential expressions that represent the same entity, entities that are connected because one is a part of, a member of or a subset of the other or, conversely, entities that are in a referential disjunction.

Regarding the link structure, the reporting events that comprise the reporting narrative are linked together, in the temporal layer, by the temporal link Identity, which identifies all the reporting events. In fact, our analysis indicates that it is impossible to determine a temporal ordering between the reporting events in a news article. In the 120 news articles that we analysed, temporal information about the temporal sequence of the reporting events is not given, nor by tenses nor by temporal expressions. The impossibility of ordering the reporting events temporally in the context of news articles is an argument in favour of treating them as part of the same reporting situation realized by different reporting events, all connected by the temporal link Identity, which means that they are all the same event. Finally, participants were linked to events by semantic role links (e.g. "agent", "medium"), describing their involvement in each event.

The 120 news articles of our dataset were fully annotated according to the aforementioned annotation scheme by a trained annotator after some experiments of agreement with other linguists. As a matter of fact, we adopted MATTER's [33] sub-cycle, MAMA, with four steps, (1) model, (2) annotate, (3) evaluate and (4) revise, and we repeated the cycle as many times as necessary until we solved the scheme's inconsistencies and the annotators' disagreements. Being our annotation scheme multilayered, the annotation process is very dense and intricate, requiring expertise and practice. For that reason, we have not had the opportunity to assign more than one annotator to this task, but we are currently training two more, which will speed up the annotation. Further, we are preparing the subset to go public, currently sorting out legal aspects with the donors.

### **3.2. The visual representation construction**

Given the complexity and density of the annotation and the fact that they constitute a separate layer from the events that make up the story being told in the news articles, it is useful to have visualizations of the reporting events and their relation with the story events. We aimed to

visualize the two separate narrative layers using different graphical representations. This visual representation can serve multiple purposes, namely enabling annotators and other users to have a bird's eye view of the interplay of the two layers to detect inconsistencies in the annotation and to assess the main lexico-grammatical features of reporting events that can be used to develop models to extract automatically one or the two narratives.

Thus, we propose a new visualization scheme that provides a mechanism to represent two different narrative layers. In this scheme, we first built a data structure suitable to represent one reporting event and all reported events connected to it. We called this data structure 'Bubble'. This structure also includes the identification of the participants with the semantic role of agent and medium and of the objectal link established between them. These two items of information are relevant to characterize the reporting events better. Next, a visual representation was built based on this proposed data structure. In what follows, we detail the construction of this data structure called Bubble and its visual generation.

### 3.2.1. The Bubble data structure.

We called Bubble a data structure encompassing a given event object and the set of events' identity relations in the narrative. There is also a more specific data structure based on Bubble that we call 'Big Bubble', which represents special pre-defined events that can include other events represented by bubbles. Our investigation considers events of the type reporting as the special pre-defined type. Using this data structure, we represent an event and a list of bubbles of events in its chunk. For instance, in the following chunk *Na nota é ainda referido que o proprietário foi identificado e foi elaborado 'um auto de contraordenação'*. ('The note also mentions that the owner has been identified and "an administrative offence notice" has been drawn up'), there are three events, *referido* ('mentions'), *identificado* ('identified'), and *elaborado* ('drawn up'). The first event is of the 'reporting' type, and so it is represented by a big bubble. The list of bubbles contained by the Big Bubble is composed of the last two events, whose types are of the class 'occurrence'. To distinguish between the different types of reporting events, the temporal link Identity was paramount since it indicated which were the reporting events that were part of the reporting narrative of the news and, hence, should be inside the Big Bubble. We will detail in the next subsection how such a representation helps to portray the problem that we investigate in this work visually.

### 3.2.2. Building the visualizations.

The visualizations are based on the Bubble concept detailed in the previous subsection. Appendix D.2 represents a more concrete example of the Bubble and Big Bubble concepts and how they can represent the two layers of the reporting and the reported events described in the news. For instance, in the news in Appendix D.1, there are four reporting events, which are represented in Appendix D.2 by four Big Bubbles with the number of the chunk in which they appear in the text: *3:disseram* ('told'), *5:disseram* ('told'), *10:acrescentaram* ('added'), and *12:acordo* ('according'). These Big Bubbles are orange circles positioned clockwise according to the event's position in the text, i.e., the first event is approximately positioned in the twelve-o'clock position, and the following events are positioned after that as in a clock. In the example depicted by Appendix



D.2, the event *disseram* ('said') appears in the text before the event *acrescentaram* ('added'). The events comprised by each reporting event are also positioned in a clockwise fashion. This order is intended to help the analyst go through the events intuitively since the clockwise sort is employed in numerous ways in human life. Additionally, the circles containing other circles are a natural way to show the context (other events) of one given event and identify the events embedded in a given reporting event.

The participants that intervene in the reporting events are also shown in the visualization. The source of the report was identified by detecting the participants annotated with the semantic role of agent. The semantic role of medium identifies the means used by the source to report on the events. In the case of the news article in Appendix D.1, the participants are *procuradores* ('prosecutors') and *gabinete* 'office'. Since the referential relation between the participants involved in the reporting events can provide important information to detect patterns for automatic extraction, we deemed it best to include in the the visual representation objectal links between those participants. In our running example, *os procuradores* ('the prosecutors') in the first Big Bubble is linked to the same expression in the third Big Bubble by the objectal link of Identity and to *o gabinete* 'the office' by 'memberOf'.

The visualization was built using the Tikz [34] package that produces pictures for L<sup>A</sup>T<sub>E</sub>X. Therefore, it produces high-quality picture files, although it has limitations for more interactive user exploitation. The code for producing such visualization is available as a python package<sup>1</sup>.

### 3.3. Some findings about reporting events

The analysis of the reporting events visualizations generated from the annotation that we produced reveals relevant features about this type of event and its role in the news structure. To be able to identify the reporting events that are external to the story news and that compose the reporting narrative, the Bubble visualization is an efficient and time-saving tool.

In our dataset, in a total of 120 news articles, 105 documents contain 3040 events, and 349 are reporting events linked by the temporal link Identity. The average of reporting events per news article is 2.09083. The elements introducing the reported events can be divided into three groups: verbs, nouns and discourse connectors. Verbs are the most frequent cues used in our corpus (272 occurrences of 35 verbs), the verbs *dizer* 'to say', *referir* 'to refer', *informar* 'to inform', *anunciar* 'to announce', *acrescentar* 'to add' and *adiantar* 'to say' being the most used. As for nouns, only two were used, *declarações* 'declarations' and *publicação* 'publication', and only once each. Finally, there are two discourse connectors, *segundo...* 'according to', and *de acordo com...* 'according to' used 75 times to express a reporting event.

On closer inspection, we can observe that the reporting narrative does not always assume the same configuration throughout the news articles of our dataset. Our analysis reveals that we can distinguish three configurations regarding the manner reporting events come about in the news, the only common trait being that all have only one main source of information based on which the news is built.

The first configuration has only one participant connected to one or several instances of reporting events by the semantic role of agent. These reporting events introduce different pieces

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<sup>1</sup><https://pypi.org/project/text2story/>

of information concerning the story. The story conveyed in the news with this configuration has one single source (**R0**), which is recursively quoted/referred to throughout the news, as illustrated by example (1).

(1) Um homem de 39 anos foi colocado sob vigilância eletrônica, em Penafiel, distrito do Porto, suspeito de violência física, injúrias e ameaças de morte à ex-companheira, de 42 anos, **informou** hoje **fonte da GNR**. Em comunicado, **a autoridade policial indicou** que o suspeito não aceitou a separação...

*A 39-year-old man was placed under electronic surveillance in Penafiel, Porto district, suspected of physical violence, injuries and death threats to his 42-year-old ex-partner, a **GNR source reported** today. In a statement, **the police authority indicated** that the suspect did not accept the separation...*

In (1), the main source (**R0**) is the participant designated by "fonte da GNR"/"the police authority", which is connected to different reporting events ("reported", "indicated") throughout the text.

In the second configuration, the news includes mentions not only of the direct source of information (**R0**) but also of a second, indirect source (**R0'**). This secondary source was used by the main, direct source to gather the information expressed throughout the news. This second configuration has two variants: the abovementioned case in which there is a single secondary 'reporting' source feeding the main 'reporting' of the news, and a second case, in which several secondary 'reporting' sources (**R0'**; **R0'**...) feed the main 'reporting' of the news. Example (2) illustrates the first possibility of this second variant: there is a main source of the news (**R0**), which is "Dutch media", and a secondary source (**R0'**), which is "police sources".

(2) O internacional holandês Quincy Promes, futebolista do Ajax, foi detido por alegadamente ter esfaqueado um familiar em julho, **informaram** hoje **os meios de comunicação holandeses**, **citando fontes policiais**.

*Dutch international Quincy Promes, Ajax footballer, was arrested for allegedly stabbing a family member in July, **Dutch media reported** today, **citing police sources**.*

Example (3) is a case of the second variant of this second configuration: there is a main source (**R0**), which is "public radio", connected to a reporting event ("reported"); and two secondary sources (**R0'** and **R0''**), also connected to reporting events ("according to"; "said"), and acting as indirect sources of the news.

(3) Três pessoas morreram no município de Camacupa, província angolana do Bié, na sequência de um ataque de um hipopótamo, **noticiou** hoje **a rádio pública**. (...) **Segundo um dos sobreviventes**, o ataque deu-se ao princípio da noite de domingo (...) **O administrados comunal da Muinha Baptista Sambango**, **disse** que o incidente foi dado a conhecer ao administrador municipal...

*Three people died in the municipality of Camacupa, in the Angolan province of Bié, following an attack by a hippopotamus, **public radio reported** today. (...) **According to one of the survivors**,*



*the attack took place early Sunday night (...) The municipal administrator of Muinha, Baptista Sambango, said that the incident was reported to the municipal administrator...*

Finally, the third configuration consists of one main reporting source in the news (as in the previous configurations) but one or more secondary reportings nested in the story. This differs from the aforementioned cases, in which the reporting sources other than the main source were “external” to the story being reported. In this third configuration, the secondary reportings are effectively “internal” to the story, as they are pieces of information comprising the story (see [3] for a similar structure). So, in (4), there is only a main source of the news, “The Sonora state attorney’s office”, but the news story includes another reporting event, “tell” (R1), which is nested in the story.

(4) O gabinete dos procuradores do estado de Sonora disse que os rapazes tinham 3,7 e 8 anos. O suspeito telefonou ao pai a contar o que tinha feito...

*The Sonora state attorney’s office said the boys were ages 3, 7 and 8. The suspect called his father to tell him what he had done...*

These three possibilities of combining ‘reporting’ events are not mutually exclusive because news can combine two or even all three reporting configurations.

## 4. Conclusions and future work

The coexistence of two different lines of narratives in the news can present a convoluted problem in extracting and representing narratives. In this paper, we presented an approach to the annotation and visual representation of the reporting events that constitute the reporting narrative in news articles. This enables us to adequately include them in a multilayer annotation and portray them in visual representations. The visual representation that we developed, since it comprises the identification of the reporting events and of their participants, as well as of the relations between the latter, acquires the same descriptive power of proposals that work with the concept of attribution, discussed earlier, with the advantage of our approach being more comprehensive allowing a wide variety of annotations and representations.

Furthermore, these visualizations are multipurpose in that they can be used, for example, during the annotation process to check for problems and, most notably, to uncover linguistic patterns of the structures that feature reporting events in a more practical and timely manner. The lexico-grammatical properties that we disclosed can act as cues for future work of automatic detection of reporting events. Moreover, the Bubble visualizations can be enriched with more relevant information, namely temporal relations, on which we are currently working.

The existing visual representations lack the mechanisms to adequately portray the two layers of narratives observed in the news articles and discussed in this paper, hence the difficulty of evaluating the visualization we put forward. Nonetheless, we intend to design an experiment with other alternatives to assert the degree of suitability of our proposal compared to others.

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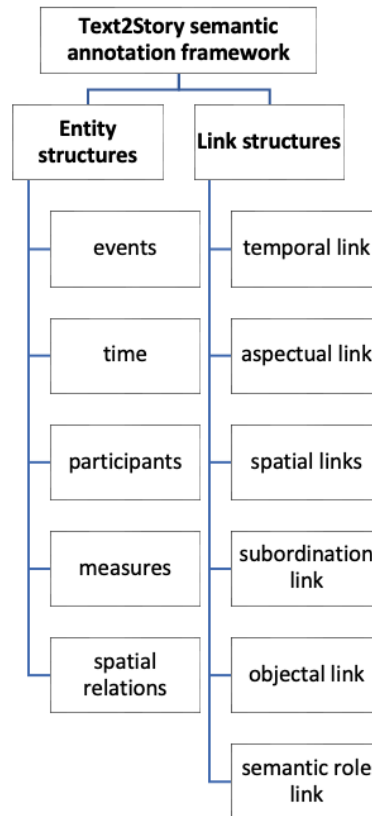
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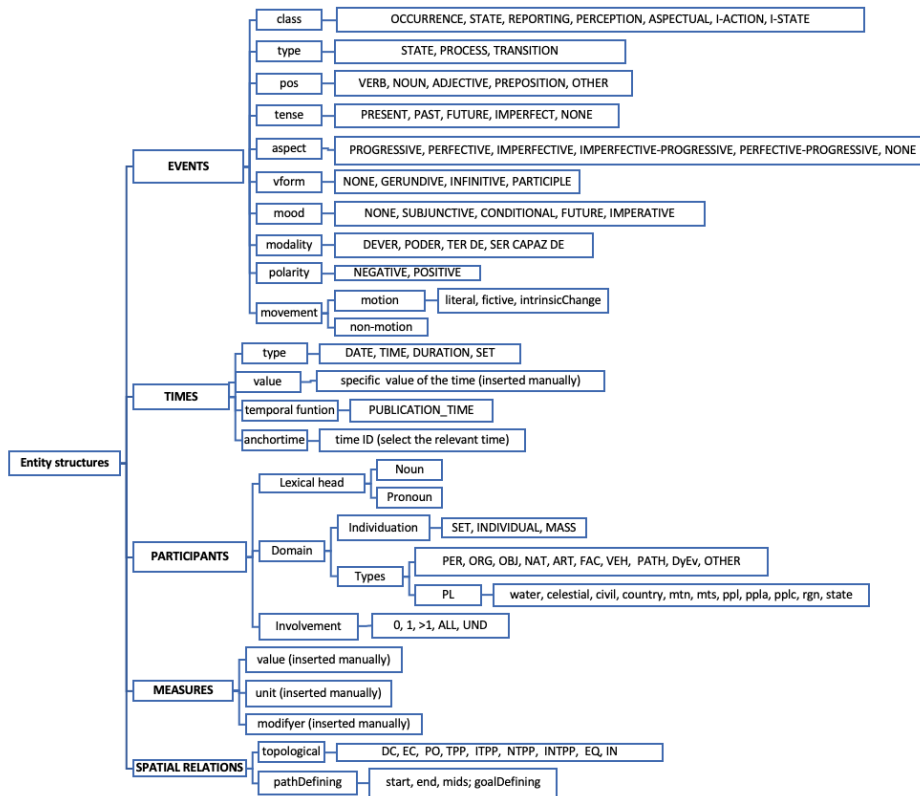
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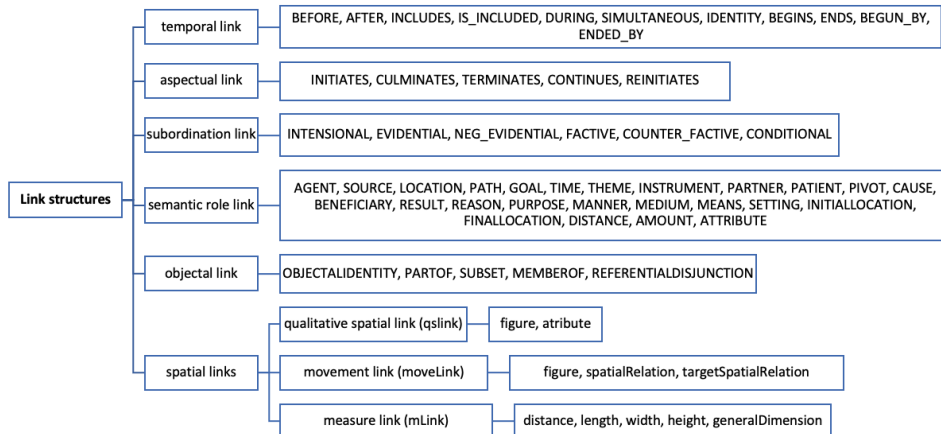
## A. Text2Story annotation scheme



## B. Tags and value of the entity structures



## C. Tags and values of the link structures





## D. An Example of Built Visualization from our Dataset

### D.1. The news article

Um homem foi detido no norte do México pelo alegado homicídio dos três filhos à pancada para se vingar da mãe das crianças, disseram os procuradores no domingo.

O gabinete dos procuradores no estado de Sonora (norte) disseram que os rapazes tinham 3,7 e 8 anos.

Os procuradores acrescentaram que o homem discutiu com a mãe das crianças e matou os filhos "de modo a causar-lhe uma grande dor". "Aparentemente, numa vingança contra a mulher, matou os filhos", de acordo com uma declaração publicada pelo gabinete.

*A man has been arrested in northern Mexico for the alleged murder of his three sons by beating to get revenge on the children's mother, prosecutors said Sunday.*

*The prosecutors' office in Sonora state (north) said the boys were 3,7 and 8 years old.*

*Prosecutors added that the man argued with the children's mother and killed the children "in order to cause her great pain." "Apparently, in a vendetta against his wife, he killed his children," according to a statement released by the office.*

## D.2. The visualization

