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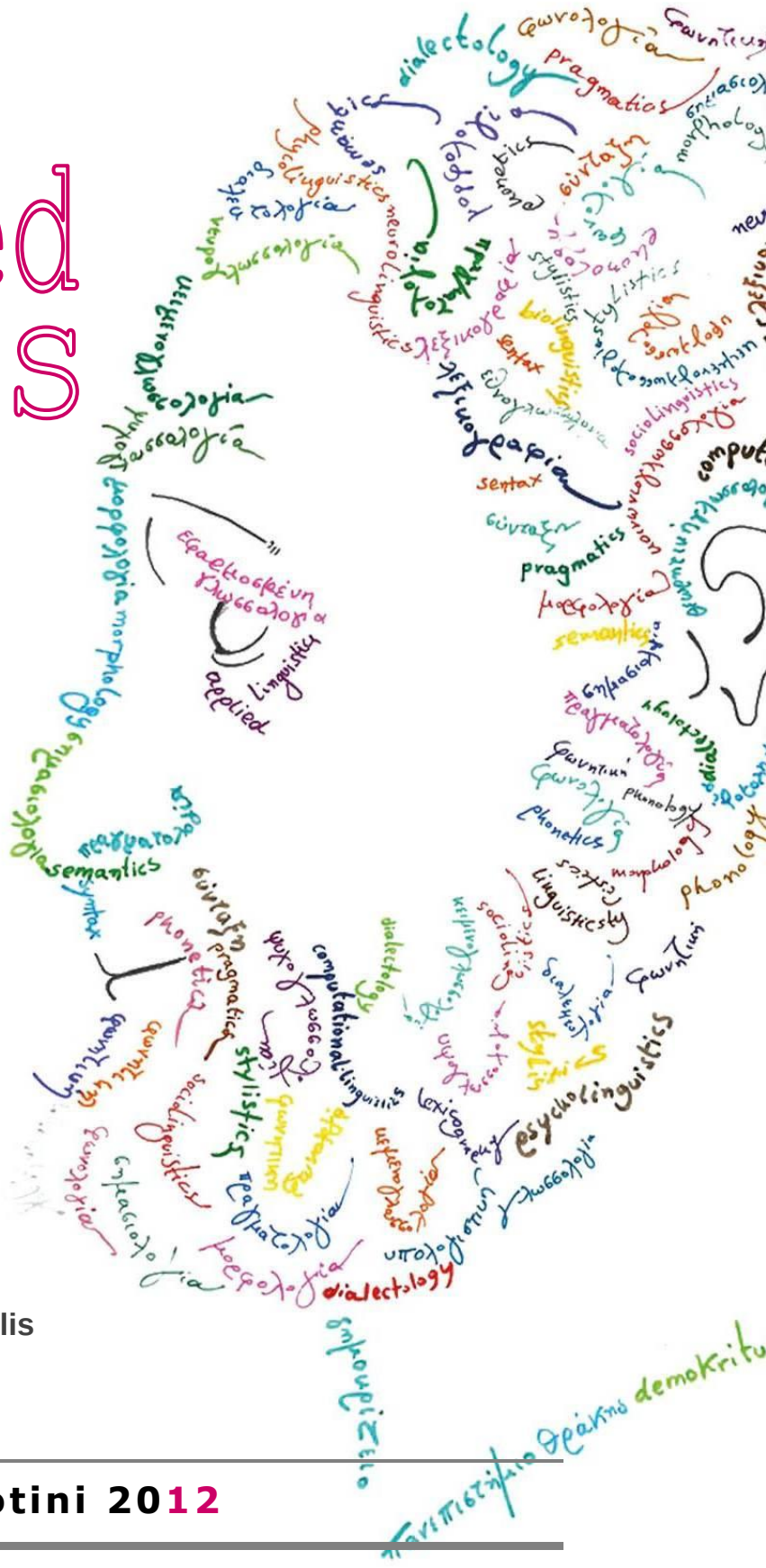
selected papers of the 10th International Conference of Greek Linguistics



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Komotini 2012

ISBN 978-960-99486-7-8

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ANNOTATION OF EVENTS IN GREEK CORPORA BASED ON THE MODEL OF TIMEML

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ABSTRACT

This paper describes ongoing work for annotation of events in Greek corpora following the specifications of the TimeML standard adapted to the Greek language. We first briefly outline the task of event recognition and the history of related annotation efforts. After that we discuss the tags used in the annotation process for a Greek Event Annotated Corpus and we provide indicative examples from the guidelines.

1. Introduction

Detection and analysis of events and their various realizations in natural language has been examined by philosophers, psychologists and linguists (Vendler, 1967). In computational linguistics and artificial intelligence, event detection is of great interest for developing complex natural language processing applications like narrative understanding, information extraction, automatic summarization and question answering. Large collections of text available today need to be robustly analyzed in order to be searchable from machines and event recognizers are crucial components of textual analytics systems that try to extract information necessary in creating automatic summaries and/or in answering questions like: "Ποιες ήταν οι σπουδαιότερες μάχες που έγιναν τον τελευταίο χρόνο του Β' Παγκοσμίου Πολέμου; Ποιες τράπεζες κατέρρευσαν το 2011;"

Many different approaches to event detection have been presented in the relevant literature. The ultimate goal of these approaches is the development of applications that automatically extract facts and recognize spatiotemporal relations between them (Παπαγεωργίου κ.α., 2007). Events are usually studied in terms of either their semantic structure or of their spatio-temporal dimension in relevant annotated corpora needed for developing and testing event recognizers. In this paper, we present our effort for the creation of a Greek Event Annotated Corpus (GEAC) based on the model of the Time Markup Language (TimeML, http://timeml.org).

In Z. Gavriilidou, A. Efthymiou, E. Thomadaki & P. Kambakis-Vougiouklis (eds), 2012,
Selected papers of the 10th ICGL, pp. 373-380. Komotini/Greece: Democritus University of Thrace.

2. Annotation schemas for time and events

One of the first efforts for annotation of events, temporal expressions and relations between them is Setzer and Gaizauskas (2001), who developed the Sheffield Temporal Annotation Guidelines. STAG was a scheme that categorized events to be marked up in occurrence, perception, reporting, and aspectual classes. The scheme also included the *relatedToEvent* and *relatedToTime* attributes, which corresponded to references to other events or temporal expressions. A *relType* attribute was used for expressing the nature of the reference and had the following values: BEFORE, AFTER, INCLUDES, IS_INCLUDED and SIMULTANEOUS. The last one was a "cover value" for all types of temporal overlaps. An annotation example according to STAG is the following:

The boy arrived on Thursday.

```
The boy <event eid="9" class="OCCURRENCE" tense="PAST" relatedToTime="5"
relType="IS_INCLUDED">arrived</event> on <timex tid="5">Thursday</timex>.
```

The Automatic Content Extraction 2005 Evaluation included a detection task for events with specific semantics (Table 1) that had entities and temporal expressions as arguments. ACE events were also annotated for modality, polarity, tense and genericity.

Event type	Subtypes
Life	be -born, marry, divorce, injure, die
Movement	Transport
Transaction	Transfer-ownership, transfer-money
Business	start-org, merge-org, declare-bankruptcy, end-org
Conflict	attack, demonstrate
Personnel	start-position, end-position, nominate, elect
Justice	arrest-jail, release-parole, trial-hearing
Contact	meet, phone-write

Table 1 Event types and example subtypes from the ACE 2005 Evaluation

The designers of the TimeML (Pustejovsky et al., 2003a) integrated and expanded elements from previous efforts and STAG in particular. The main TimeML tags include TIMEX3, EVENT, MAKEINSTANCE and three types of links. The reference corpus for TimeML is TimeBank (Pustejovsky et al., 2003b), a resource that contains 183 news articles with 61K non-punctuation tokens and is available from http://www.timeml.org. The latest version (1.2) of TimeBank includes 8K events, 1.4K TIMEX3 tags and 9.6K links. Similar resources for other languages include timebanks for Spanish, Italian, Chinese, Korean and French that range from 10K to 60K tokens. Some of them have been used in shared tasks for the evaluation of automatic multilingual event annotation (Verhagen et al., 2010).

3. A Greek Event Annotated Corpus

The main properties for each TimeML element are described in the following subsections, with particular focus on the EVENT and the MAKEINSTANCE tag. Each description is accompanied by Greek examples that we have collected in order to develop guidelines for the GEAC. In its current version, GEAC contains 41 annotated texts, including news articles, historical narratives and travel documentaries. We drew these documents from online newspaper sites, the Greek Wikipedia and transcripts of TV interviews on historical periods. The total size of the corpus amounts to 31,920 words and it is currently annotated for temporal expressions and events only. The annotation editor we used was Callisto (
Figure **1**), a freely available tool from the non-profit organization MITRE. An alternative environment for event and other annotation tasks is the Brandeis Annotation Tool (Verhagen, 2010).

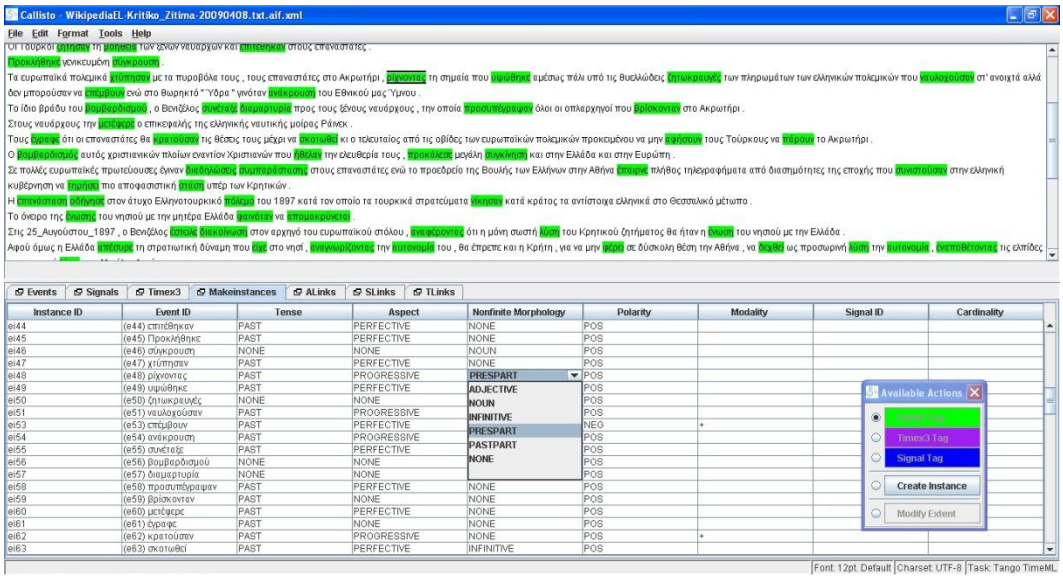

Figure 1 Annotating MAKEINSTANCE tags (Section 3.3) with Callisto, the editor used for the construction of the Greek Event Annotated corpus

3.1. The TIMEX3 tag

Temporal expression annotation is accomplished through the TIMEX3 tag. TIMEX3 markables include dates, times, and durations. The temporal value of these markables appears explicitly in the text or can be defined in relation to another explicit expression, including the document creation time. The next example shows the annotation of an explicit TIMEX3:

Έφυγα από την Γερμανία στις 2 Αυγούστου του 2009.
<TIMEX3 tid= 't1' type= 'DATE' value = '2009-08-02' temporalFunction = 'FALSE'>02 Αυγούστου του 2009</TIMEX3>

Each TIMEX3 includes a unique identification attribute (tid) which can be used in other tags for reference to this expression. The value attribute is used for normalizing durations (δώδεκα βδομάδες: P12W), times (8:05 της 21ης Φεβρουαρίου 2009: 2009-02-21T08:05:00). The *temporalFunction* attribute has a value FALSE since the expression can be unambiguously evaluated in the text. Other expressions like *χθες* have to be anchored to another expression for their value to be defined. Thus, given the 't1' expression above, the following example should be annotated as follows:

Την επόμενη μέρα έφτασα στην Πάτρα.
<TIMEX3 tid= 't2' type= 'DATE' value= '2009-08-03' temporalFunction= 'TRUE' anchorTimeID = 't1' > επόμενη μέρα <TIMEX3>

3.2. The EVENT tag

According to TimeML, events are "situations that happen or occur". The term also includes situations that change throughout the text or states that hold true. State events are considered markables if they develop or change in the text, if they are directly related to a specific TIMEX3, or if they are introduced by another event. Expressions that are not annotated include generics not referring to temporally anchored events (*οι κρατούμενοι απαγορεύεται να κρατάνε όπλα, τα αντικείμενα πέφτουν λόγω της βαρύτητας*), verbs introducing generics (*είπε ότι η Γη γυρίζει γύρω από τη Σελήνη*), nominalizations that provide no further information beyond that of their associated verb (*δημοσιεύματα σε εφημερίδες αναφέρουν…*). Events can be punctual or last for a period of time, and they can be realized as verbs (*ο διαιτητής διέκοψε τον αγώνα*), nouns (*η βροχόπτωση προκάλεσε ζημιές*), adjectives (*τα κέρδη ήταν ελαφρά υψηλότερα*), prepositional phrases (*ένας υπάλληλος σε διαθεσιμότητα κατηγορείται* ...) and participles (*η κατεστραμμένη από τη χαλαζόπτωση σοδειά θα αποζημιωθεί*).

Our guidelines contain instructions for typical constructions. If an event is realized as a verbal cluster containing an aspectual and a main verb, both verbs are annotated as individual events. The set of aspectual verbs includes the verbs *αρχίζω, σταματώ, τελειώνω, συνεχίζω, etc*. In the case of events realized as noun phrases, only the head is annotated and any modifiers are excluded from annotation (*παρατήρησαν σημαντική βελτίωση*). In the case of events in prepositional phrases, we annotate the head of the embedded NP (*βρίσκεται από χθες σε διαθεσιμότητα*). For events realized as predicative complements of copula verbs, we annotate only the complement (*ήταν δάσκαλος*). If an event is realized as a nominalization preceded by a support verb (*δημιουργούν εντυπώσεις*), both words are annotated as individual events, which are linked via an IDENTICAL TLINK (see Section 3.4). In the case of causative predicates (*η επίθεση προκάλεσε την οργή των αιγυπτιακών αρχών*), it is often difficult to distinguish the event introduced by the causative predicate from the result event. For constructions with similar predicates (*προκαλώ, οδηγώ σε, προξενώ, επιφέρω*), we annotate three events if the subject is an event itself, and we create a BEFORE TLINK between the subject and the object event.

Each event has to be classified on the basis of its semantic and factual characteristics. The set of classes includes REPORTING, PERCEPTION, ASPECTUAL, I_ACTION, I_STATE, STATE and OCCURRENCE events. Reporting events (*λέω, εξηγώ, δηλώνω, περιγράφω, διευκρινίζω, ξεκαθαρίζω, διατυπώνω, ανακοινώνω, σχολιάζω*) describe the action of an entity declaring something or providing information about an event, etc:

Ιστορικές πηγές *αναφέρουν* ότι ο πόλεμος του '40 επηρεάζει και τις σύγχρονες γενιές.
Σχολιάζοντας τα αποτελέσματα εννεαμήνου…
Δήλωσε ο Υπουργός Πολιτισμού.
Παράλληλα η ΕΣΥΕ *ανακοίνωσε* ότι ο δείκτης όγκου λιανικών πωλήσεων.
Αναφερόμενος στο θέμα, ο «ισχυρός άνδρας» της Ράπιντ *μίλησε* στην εφημερίδα της Ρουμανίας.
Η Εθνική Τράπεζα *είπε* ότι τα καθαρά κέρδη αυξήθηκαν 48%.

Perception events *(βλέπω, ακούω, κοιτάω, διακρίνω, παρακολουθώ, παρατηρώ, ατενίζω, θωρώ, ακούω, παρακούω)* are used to describe the physical perception of another event:

Από την άλλη *παρατηρήσαμε* και πάλι στενότητα στις συνθήκες ρευστότητας.
Το *είδατε* στην Τουρκία.
Πρώτα να *δούμε* σε τι κατάσταση θα είναι οι παίκτες.
Η χαρά μου ήταν μεγάλη που *άκουσα* τη φωνή τους.
Έβλεπα με τα μάτια μου τα άλογα που πέθαιναν από τα χτυπήματα.

Aspectual events focus on different temporal facets of an event introduced by the aspectual event. This class includes initiation (*αρχίζω, ξεκινώ)*, reinitiation (*ξαναξεκινώ)*, termination *(σταματώ, τερματίζω, διακόπτω, αναβάλλω, ανακαλώ, ματαιώνω)*, culmination (*τελειώνω, ολοκληρώνω)* and continuation (*συνεχίζω, εξακολουθώ, επιμένω)* events:

Με υψηλό ρυθμό *συνεχίζει* να τρέχει η ελληνική οικονομία.
Μετά από δυο μέρες *άρχισαν* οι ανακρίσεις.

Intensional action events (I-ACTION) include verbs that introduce an argument which must exist in the text and which describes an event or a state, for which we can infer something, given its relation to the I-ACTION verb. For example, the eventual arguments of the first group of sentences below did not necessarily occur.

προσπαθώ, επιχειρώ, αποπειρώμαι, δοκιμάζω
Με την κίνηση αυτή *προσπαθεί* να αιφνιδιάσει.
Και οπωσδήποτε *προσπάθησε* να κρατήσει κάποια απόσταση.

ερευνώ, ψάχνω, διερευνώ, εξετάζω
Έψαχναν να μας βρουν για 13 χρόνια
Θα *ερευνήσουν* την οργανωμένη γενοκτονία χιλιάδων Εβραίων.

καθυστερώ, αναβάλλω, αργοπορώ, επιβραδύνω, χρονοτριβώ, εμποδίζω, αναστέλλω
Τότε όμως *καθυστερούσαν* να φτάσουν γιατί στη διαδρομή βρίσκονταν οι ενδιάμεσες φυλακές.
Κι έτσι *ανέβαλε* το ταξίδι.

αποφεύγω, προλαμβάνω, εμποδίζω
Προσπαθούσαν να *εμποδίσουν* τους στρατιώτες τους από να έχουν σχέσεις με τους ντόπιους.
Ο Υπουργός *απέφυγε* να απαντήσει στις ερωτήσεις.

ρωτώ, ζητώ, παρακαλώ, προστάζω, διατάζω, παραγγέλλω, πείθω, αιτούμαι, ικετεύω, παροτρύνω, προτρέπω, παρακινώ
Θέλω να σας *ζητήσω* και γραπτώς να με συγχωρήσετε
Προσφέρθηκε να επισκευάσει το ποδήλατό της

υπόσχομαι, τάζω, προσφέρω, προσφέρομαι, διαβεβαιώνω, βεβαιώνω, προτείνω, προτίθεμαι, συμφωνώ, δέχομαι, αποφασίζω, καθορίζω, επιτρέπω
Η ΟΥΕΦΑ τους *επέτρεψε* να χρησιμοποιήσει τον αδήλωτο Μπέτε
Μου *υποσχέθηκε* να γυρίσει νωρίς το βράδυ.

ισχυρίζομαι, προτείνω, υπαινίσσομαι, εισηγούμαι, υποδηλώνω, υποστηρίζω
Ισχυρίστηκαν ότι δεν είχαν μαζί τους τίποτα άλλο αξιόλογο
Πρότεινε στη μαμά μου να πλένει τα πουκάμισα των Γερμανών

The intensional state (I-STATE) class is used for states that refer to alternative or possible worlds where their argument might occur:

πιστεύω, νομίζω, φρονώ, σκέπτομαι, κρίνω, υποψιάζομαι, υποπτεύομαι, αισθάνομαι, νιώθω
Το *πιστεύατε* ότι θα τις βρείτε ποτέ;
Νόμιζαν πως είχε αποπλεύσει από τη Ρόδο.

θέλω, χρειάζομαι, αρέσει να..., βρίσκω καλό, επιθυμώ, λαχταρώ, ποθώ
Θέλουν να φύγουν από την Αϊτή.
Υπάρχουν οικογένειες που θα *ήθελαν* να υιοθετήσουν ένα παιδί από την Ασία

ελπίζω, περιμένω, ευελπιστώ, προσδοκώ, αναμένω, φιλοδοξώ, σχεδιάζω
Ο Παπαδόπουλος *φιλοδοξεί* να πάρει μεταγραφή στην Αγγλία
Ώστε να φτάσει στους «6» και να *ελπίζει* βάσιμα σε πρόκριση

φοβάμαι, σιχαίνομαι, μισώ, τρέμω, στενοχωριέμαι, ανησυχώ, σκοτίζομαι
Οι αρχές *φοβούνται* ότι δε θα είναι σε θέση να αντιμετωπίσουν...
Οι συγγενείς του *ανησυχούν* για την έκβαση της υγείας του

είμαι σε θέση, μπορώ
Το σχολείο δε θα *είναι σε θέση* να δεχτεί περισσότερους μαθητές την επόμενη χρονιά.

STATE events describe circumstances in which something holds true. We annotate a) states that change in the temporal framework of the text being annotated, b) states that are directly related to a temporal expression c) states that are introduced by an I-ACTION or a REPORTING event and d) states realized by a copula verb and a predicative complement if the state depends on the document creation time. In the example below, the relation of the airplane to the owner company does not change during the temporal framework of the text. Thus it is not annotated as a STATE. On the contrary, the state expressed by *επέβαιναν* changes during the document framework and is to be annotated.

Και οι 125 άνθρωποι που *επέβαιναν* στο airbus της Quantas σώθηκαν.

In a similar way, the complements of verbs like *είμαι* and *βρίσκομαι* are to be annotated as states since they can be interpreted only in a relation to the document creation time.

Ισχυρές ναυτικές δυνάμεις αποτελούμενες από 15 πολεμικά πλοία βρίσκονται *στο λιμάνι του Πειραιά.*

The next two examples regard states that are related to a temporal expression and should be connected to these expressions via a TLINK.

Ο Κωνσταντίνος Καραμανλής διετέλεσε *Πρωθυπουργός της Ελλάδας* για 5 χρόνια.

Έμεναν *σε καταυλισμό* για αρκετά χρόνια.

Occurrence events are all the other kinds of events describing something that happens or occurs in the world.

Η ΑΕΚ *νίκησε* με 3-0 την Ρόμα.

The classes of the events described above are not uniformly represented in GEAC. Not surprisingly, the occurrence class is the most frequent one, followed by events classified as states (**Table 2**).

Event class	Percentage
Occurrence	65,15%
State	21,63%
Reporting	3,71%
I-action	3,12%
Aspectual	3,02%
I-state	2,27%
Perception	1,08%

Table 2 Event classes and their distribution in the Greek Event Annotated Corpus

3.3. The MAKEINSTANCE tag

Events in TimeML are distinguished from their realizations. Thus, each EVENT tag is accompanied by at least one MAKEINSTANCE, a tag that is used for the specification of the actual realization of an event. It includes information like the id of the event it refers to, together with attributes concerning tense, aspect, non-finite morphology, polarity, modality, and cardinality.

In most cases, only one MAKEINSTANCE is needed and it is automatically created and associated with a new EVENT tag by the annotation editor. Thus, the human annotator has only to create additional MAKEINSTANCE tags for the second (and more, if needed) instances when an event is associated with two or more temporal expressions:

Η Μαρία δίδαξε τη Δευτέρα και την Τρίτη.

```
<MAKEINSTANCE eiid="ei1" eventID="e1" tense="PAST" aspect="NONE" pos="VERB"/>
<MAKEINSTANCE eiid="ei2" eventID="e1" tense="PAST" aspect="NONE" pos="VERB"/>
```

There are also cases, when the human annotator can either create as many MAKEINSTANCE tags as needed or, for large numbers of instances, just one MAKEINSTANCE that includes cardinality information:

Η Μαρία δίδαξε δύο φορές τη Δευτέρα
Η Μαρία δίδαξε 150 φορές πέρυσι

Tense and aspect attributes of MAKEINSTANCE tags are non-optional. Possible values for tense are PAST, PRESENT, FUTURE, or NONE. Aspect can be assigned values from PROGRESSIVE, PERFECTIVE, PROGRESSIVE_PERFECTIVE, or NONE.

Figure 2 presents some typical annotations for finite verbal types.

Example	Tense	Aspect
Δεν *βλέπει* να ανεβαίνουν στην κατηγορία	PRESENT	NONE
έχει *αναθέσει* τη διαχείριση σε τρίτους	PRESENT	PERFECTIVE
Τα στρατεύματα *μαζεύονταν* γύρω από το νησί	PAST	PROGRESSIVE
Ο ΑΓΕΕΘΑ *πρότεινε* αύξηση της θητείας	PAST	NONE
Είχαν φύγει πριν να γυρίσω	PAST	PERFECTIVE
Όλοι *θα θέλουν* δεύτερο και τρίτο	FUTURE	PROGRESSIVE
Εμείς *θα κερδίσουμε* με τη Ντινάμο	FUTURE	NONE
Θα έχει σχολάσει απ' τη δουλειά του στις 6	FUTURE	PERFECTIVE

Figure 2 Annotation of tense and aspect attributes for finite verbal types

The non-finite morphology attribute is mainly used for non-verbal events and can take the following values: ADJECTIVE, NOUN, PRESPART, PASTPART, or NONE. All finite verbal types are assigned a NONE value, while PRESPART and PASTPART values are reserved for participles like *ερευνώντας* and *διορισμένος*. The polarity attribute depends on whether the event instance is negated or not in the text (*δεν έπλυνε*) and it can either be assigned the implied default value POS, or NEG.

3.4. The LINK tags

When all events and temporal expressions have been annotated in a text, the next step is to define relations between these events (actually MAKEINSTANCEs) and temporal expressions using temporal links (TLINK), aspectual links (ALINK) and subordination links (SLINK). Although we have not yet annotated LINKs in GEAC, we provide in this subsection a brief overview of these TimeML tags, together with indicative examples from our guidelines for Greek.

The large majority of the 9615 links in TimeBank 1.2 are TLINKs (6418) followed by 2932 SLINKs, and 265 ALINKs. TLINKs depict the temporal relation between two events, two temporal expressions or between an event and a temporal expression. A *relType* attribute describes explicitly the nature of this relation.

Table 3 presents some of the possible values for the *relType* attribute.

relType	Example	relType	Example
Before	*Έφυγε* πριν να *γυρίσω*	Simultaneous	Όσο η Αντιγόνη *έπαιζε*, η Αρετή *διάβαζε*
After	Τον *συνάντησα* μετά τη *γέννηση* της Βιολέτας	Immediately After	Όλοι οι επιβάτες *πέθαναν* μόλις *ανατινάχθηκε* το αεροπλάνο.
Includes	*Έφυγε* για το χωριό την προηγούμενη *Τετάρτη*	Begins	Η *δικτατορία* διήρκεσε από *το 1967* μέχρι το 1974
During	*Δίδασκε* σ' αυτό το σχολείο για *30 χρόνια*	Ends	Η *δικτατορία* διήρκεσε από το 1967 μέχρι *το 1974*

Table 3 TLINK relation types and examples

ALINKs connect an aspectual event with another event. Table 4 presents possible values for the *relType* attribute of ALINKs, together with indicative examples.

relType	Example
initiates	*άρχισε* να *πουλάει* την περιουσία του
culminates	*ολοκλήρωσε* τη *συμφωνία* με τους Άραβες
terminates	η Σπίθα *σταμάτησε* να *γαβγίζει*
continues	*συνέχισε* να την *ενοχλεί*
reinitiates	*ξανάρχισαν* να *παίζουν*

Table 4 ALINK relation types and examples

Finally, SLINKs are used for all relations between events in subordination structures (**Table 5**). SLINK *relTypes* include the value *modal* for references to a possible world; *evidential* and *neg_evidential* for connections of a reporting or perception event to its argument; *factive* and *counter_factive* in relations that imply something about the veracity of an argument; and *conditional* between verbs in conditional and apodosis clauses.

relType	Example
modal	η λύση αυτή *προϋποθέτει* το *συμβιβασμό* των 2 πλευρών
evidential	*είπε* ότι *αγόρασε* τα βιβλία
neg_evidential	*αρνήθηκε* ότι *χτύπησε* το σκυλάκι
Factive	*κατάφεραν* να το *αποκτήσουν*
counter_factive	*ματαίωσαν* τη *συμφωνία*
conditional	αν *προκριθούν* στον τελικό, θα *πάρουν* και τον τίτλο

Table 5 SLINK relation types and examples

4. Conclusions and Future Work

We have presented an ongoing effort for the creation of a Greek Event Annotated Corpus, which has also been annotated for temporal expressions. The annotation was based on a TimeML annotation scheme adapted to the Greek language. Next steps in this line of research include annotation of temporal, aspectual and subordination links between events and temporal expressions. Prokopidis et al. (2009) have reported on work for the development of a TIMEX recognizer. Based on the annotation effort presented in the current paper, we plan to augment our pipeline of NLP tools with an event recognizer. Besides the temporal aspect of events, we are currently experimenting with the creation of a spatial annotation scheme.

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