

# Temporal Referentials with Formal Semantic Representation

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## Abstract

Over the analyses being increasingly diversified, the notion of referential becomes more and more important in the theoretical plan and in the associated descriptions. We introduce the specification of this notion of referential with several examples, and then we propose its formalized approach which would admit the computing treatments later. We put this notion within the theoretical framework of the temporality (i.e. aspecto-temporal theory) apprehended by the languages while arguing its introduction and formalizing their concepts.

## 1. Introduction

We know that the language is very complex, which is explained by following hypothesis:

- (i) The literature considers the referential as an absolute concept like a time;
- (ii) A non-realized enunciation in a non-actualized referential (an enunciation of narrative type or history) cannot be represented linearly;
- (iii) For a certain enunciation, the enunciative referential created by an enunciator happens naturally in relation with other types of referentials.

Indeed, it is necessary to consider the enunciative operations which allow inserting a predicative relation into the temporal referential. In this paper we present, in particular, the aspectual operations which determine a certain conceptualization of the situation expressed by each predicative relation of the enunciation. First, we introduce the notion of temporal referential; secondly, several types of referential with their examples; and last, the formalization in the form of the applicative schema.

## 2. Temporal referentials

The notion of referential, in particular, the temporal referential is essential to scientific activities like the physics or the other domains of knowledge.

A temporal referential is organized by the whole of instants which are structured with the temporal relations as concomitance (symbolized by '='), or differentiation (symbolized by '≠' which includes anteriority '<' or posteriority '>'): each instant has relation to another instant, and they are identified by these relations. The temporal referential is not necessarily linearly organized. As an example of French, "*Le verre est cassé*" (*The glass is broken*) expresses an event aspect which creates also a resultative state aspect "*Maintenant, le verre reste cassé*" (*Now, the glass remains broken*). Therefore, to represent this kind of the resultative state's example, we have to trace back our temporal referential to the event. This example shows us that the orientation of the enunciative referential (abbreviated to 'REN') is not symmetric. The natural languages choose the orientation of the temporal referential. In the case of French, it follows the chronological orientation of the events.

The whole of these instants is continuous; therefore we define the topological intervals of instants with the opened or closed boundaries. A temporal referential can be also determined from another type of referential by the rupture (break) relation (symbolized by '#').

We define the system of temporal referential as follows:

- (i) for all instants of a certain temporal referential (REF1), it exists an instant 't' of another temporal referential (REF2), where this instant 't' cannot be identified by the relations of concomitance or differentiation in the referential REF1;
- (ii) this instant 't' establishes the rupture relation with any instant (for example, 't1') of REF1, so this relation between two instants of each different referential is symbolized by [t # t1].

To treat the aspecto-temporal analysis, it is necessary to distinguish clearly the *temporal referential organized by an enunciator* which constitutes the modeling of the "linguistic time", from the *chronological referential organized from an external cosmology* which is both linear and cyclical time of the stars or the planets (in other words, "chronic or physical time"). In this paper, we focus our attention on the linguistic time which can be expressed by

several temporal referentials organized by the enunciator. The notion of the referential is essential to organize the temporal and aspectual reference. This notion becomes finally as a necessity for the temporal and aspectual conceptualization of the natural languages.

The aspect reflects the predicative relation that an enunciator represents; and the tense reflects the relations which situate either in the referential of the enunciator or in the other referentials which are relatively independent of the enunciation, but always tied to the *enunciative process* (symbolized by 'PROC<sub>0</sub>'). This enunciative process expresses the unaccomplished act of enunciation and it is deployed upon an interval which is closed on the left and opened on the right. So then, that couldn't bring a simple temporary "moment of enunciation": because each enunciative process consumes the time. To represent the aspecto-temporal values which are observed in the natural languages, we need different types of temporal referentials:

- (i) External referential (abbreviated to 'REX');
- (ii) Enunciative referential ('REN');
- (iii) Referentials identified by the rupture relation (#) in relation to the enunciation (Possible referential 'RPOS', Narrative referential 'RNA', etc.).

A referential can be determined by another referential.

### 3. Enunciative referential (REN) vs. External referential (REX)

Above all of other referentials, we have the first essential referential: the *enunciative referential*, named **REN**. The enunciator constructs this referential which is detachable from the external world. We must not be confused this referential with the *external referential*, named **REX**. The REN presents enunciator's point of view, but the REX can ignore it. In fact, the REN is dependent on the REX, but with the rupture relation.

The REN is localized from a particular instant<sup>1</sup>, symbolized by ' $T^0$ ', which is the temporal mark of the unaccomplishment (i.e. the first instant of the act of enunciation), and the right opened boundary of the enunciative process is concomitant with this instant ' $T^0$ '. When this instant ' $T^0$ ' is projected onto the REX, it becomes a mobile point of reference, symbolized by ' $t_m$ ', which can be changed with the flow of time. As a result, it wouldn't be considered as an origin.

Each enunciator constructs his own enunciative referential that can be the nature of modal domain

"realized", which means that all instants of this domain are already passed and realized. All events located in the REN are the realized events or in the process of realizing. These events belong to the past tense or to the present tense which is in progress. On the contrary, the events which will come are located in the non-realized domain. We represent these two referentials through the following diagram:

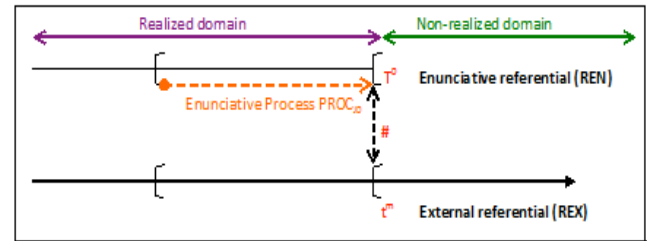


Figure 1 : Enunciative referential (REN) and External referential (REX)

When an enunciator enunciates, the act of enunciation is expressed in the form of aspects (state, event, and process) and represented in the REN (or in another type of referential in connection with the REN).

We take several examples in French which have a same predicative relation "*Le-vapeur traverser le-lac* (*A-steamboat cross the-lake*)" with different aspectual values in the REN:

(1) (*En ce moment,*) *Le vapeur traverse le lac.*

(*At this moment,*) *A steamboat crosses the lake.*

Aspecto-temporal value: unaccomplished process concomitant with the enunciation

(2) *Le vapeur traversait le lac quand un orage a éclaté.*

(*A steamboat was crossing the lake when a storm burst.*)

Aspecto-temporal value: unaccomplished process non-concomitant with the enunciation

(3) *Hier, le vapeur a traversé le lac.*

(*Yesterday, a steamboat crossed the lake.*)

Aspecto-temporal value: event non-concomitant with the enunciation

(4) *Enfin, le vapeur a traversé le lac, il est maintenant en sécurité.* (*At last, a steamboat crossed the lake, it is secure now.*)

Aspecto-temporal value: resultative state in the present concomitant with the enunciation

Each aspecto-temporal value of these examples is different. For the example (2), the event "*un orage a éclaté* (*a storm burst*)" is secant at the ongoing process "*Le vapeur traversait le lac* (*A steamboat was crossing the lake*)". This process is situated in the past from the act of enunciation and unaccomplished compared with the event which is cutting off the right boundary of the process. For the example (4), the event "*le vapeur a traversé le lac* (*a steamboat crossed the lake*)" causes the resultative state. The contextual constituents such as *enfin* (*at last*), *il est*

<sup>1</sup> The instant ' $T^0$ ' must not be considered as the « enunciative moment », because the enunciation consumes the time. It is considered as a fixed point of reference in the REN. From this instant ' $T^0$ ', the non-realized domain begins; also it would be the last instant of the realized domain of the enunciation.

*maintenant* (now) allow to distinguish the value of event (example (3)) from the resultative state (example (4)), even though they have the same form of tense in French “*le vapeur a traversé le lac* (a steamboat crossed the lake)” (passé composé – perfect tense).

We formalize these examples in the following metalinguistic expressions with their diagrams:

- (1') (En ce moment,) *Le vapeur traverse le lac*  
 $PROC_{J0}$  (JE-DIS [( $PROC_{J1}$ (traverser (le-vapeur, le-lac))) & [ $\delta(J^0) = T^0$ ] & [ $\delta(J^1) = \delta(J^0)$ ]])  
 =  $ENONC_{J0}$  [ $PROC_{J1}$  (traverser (le-vapeur, le-lac))] & [ $\delta(J^0) = T^0$ ] & [ $\delta(J^1) = \delta(J^0)$ ]]
- (2') *Le vapeur traversait le lac quand un orage a éclaté*  
 $PROC_{J0}$  (JE-DIS [( $PROC_{J1}$ (traverser(le-vapeur,le-lac))) & [ $\delta(J^0) = T^0$ ] & [ $\delta(J^1) < \delta(J^0)$ ]])  
 =  $ENONC_{J0}$  [ $PROC_{J1}$  (traverser (le-vapeur, le-lac))] & [ $\delta(J^0) = T^0$ ] & [ $\delta(J^1) < \delta(J^0)$ ]]
- (3') *Hier, le vapeur a traversé le lac*  
 $PROC_{J0}$  (JE-DIS [( $EVEN_{F1}$ (traverser(le-vapeur,le-lac))) & [ $\delta(J^0) = T^0$ ] & [ $\delta(F^1) < \delta(J^0)$ ]])  
 =  $ENONC_{J0}$  [ $EVEN_{F1}$  (traverser (le-vapeur, le-lac))] & [ $\delta(J^0) = T^0$ ] & [ $\delta(F^1) < \delta(J^0)$ ]]
- (4') *Enfin, le vapeur a traversé le lac, il est maintenant en sécurité*  
 $PROC_{J0}$  (JE-DIS [( $ETAT-RESUL_{O1}$  (traverser (le-vapeur, le-lac))) & [ $\delta(J^0) = T^0$ ] & [ $\delta(O^1) = \delta(J^0)$ ]])  
 =  $ENONC_{J0}$  [ $ETAT-RESUL_{O1}$  (traverser (le-vapeur, le-lac))] & [ $\delta(J^0) = T^0$ ] & [ $\delta(O^1) = \delta(J^0)$ ]]

#### Commentaries of the above metalinguistic expressions:

For the metalinguistic expressions:

- (i) ‘ $PROC_{J0}$ ’ represents the enunciative process actualized in the semi-opened (opened on the right, closed on the left) interval, named ‘ $J^0$ ’;
  - (ii) ‘ $PROC_{J1}$ ’ represents the unaccomplished process of the enunciation, actualized in the semi-opened interval, named ‘ $J^1$ ’ which is different from ‘ $J^0$ ’;
  - (iii) ‘JE-DIS’ means that the enunciator takes care of the enunciation;
  - (iv) ‘ $ENONC_{J0}$ ’ means the synthesis of ‘ $PROC_{J0}$ ’ and ‘JE-DIS’;
  - (v) ‘ $EVEN_{F1}$ ’ represents the event of the enunciation which is actualized in the closed interval, named ‘ $F^1$ ’;
  - (vi) ‘ $ETAT-RESUL_{O1}$ ’ represents the resultative state of the enunciation actualized in the state’s opened interval, named ‘ $O^1$ ’;
- There are also the temporal relations between the boundaries of each interval. The symbol ‘ $\delta$ ’ means the right boundary of an interval, and ‘ $\gamma$ ’ means the left boundary of an interval:
- (vii) ‘ $[\delta(J^1) = \delta(J^0)]$ ’ symbolizes the concomitant with the enunciation (i.e. the right boundary of the interval ‘ $J^1$ ’ is concomitant with the right boundary of ‘ $J^0$ ’);
  - (viii) ‘ $[\delta(J^1) < \delta(J^0)]$ ’ symbolizes the non-concomitant with the enunciation (i.e. the right boundary of the interval ‘ $J^1$ ’ is non-concomitant with the right boundary of ‘ $J^0$ ’. The former is situated before the other);

(viv) ‘ $[\delta(F^1) < \delta(J^0)]$ ’ symbolizes that the interval ‘ $F^1$ ’ is situated before the ‘ $J^0$ ’;

(x) ‘ $[\delta(O^1) = \delta(J^0)]$ ’ symbolizes that the right boundary of the state’s interval ‘ $O^1$ ’ is concomitant with the right boundary of ‘ $J^0$ ’, therefore it is concomitant with the act of enunciation.

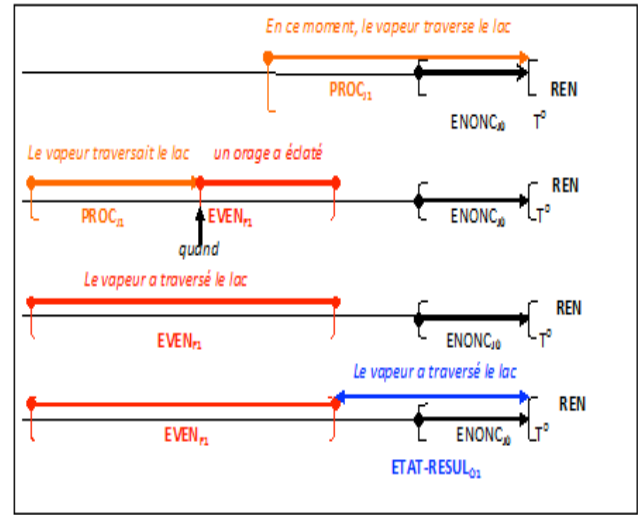


Figure 2 : Temporal diagrams of the examples in possessing the same predicative relation “*Le-vapeur traverse le-lac*” in the REN

The other referentials are organized from this REN with the temporal relations (concomitant, differentiation, rupture).

## 4. Referential with the rupture relation: non-actualized referential (RNA)

Some of enunciations are necessary to use the other referentials different from the REN or the REX. These referentials are related to the REN with the temporal relations, but they are not identifiable directly with the act of enunciation. There are several types of referentials: *non-actualized referential* (or *narrative referential*), *possible referential*, *frame of mind referential*, *commentary referential*, *indirect speech referential*, etc. In this paper, we introduce the examples of only one referential, the non-actualized referential, with their formalization<sup>2</sup>.

The non-actualized referential, named RNA, represents the narrative situations which could be real or fictive. These situations are not part of the realized domain of the enunciator, but always being tied to the REN. Some narrations, like imaginary fictions, are even apart from this realized domain and not identifiable with the act of enunciation although this act produces them.

The distinction between the REN and the RNA is presented in the literature and expressed with the different

<sup>2</sup> For the other referentials with their examples, see Desclés and Guenchéva (2006; 2010), Desclés and Ro (2011 – in English), and for their formalizations, see Ro (2012),

concepts or terminologies: “discours (speech)” and “histoire (history)” in the Benveniste’s linguistic works; “énonciation (enunciation)” and “narration” in the Weinrich’s work; “actuel (actual)” and “non actuel (non-actual)” in the Seiler’s work; “énonciatif (enunciative)” and “aoristique (aoristic)” in the Culioli’s work; “déictique (deictic)” and “anaphorique (anaphoric)” in the Danon-Boileau’s work, etc.

Many of narrative situations can be situated neither in the past, nor in the present, nor in the future. The linguistic markers like *Ce jour-là* (*That day*), *Il était une fois* (*Once upon a time*), *Un jour* (*One day*), ... point out certainly the rupture relation with the enunciation in progress. These markers require the creation of a special referential, that is the RNA, where the verbalized situations would be inserted. All instants of the RNA are in the rupture relation (#) with all instants of the REN, in particular, with  $T^0$ . We represent this relation as following diagram:

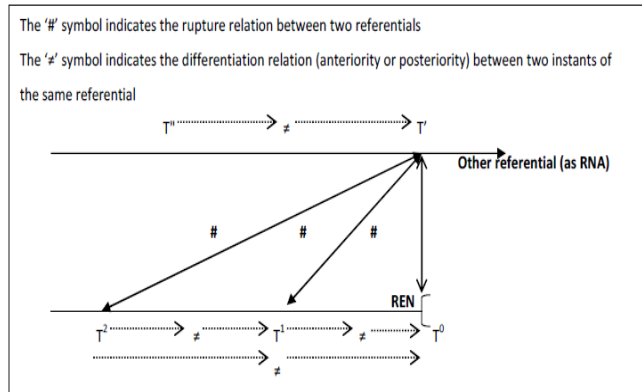


Figure 3 : The rupture relation between all instants of the REN and all instants of the other referential (RNA)

We take an example with the linguistic marker *Ce jour-là* (*That day*) which indicates the creation of the RNA:

*Ce jour-là, il faisait mauvais; le vapeur traversait le lac lorsqu'un orage a éclaté.*  
*(That day, the weather was bad; a steamboat was crossing the lake when a storm burst)*

The clause “*il faisait mauvais (the weather was bad)*” constructs a state ‘ETAT<sub>O2</sub>’ inside another state ‘ETAT<sub>O1</sub>’ built by the linguistic marker “*Ce jour-là (That day)*”. The clause “*le vapeur traversait le lac (a steamboat was crossing the lake)*” represents the unaccomplished process ‘PROC<sub>J1</sub>’ non-concomitant with the act of enunciation and relates to the event ‘EVEN<sub>F1</sub>’ in the past “*un orage a éclaté (a storm burst)*” which cuts this process. We visualize the intervals of each clause (including the adverbial expression “*Ce jour-là*”) in the RNA which is in the rupture relation with the REN. In this following diagram, ‘ETAT<sub>O1</sub>’ or ‘ETAT<sub>O2</sub>’ represent each of states actualized in the opened intervals, named ‘O<sup>1</sup>’ and ‘O<sup>2</sup>’:

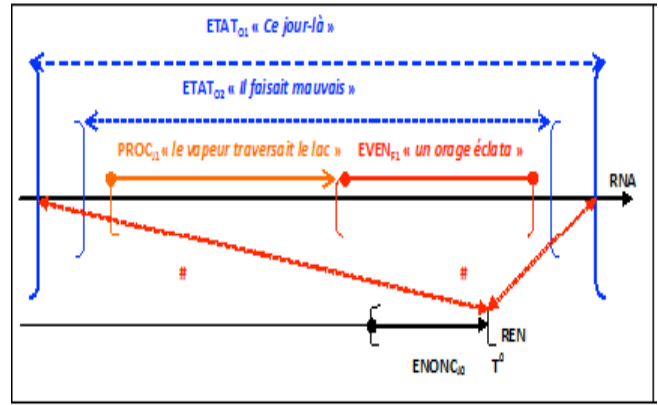


Figure 4: Temporal diagram of the example where the RNA is in rupture relation with the REN

Certain of narrations can be inserted in the REN, therefore we note that the narration is not typically related to the RNA. Inversely, many of narrations expressed in the novels, the tales, and the fictions are completely detached from the REN, and then they are inserted into the RNA.

## 5. Formalization integrated into the referential

We propose the applicative schema for the formalization of the aspecto-temporal analysis, in adopting the *reference theory* (in French, “*théorie du repérage*”, see Desclés and Froidevaux, 1982; Desclés, 1987; Ro, 2012).

In this theory, [X **rep** Y] (in French, ‘X’ est repéré par rapport à ‘Y’) means that ‘X’ is referred to ‘Y’, or ‘X’ is located in relation to ‘Y’. The symbol ‘**rep**’ takes three values of temporal relations: concomitance (=), differentiation (≠ which includes the anteriority <, and the posteriority >), rupture (#). For the specific formalization, we add two more symbolic notations of reference into this theory: ‘**rep-ING**’ and ‘**rep-loc**’. The former notation indicates the *belonging of reference* which belongs to the temporal relation of differentiation. Therefore, [X **rep-ING** Y] signifies that ‘X’ is referred to the ingredient of ‘Y’, or ‘X’ is a part of ‘Y’. We used this notation to indicate which interval belongs to a certain referential. For example, [ $J^0$  **rep-ING** REN] means that the interval of the enunciative process  $J^0$  belongs to (is in) the REN. The latter symbolic notation is specific for the temporal reference, in defining the *localization*. [X **rep-loc** Y] signifies that ‘X’ is referred to the localization of ‘Y’. This symbol contains also 4 values of localization: (i) the *concomitance* or the *equality* (=), for example, [ $\delta(J^0) = T^0$ ] means that the right boundary of the process  $J^0$  is concomitant with  $T^0$ ; (ii) the *inclusion* ( $\subset$ ), for example, [ $F^1 \subset O^1$ ] means that the state  $O^1$  includes the event  $F^1$ ; (iii) *before* or the *anteriority* (<), for instance, [ $F^1 < J^0$ ] means that the event  $F^1$  is situated before the enunciative process

$J^0$ ; (iv) *after* or *posteriority* ( $>$ ), for instance,  $[J^0 > F^1]$  means that the enunciative process  $J^0$  is situated after the event  $F^1$ .

We resume again these three notations:

- (i) **rep** (generic term) : =, ≠, #
- (ii) **rep-ING** (ingredient, a part of) : ε
- (iii) **rep-loc** (localization) : =, <, >

With these reference notations, we can represent the relation between two boundaries, between two intervals, between an interval and a referential, and even between two referentials.

Now, we formalize each example of referential (REN and RNA). The abstract applicative schema<sup>3</sup> for the formalization forms and illustrates as follow:

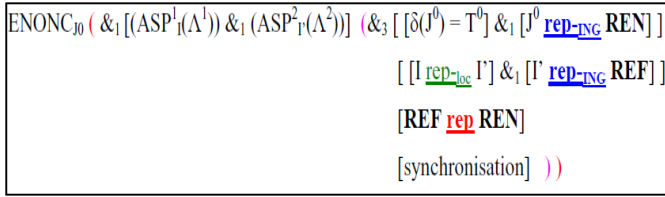


Figure 5 : abstract applicative schema

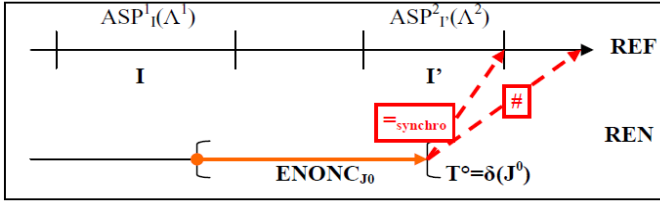


Figure 6: Diagram of the abstract applicative schema

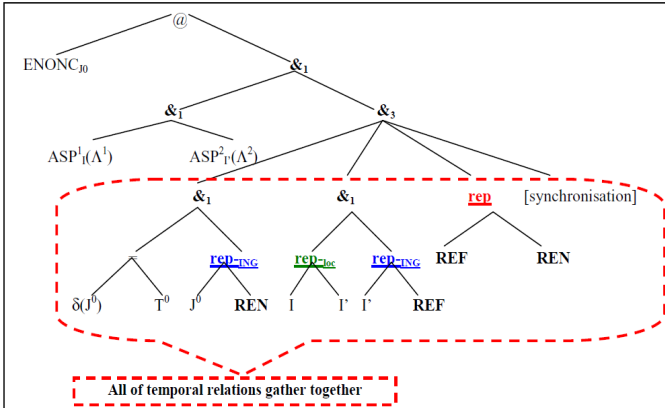


Figure 7: Abstract tree form of the applicative schema

In the above schema, ' $ASP^1_I$ ' and ' $ASP^2_{I'}$ ' mean two different aspectualized predicative relations, and each of them is actualized in a certain interval  $I$  or  $I'$ . If we have

<sup>3</sup> In this paper, we omit the part of « synchronization » (its explanation and examples) from the applicative schema. We notice only that there are several situations needed to the synchronization between two different referentials, even if they have the rupture relation.

only one clause in a sentence, this schema would be simplified in removing the unnecessary information (like the information about ' $ASP^2_{I'}$ ', and by the *modus ponens* law, remove  $[J^0 \text{ rep-ING REN}]$ ). It becomes as follow:

$$ENONC_{J^0} ( \&_1 (ASP^1_I(\Lambda^1)) ( \&_1 [\delta(J^0) = T^0] [\delta(I) \text{ rep-loc } \delta(J^0)] ) ) )$$

We already showed the formalization of this kind of examples (only one clause in a sentence) with their diagrams in §3: *Le vapeur traverse le lac* (unaccomplished process concomitant with the act of enunciation), *Le vapeur a traversé le lac* (event in the past), *Le vapeur traversait le lac quand...* (unaccomplished process non-concomitant with the enunciative process), etc.

Now, we treat an example of a sentence including two clauses<sup>4</sup>:

*Un jour, Paul affirme son identité aux policiers*  
(*One day, Paul affirmed his identity to the police*)

This example represents a narrative situation, and the linguistic marker *Un jour* (*One day*) indicates the non-reference to the REN. This marker permits to create a new certain referential REF with the rupture relation (#) referred to the enunciation in progress. This adverbial expression defines an opened interval of state ' $O^1$ ', then represented by ' $((Un\ jour)_{O^1})$ ' which would determine the event of the predicative relation.

We put all information (aspecto-temporal information and information of temporal relations) of this example to the abstract applicative schema:

- (i) put 'RNA' into each occurrence of 'REF';
- (ii) remove the part of the synchronization;
- (iii) according to the example, the predicative relation is aspectualized by the event aspectual value, which is actualized in the closed interval ' $F^1$ ': ' $EVEN_{F^1}$ ';
- (iv) the adverbial expression is not aspectualized, but defines an opened interval ' $O^1$ ': ' $((Un\ jour)_{O^1})$ ';
- (v) according to the signification of the example, the event ' $F^1$ ' is included in the opened interval ' $O^1$ ', so  $[F^1 \subset O^1]$ ;
- (vi) the relation between two referentials is in rupture, because all instants of RNA are not related to the all instants of REN, so  $[RNA \# REN]$ .

Now, the applicative schema and its diagram of this example becomes as follow:

<sup>4</sup> We will not treat the example introduced in §4 (*Ce jour-là, il faisait mauvais, le vapeur traversait le lac lorsqu'un orage a éclaté*). Because this example contains four clauses, including the adverbial expression (*Ce jour-là*). To represent this kind of example, the formalization would be very complicated. Therefore, for the question of understanding, we take another example which have only two clauses without the synchronization.



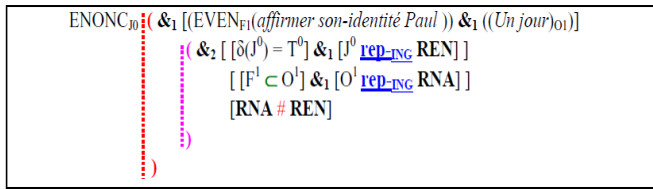


Figure 8: Applicative schema of the example “Un jour, Paul affirma son identité aux policiers”

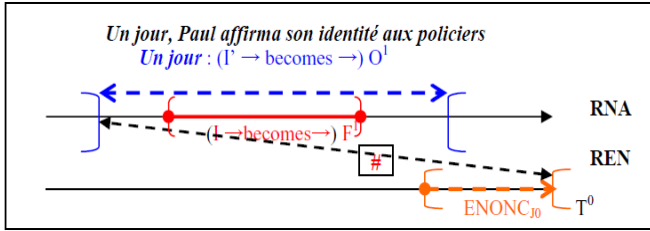


Figure 9 : Temporal diagram of the example

The predicative relation “Paul affirmer son-identité” represented the aspect of event in this example. The linguistic marker *Un jour* creates a non-actualized referential (RNA). The temporal relations are composed of three parts: (i) the first part expresses the enunciative conditions, so ‘ $[\delta(J^0) = T^0] \&_1 [J^0 \text{ rep-ING REN}]$ ’; (ii) the second part concerned with the aspectualized predicative relation, so ‘ $[F^1 < O^1] \&_1 [O^1 \text{ rep-ING RNA}]$ ’; (iii) the last part indicates the relation between two referentials REN and RNA, so ‘ $[RNA \# REN]$ ’.

## 6. Conclusion

We presented in this paper the notion of the temporal referential, the introduction of some referentials (REN, REX, and RNA), and we also developed the abstract applicative schema to formalize any types of enunciation, then we treated several examples of formalization. From these examples of formalization, we can conclude that the notion of referential is the “unifying concept”. It contains not only the temporal relations (concomitance or non-concomitance with the enunciation), but also the aspectual relations which are represented around the referential. This unifying concept allows of the conceptual economy, because it traverses the diversity of languages. The concept of referential could be a function in permitting to analyze almost all languages.

The formalization of the enunciations integrated in the referential must not stay only in the aspecto-temporal analysis’s level. It will be able to expand the range of its analysis: for example, to the integration of the Semantico-Cognitive Scheme of verbal predicate into the formalization, or to the aspecto-temporal inferences.

We expect to continue this expanded subject of the formalization in other paper.

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