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COERTION IN PHASE PERIPHRASES: FROM COGNITION TO COMPUTATION

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ABSTRACT

This article presents an investigation in the field of verbal semantics, focusing on how phase periphrases affect the aspectual class of a lexical verb, that is, on the phenomenon of coercion. Our approach is based on Croft's proposal for the analysis of lexical aspectual classes. This model has been extended by two new categories: locus and energy. Our theoretical starting point is Cognitive Linguistics, thus, based on cognitive representation and in order to demonstrate the viability of our proposal, the different coercion processes detected in our analysis have been computationally implemented. For this purpose, we have developed a set of heuristic rules, which allow us to represent the changes that the periphrasis exerts on the lexical verb (coercion). Finally, applying these rules also allows us to obtain automatically the interpretation of the clause.

KEYWORDS: phase periphrases, lexical aspectual class, coercion, non-lexical aspectual class, cognitive linguistics, computational representation.

LA COERCIÓ EN LES PERÍFRASIS DE FASE: DE LA COGNICIÓ A LA COMPUTACIÓ

RESUM

Aquest article presenta una investigació en el camp de la semàntica verbal, centrant-se en com les perífrasis de fase afecten la classe aspectual d'un verb lèxic, és a dir, en el fenomen de la coerció. El nostre enfocament es basa en la proposta de Croft per a l'anàlisi de les classes aspectuals lèxiques. Aquest model s'ha ampliat amb dues noves categories: locus i energia. El nostre punt de partida teòric és la lingüística cognitiva, per tant, basant-nos en la representació

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cognitiva i per tal de demostrar la viabilitat de la nostra proposta, s'han implementat computacionalment els diferents processos de coerció detectats en la nostra anàlisi. Per a aquest propòsit, hem desenvolupat un conjunt de regles heurístiques, que ens permeten representar els canvis que la perífrasi exerceix sobre el verb lèxic (coerció). Finalment, l'aplicació d'aquestes regles també ens permet obtenir automàticament la interpretació de la clàusula.

PARAULES CLAU: perífrasis de fase, classe aspectual lèxica, coacció, classe aspectual no lèxica, lingüística cognitiva, representació computacional.

1. INTRODUCTION

This article presents a proposal for the semantic representation of events in appearing in the context of phase periphrases. More specifically, it focuses on the event class and the phenomenon of coercion, that is, how the context can modify the event class of a lexical verb. This theoretical proposal has been implemented in a computational system in order to prove its viability and functionality when calculating the resulting event class.

Firstly, the main concepts involved, such as phase periphrases (PPs), especially in relation to aspect (2.1) and coercion (2.2) are presented. Section 3 describes the objectives and the methodology that has been used in this research. In section 4, the specification of the lexical classes associated with the verbal unit (4.1), and the non-lexical classes resulting from coercion (4.2) are explained in detail. In section 5, the types of coercion that have been detected are listed, and their computational representations presented. Finally, in section 6, we draw some conclusions and present some future work.

2. PHASE PERIPHRASES

For some time, most authors who have studied PPs (Fernández de Castro 1990, Fogsgaard 2002, Olbertz 1998, among others) have relied largely on semantic-aspectual considerations. This approach, which can be enlightening, is the one we are going to follow in our study.

PPs are complex verbal units where syntactic and semantic cohesion is perceived between the two verb forms (V1 and V2). Both forms make up a single predicative core that corresponds to a unitary event structure.

Aspectual periphrastic verbs (V1) are sensitive to the *Aktionsart* of the situation denoted by the aspectualized verb (V2), for example, according to García-Miguel (2005), when some verbs such as *ser aburrido* 'be boring' appear as simple predicates they are prototypically states; however, when they appear in an initial or inchoative PP they denote a dynamic situation (1).

(1) El juego *empezó a* (V1) ser aburrido (V2).
'The game started (V1) to be boring (V2).'

Similarly, according to Olbertz (1998), other verbs such as *hablar* 'to speak' when working as simple predicates denote a situation that does not have to reach

a culmination point to happen; however, when they appear in a culminating final PP, a telic interpretation is imposed (2).

(2) *Acabó de* hablar a las 8.
'He finished speaking at 8.'

Moreover, according to García-Miguel (2005), when some simple predicates that denote situations that occur at a specific moment, such as *morir* 'to die', appear in final phase periphrastic contexts, a durative interpretation is imposed (3).

(3) Ellos son moribundos que no *acaban de* morir.
'They are about to die but they have not finished dying yet.'

What we have just illustrated in these examples is one of the aspectual characteristics of PPs: verbs which belong to an aspectual class as lexical predicates can be moved to other classes when appearing in these periphrastic constructions. This process affects the event structure and therefore the linguistic representation.

In this sense, it is essential to take into account the level of the basic aspectual analysis (lexical aspect) and its relationship with the aspect of the sentence, that is, the interrelationship between lexicon and syntax. It is also relevant to consider phenomena such as aspectual reinterpretation, which have to do with coercion processes.

2.1. Aspect

A fundamental property of verbal semantics is aspect, that is, all that information related to the internal temporal structure of the event described by a verbal predicate. Following De Miguel's (1999) proposal, the semantic parameters that support the different event classifications can be divided into two large groups. On the one hand, qualitative parameters, such as dynamicity and telicity, refer to the way in which an event develops over time. On the other hand, quantitative parameters are characterized by expressing the way in which an event is distributed over time, that is, its duration, or whether it occurs once or repeatedly, etc.

2.2. Coercion

Rothstein (2004) supports the hypothesis that, in addition to the aspectual effects of sentence modifiers, a theory of lexical aspect must consider change operations that commute a verbal meaning from one class to another. In the compositional models of aspect, the aspectual information of the syntactic context often denotes a class of event that does not have to coincide with that provided by the lexical

verb *per se*. Following this line of thought, other models of approaching aspectual compositionality are based on the so-called coercion processes (De Swart 1998, Michaelis 2004, Moens & Steedman 1987). These models assume that the verb presents inherent aspectual information that on some occasions has to be reinterpreted in order to form an acceptable sentence. We could say that the aspectual category of the verb has been coerced to a different aspectual category.

Coll-Florit (2012) states that the processes of coercion are not carried out arbitrarily but follow a conceptual systematicity. Thus, these processes are much easier to occur between contiguous categories that share some aspectual structure or parameter than between categories that do not. The achievement to accomplishment coercion, for example, seems quite natural, since both categories share telicity and dynamism, differing only in duration.

The point to be highlighted here is that it seems that none of the authors who study coercion processes consider PPs as possible structures that can cause an event to be coerced from one aspectual category to another. In this sense, one of the objectives of our research is to help fill this gap.

3. OBJECTIVE AND METHODOLOGY

The overall objective of our study is to verify whether there is an interrelationship between the aspectual class of a verb and its occurrence in certain periphrastic constructions. In order to do this, we have carried out an empirical study based on real examples obtained from a corpus.

The data has been extracted from the *Corpus del Español* created by Mark Davies (2002). Our event classification proposal consists of six aspectual categories: states, processes, points, achievements, accomplishments and graduals (Aparicio *et al.* 2011). We have selected 25 verbs for each category, on the condition that they have been cited as examples of their category by one of the authors who have studied aspect (Croft 1998, 2009; De Miguel 1999; Dowty 1979; Havu 1997; Hay 1998; Hay, Kennedy & Levin 1999; Kennedy 2001; Moens & Steedman 1988; Pustejovsky 1991; Rothstein 2008; Smith 1991; Talmy 2000; Vendler 1967, among others). The verbal sample can be seen in appendix 1 (Spanish) and appendix 2 (English).

We have selected 14 periphrastic constructions that most authors consider to be PPs (Fernández de Castro 1999, Fogsgaard 2002, García Fernández 2006, Gómez Manzano 1992, Gómez Torrego 1988, Olbertz 1998, Topor 2011, among others). In table (1) we present the total number of PPs selected.

We have analyzed each periphrasis in relation to the set of verbs that make up each aspectual category. This has allowed us to establish routes or types of coercion. We have selected 85 representative examples of the set of coercions observed. These examples constitute our corpus for computational treatment.

Regarding semantic representation, our theoretical starting point is Cognitive Linguistics (Johnson 1987; Lakoff & Johnson 2001; Langacker 1987;

Talmy 1988, 1991, among others). Thus, from this cognitive approach, we have designed a system of computational representation of the aspectual classes, the selected PPs and the routes of detected coercions. This way, the computational representation allows us to proof the feasibility of the semantic-cognitive representation, this being the specific objective of this research. In order to carry out the formal representation, it is necessary to analyze the sentences. For this reason, we have chosen Freeling4.1 (Padró *et al.* 2012), where lexical, syntactic and semantic patterns are annotated. The formal representation of the classes and the coercion heuristic rules has been done in Python 3.8, an open-source implementation.

Aspect expressed	Verb periphrases	Examples[1]
Preparation	*Estar a punto de* + $V_{Infinitiv}$	*Están a punto de casarse.* 'They are about to get married.'
Beginning	*Empezar/Comenzar a* + $V_{Infinitiv}$	La cosa *empieza a funcionar.* 'The plan begins to work.'
	Ponerse a + $V_{Infinitiv}$	A lo mejor *me pongo a estudiar.* 'Perhaps I start studying'.
	Echar(se) a + $V_{Infinitiv}$	*Se echó a reír.* *'He burst out laughing'.*
	Romper a + $V_{Infinitiv}$	Mi hermana *ha roto a llorar.* 'My sister has burst into tears.'
Continuation	*Seguir/Continuar* + V_{Gerund}	*Siguen estudiando.* 'They go on studying.'
Interruption	*Dejar de* + $V_{Infinitiv}$	*Ha dejado de llorar.* 'She has stopped crying.'
	Cesar/Parar de + $V_{Infinitiv}$	No *paran de quejarse.* 'They do not stop complaining.'
End	*Acabar/Terminar de* + $V_{Infinitiv}$	No *me acabo de acostumbrar.* 'I do not finish getting accustomed.'
Retrospect	*Acabar de* + $V_{Infinitiv}$	Justo *acabo de verlo.* 'I just saw it.'

TABLE 1. Selected periphrases

4. CLASSES AND REPRESENTATION

A cognitive-computational representation has been applied in the definition of event classes, both lexical and non-lexical. Moreover, this representation has allowed us to develop the coercion heuristic rules to calculate the resulting class.

For the representation of events two dimensions, time (T) and qualitative change (C) (Croft 2009), have been used. These two dimensions are represented by sets of pairs (t and c) corresponding to the coordinates of the graphs that will be presented throughout this work. These coordinates are associated with initial and final numerical values that indicate the changes suffered in the event in terms

[1] We can see in the following examples how in some cases, in English, a non-periphrasis construction is used to express the same meaning of the periphrasis in Spanish.

of time and qualitative change. This representation can be seen in table 2 where the minimum events are represented both graphically and computationally.

Graphic representation	Computational representation	
	Qualitative change	Progression in time
—	c(n,n)	t(n, n+1)
|	c(n,n+1)	t(n,n)
/	c(n,n+1)	t(n,n+1)

TABLE 2. Correspondence between graphic and computational representation

4.1. Lexical classes

Our proposal for the classification of events is carried out within the framework of semantic decomposition models (Dowty 1979; Grimshaw 1990; Levin & Rappaport Hovav 1995; Moens & Steedman 1988; Pustejovsky 1991, 1995; Rappaport Hovav & Levin 2000; Tenny 1994, among others). According to this approach, the events expressed by the verbal predicates do not constitute atomic entities, but they contain a sub-lexical or sub-event structure. Specifically, a simple event consists of a single sub-event, while a complex event consists of more than one sub-event.

In our classification of events, three simple lexical classes are proposed: *states* (S), *processes* (Pr) and *points* (Po). Likewise, we present three complex lexical classes that result from the combination of two or more simple classes: *achievements* (A), *accomplishments* (Ac) and *graduals* (G).

The features that underlie our aspectual classification are four: *dynamism*, *telicity*, *duration* and *gradualness*. Based on these features, a set of event classes that characterize verbal behavior has been defined. In table 3 we present a synthesis of the proposed general classes, according to the features that they fulfill, as well as some examples.

As previously mentioned, the representation system that will be used is based on Croft (2009). According to this author, a two-dimensional representation system, capable of defining the aspectual characteristics in terms of the geometric properties of the representation, is necessary. In this model, events are represented in two dimensions: time (T) and qualitative change (C). Punctual events are points in T, while durative events extend in T. Static events are points in C (only one qualitative state is maintained in a period of time), while dynamic events extend in C (representing changes from one qualitative state to another). According to Croft (2009), with this set of basic distinctions, along with the concepts of PROFILE and ASPECTUAL CONTOUR, we can cognitively represent the set of aspectual classes. A particular verb denotes or PROFILES one (or more) of the different phases that make up the ASPECTUAL CONTOUR of an event. In this model of representation, both the PROFILE and the ASPECTUAL CONTOUR are part of the meaning of the linguistic form.

	Dynamism	Telicity	Duration	Gradualness	Examples
State S	-	-	+	-	*equivaler*, *caber*, *conocer* 'equal, fit, know'
Process Pr	+	-	+	-	*caminar*, *buscar*, *perseguir* 'walk, seek, chase'
Point Po	+	-	-	-	*pestañear*, *saltar*, *toser* 'blink, jump, cough'
Achievement A=Po + S	+	+	-	-	*pestañear*, *saltar*, *toser* 'blink, jump, cough'
Accomlishment Ac=Pr + A [Po + S]	+	+	+	-	*construir*, *aprender*, *instalar* 'build, learn, install'
Gradual G=A[Po + S]$_{1...}$ A[Po + S]$_{n}$	+	+	+	+	*envejecer*, *engordar*, *calendar* 'grow old, grow fat, warm up'

TABLE 3. Synthesis of features and event classes

As an example, we present in detail the characterization and representation of the lexical class accomplishment (Ac) (e.g. *construir* 'to build'). This class presents a complex structure (Ac) = Pr +A [Po + S], that is the result of the combination of a process (Pr) and an achievement (A) formed in turn by a point and a state (Po + S).

The PROFILE of an accomplishment (continuous lines in the graph of figure 1) is composed of two events:

- A process that includes progression in both change and time (process_result) (c(1,2),t(0,1)),
- An achievement, which consists of a point that progresses in change (process_result_point), but not in time (c(2,3),t(1,1))) and a state: (process_result_state>, which does not progress in change, but does in time (c(3,3),t(1,2)).

The CONTOUR of an accomplishment (dotted lines in the graphic of figure 1) adds to the PROFILE:

- A (prior_state), represented by the temporal feature with negative values, since it is prior to the outlined structure (c(0,0),t(-1,0)).
- And a (go-point) that triggers the process (c(0,1),t(0,0)).

Accomplisment

PROFILE

['process_result', ['change', [1, 2], 'time', [0, 1]]]
['process_result_point', ['change', [2, 3], 'time', [1, 1]]]
['process_result_state', ['change', [3, 3], 'time', [1, 2]]]

CONTOUR

['prev_state', ['change', [0, 0], 'time', [-1, 0]]]
['go_point', ['change', [0, 1], 'time', [0, 0]]]
['process_result', ['change', [1, 2], 'time', [0, 1]]]
['process_result_point', ['change', [2, 3], 'time', [1, 1]]]
['process_result_state', ['change', [3, 3], 'time', [1, 2]]]

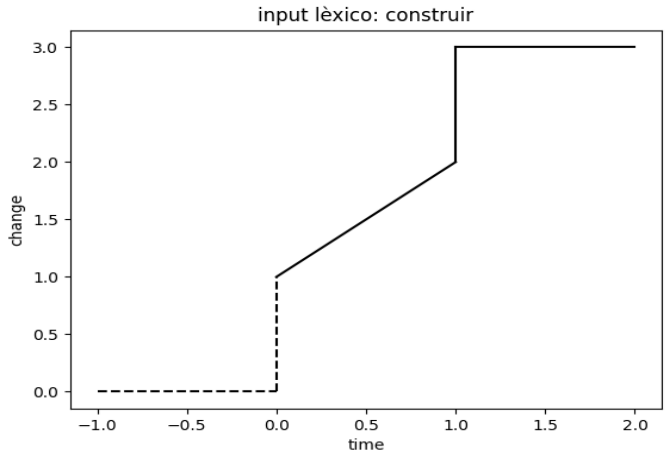

FIGURE 1. Computational and graphic representation of an accomplishment

4.2. Non-lexical classes

The non-lexical classes constitute the resulting interpretation and therefore the output of our aspectual calculation system. The defined non-lexical (NL) classes are part of the PPs domain and there are a total of 7 classes: non-lexical process, non-lexical point, non-lexical state, non-lexical accomplishment, non-lexical achievement, non-lexical undirected process and non-lexical habitual.

The set of non-lexical classes is made up of categories already presented in the lexical classes, plus two new ones that correspond to a non-lexical undirected process and a non-lexical habitual class. Following Croft (2009), an undirected process (e.g. *dejó de toser* 'he/she stopped coughing') does not lead to a change of state but each time it progresses it returns to its initial state. Meanwhile, the iterative habitual class represents the repetition of an event over time (e.g. *empezaron a recibir llamadas amenazantes* 'they started receiving threatening calls').

In order to represent non-lexical aspectual classes, it has been necessary not only to adapt Croft's (2009) model, but to expand it with the LOCUS figure and the <energy> feature.

4.3. Locus and Energy

LOCUS in our representation system means a place and symbolizes the temporal position of the event INITIATOR, who interacts with the underlying schema of the event and the state of the world.

The <energy> feature is related to those PPs in which an intentional causal scheme of FORCE DYNAMICS (FD) is used. Talmy (1988) makes reference to the FD schema as a semantic category that refers to the conceptualization of the world governed by an interaction of forces and the corresponding semantic organization of the linguistic structure. This scheme highlights an antagonism between two opposing forces. The antagonist represents the entity that exerts force on the agonist. In the end, one of them always wins and, consequently, the winner has the ability to start, continue or interrupt the realization of an event.

Regarding FD, Johnson (1987) considers a series of features that interact in any scheme that involves the use of force. One of these features is the intensity of the force. Thus, in our proposal, the feature <energy>, with its possible values (i.e., 0, medium, high and maximum), constitutes a gradient structure that conforms the relative ranking of forces that participate in the PPs.

Thus, unlike lexical aspectual classes, non-lexical aspectual classes include information about the LOCUS in their profile; that is, the reference time of the event initiator. The specific value of the locus is given by each periphrasis. For example, as we can see in figure 2, in the preparatory phase of an achievement (*estaba a punto de pertenecerle* 'it was about to belong to him'), the LOCUS (red dot) is located just before the event starts (c(0), t(-0.1)), while in the final culminating phase of an accomplishment (*ella terminó de estudiar* 'she finished studying') it is located just when the event ends (c(3),t(2)).

Although not included in the graphic, the computational representation also includes the value corresponding to the <energy> feature, that is, the force used by the initiator to go from the non-existence of an event to its existence, as shown below.

As an example, the implementation of a non-lexical accomplishment in its culminating phase (e.g. *ya ha terminado de cerrar la puerta* 'she/he has already finished closing the door') is presented below. In this case, if we compare it with the implementation of a lexical accomplishment (figure 1), we can see that there is no variation regarding the aspectual class (accomplishment), but a specific LOCUS and a type of <energy> are added to the profile of a non-lexical accomplishment. As shown in figure 3, the LOCUS of a non-lexical accomplishment in the culminating phase is located right at the end of the event ['change', 3, 'time' 2]. The <energy> used by the initiator is of the neutral type.

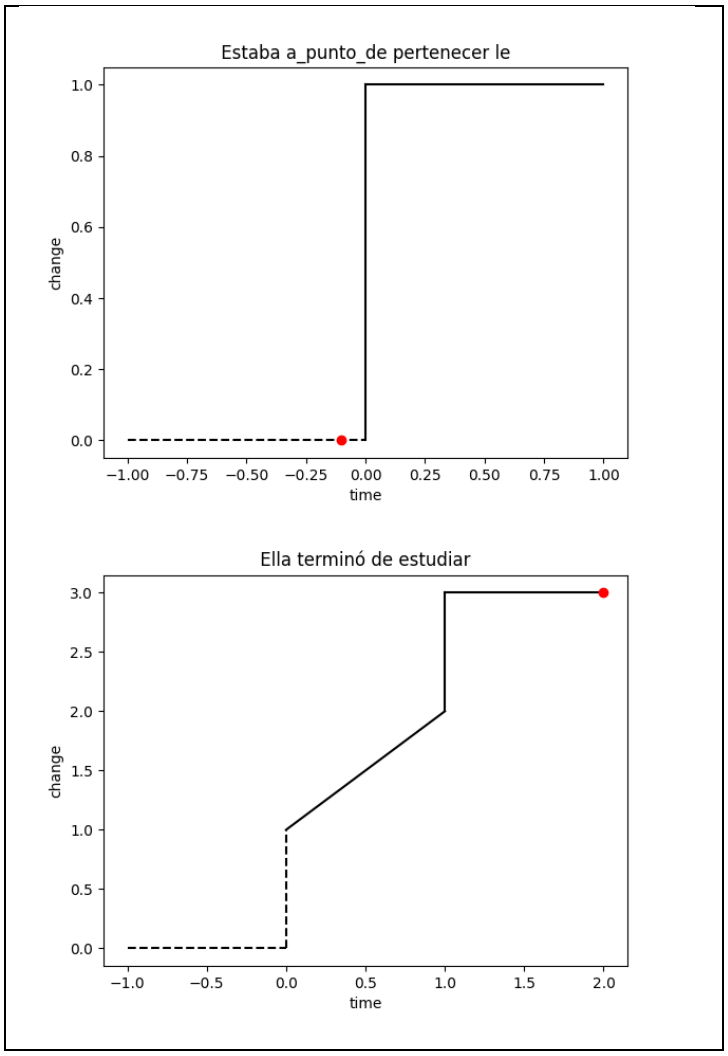

FIGURE 2. LOCUS in a non-lexical achievement and an accomplishment

5. PPS COERCION AND COMPUTATIONAL REPRESENTATION

Our objective in this phase is to demonstrate that the proposed representation is sufficient and adequate to determine the class of a verb in a specific periphrastic context, that is, to determine the result of the coercion that the context exerts on the lexical item. This requires a computational system that allows us to represent linguistic data and obtain an automatic classification of examples. The computational representation developed is divided into two stages that have already been presented: firstly, the representation of the classes and, secondly, the development and application of coercion heuristics. We use the term *coercion heuristics* to refer to a set of rules that test the context and obtain a classification for the example under analysis.

Output: non-lexical_accomplisment
PROFILE [‘process_result’, [‘change’, [1, 2], ‘time’, [0, 1]]]
[‘process_result_point’, [‘change’, [2, 3], ‘time’, [1, 1]]]
[‘process_result_state’, [‘change’, [3, 3], ‘time’, [1, 2]]]
CONTOUR [‘prev_state’, [‘change’, [0, 0], ‘time’, [-1, 0]]]
[‘go_point’, [‘change’, [0, 1], ‘time’, [0, 0]]]
[‘process_result’, [‘change’, [1, 2], ‘time’, [0, 1]]]
[‘process_result_point’, [‘change’, [2, 3], ‘time’, [1, 1]]]
[‘process_result_state’, [‘change’, [3, 3], ‘time’, [1, 2]]]
locus= [‘change’, 3, ‘time’, 2]
neutral_energy

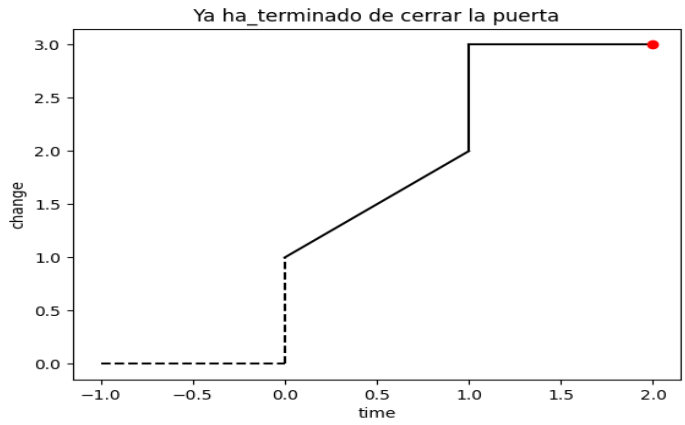

FIGURE 3. Computational and graphic representation of a non-lexical accomplishment

The linguistic information used by these heuristics is of different types. The representation of the context is done through morphological, syntactic and lexico-semantic patterns. Firstly, these patterns use lexical information such as aspectualized verbs, aspectualizing verbs or collective nouns (people, group, team, etc.). Secondly, the rules test the syntactic information to locate the verb complements (including the subject) and the dependencies of other elements of the verb. Last, the morphological information of both the verb (e.g. perfective and imperfective tenses), and those elements that depend on the verb (e.g. the grammatical number of a direct object), is tested.

As previously mentioned, for the development of the heuristics we have built a reduced corpus with a sample of verbal periphrases that has also allowed us to validate the rules. Specifically, 85 examples based on real uses of the language, extracted from the *Corpus del Español* by Davies (2002) have been used. These examples correspond to the set of periphrases analyzed and to all the possible combinations of coercion routes observed.

This corpus and its automatic treatment will allow us to demonstrate the representative feasibility of the specified formalization at the computational level. It is, therefore, the first stage in the construction of a future automatic classifier.

Next, the set of coercions detected in our study on PPs are presented. These coercions have been classified according to the profile and contour changes observed in the analysis. The coercions defined are of two types, simple coercion (it only implies one change) and complex coercion (it implies more than one change). Figure 4 presents the types of coercion observed.

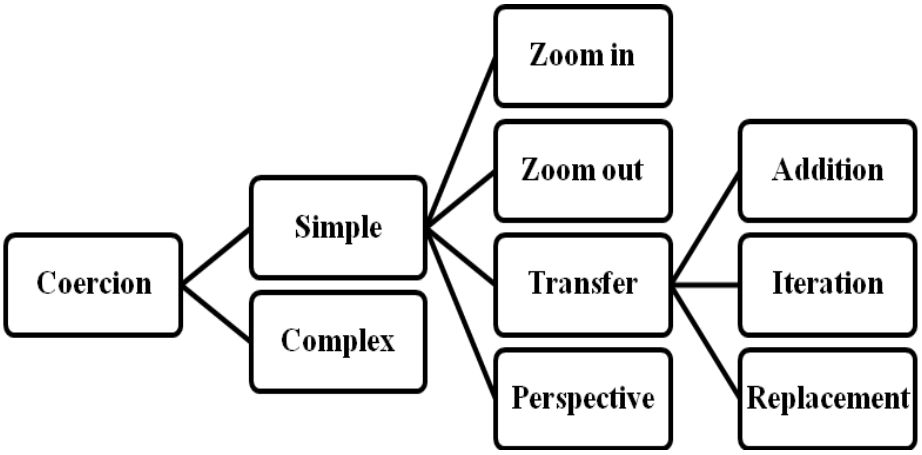

FIGURE 4. Types of coercion

5.1. Simple coercion

Simple coercion includes four subtypes: *zoom in*, *zoom out*, *transfer*, and *perspective*. In turn, coercion by transfer includes three subtypes: *addition*, *iteration* and *replacement* (see figure 4).

5.1.1. Zoom in coercion

The *zoom in* coercion causes a change in the focused classes. When the zoom closes on the profile of the original category of a verb, fewer phases are contemplated; that is, the interpretation is restricted to a part of the profile. Next some examples are presented.

(A) Accomplishment to Achievement

In this case, when the zoom closes on the accomplishment (*convertir* 'convert'), the previous process that conforms an accomplishment is removed. The final result is an achievement (*estuvo a punto de convertirse en una estrella* (CE)[2] 'he/she was about to become a star') (figure 5).[3]

[2] With CE we mean that the example has been extracted from the *Corpus del Español* by Davies (2002).

[3] The red circle indicates the focus of each structure.

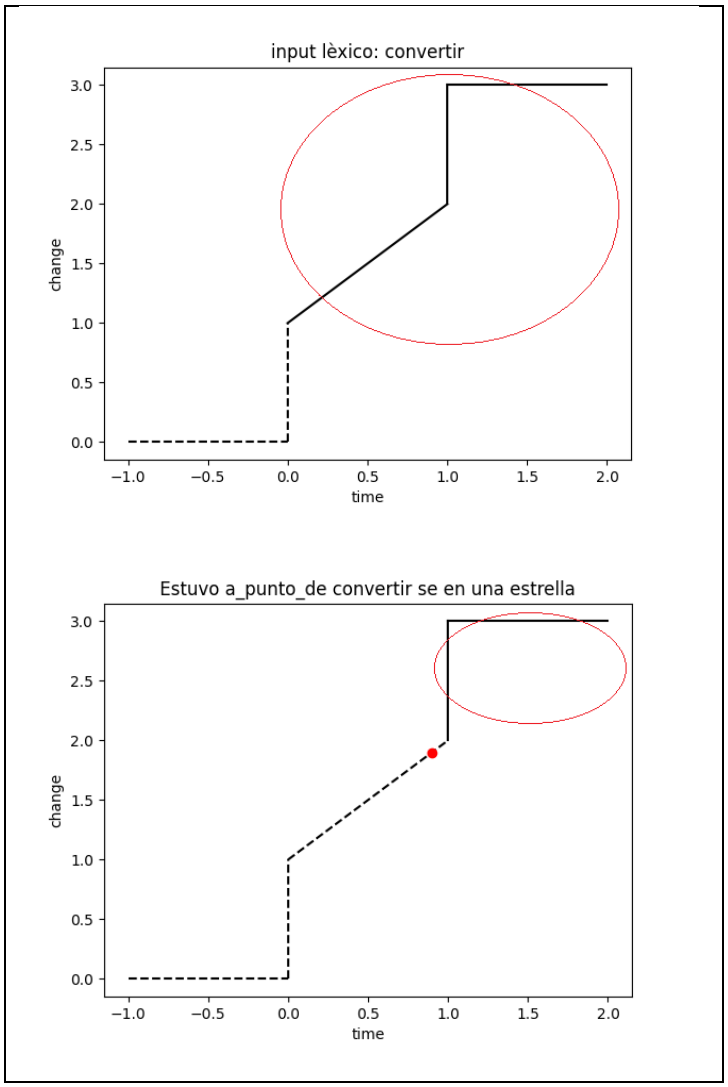

FIGURE 5. Coercion from an accomplishment to an achievement

(B) Gradual to Achievement

A gradual is formed by an iteration of achievements placed on a scale. However, the periphrastic context can cause that when the zoom closes, all the achievements except the first one disappear from the profile. As a result, a gradual predicate (*aumentar* 'increase') is moved to an interpretation of achievement (*la ventaja estuvo a punto de aumentar* (CE) 'the advantage was about to increase'), as illustrated in figure 6.

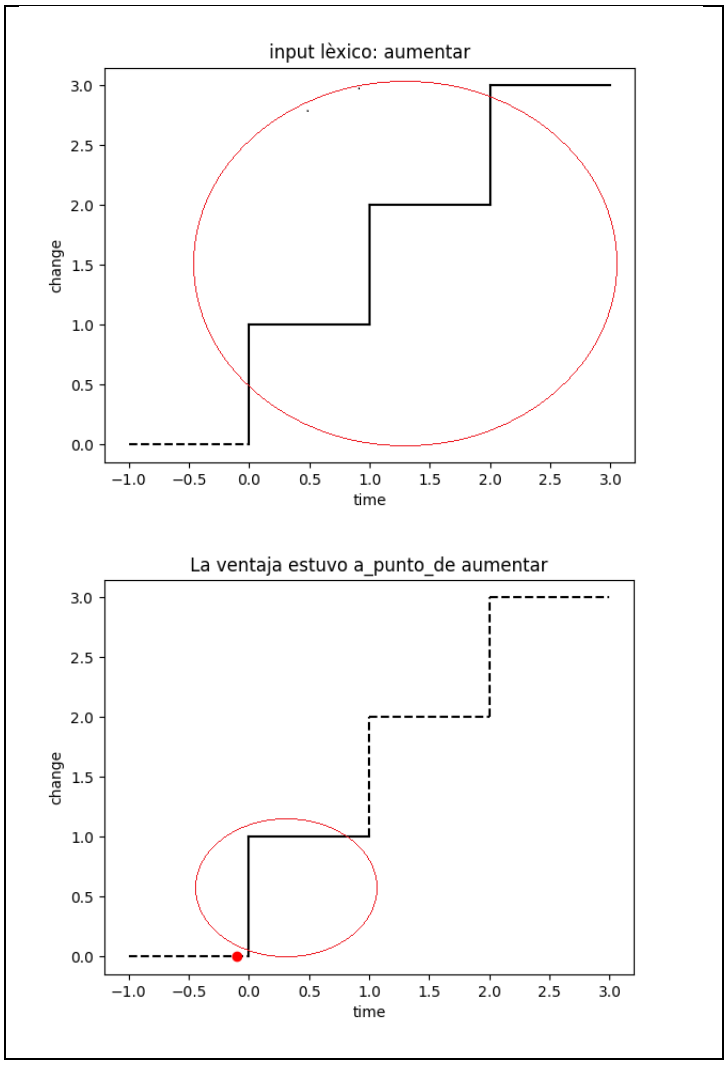

FIGURE 6. Coercion from a gradual to an achievement

5.1.2. Zoom out coercion

The *zoom out* coercion causes that when the zoom opens on the original category of a verb, new phases are included in its profile.

(A) State to Achievement

In figure 7, the periphrasis (*estaba a punto de pertenecerle* (CE) 'it was about to belong to him'), opens the zoom and originates one more phase to be contemplated in the profile of the state *pertenecer* 'belong to'. The final result is an achievement.

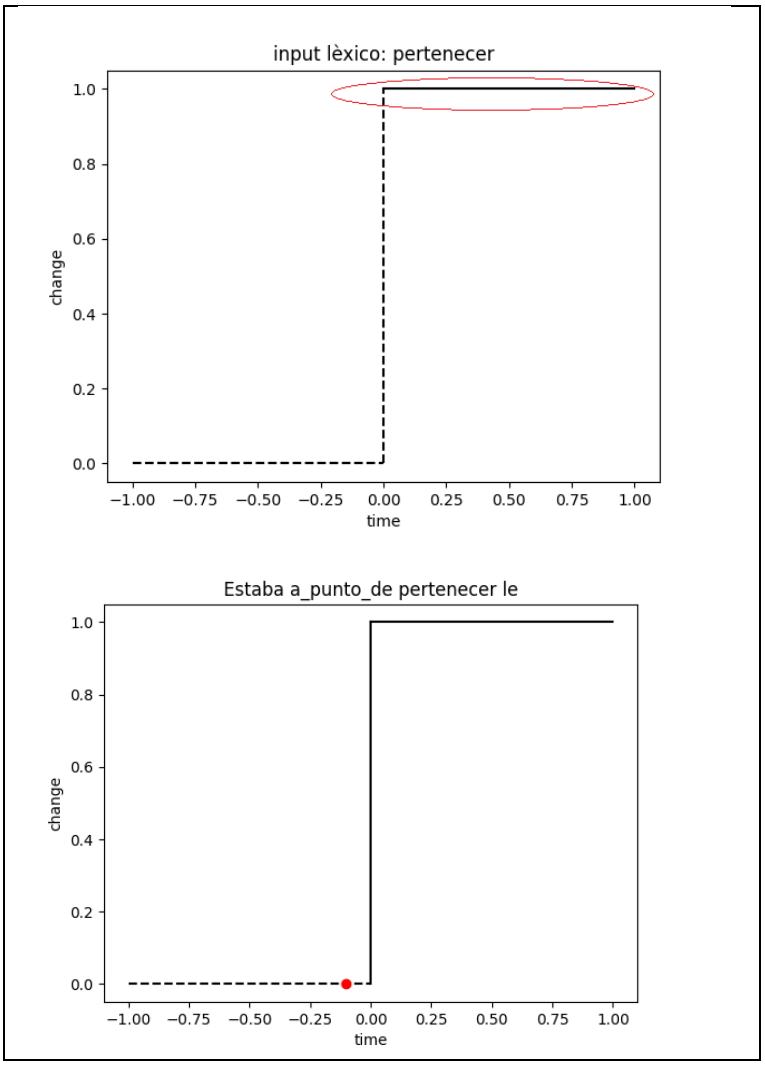

FIGURE 7. Coercion from a state to an achievement

5.1.3. Transfer coercion

In our representation, the *transfer* coercion implies a radical change of class which can be produced either by the *addition, iteration* or *replacement* of some phase.

5.1.3.1. Addition

(A) Process to Accomplishment

To move from a process (*estudiar* 'study') to an accomplishment, an achievement is added. In this way, the periphrasis introduces a limit to the process of studying (*ella terminó de estudiar* (CE) 'she finished studying') (figure 8).[4]

[4] The green rectangle indicates the structure that has been added to the final interpretation.

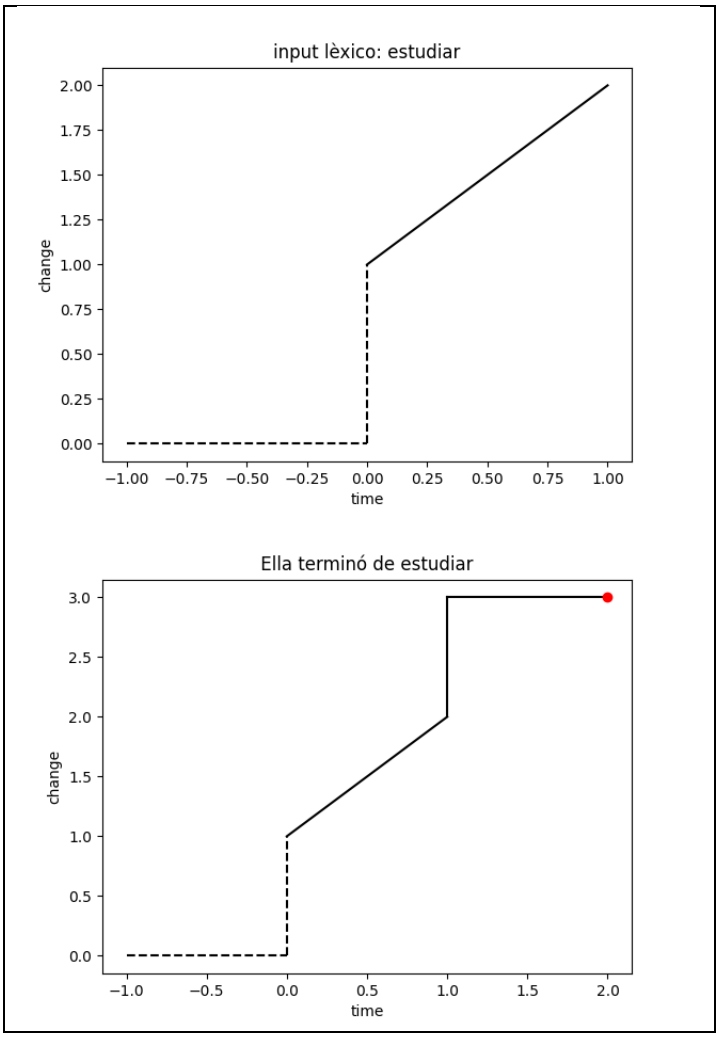

FIGURE 8. Coercion from process to accomplishment

(B) Achievement to Accomplishment

Again, this coercion causes that a previous process is added to an achievement (cerrar 'close'), thus, generating a displacement from an achievement to an accomplishment (*ya ha terminado de cerrar la puerta* (CE) 'he/she has finished closing the door'), as shown in figure 9.

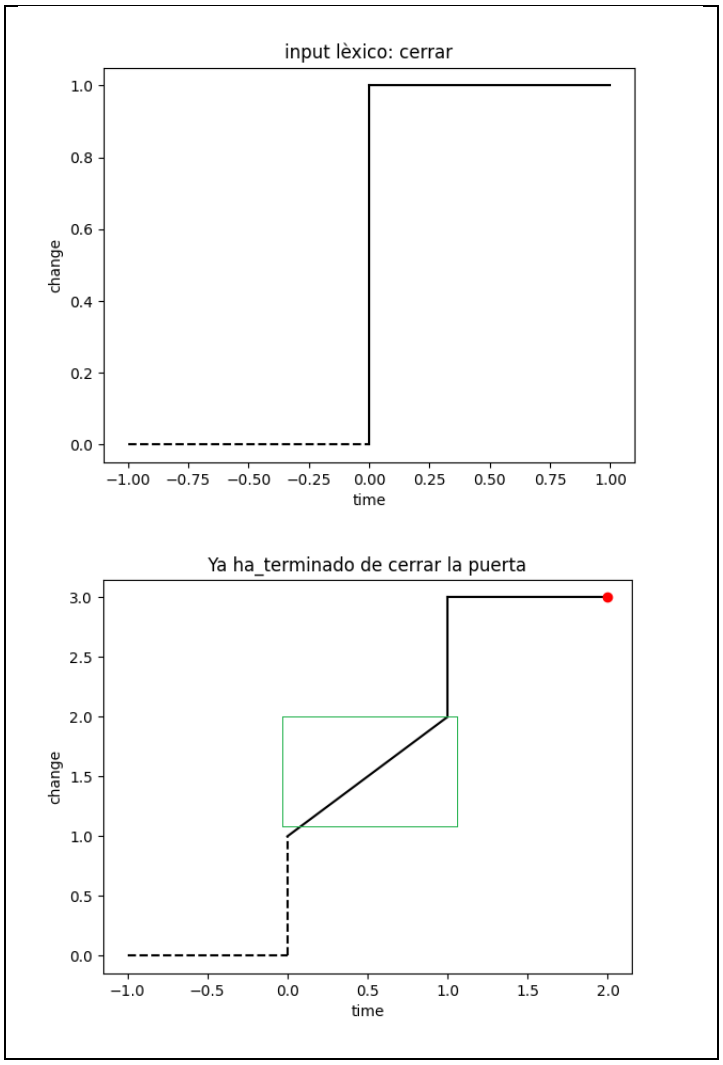

FIGURE 9. Coercion from achievement to accomplishment

5.1.3.2. Iteration

(A) Point to Undirected Process

According to Croft (2009), points can appear, either as simple events (*toser* 'cough'), or as a reiteration of events (*dejó de toser* (CE) 'he/she stopped coughing'). Following this author, we call this type of reiteration 'undirected process' since it is not directed towards a change of state, but each time it advances it returns to its initial state, as illustrated in figure 10.

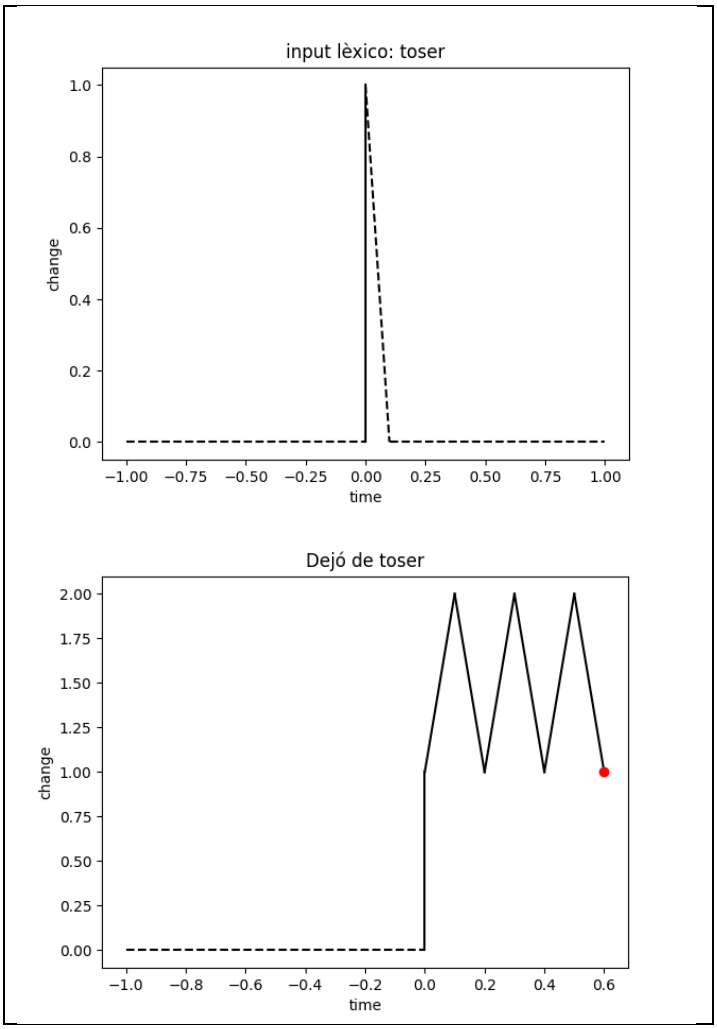

FIGURE 10. Coercion from point to undirected process

5.1.3.3. Replacement

(A) Achievement to Process

In this coercion, a punctual change of state (*abrir* 'open') is moved into a process by a replacement. In this case, as shown in figure 11, the achievement becomes durative when it is replaced by a process (*la puerta del departamento de la portera empezó a abrirse* (CE) 'the door of the concierge's apartment began to open').[5]

[5] The rectangle indicates the part of the structure that is replaced.

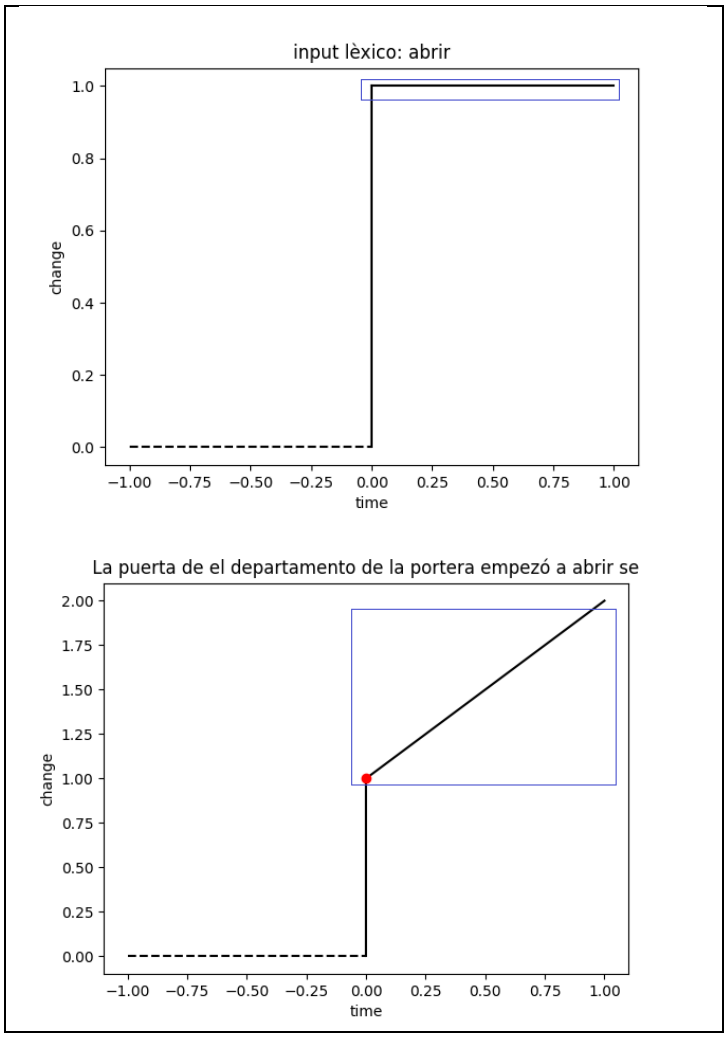

FIGURE 11. Coercion from achievement to process

5.1.4. Perspective

In this type of coercion, the scene is viewed from a different perspective. Some examples are presented below.

(A) Gradual to Process

Gradual verbs denote complex events formed by an iteration of achievements, with a gradual change (*aumentar* 'increase') (figure 12a). Thus, the periphrasis with this type of verbs generates an interpretation of process (*la mortalidad por cancer ha dejado de aumentar* (CE) 'the cancer mortality has stopped increasing'). In this case, cognitive processes of perspective and distribution of attention, in which the structure of a scene is viewed from a different perspective, are involved (Talmy 2000) (figure 12b).

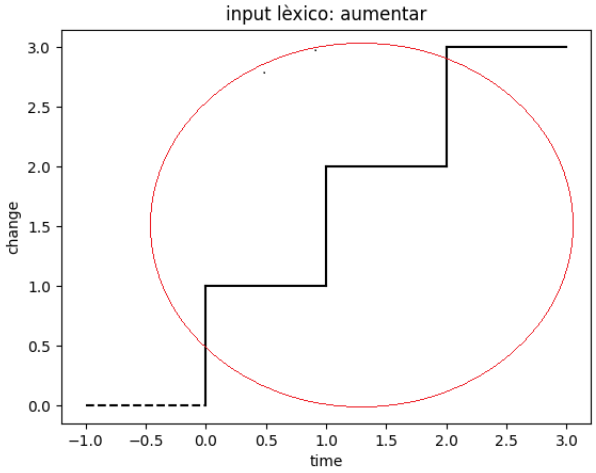

Figure 12a. Gradual

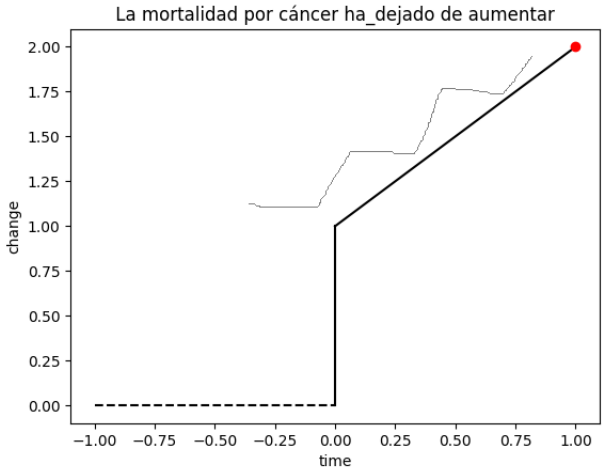

Figure 12b. Process

(B) Gradual to Accomplishment

As mentioned above, a gradual verb denotes an iteration of achievements, with a gradual change (*secar* 'dry'). In this case, the periphrasis denotes an accomplishment (*acabé de secarme la cara* (CE) 'I finished drying my face'). As in the previous coercion, here, cognitive processes of perspective and distribution of attention are involved (Talmy 2000) (figure 13).[6]

[6] The line drawn manually corresponds to the lexical structure and we represent it in this way for explanatory purposes.

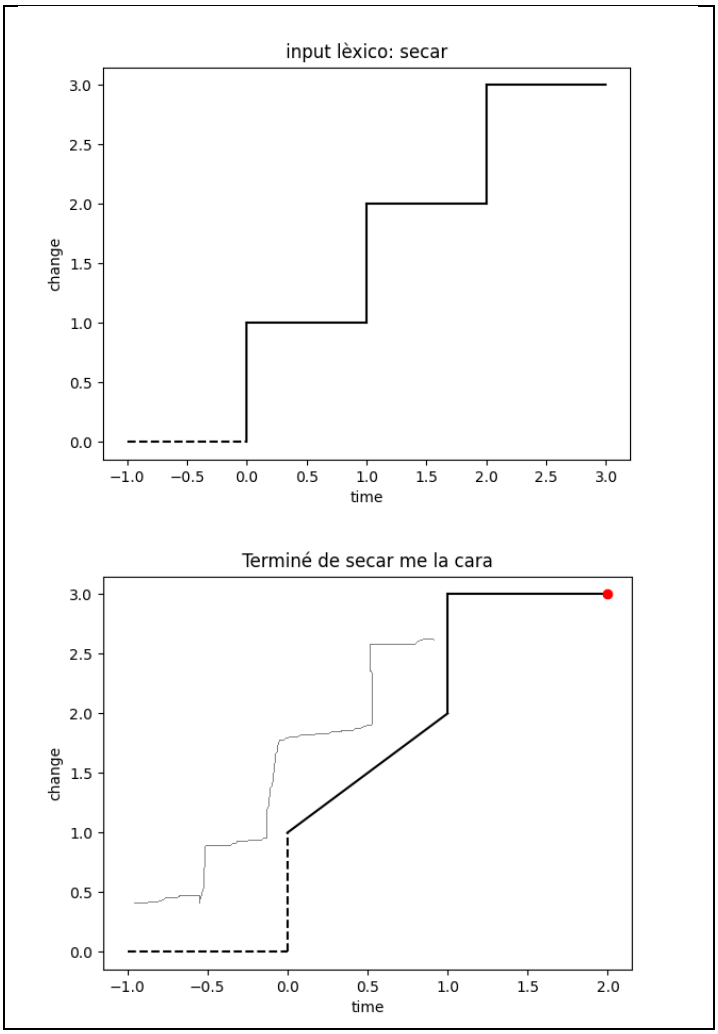

FIGURE 13. Coercion from gradual to accomplishment

5.2. Complex Coercion

Complex coercions are the result of different combinations of simple coercions, organized sequentially. However, in our implementation we have carried out these operations in a single step, as if it were a *replacement*. As part of our future work we will design a mechanism so that the application of two or more rules can be chained to a sentence. In table 4 we can see the entire set of complex coercions found in our corpus.

Complex coercions	Zoom out + Addition	State → Accomplishment
	Zoom out + Replacement	State → Process
	Zoom in + Iteration	Achievement → Iterative
	Zoom out + Zoom in	Accomplishment → Process
	Addition + Zoom in	Process → Achievement
	Perspective + Zoom in	Gradual → Achievement

TABLE 4. Complex coercions

As an example, the first three complex coercions detected are detailed.

(A) State to Accomplishment

The path of this coercion is explained as a double coercion. First, *a zoom out* coercion opens a state (4), giving rise to a dynamic event (achievement). In the second coercion, a *transfer* is produced by *adding* a preparatory process to an achievement, resulting in a durative event: accomplishment (5). Thus, through a double coercion, the context imposes the interpretation of an accomplishment to a state.

(4) conocer
'to know'

(5) Nunca la *acabas de* conocer. (CE)
'You never finish knowing her.'

(B) State to Process

In this complex coercion, the transition from a state to a process is done through a double coercion. In the first coercion, the zoom opens on the state (6) producing an achievement; this way, a static event becomes dynamic. In the second step, through a *replacement*, a punctual event becomes durative (process) (7).

(6) desear
'whish'

(7) *Empiezo a* desear que suden sangre. (CE)
'I begin to wish they sweat blood.'

(C) Achievement to Habitual Iterative

We can explain this complex coercion as follows. In the first stage, a point (zoom in) disappears from the profile of an achievement (8), thus turning a dynamic event into a state. Later, an iteration of that same state occurs (*cada una de las llamadas recibidas* 'each of the calls received') producing a *displacement* by *iteration* (9).

(8) recibir
'receive'

(9) Se *empezaron a* recibir llamadas amenazantes. (CE)
'Threatening calls began to be received.'

6. CONCLUSIONS AND FUTURE WORK

We consider that the coordinates of change (c) and time (t) together with the concepts of LOCUS and <energy> are computationally adequate to represent the PPs and the aspectual categories. Thus, we have designed a computational

representation model that, through its implementation, allows us to obtain a semantic-event representation of a sentence that contains a PP, producing a graphic and a computational output. The system consists of the representation of the aspectual classes and a set of lexical-syntactic patterns applied through condition-action rules. This allows us to demonstrate the adequacy of the proposed representation. In addition, we believe that this work allows cognitive linguistics to be brought closer to computational linguistics, empirically assessing that the parameters of cognitive linguistics can be formalized and, furthermore, that they are suitable for a computational representation.

Regarding coercion, we think that a lexical aspect theory should consider change operations that incorporate the original verbal class into a new structure with the characteristics of a different aspectual class. However, none of the authors who study coercion processes treat FPs as possible structures that can cause an event situation to be coerced from one aspectual category to another. In this sense, our research aims to fill this gap. We have identified different routes of coercion and, according to Coll-Florit (2012), everything seems to indicate that the changes in interpretation between categories follow a conceptual systematicity. Thus, the most frequent changes are carried out between contiguous categories that share some aspectual parameter, as in the case of the change from process to accomplishment. However, we have also observed other less frequent coercions that cannot be explained via shared structures, such as the change from state to process. In this sense, we have presented a proposal for the classification of the different processes of coercion, where we have not taken into account the parameters shared by two aspectual categories, but rather the changes in the profile and contour resulting from the sentence composition.

As future work, we would like to deal with the extension of the computational treatment with the ultimate goal of obtaining an automatic annotator of the event classes. This extension involves dealing with complex coercions, that is, designing a mechanism so that the application of two or more rules can be chained to a sentence. This will allow us to represent the theoretical proposal in the treatment of PPs more accurately.

Moreover, one of the limitations to extend the coverage of the current system is that, currently, the classification of verbs into classes is done manually. In the future, we would like to use a mechanism applied to corpus for the extraction of sentences-examples of each lemma. In order to do this, we want to make use of *deep learning* techniques to identify the similarity between verbal units and also employ lexical-syntactic schemes based on aspectual tests for their classification into event classes.

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Appendix 1: Verbal sample

States	*Processes*	*Points*	*Achievements*	*Accomplisments*	*Graduals*
abundar	acariciar	azotar	abrir	acceder	agrandar
amar	bailar	chillar	acertar	acudir	aclarar
anteceder	buscar	chocar	apagar	aparcar	acortar
bastar	caminar	crujir	atrapar	aprender	alargar
caber	correr	destellar	caer	beber	alisar
carecer	empujar	disparar	callar	comer	ampliar
conocer	escuchar	embestir	capturar	concretar	aplanar
consistir	esperar	escupir	cerrar	construir	aumentar
constar	estudiar	estornudar	descubrir	convencer	ahondar
creer	explorar	golpear	desmayarse	convertir	calentar
depender	fumar	guiñar	despertar	decidir	congelar
desear	investigar	hipar	detectar	destruir	dilatar
equivaler	jugar	parpadear	encender	dibujar	enderezar

existir	llorar	pegar	enterarse	elaborar	enfriar
gustar	mecer	pellizcar	ganar	escribir	envejecer
merecer	mirar	pestañear	iniciar	fabricar	estirar
necesitar	nadar	pinchar	localizar	instalar	estrechar
odiar	pasear	pitar	lograr	leer	empeorar
permanecer	pensar	pulsar	morir	pintar	humedecer
pertenecer	perseguir	resbalar	nacer	recorrer	madurar
poseer	reír	saltar	obtener	reparar	mejorar
preferir	soñar	suspirar	perder	resolver	oscurecer
residir	temblar	topar	recibir	resumir	profundizar
sobrar	trabajar	toser	reconocer	solucionar	rejuvenecer
temer	viajar	tropezar	surgir	volver	secar

Appendix 2: Verbal sample translated into English

States	*Processes*	*Points*	*Achievements*	*Accomplisments*	*Graduals*
abound	stroke	spank	open	accede	enlarge
love	dance	scream	get rightr	go	clarify
precede	look for	crash	turn off	park	shorten
be enough	walk	creak	catch	learn	lengthen
fit	run	flash	fall down	drink	smooth
lack	push	shoot	silence	eat	increase
know	hear	charge	capture	summarise	flatten
consist	wait	spit	close	build	grow
record	study	sneeze	discover	convince	deepen
believe	explore	hit	faint	transform	heat
depend	smoke	wink	wake up	decide	freeze
want	investigate	hiccup	detect	destroy	dilate
be equivalent	play	blink	turn on	draw	straighten
exist	cry	strike	find out	prepare	cool
like	rock	pinch	Win	write	age
deserve	look at	blink	begin	make	strech
need	swim	puncture	locate	install	narrow
hate	stroll	whistle	achieve	read	worsen
stay	think	press	die	paint	moisten
belong	chase	slip	be born	traverse	mature
poseess	laugh	jump	obtain	repair	improve
prefer	dream	sigh	lose	solve	get dark
reside	tremble	run into	receive	sum up	make deeper
spear	work	cough	recognise	resolve	rejuvenate
fear	travel	trip on	arise	return	dry