

## Measuring reformulation through eye-tracking. The role of reformulation markers in establishing reformulation: an experimental approach

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**Abstract.** This paper builds on the notion of reformulation as a category which can be distinguished from other closer functions (paraphrase, conclusion, correction) (Pons Bordería, 2013, 2017). In particular, it focuses on the relationship between reformulation and reformulation markers in Spanish. On the basis of previous theoretical works (Rossari, 1990, 1994), it is argued that paraphrases can be produced and assimilated without any discourse marker since they are based on equivalence, while reformulation involves some degree of distance which can only be highlighted (even established) by using reformulation markers (e.g., Sp. *o sea, es decir* ‘that is’). Experimental results obtained from *eye-tracking* experiments (Rayner, 1998, 2009) show that reformulation can be produced with or without reformulation markers; their presence facilitates its assimilation throughout the whole reading, but its absence does not affect the complete processing. Eye-tracking experiments are based on the eye-mind hypothesis (Just & Carpenter, 1980), by which ocular movements produced when contents are observed reveal how information is being cognitively processed. Eye-tracking data allow thus for completing theoretical ideas and hypotheses from a new dimension offering qualitative and quantitative results (Noveck & Sperber, 2004).

**Keywords:** reformulation, reformulation markers, experimental pragmatics, eye-tracking.

### [es] La medida de la reformulación a través de eye-tracking. El papel de los marcadores discursivos de reformulación: Un acercamiento experimental

**Resumen.** El presente artículo analiza la categoría reformulación como diferenciable de otras categorías próximas, como paráfrasis, conclusión o corrección (Pons Bordería, 2013, 2017). Concretamente, se centra en la relación entre reformulación y marcadores de reformulación en español peninsular. En línea con trabajos previos (Rossari, 1990, 1994), es habitual defender que la paráfrasis puede producirse y asimilarse sin marcadores discursivos dada su base semántico-pragmática de equivalencia, mientras que la reformulación implica un cierto grado de distancia que solo puede ser destacado (o incluso establecido) mediante el uso de marcadores discursivos (por ejemplo, *o sea* o *es decir* en español). Los resultados experimentales con *eye-tracker* (Rayner, 1998, 2009) muestran que la reformulación puede producirse con y sin marcador discursivo; su presencia facilita la asimilación de toda la lectura, pero su ausencia no afecta al procesamiento total del enunciado. Los experimentos con *eye-tracker* están basados en la hipótesis ojo-mente (Just & Carpenter, 1980), por la que los movimientos oculares al observar un determinado input reflejan su procesamiento cognitivo en términos de mayor o menor dificultad. Este tipo de dato permite complementar ideas teóricas e hipótesis desde una nueva dimensión basada en resultados cualitativos y cuantitativos (Noveck & Sperber, 2004).

**Palabras clave:** reformulación, marcadores reformulativos, pragmática experimental, eye-tracker.

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## 1. Introduction

Reformulation markers are commonly employed to reformulate across languages (Rossari, 2000: 110; Gülich & Kotschi, 1983: 315). Several seminal papers define reformulation markers as marks indicating that the new utterance is the best option to re-express the idea(s) previously formulated. They are guides reflecting the way discourses are construed and how formulation obstacles are solved (Gülich & Kotschi, 1995).

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As shown by different works (Fuentes, 1993; Gülich & Kotschi 1995; Rossari 1990, 1994), researchers in reformulation tend to argue that all reformulation markers are key not only in highlighting but in producing reformulation processes, regardless the category to which they belong. According to this idea, suppressing reformulation markers from the context where they are placed could involve the cancellation of the reformulation meaning uttered by the speaker/writer and, consequently, assimilation problems. This idea has been theoretically addressed and usually accepted; however, there is no quantitative evidence supporting it.

This paper aims to delimit the role of reformulation markers in reformulation contexts from an eye-tracking experimental approach (Rayner & Pollatsek, 1987; Richardson, Dale & Spivey, 2004). Eye-tracking allows for measuring how this function is processed by real Peninsular Spanish naïve speakers through reading reformulation texts expressed with/ without the Sp. discourse marker *o sea*. Eye-tracking experiments are based on the *eye-mind hypothesis*: ocular movements reflect cognitive information processing in real-time (e.g., slow readings mean that the content observed has not been adequately assimilated or that it is based on complex linguistic relationships). This paper presents qualitative and quantitative results based on eye-movements duration and statistically supported. Results are relevant since: (i) they confirm or improve theoretical linguistic descriptions, and (ii) validate experimental methods as a new tool to test theoretical hypotheses in Pragmatics.

## 2. Reformulation and reformulation discourse markers.

Reformulation has been widely addressed in linguistics literature through analyzing reformulation markers. These works (Gülich & Kotschi, 1983, 1987, 1995; Charolles & Coltier, 1986; Murat & Carter-Bresson, 1987; Roulet, 1987; Adam & Revaz, 1989; Blakemore, 1993; Vázquez Veiga, 1994; Schwenter, 1999; Del Saz, 2003; Murillo, 2007; Bach, 2009) define reformulation markers as marks indicating that the new utterance is the best option to re-express the idea(s) previously formulated (Rossari, 1994).

First works in the field (Gülich & Kotschi, 1983, 1987; Roulet, 1987) argue for a clear distinction between the function (reformulation) and the marks highlighting the function (reformulation markers); however, subsequent works state that reformulation is namely produced through reformulation markers, and that their suppression leads to meaning changes/loss in such contexts.

### 2.1. First works on reformulation and reformulation markers

Gülich & Kotschi (1983) and Roulet (1987) provide a starting point because they focus, on the one hand, on different structural features to determine with which parameters reformulations are produced in written and oral discourses, and, on the other hand, on the discourse markers –reformulation markers– employed by the speakers in reformulation contexts. Specifically:

- Gülich & Kotschi (1983) establish that reformulation markers are key in paraphrase: their presence is optional, but they help to establish semantic similarities shared by the first and the new utterance, even when a complete semantic correspondence between contents does not exist (1983: 310).
- Roulet (1987) introduces the notion of distance, which reflects a change in the discourse orientation to modify the illocutionary force expressed in the first utterance (Roulet, 1987: 117). This change of discourse orientation is determined by the concept of *negotiation* (Roulet, 1986; 1987: 115). Reformulation markers help at showing such distance in three different ways: (a) by invalidating the enunciative perspective offered in the first utterance; (b) by highlighting the new perspective adopted by the speaker in the new utterance; and (c) by focusing on the type of change executed from the first to the new utterance (Roulet, 1987: 120-121).

According to this, reformulation markers are key –they invalidate previous formulations thanks to their semantic meaning, or show changes of perspective on what has been said–, but speakers can reformulate without them. This idea is supported by the fact that initial studies define reformulation and its markers clearly separated, certifying that semantic and pragmatic features behind reformulation contexts are enough to determine that a change of discourse orientation is being produced.

Other works in line with such first studies (Charolles & Coltier, 1986; Murat & Cartier-Bresson, 1987; Gülich & Kotschi, 1987) begin to open reformulation up to the description of the reformulation markers employed to express it. Reformulation markers, however, are not described as the only trigger for reformulation.

### 2.2. Subsequent works on reformulation and reformulation markers

A series of studies amplifies first definitions of reformulation and reformulation markers: Fuentes (1993); Gülich and Kotschi (1995); Martín Zorraquino and Portolés (1999); Del Saz (2003), or Murillo (2007), among

others. These subsequent studies focus on reformulation markers and explain every reformulation process by analyzing them. In comparison with bridge studies, they show a complete intrusion of semasiology into onomasiology, since their descriptions put the focus on reformulation markers (or other discourse markers expressing reformulation and further functions):

- **Fuentes (1993):** follows the paraphrastic/non-paraphrastic distinction. Such distinction presents further subdivisions into new subcategories, e.g., explanation, correction, conclusion, recapitulation. Several new labels are employed: paraphrastic reformulation is subdivided into *explanation* and *denomination*; correction covers *generalization* (*label*, *conclusion*, and *recapitulation*) and *expansion* (*enumeration* and *particularization/exemplification*) (Fuentes, 1993: 177). This description is purely based on discourse markers.
- **Rossari (1990, 1994):** paraphrastic reformulation does not require reformulation markers to be produced or highlighted: equivalent content is enough to detect this operation (Gülich & Kotschi, 1983). However, non-paraphrastic reformulation needs the presence of reformulation markers to be established (Rossari, 1990: 348). In this sense, suppressing the reformulation marker employed involve the suppression of reformulation itself (i.e., a total meaning-loss) since reformulation markers easily establish the change of perspective behind the process and highlight different degrees of non-paraphrastic reformulation (Rossari, 1990: 349).
- **Gülich & Kotschi (1995):** their work opens up a broader approach to reformulation. On the one hand, they focus on reformulation markers and their importance as prototypical reformulation structures; on the other, they approach explanation, correction, or subtle modification as reformulations. In line with Rossari, reformulation cannot be produced without reformulation markers: “A speaker realizing ‘dissociation’ procedures cannot omit the markers mentioned above without any loss; these procedures can only be realized (and recognized) if the corresponding markers are present (...)” (Gülich & Kotschi 1995: 48-50).
- **Martín Zorraquino & Portolés (1999):** they define reformulation through its markers in Peninsular Spanish. Previous studies influenced this work, as shown by the four subcategories of reformulation markers proposed: *explanation*, *recapitulation*, *detachment*, and *rectification* markers. Their definition goes from semasiology to onomasiology, in which reformulation markers introduce new content, reformulating the preceding information (Martín Zorraquino & Portolés, 1999: 4121–4122); therefore, reformulation markers are also key in reformulating. There are no description indicating that reformulation can be produced without reformulation markers.
- **Del Saz (2003):** Del Saz argues for the importance of markers in displaying reformulation processes and even establishing them (2003: 211-212): “a reformulation takes place between a source discourse segment S1 or any of its constituents, and a reformulated segment, or S2, along with the presence of a marker or reformulator, which displays the type of relationship accomplished between the two linked discourse segments and indicates that a recharacterization of the previous discourse segment (S1) has been carried out, so that a new formulation or reformulation is “on the way.” Again, the discourse marker is necessary for reformulation to be produced.
- **Murillo (2007):** this work identifies several discursive instructions related to reformulation since up to eleven types of procedure are expressed by *es decir* in Peninsular Spanish. (i) Identification, (ii) specification, (iii) orientation, (iv) explanation, (v) introduction of restrictions, (vi) correction, (vii) definition, (viii) denomination, (ix) conclusion, (x) mathematical operation, and (xi) consequence. All these functions are derived from the polyfunctionality of this marker, rather than the function itself. This again reflects the importance of reformulation markers in establishing reformulation.
- However, some of these studies (Noren, 1999; Garcés, 2008; Pons 2013, 2017) highlight the relevance of reformulation markers without considering them the trigger of reformulation (i.e., speakers can only reformulate when they introduce a reformulation marker):
- **Noren (1999):** Noren’s approach to reformulation is based on the actualization of *topoi* (that is, conversational topics) determining the semantics of the discourse. This leads to three subtypes of reformulation without considering reformulation markers: repetition, repetition with strong semantic similarity, and repetition with weak semantic similarity (Noren, 1999: 52). Strong semantic similarity approaches what has been defined here as paraphrastic reformulation; weak semantic similarity refers to subtle variations in the M2. This definition of reformulation does not contemplate cases such as recapitulation or summary, addressed as subcategories of reformulation in previous studies because of addressing discourse markers as the trigger of reformulation (Noren, 1999: 36).
- **Garcés (2008):** this proposal considers that the presence of discourse markers is not required for reformulation, but that their use shows the type of discourse operation established between the old and the new formulation. In this sense, there are two types of reformulations: paraphrastic and non-paraphrastic, which are subdivided into different meanings such as *identification*, *specification*,

*clarification, correction, conclusion* (paraphrastic) or *consequence, recapitulation, reconsideration, or detachment* (complete or partial) (non-paraphrastic) (Garcés, 2008: 71).

- **Pons (2013, 2017):** Pons's publications are clearly onomasiological (i.e., reformulation and neighboring functions can be defined without considering reformulation markers features). It is explicitly stated that "the presence of formal items, such as discourse markers, does not guarantee the existence of paraphrase or reformulation". Reformulation markers contribute to interpreting paraphrase or reformulation, but they are not determinant for their production or to distinguish between the functions (Pons, 2013: 160).

### 2.3. Reformulation with/without reformulation markers: an experimental approach

According to 2.1. and 2.2., studies on reformulation can be classified into two big groups: semasiological and onomasiological. Semasiological approaches, by which reformulation is highly influenced by the meaning behind reformulation markers and their polyfunctionality (reason why reformulation tends to be related to other closer but different functions, such as conclusion, correction, summary, amplification, reduction, etc.), and onomasiological approaches arguing for reformulation as an independent function addressed from its semantic-pragmatic and structural features, which can be produced without reformulation markers or, at least, assimilated when they are not employed in both oral or written discourses. Both approaches have been theoretically demonstrated and, thus, researchers should not refuse one or another: on the one hand, it is true that reformulation expressed through reformulation discourse markers is stated in a clearer way (semasiological approach), and, on the other, it is also possible to produce or understand reformulations expressed without reformulation marker (onomasiological approach).

At this point, theory must be to be completed with further methods, such as those employed in Experimental Pragmatics, so as to improve the theoretical framework behind reformulation and reformulation markers. Reformulation has been widely theorized using different frameworks: textual analysis (Adam & Revaz, 1989); enunciation theories (Fuentes, 1993; Fuchs, 1994); conversation analysis (Schegloff, Jefferson, & Sacks 1977); argumentation theory (Nolke, 1994); relevance theory (Blakemore, 1996, 2002); and polyphony (Murillo, 2010, etc.); across languages (English, Spanish, French, and Catalan; see Murillo, 2007) and in spoken (Apotheloz & Zay, 1999) and written language (Charolles & Coltier, 1986; Murat & Cartier-Bresson, 1987). However, no experimental study of reformulation or reformulation markers has been found (except López Serena & Loureda, 2013).

An eye-tracking experimental approach will complement all previous theoretical and corpus-based studies and will establish a bridge between theory and cognition leading to new complementing data. Such an approach provides research with answers to the following question: is it possible to reformulate without reformulation markers?

## 3. Experimental pragmatics and eye-tracking studies: what the eyes tell us about language

Experimental methods have become an important tool in linguistics to test theories which, in turn, generate new experimental hypotheses, even despite skepticism in some research fields (Gibbs, 2005: 50). Experimental pragmatics provides descriptions and intuitions with empirical data supporting, refusing, or questioning current pragmatic theories and proposing new models for interpreting pragmatic phenomena.

A large number of experimental techniques were developed in the 1990s, with a notable increase in the 2000s: response time measuring, questionnaires, electroencephalographic recordings, magnetoencephalography or eye-tracking, etc. Considering the object of study and objectives behind this research, eye-tracking technology is the most appropriate because it can establish relationships between the way reformulation and closer functions are processed and their treatment using exclusive or inclusive approaches. In this technique, experimental results are based on processing times measured through different reading parameters.

### 3.1. Eye-tracking framework

Eye tracking allows detect and record different ocular movements produced during (semi)controlled experiments. Eye-movements in relation to language processing have been approached by focusing on various linguistic issues, specifically on visual attention. Visual attention has been studied for over one hundred years in several pioneer works (Brewster, 1832; Boettner & Wolter, 1962; Campbell & Green, 1965). It has been found that human vision relies on the perceptual integration of small regions to construct coherent representations of what is observed (Duchowski, 2007: 3–4).

In pragmatic studies, the content observed is linguistic and functional, e.g., discourse markers, focus operators, adverbs, sentences, texts, and so on–. In such cases, mental representations are construed from the meaning of what is read. These mental representations are only plausible thanks to the accuracy of vision



through the iris and the retina and the different eye-movements executed by recti and oblique muscles. The light received creates an optical image, which is transformed into electrical impulses and, finally, information (Artal, 2015). Eye movements seeking the best visual accuracy also facilitate light reception. Eye movements indicate the difficulty level of understanding what is being observed: the longer and more repeated eye movements are, the harder the processing is (Rayner, 1977: 443). These movements (shorter or longer, with more or less repetitions) are produced during different stages of the reading process related to morphological, syntactic, or semantic-pragmatic information (Liversedge et al., 1998): eyes move back and forth several times. This idea is the basis of the *eye-mind hypothesis* (Rayner, 1998): depending on the content or linguistic function processed (in this case, reformulation and reformulation markers), eye-movements (type and duration) will show how easy or difficult is to assimilate it.

### 3.2. Eye movements and their duration

Ocular movements are related to reading duration: participants produce all fixations, saccades, and regressions within a specific time-lapse from the time the reading process begins until it ends. Time measurements are position duration measurements: they describe how long a participant's gaze stays within a position (Holmqvist et al., 2011: 376). Reading researchers distinguish *pure fixation measurements* from *pure dwell measures*. For example, *first fixation duration* and *single fixation duration* only refer to the first (or the only) fixation a target receives during forward reading movements (Winke, Godfroid, & Gass, 2013: 206); *dwell times* refer to the whole group of fixations and regressions in and out of specific zones of the text.

Researchers distinguish three different dwell times representing different cognitive processes in reading: *First-pass reading time*, *second-pass reading time* and *total reading time*.

- First-pass reading time (henceforth, FPRT) refers to all the fixations accumulated on a word or part of the text before leaving it and fixating other content. It does not include any subsequent fixation on the region. This dwell measurement has been often assumed not only to reflect lexical access but also oculomotor processes and visual properties of the read content (Demberg & Keller, 2008: 202).
- Second-pass reading time (henceforth, SPRT) sums up fixations that return to a text region after having been fixated at least once (Höyöna et al., 2003b: 316). This measurement has also been referred to as rereading measurement since it comprises all regressions to previously read content. All researchers focus on the reprocessing or verification behavior it involves, associated with pragmatic meanings (Baccino, 2011: 859).
- Total reading time (henceforth, TRT) encompasses the total number of milliseconds individuals attend to a particular scene (texts, in this case), and includes all the movements produced (Traxler & Pickering, 1996: 460).

These three dwell-time measurements are essential in describing reading processes with eye tracking. Researchers have usually related them to syntactic, semantic, and pragmatic processing: for example, lexical recognition processing is usually attributed to first-pass reading time (during the first 100-150 ms.; Sereno, Rayner, & Posner, 1998); reanalysis is associated to second-pass reading time since the eyes regress directly to the earlier region, whose structural analysis must be revised.

## 4. Experimental design: basic steps

Eye-tracking is a type of research included within the empirical field. As Geeraerts (2006) highlights, eye-tracking research is data-driven and quantitative, which does not mean that it cannot be qualitatively approached, as shown in this paper, and involves the formulation and operationalization of hypotheses (Geeraerts, 2006, p. 23–25).

A standard eye-tracking reading experiment is made with, at least, 20 participants (Loureda et al., 2013), but this number can change. Such variation in the number of participants results from the different research objectives in each reading study. Results in this paper are obtained from 40 participants which read reformulation contexts with and without reformulation marker, so as to compare how this function is assimilated in both conditions and test the following hypotheses. This number of participants fits the Central Limit Theory (Alvarado, 2007), by which an amount of 30 or more subjects is enough to consider data representative when big populations cannot be retrieved.

### 4.1. Research hypotheses

Reformulation (Roulet, 1987) tends “to foreground the nuance(s) derived from presenting two contexts as alternative formulations” (Cuenca, 2003: 1073) or, in other words, the distance. Speakers change the discourse

orientation to find a more accurate formulation expressing the meaning initially intended. This change results from the speaker's perception concerning the adequacy of the message or the recipient's reaction to what is being said or read. According to this, reformulation can be defined as a discursive function which should lead to some specific temporal/type eye-movements results: the more discursive a function is, the bigger FPRT, SPRT or eye-movements (regressions or fixations) could be (see Loureda et al. 2020, or Salameh, in press, to address cause-consequence or conclusion relationships, which are based on an easier relationship not involving distance between formulations). In this sense, reformulation expects:

- Medium-high temporal measurements because distance between units of content involves a certain degree of difficulty in their assimilation. The FPRT should be harder than the SPRT, because two words with subtle semantic differences are related, but not considered equal. In other words, they are put at the same discursive level but distinguished at the same time. The SPRT should be big because the retroactive subordination behind any reformulation (Roulet, 1987) requires more effort than simpler relationships between linguistic contents. As a result, the TRT should be big, as it includes both FPRT and SPRT.
- Concerning discourse markers, they should also facilitate such a hard process because their instruction would make the "break" between the old and the new formulation clearer.

These ideas can be operationalized through the following hypotheses to be tested:

1. Discursive functions (such as reformulation) result in long durations for the TRT, FPRT and SPRT in comparison with less discursive functions. Reading times show differences, they are not identical;
2. Discursive functions (such as reformulation) result in equilibrated durations for the TRT, FPRT and SPRT. Reading times show similarities, they are very homogeneous;
3. The presence of a reformulation marker facilitates and even reduces processing costs in assimilating or producing reformulation;
4. The absence of a reformulation marker does not influence the assimilation or production of reformulation.

Hypotheses 1 and 2 focus on the functioning of reformulation as a function; hypotheses 3 and 4 address the role of reformulation markers in reformulation. Their acceptance or refusal would lead to the following results:

- The acceptance of hypothesis 1 would reflect how distance, as described previously, works in reformulation processes;
- The acceptance of hypothesis 2 would show that the notion of distance cannot be experimentally supported;
- The acceptance of hypothesis 3 would support that reformulation markers play an important role in reformulation;
- The acceptance of hypothesis 4 would reject that reformulation markers play an important role in reformulation.

Hypotheses 1-4 will be addressed quantitatively and qualitatively; therefore, their basis will be outlined through the data obtained and their relationship with the theoretical framework of reformulation.

## **4.2. Contexts and sentences design**

Eye-tracking experiments require contexts and sentences to be included and analyzed. Their design must follow some steps and theoretical recommendations so as to avoid data to be incorrect or non-representative. Contexts and sentences must be related.

### **4.2.1. Contexts**

Contexts contribute to the establishment of inferences on the critical sentences in reading experiments, and lead to faster identification of targets and support restrictive interpretations of contents (Aparicio, Xiang & Kennedy, 2016, p. 413). They provide, in sum, word decoding cues (Huestegge, Radach, Corbic, & Huestegge, 2009, p. 2957). They are thus useful to introduce some information related to the critical contents to reduce the length of the sentences and thus avoid extra processing costs. Ambiguous referents, long structures, and complex words can also be introduced in some contexts in order to avoid their presence in the critical sentences (Wittek, Hsang Liu, Darányi, Gedeon, & Soo Lim, 2016).

The following contexts have been employed at this paper:

<b>Reformulation</b>	Emilio y Javier son hermanos. Normalmente, nunca están enfermos. Hoy se han levantado con dolores de barriga.	Sonia y Mónica estudian medicina. Siempre preparan con antelación los exámenes de semestre. Las dos quieren sacar buenas notas.
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Table 1. Reformulation contexts

These contexts share the same structure, or at least, they are as similar as possible. Two people are described by addressing their origin, job, interests, or current situation. The people described are protagonists in the critical sentences. Their presence in contexts disambiguates referents and avoids several difficulties when the reading starts. The linguistic functions addressed in the critical sentences are expressed by examples based on these contextual stories. All the stories are written in present tense, which facilitates their interpretation.

#### 4.2.2. Sentences

The set of sentences combined with such contexts are called critical items or critical sentences (Rayner, 1989). They are critical because they encompass the main procedural information expected in oculomotor control eye-tracking experiments. Their correct design is crucial: the structure of critical sentences is highly controlled and accurately planned, and they show several linguistic constraints. The following sentences with and without reformulation marker have been employed:

1. Emilio y Javier están enfermos; o sea, indispuestos. No es tan grave como parece. Emilio y Javier están enfermos; indispuestos. No es tan grave como parece.	2. Sonia y Mónica están angustiadas; o sea, nerviosas. Pronto sabrán la nota de sus exámenes. Sonia y Mónica están angustiadas; nerviosas. Pronto sabrán la nota de sus exámenes.
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Table 2. Reformulation sentences

These sentences are reformulations based on a distance between an inaccurate content and a new, precise content, later introduced. In 1, *enfermos* and *indispuestos* show semantic differences which, in turn, involve a discursive distance; the same is true of 2 with *angustiadas* and *nerviosas*. The design of these critical sentences follows the definition of non-paraphrastic reformulation proposed by Roulet (1987) and subsequent works: the new formulation does not completely invalidate the previous formulation; rather, it presents new content better expressing the speaker's communicative aim (the post-phrase works better with the new formulation than with the former). In this case, *indispuestos* and *nerviosas* better suit their corresponding contexts than *enfermos* and *angustiadas*, which are semantically and pragmatically stronger.

The inclusion of such structure and contents in the sentences is based on various theoretical and experimental factors: subjects are long because participants often present difficulties for reading the beginning of sentences (Rayner, 1977). This is, in other words, like runners starting a race and gathering speed progressively. Likewise, the use of present tense verbs is recommended because readers process them better than past or future tense verbs. Accessing or integrating complex verbs might be expected to be more time consuming than easier forms (Rayner & Duffy, 1986: 192). Formulations are separated by a semicolon (;) in sentences with and without reformulation marker. Semicolons highlight orthographically and pragmatically a separation between discourse planes (Figueras, 2000, 2018). And, finally, post-phrases are introduced to avoid the wrap-up effect of reading processes (Rayner et al., 1989), produced because "readers tend to spend a longer time reading sentence or clause-final words than sentence or clause-internal words".

#### 4.3. Statistical techniques

Raw data are first-hand data gathered by the researcher himself for a specific research goal (Hox & Boeije, 2005: 593). In this study, raw data correspond to all the measurements obtained from the 40 participants in the experiments once they read the utterances under each function and condition. These data are based on the reading times analyzed (TRT, FPRT and SPRT). Obtention and observation of such raw data is essential in this research, but they first need to be filtered before their analysis for two reasons. First, it is impossible for the researchers to account for all the data one by one, so reducing the number of values would be useful; second, comparisons between raw data are inadequate because they result from different experimental parameters.

That said, statistical auxiliary inferential methods are needed to manage the information provided by the data adequately. Considering all the variables and experimental conditions tested in this thesis, multivariate statistical methods are the best option. Multivariate statistics deals with analyses based on several interrelated variables to know to what extent they influence the results obtained. They can be applied by adopting two main approaches: classical or new. Classical approaches work with significance tests and p-values; new approaches employ different ways to test the validity of data (e.g., the magnitude of effects (Cohen, 1988), etc.). There

is currently a polemic on how strong validations with classical and new approaches are. On the one hand, significance tests based on p-values determine whether the results are arbitrary or not; however, p-values could lead to type I errors (i.e., the null hypothesis is rejected when it is not false because the significance test is 0.059 and not 0.05). Furthermore, if the experiment is repeated, the results could vary. On the other hand, statistical models without p-values can measure how big or small differences between groups of data are, but they could lead to type II errors (i.e., the null hypothesis is not rejected despite being false).

This paper adopts linear mixed models (Laird & Ware, 1983), in line with other studies in the field (Loureda et al. 2020), a generalization of classical regression models (Wood, 2011) which allows measuring the relationship between dependent, independent and other hidden variables. So as to refine results, mixed models cover correlated observations and heterogeneity in the data by combining fixed and random statistical effects.

Mixed models are an optimal method to solve complex experimental designs (Nakagawa & Schielzeth, 2013) such as that behind this research: at least 40 participants (20\*2) are required to analyze reformulation, and such participants present different features as individuals (e.g., reading speed, concentration, the moment when they make the experiment, and so forth). Furthermore, the words employed in the critical sentences and their length are also random variables related to the fixed ones: the function, the conditions (presence or absence of reformulation marker), the eye-movements duration (FPRT, SPRT, and TRT). All these variables are, in turn, hierarchized.

The values obtained and presented in the following section represent an average of all the reading times and the combination of fixed and random statistical effects as possible variables determining the final data (e.g., the reading speed, the number of characters per word, the meaning of the words, the themes, the participants, and their differences, etc.). Results are presented through percentages and comparisons between groups of data (effects).

## 5. Results

### 5.1. Cognitive temporal pattern in reformulation

Contexts and sentences for participants were randomized; readers could not read twice a context or sentence with/without discourse marker (e.g., a participant should read “*Emilio y Javier están enfermos; o sea, indispuestos*” and “*Sonia y Mónica están angustiadas; nerviosas*”). They also read sentence fillers to avoid the object of study to be detected. Figs. 1 and 2 are the first visual output obtained from the reading eye-tracking experiment. Such visual patterns were produced by all the 40 participants:

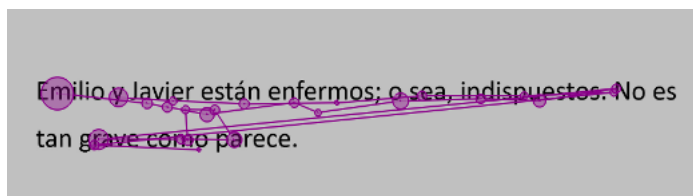


Fig. 1. Reformulation visual pattern with reformulation marker

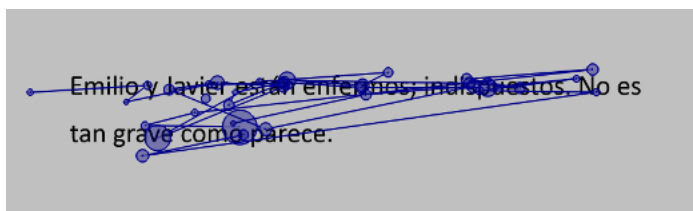


Fig. 2. Reformulation visual pattern without reformulation marker

Figs. 1 and 2 show a nonlinear reading. They present an unstable picture compared to paraphrases (Salameh, 2019), which supports the idea that they are differently produced and assimilated. Apparently, both figures reflect similarly high numbers of circles and lines: that is, reformulation with and without a discourse marker is cognitively complex; few differences between them are found. These visual patterns suggest that reformulation could work experimentally as theory describes: speakers must remember M1 (the first formulation) to compare it to M2 (the new formulation) and confirm whether the latter is the best option to achieve a complete interaction (Pons, 2013). That is why *indispuestos* and *enfermos* receive several fixations. Concerning the discourse



marker, it seems that the absence affects the whole processing since further and longer fixations are generated in fig. 2.

This visual pattern is related to the following reading times. As it was formulated through research hypotheses, reformulation is expected to present medium-high values due to its discursive nature. See Figs. 3 and 4, where M1 indicates the first formulation; M2, the second, new formulation, and *o sea* refers to the reformulation marker:

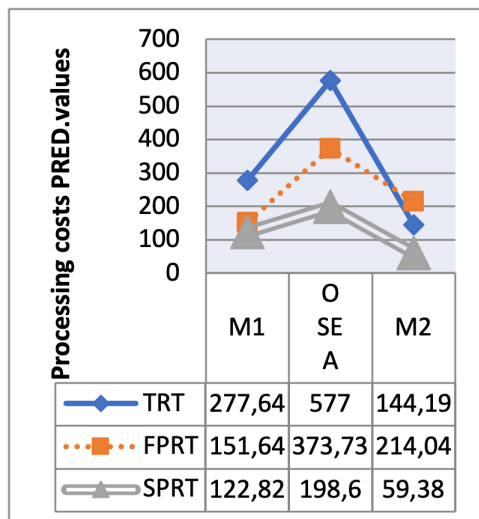


Fig. 3. Reading-time reformulation pattern with reformulation marker

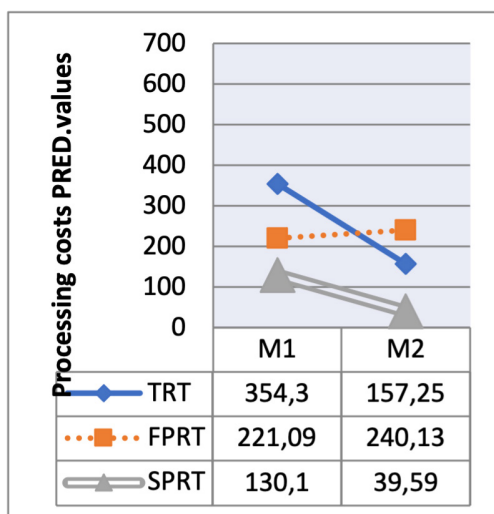


Fig. 4. Reading-time reformulation pattern without reformulation marker

A general data overview contributes to establish some basic points: TRT costs between approximately 140 and 350, which indicates the existence of processing peaks throughout the whole experiment; this result is expected for a discursive function such as reformulation. For its part, the FPRT (i.e., all the fixations accumulated on a word or part of the text before leaving it and fixating other content ahead; in this case, M1, M2 and *o sea*) accumulates cognitive efforts involved in both cases with and without reformulation marker; reading times with an average 220-230 ms. are obtained in the M2. Last, the SPRT (i.e., all fixations that return to a text region after having been fixated at least once) shows a general considerable reduction in assimilating reformulation.

Both figures with/without reformulation markers are irregular in a certain degree. Data, however, require further details. Tables 3, 4 and 5 show explicit comparisons between reading areas and values.

TRT	M1	<i>o sea</i>	M2
Con. <i>o sea</i>	277.64	577	144.19
Con. Ø	354.30		157.25
[effects]	27.61%		9.06%

Table 3. TRT reformulation reading times comparison

FPRT	M1	<i>o sea</i>	M2
Con. <i>o sea</i>	151.64	<b>373.73</b>	214.04
Con. Ø	221.09		240.13
[effects]	<b>45.80%</b>		12.19%

Table 4. FPRT reformulation reading times comparison

SPRT	M1	<i>o sea</i>	M2
Con. <i>o sea</i>	122.82	<b>198.6</b>	59.38
Con. Ø	130.1		39.59
[effects]	<b>5.93%</b>		-33.33%

Table 5. SPRT reformulation reading times comparison

First, the TRT shows that M1 costs more than the M2 in sentences without *o sea* (a 27.61% more; very large effects). M1's costs are also bigger in sentences with *o sea*, but their difference is more equilibrated. These results lead to three ideas: (a) reformulation involves bigger efforts in sentences without *o sea* during FPRT or SPRT; (b) in general terms, the second formulation is easier than the former; and (c), the absence of reformulation marker does not involve a lack of comprehension for this function. Ideas (a-c) require further details by analyzing FPRT and SPRT individually.

FPRT presents closer results between formulations: M2 costs more than M1 in sentences with *o sea* (41.15%) and without the marker (8.61% more). After addressing M1 for the first time (during 151.64 ms. with the marker and 221.09 ms. without the marker), differences between contents are established. Readers detect that M2 is not equivalent to the M1 despite being placed together and, thus, need more time to understand their relationship. This is why they spend more time addressing this content (the M2): they perceive that *enfermos* and *indispuestos* share subtle semantic differences once *indispuestos* is observed.

After first reading assumptions, the function addressed must be pragmatically assimilated, which happens during SPRT. Results show that SPRT decreases reading costs for both conditions, especially in sentences without a discourse marker, which, at first sight, could seem an unexpected result:

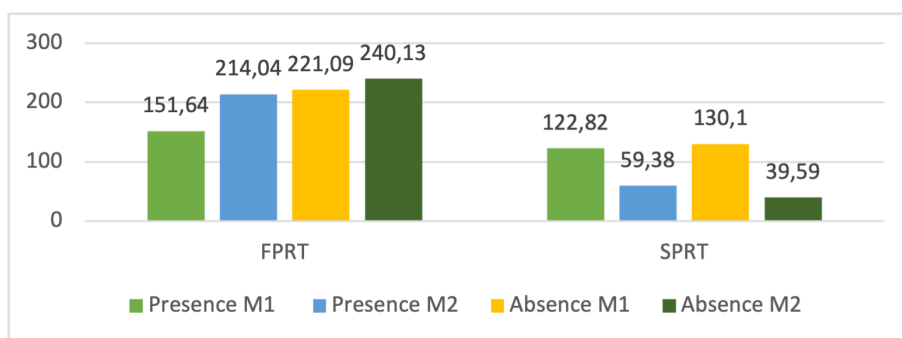


Fig. 5. Comparison between FPRT and SPRT with/without reformulation marker

SPRT confirms all cognitive processes produced during FPRT (i.e., lexical recognition and first structural assumptions). On the one hand, the M2 costs 148.35% and 130.45% less than M1 in sentences with and without a discourse marker respectively (very large effects). M1's cost is greater than M2's, probably because M1's meaning must be kept in mind once the M2 meaning is assimilated. This allows comparing both of them to confirm that the new formulation is the best option to continue the discourse. As a result, lower results for the M2 are obtained. On the other hand, M1 results are similar in both conditions (5.93% of small effects), but M2 in sentences without discourse marker costs 33.33% less than in sentences containing it: reformulation seems to be harder when the reformulation marker is introduced, probably because readers must process both the distance relationship and the procedural meaning behind *o sea*. Despite the M2 is costlier in sentences without the discourse marker (240,13 vs. 214,04 with marker), readers can pragmatically integrate the distance relationship both formulations share. This is why reading times are considerably reduced for the M2 during the SPRT in both sentences with/without reformulation marker.

## 5.2. Data analysis: main conclusions

In conclusion, reformulation is based on a nonlinear cognitive temporal pattern (i.e., results are not M1 100ms.; M2 110 ms.), as shown by figs. 1-4 (a linear cognitive pattern would show more similar eye-movements and reading times); such non-linearity reflects the notion of distance, as it has been defined in the literature. Reading results confirm temporal hypotheses (1) and (3): TRT, FPRT, and SPRT are high and less equilibrated in reformulation than in other functions experimentally addressed (see Salameh 2019; in press for conclusion or even paraphrase results). This function involves a new discursive organization to offer a new accurate formulation in order to accomplish communication successfully (Roulet, 1987: 116). As a result, processing peaks are produced.

Focusing on each reading time, the presence of *o sea* facilitates the establishment of first syntactic-semantic assumptions of reformulation (FPRT), but complicates its pragmatic assimilation (SPRT), perhaps because the presence of the discourse marker, which codifies a procedural meaning, leads to bigger reading costs (probably because readers could detect a possible relationship of similarity between contents, which, in turn, is cancelled when the semantic-pragmatic relationship between *enfermos* and *indispuestos* is assimilated). Furthermore, data show that even without reformulation marker, this function can be well understood (i.e., no outliers have been obtained, such as processing costs of 2000 ms. for both M1 or M2). In this sense, in accordance with Noren (1999), Garcés (2008) or Pons (2013, 2017), the discourse marker is important (it facilitates the pragmatic assimilation of the function) but not decisive in establishing this function: speakers are able to understand distance between contents without procedural instructions (indeed, semantic-pragmatic differences behind the meanings of *enfermos* and *indispuestos* or *angustiadas* and *nerviosas* are enough to highlight the distance they share). In this case, the presence of *o sea* even increases processing costs (especially during the SPRT) because participants must (i) assimilate distance and (ii) procedural meanings at the same time.

## 6. Conclusions

The experimental patterns retrieved from the eye-movements produced and their duration support the existence of a procedural meaning behind discourse markers, one of the most common features attributed to discourse markers in the literature. In line with other recent experimental approaches (Nadal, 2020; Loureda et al., 2016), results reflect the way discourse markers are assimilated as procedural guides that help interpret messages. In particular, it has been experimentally demonstrated that reformulation markers facilitate establishing and assimilating this discursive function (Roulet, 1987; Rossari, 1994; Cuenca, 2003), especially when first assumptions of the function are produced: readers make some efforts so as to process reformulation markers (see TRT values), but such efforts facilitate first readings of formulations based on distance, which is considerably harder in comparison with paraphrase or summary. However, as especially shown by SPRT results, reformulation can be pragmatically assimilated with or without reformulation markers. Further data support eye-tracking reading times, such as the type of number of ocular movements obtained in processing distance relationships (see Salameh, in process). In other words, reformulation is easily processed at first processing stages with reformulation marker, but it can be completely assimilated with or without its presence.

As general conclusions, some ideas can be highlighted: results validate the applicability of experimental methods such as eye tracking in testing discursive and grammatical functions during reading, and, in turn, shed light on theoretical problems related to discursive functions. In short, both research fields can be benefited: theory, on the one hand, and experimental pragmatics, on the other.

Concerning the experimental design, future research could design a larger experiment, gathering four related functions (paraphrase, reformulation, conclusion, correction) addressed at the same time, to obtain further quantitative and generalizable results. Likewise, other neighboring (sub)functions should be included in such experiments, for example, summary, amplification, reduction, mathematical operation, recapitulation, reconsideration, expansion, etc., which are placed in the limit with reformulation or paraphrase, so as to determine whether the role of discourse markers is similar to the data presented in this paper. Such an experimental reading study will be complemented in the future with corpus-based data and further complementary experiments (answer-timing analysis, other marks which are not discourse markers -hesitations in formulating, pauses, etc.-). Last, the experimental method applied can be tested for reformulation in other languages to obtain a contrastive experimental map supporting theoretical ideas about reformulation and reformulation markers across languages (Murillo, 2016a). This study proposes a replicable method to do so.

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