

**Stepping back to look ahead:
Neuter encapsulation and referent extension in counter-argumentative and causal
relations in Spanish**

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Abstract

In discourse comprehension, if all goes well, people tend to create a rich and coherent mental representation of the events described in the text. To do so, referential and relational coherence must be established in order to construct a connected discourse. The objective of this follow-up eye tracking study (N = 72) is to explore the existence of an interaction effect between two factors: a) the extension of the referent (short and long antecedent), and b) the semantic relation (counter-argumentative, *a pesar de*, and causal, *por*), when processing the neuter pronoun *ello* in texts written in Spanish. No previous study has systematically compared the on-line processing of texts in which different extensions of the encapsulated anaphoric antecedent by the neuter pronoun *ello* (this or it in English) are presented in diverse marked semantic relations (causal and counter-argumentative). Based on three eye tracking measures, we found distinctive patterns of reading behavior when anaphoric neuter reference and semantic relations must be processed conjointly in order to construct a coherent mental representation. The main findings show that reading longer and more complex antecedents encapsulated by the neutral pronouns *ello* exerts more cognitive effort in late processing (Look Back measure), particularly when simultaneously and in the same discourse construction there is an explicitly marked counter-argumentative semantic relation. Implications for theories of referential and relational coherence are discussed.

1. Introduction

In discourse comprehension, if all goes well, people tend to create a rich and coherent mental representation of the events described in the text. Halliday and Hasan (1976) claim that most people have the natural ability to determine whether a succession of sentences is a coherent text or an accidental collection of unconnected pieces. Anaphoric associations, the use of a word or a phrase to refer to previously mentioned antecedents in the text, and semantic relations, the logical or rhetorical connections between adjacent textual segments, are two crucial phenomena in the process of constructing a mental coherent representation of the text being read. Pronominal co-referential pointers and discourse connectives are linguistic devices whose function is to guide the building of this representation, thus helping the comprehender to invest less cognitive resources in reading tasks.

As well known, referential and relational coherence relations have been explored profoundly (Brown-Schmidt, Byron & Tanenhaus, 2005; Cornish, 1999; Halliday & Hasan, 1976; Hogeweg & de Hoop, 2015; Prandi, 2004; Reinhart, 1981; Rysová & Rysová, 2018; Sanders, Spooren & Noordman, 1992, 1993; Spooren & Sanders, 2008; van Gompel, 2013). On the one hand, third person gendered and numbered pronouns or co-referential anaphoric personal links have been studied extensively from diverse perspectives and with focus on an important number of variables (e.g., Asher, 1993; Cornish, 1996, 2008; Ehrlich, 1980). Particular attention has been devoted to the distance of the preceding antecedent (e.g., Carpenter & Just, 1977; Çokal et al., 2018; Duffy & Rayner, 1990; Ehrlich & Rayner, 1983; Fukumura & van Gompel, 2012), and to the gender and syntactic ambiguity that may arise in some contexts (Kennison, Fernandez & Bowers, 2009; Kennison, 2003; Kennison & Trofe, 2003; Sturt, 2003, 2013). At the same time, causal and counter-argumentative semantic intersentential relations have also been studied intensely from different theoretical perspectives and with differing methodological techniques (Köhne & Demberg, 2013; Morera, León, Escudero & de Vega, 2017; Parodi, Julio & Recio, 2018; Prandi, 2004; Recio, Nadal & Loureda, 2018; Sanders et al., 1992, 1993; Xu, Chen, Panther & Wu, 2018; Zunino, 2017). Yet, rarely do studies center on them together focusing on the binary procedural instruction they provide to the reader (referential and relational), particularly from a distinctive discourse-oriented

approach and with eye tracking techniques (e.g., Ackerman, 1986; Çokal, Sturt & Ferreira, 2018; Koornneef & Sanders, 2013).

Complementarily, in a previous pioneering study, Parodi, Julio, Nadal, Burdiles and Cruz (2018) demonstrated that the variation of the extension of the preceding referent exerted an influence on the online processing of causally-related texts written in Spanish, specifically on anaphora resolution of the neuter Spanish pronoun *ello* ('extension effect'). In this preliminary eye tracking research, we observed longer processing times in three reading measures, when the antecedent of the neuter pronoun *ello* was composed of two causal clauses, compared to a shorter referent comprising only one clause. Furthermore, recent corpus-based studies on disciplinary written genres in Spanish have reported that the neuter pronoun *ello* occurs as an encapsulator in a much higher proportion in the two selected semantic relations (counter-argumentative and causal) than in others such as temporal or additive (Parodi & Burdiles, 2016, 2019).

Based on previous research, we were interested in studying how different semantic relations may affect the processing of neuter anaphoric encapsulation of varying antecedent extensions. This follow-up study aims to explore the existence of an interaction effect between these two factors: a) the extension of the referent (short and long antecedent), and b) the type of semantic relation (counter-argumentative, *a pesar de*, and causal, *por*), when processing the neuter pronoun *ello* in texts written in Spanish. Our interest in counter-argumentative relations is based on the fact that they introduce a conclusion contrary to the readers' expectations that could have been inferred from a previous argument (Rudolf, 1996). While causality fulfills the natural anticipation of human cognition (Sanders, 2005), counter-argumentation cancels out these expectations; therefore, these two semantic relations are expected to be processed differently and to impact inversely in their cognitive demands. In direct connection, encapsulation executed by a neuter pronoun *ello* is a recurrent text cohesion and coherence resource, but it is not known how variation of its extension in different semantic contexts may impact on working memory and on the construction of a situational model (van Dijk & Kintsch, 1983).

In the following, we will first discuss previous research on causal and counter-argumentative semantic relations (marked by *por ello*, and *a pesar de ello*), and then connect this framework to discourse encapsulation processes executed by the neuter pronoun *ello*. In the following section, the method is described, focusing on the experimental design, the materials, and the participants. Section 3 presents the results. Finally, we discuss the findings and present conclusions, highlighting some projections for future research.

1.1 Causality and counter-argumentation: *por ello* (as a result of this) and *a pesar de ello* (in spite of this)

Languages foster discourse units with a fundamentally procedural meaning that make explicit the argumentative orientation between two text segments, so that they act as guides in the deduction of implications, restricting the possible contexts to which the reader should have access (Blakemore, 1987; Halliday & Hasan, 1976; Loureda & Acín 2010; Portolés, 2001; Wilson & Sperber, 2012). These are invariable linguistic units, which do not exercise a syntactic function in sentence predication, but which guide, according to their various morphosyntactic, semantic and pragmatic features, the inferences drawn in communication (Cornish, 2008; Graesser, Singer & Trabasso, 1994; Martín Zorraquino & Portolés, 1999; McNamara, Kintsch, Songer & Kintsch, 1996; Parodi, 2014).

This procedural function is carried out by connective units, such as *por ello* (as a result of this), which links two co-oriented segments in a cause-consequence relation (1a), and *a pesar de ello* (in spite of this), which marks a counter-argumentative relation (1b) (Domínguez García, 2007):

- 1a. Marta y David practican muchos deportes. *Por ello* están sanos.
(Marta and David play a lot of sports. As a result of this, they are healthy.)
- 1b. Marta y David practican pocos deportes. *A pesar de ello* están sanos.
(Marta and David play few sports. In spite of this, they're healthy.)

The connective expressions *por ello* and *a pesar de ello* are units made up of a prepositional phrase in which the preposition *por* and the prepositional conjunction *a pesar de* are combined with the neuter pronoun *ello* in order to establish a referential and relational

connection with a previous segment and give rise to a process of cohesion and coherence (Domínguez García 2007; Fuentes 2009; Martín Zorraquino & Portolés, 1999; Montolío, 2001; Portolés, 2001; Recio et al., 2018; Santos Río, 2003).

In (1a) a co-oriented argumentative relationship is established between the two discourse segments; in (1b), however, the incoherence of arguments would result from the combination of two anti-oriented arguments (Portolés, 2001). The presence of a linguistic expression would be necessary as an explicit mark of counter-argumentation (e.g., *a pesar de ello/in spite of this*), since it produces a disruption of the causal chain and a denial of expectations in the discourse (Blakemore 1989; Nadal, Cruz, Recio & Loureda, 2016; Rudolph, 1996).

Thus, based on the continuity hypothesis (Murray, 1997), it has been experimentally demonstrated that causality is a more predictable relation in discourse, unlike counter-argumentation (Brehm-Jurish, 2005; Drenhaus, Demberg, Köhne & Delogu, 2014; Köhne & Demberg, 2013; Spooren & Sanders, 2008; Zunino, 2014, 2016). Causality is inferable by default ('causality by default hypothesis') in the absence of a connective unit that makes explicit the discourse relationship between two segments:

“... because readers aim at building the most informative representation, they start out assuming the relation between two consecutive sentences is a causal relation (given certain characteristics of two discourse segments). Subsequently, causally related information will be processed faster, because the reader will only arrive at an additive relation if no causal relation can be established.” (Sanders, 2005:9)

1.2 Encapsulation processes: Neuter pronoun *ello* (it, this)

Encapsulation is a mechanism of reference and substitution carried out by a linguistic form that contributes to the thematic progression of the text and its referential maintenance, through the condensation or labelling of the meaning of discourse segments, which may precede or follow the encapsulator (Ariel, 1988, 1991; Francis, 1986; Halliday & Hasan, 1976; Montolío, 2013, 2014; Parodi & Burdiles, 2016, 2019; Schmid, 2000; Sinclair, 1993, 1994; Tadros, 1994). This connecting mechanism is executed by a variety of linguistic forms,

which -interestingly- cannot be categorized as a class of words *per se* (González-Ruiz, 2009; Llamas, 2010; López Samaniego, 2011; López Samaniego & Taranilla, 2014).

As *ello* belongs to "a grammatical class of words that designate certain abstract notions" (RAE & ASALE, 2010: 24) and has no conceptual meaning, it would have greater interpretative dependency on the preceding clause(s), since it refers to "what has just been said" (Zulaica, 2009: 59). From a psycholinguistic perspective, the neuter pronoun provides a procedural meaning (Cornish, 1999, 2008; Escandell & Leonetti, 2000, 2011; López Samaniego, 2011; Portolés, 2004; Prandi, 2004) that restricts, although to a lesser extent than in the nominal anaphora, the possible interpretations of the text segments in which it appears and that it relates. The procedural meaning of *ello* can help connect the necessary contextual information to reach the relevant interpretation of discourse. Therefore, in order to guide the reader, it constrains the inferential processes in communication (Blakemore, 1987, 1992, 1997; Carston, 2002, 2004; Murillo, 2010; Portolés, 2001; Sperber & Wilson, 1995). For this reason, this neuter pronoun is one of the encapsulating mechanisms that writers can employ when recovering, in a condensed form, a large propositional content (López Samaniego, 2011).

The pronoun *ello* may have as antecedent sentences, pronouns or neuter nominal groups and even several nouns that name things, considered together (RAE, 2005; Fernández, 1999). In addition to sentences, it admits as antecedents "abstract, often deverbal, names that are interpreted as events or refer to situations or states of things that are usually represented by sentences" (RAE & ASALE, 2010: 303). This means that the endophoric reference (Ersan & Akman, 1994; RAE & ASALE, 2009) can be expressed in text units of different extension, such as noun phrases, clauses or clause complexes, text portions or even interparaphrastic text segments (Borreguero, 2006; Figueras, 2002; González-Ruiz, 2009; Llamas, 2010; López Samaniego, 2011; Montolío, 2013, 2014). Parodi and Burdiles (2016, 2019) have described, from corpus studies of Economics discourse in Spanish, that neuter pronouns encapsulate - mainly in an anaphoric orientation- extensive text antecedents.

According to the above, *ello*, as an encapsulator, by synthesizing preceding text information, contributes to the cohesive construction of texts; it also contributes to coherence in that it guarantees the construction of consistent representational relationships in the reader's mind (Louwerse 2004). In this regard, it plays an important role at the cognitive level (Ariel, 1988, 1991, 1999; Borreguero, 2006; Figueras, 2002; López Samaniego, 2011), since it guides comprehension by converting what is encapsulated into shared knowledge available to the reader (Sinclair, 1993, 1994).

The following examples display part of the problem we are interested in:

2a. *Los incendios forestales aumentaron en las últimas dos décadas. Por ello la producción maderera experimentó una severa reducción.*

(Forest fires have increased in the last two decades. As a result of this, wood production fell sharply.)

2b. *Los incendios forestales aumentaron en las últimas dos décadas. La tasa de lluvias ha disminuido casi por completo. Por ello la producción maderera experimentó una severa reducción.*

(Forest fires have increased in the last two decades. Rainfall rates have almost completely diminished. As a result of this, wood production fell sharply.)

In (2a) there is a short antecedent of *ello* (one causal clause, e.g. *Los incendios forestales aumentaron en las últimas dos décadas*), but in (2b) there is, by contrast, a long antecedent (two causal clauses, e.g. *Los incendios forestales aumentaron en las últimas dos décadas + La tasa de lluvias ha disminuido casi por completo*). In these two examples the reader faces the challenge of causally connecting the neuter pronoun *ello* to a short previous antecedent (2a), or, in the second case, to a longer and more complex one. In both examples, there is -at the same time- a double marked instruction to the reader, one of referential *status* (*ello*) and the other of relational (*por*). This is the focus of the current study, the binary procedural instruction (relational and referential coherence) contained in two phrasal connectives: *a pesar de ello* and *por ello*.

In sum, the general hypothesis that guides this study is that the construction of a cognitive representation based partially on the resolution of a neuter pronoun with an antecedent of a long extension and the establishment of a counter-argumentative semantic relation would demand higher processing cognitive efforts to the reader. These two concurrent growing

demands on the cognitive processing are due to the increased working memory load (long antecedent) and the denial of expectations (counter-argumentation). This paper thereby aims to move forward the complementary study of both semantic relations and neuter encapsulation processes, as such specificity is crucial for understanding how the mind and brain construct -in connection- referential and relational discourse coherence.

2. Method

2.1 Experimental Design

The current study purports to explore the existence of an interaction effect between the extension of the referent (short and long) and the semantic relation (counter-argumentative and causal) on the processing of a neuter pronoun *ello* in written texts in Spanish. The intra-subject factors are represented by the extension of the referent, which has two levels: short (Clausal Referent) and long (Textual Referent); and by the semantic relation, which has also two levels: counter-argumentative and causal.

In order to carry out the objective, a two-factor within subjects design was implemented, which included four experimental conditions:

		Semantic Relation	
		Counter-argumentative <i>(a pesar de ello)</i>	Causal <i>(por ello)</i>
Referent Extension	Clausal Referent (CR)	CR-counter: Short antecedent and counter-argumentative relation	CR-causal: Short antecedent and causal relation
	Textual Referent (TR)	TR-counter: Long antecedent and counter-argumentative relation	TR-causal: Long antecedent and causal relation

Table 1. *Four experimental conditions*

The Clausal Referent (CR) is composed of one independent clause or one independent discourse segment that is encapsulated by the neuter pronoun *ello*. This may also be referred to as the ‘short antecedent’ in the context of a counter-argumentative (*a pesar de*) or a causal semantic relation (*por*).

The Areas of Interest (AOIs) were segmented manually using Data Viewer software (SR-Research). They correspond to the Preceding Text-Portion (PTP) and to the encapsulator *ello* in both semantic relations. Figure 1 shows an example of the two critical areas (CR and encapsulator *ello* in a counter-argumentative semantic relation), and Figure 2 shows an example of a long antecedent (TR) in a cause-consequence semantic relation.

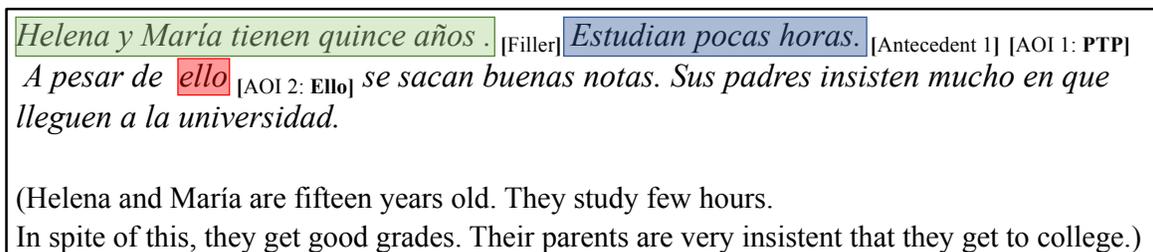


Figure 1. AOIs in a counter-argumentative relation and clausal referent

The Textual Referent (long version) is composed of two independent clauses or two independent discourse segments that are encapsulated by the neuter pronoun *ello*. This may also be referred as the ‘long antecedent’ in the context of a counter-argumentative (*a pesar de*) or a causal semantic relation (*por*) (see Figure 2).

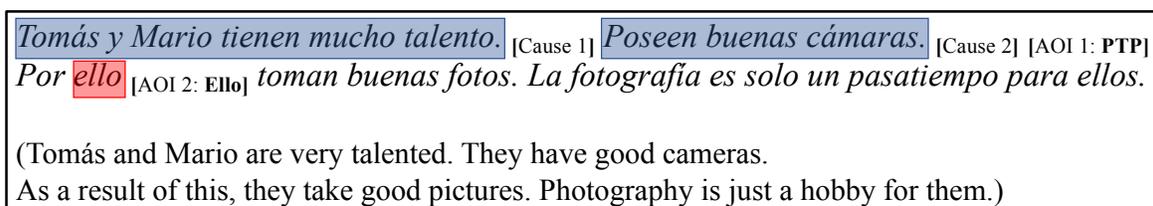


Figure 2. AOIs in a causal relation and textual referent

In order to balance the presentation of the critical texts, the CR is introduced by a previous independent clause that is not part of the encapsulated antecedent required by the neuter pronoun *ello*. This independent clause is not a potential preceding premise or cause to integrate the counter-argumentative or causal construction. The first clause in the CR condition is a filler discourse segment with no semantic implication in the text (see Figure 1). This addition to the CR provides the reader the same previous co-text to the pronoun *ello* as in the TR condition (in quantitative terms); that is, two potential candidates

for consideration as disambiguating antecedents of the anaphoric pronoun and two discourse segments. Nevertheless, only the second clause in the CR condition is required to establish referential and relational coherence. Figure 3 shows a diagrammatic description of these interactions (four experimental conditions):

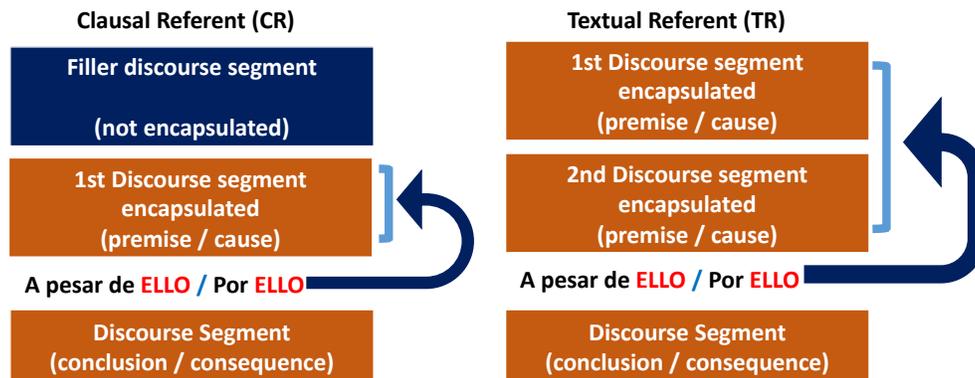


Figure 3. *Diagram of the two factors (referential and relational coherence) and the four experimental conditions*

In the long condition, the two previous clauses or discourse segments are required to establish anaphoric referential coherence, and both segments are encapsulated by the neuter pronoun *ello*. As mentioned previously, these preceding text-portions (short and long) differ in terms of the number of clause segments that are encapsulated by the anaphoric neuter pronoun *ello* but are tied by two possible different discourse connectives that reinforce a counter-argumentative or a causal connection between the two main discourse segments.

2.2 Materials

The target texts focus on general knowledge topics. The experimental conditions were counterbalanced (Latin-square) in order to avoid carry-over and order-learning effects and to prevent the participants from developing specific reading strategies (Duchowski, 2007; Seltman, 2015). A set of 32 critical items were created for the experiment, which were distributed in four experimental list. All participants read two sets of critical items in all conditions (i.e., CR-counter, CR-causal, TR-counter, TR-causal) in different topics. Therefore, all participants read a total of eight critical items. Filler items were added to the

critical stimuli in a 2:1 ratio. The texts were presented using Experiment Builder (SR Research).

An example of a set of critical items, arranged to represent all conditions, is presented in Table 2.

CR-causal	TR-causal
<p><i>Tomás y Mario tienen 35 años. Tienen mucho talento. Por ello toman buenas fotos. La fotografía es solo un pasatiempo para ellos.</i></p> <p>(Tomás and Mario are 35 years old. They are very talented. As a result of this, they take good pictures. Photography is just a hobby for them)</p>	<p><i>Tomás y Mario tienen mucho talento. Poseen buenas cámaras. Por ello toman buenas fotos. La fotografía es solo un pasatiempo para ellos.</i></p> <p>(Tomás and Mario are very talented. They have good cameras. As a result of this, they take good pictures. Photography is just a hobby for them)</p>
CR-counter	TR-counter
<p><i>Tomás y Mario tienen 35 años. Tienen mucho talento. A pesar de ello, toman malas fotos. La fotografía es solo un pasatiempo para ellos.</i></p> <p>(Tomás and Mario are 35 years old. They are very talented. In spite of this, they take bad pictures. Photography is just a hobby for them)</p>	<p><i>Tomás y Mario tienen mucho talento. Poseen buenas cámaras. A pesar de ello, toman malas fotos. La fotografía es solo un pasatiempo para ellos.</i></p> <p>(Tomás and Mario are very talented. They have good cameras. In spite of this, they take bad pictures. Photography is just a hobby for them)</p>

Table 2. Example of a critical item in the four experimental conditions

2.3 Participants

The sample of participants in the study was composed of 72 second- or third-year university students attending to a private university in Chile (49 females, 29 males, mean age=20.04, S.D.=1.7). All participants were native speakers of Spanish. They were all naive participants, which means that they were unaware of the specific purpose of the study, and none was a specialist in the field of linguistics (Keating & Jegerski, 2014). All university students taking part in the experiment gave their written consent to participating in the experiment, as required by the National Commission of Scientific Research and Technology of Chile (CONICYT). None of the participants presented vision disorders that could interfere with the eye tracker recordings.

The *a priori* sample size estimation considered the following parameters: a) significance

level $\alpha = .05$, b) $(1-\beta) = 0.8$, and c) effect size $f = .128$. As a result, the minimum required sample size was seventy-two participants. All analyses were conducted using GPower 3.0 (Faul, Erdfelder, Lang & Buchner, 2007).

2.4 Apparatus

Eye movements were collected by the Eye-Link 2 Eye Tracker (SR Research, Toronto, Canada). The eye tracker is a head mounted infrared video-based tracking system. Eye-Link 2 consists of three miniature cameras mounted on a headband: two cameras for each eye and an optical head-tracking camera that is integrated into the headband. The third camera allows an accurate tracking of the participant's point of gaze. The Eye Tracker captures gaze data at 500 Hz. Registration can be done either monocularly or binocularly. We performed it for the selected or dominant eye (usually the right eye) by placing the camera and the two infrared lights 4- to 6- cm away from the eye. The accuracy of the system is less than 0.5 degrees in optimal conditions.

2.5 Dependent variables

Three eye-movement numerical measures were computed as dependent variables:

- 1) Fixation Time (Holmqvist, Nystrom, Andersson, Dewhurst, Jarodzka & van de Weijer, 2011; Hyönä, Lorch & Rinck, 2003; Rayner, 2009),
- 2) Look Back time (Hyönä, Lorch & Kaakinen, 2002; Mikkilä-Erdmann, Penttinen, Anto & Olkinuora, 2008), and
- 3) Look From time (Hyönä et al., 2002; Hyönä et al., 2003; Mikkilä-Erdmann et al., 2008).

Fixation Time (also Total Reading Time or Fixation Duration) amounts to the total time spent on an AOI, including rereading the same AOI or all reinspections of the critical region (Hyönä et al., 2003; Rayner, Chace, Slattery & Ashby, 2006). Look Back time was obtained by summing the time of all the fixations on an AOI subsequent to its first reading (Hyönä et al., 2002; Mikkilä-Erdmann et al., 2008). In some studies, this measure is also called

Second pass reading time (Hyönä et al., 2002). Look From time was obtained by summing all the durations of the refixations that landed on a preceding AOI (in this study PTP AOI), having a specific AOI as the origin (in this study, from Ello AOI) (Ariasi & Mason, 2014; Hyönä et al., 2002; Mikkilä-Erdmann et al., 2008).

These measures were selected for their reliable performance as reading indicators of intersentential processing and discourse segments integration (Holmqvist et al., 2011; Hyönä et al., 2002; Hyönä et al., 2003; Mikkilä-Erdmann et al., 2008); furthermore, they may help detect difficulties in the reading process. According to Mikkilä-Erdmann et al. (2008), regressions in text processing might occur when the reader rereads a target discourse segment that causes cognitive problems and has content that needs to be elucidated (look backs). Moreover, when the reader departs from a text segment to read previous text again, there is always a starting point for this regressive movements (look froms).

2.6 Procedure

Participants read the texts at their own pace while their eye movements were recorded. They were seated in a chair facing a computer monitor in a quiet room, at a distance of approximately 70 cm from the monitor. To calibrate the head position, a chin rest was used to minimize head movements. An initial calibration pattern was displayed on the computer screen. To avoid miscalibration, a drift correction was performed between each critical stimulus.

Participants were told that they would be shown a series of texts while their eye position was recorded. They were instructed to read silently at a normal pace and to answer a comprehension test at the end of the experiment. After reading the instructions at their own speed, participants moved to the next screen by pressing a key on the keyboard. In order to adjust participants to the eye tracking equipment and to present the general instructions of the experiment, a short practice trial preceded the recording of the target series of texts. Participants were allowed to start whenever they were ready. The total length of the experimental session was approximately 20-25 minutes.

2.7 Clausal vs textual referents: Comparison in both semantic relations in the PTP AOI

To ensure comparisons and due to a possible source of variability in the Preceding Text-Portion (clausal vs. textual antecedents: see Figure 3), statistical analyses were conducted regarding the Total Reading Time. On the one hand, a comparison was implemented between the Filler Discourse Segment and the Premise / Causal Discourse Segment on the short condition. A second comparison was performed between the Premise / Causal Discourse Segment 1 and Premise / Causal Discourse Segment 2 on the long condition. For both comparisons, we conducted paired t-tests and Wilcoxon signed-ranks tests respectively on Fixation Time in both semantic relations (counter-argumentative and causal).

Results on the short condition showed that Fixation Time were greater on the Premise / Causal Discourse Segment (encapsulated antecedent) than in the Filler Discourse Segment. All differences were statistically significant in both semantic relations (see Appendix 1). For the long condition, the Premise / Causal Discourse Segment 1 and the Premise / Causal Discourse Segment 2 were also compared on the Fixation Time. No statistically significant differences were observed in both semantic relations (see Appendix 2). Based on these results, it can be concluded that the Preceding Text-Portion AOI is comparable across all conditions.

2.8 Data Analysis

To achieve the objective of the study, main effects and interaction analyses were performed for RE and SR factors (RE, referent extension; SR, semantic relation). We used mixed-effects models for the three measures on the Ello AOI and the PTP AOI because they offer the opportunity of including “subjects and items as crossed, independent, random effects, as opposed to hierarchical or multilevel models in which random effects are assumed to be nested” (Baayen, Davidson & Bates, 2008: 391). Hence, linear mixed-effects models are more appropriate for analyzing eye tracking linguistic data with several observations by participants than other tests such as ANOVA. All statistical analyses were conducted using R software (R Development Core Team, 2008) and lme4 library (Bates, Maechler & Bolker, 2011; Bates, Mächler, Bolker & Walker, 2014).

Before the statistical analyses were conducted, all extreme values and outliers were excluded if: a) the mean per word was < 80 ms in the first-pass reading time and the Look Back was also < 80 ms; for any AOI; and b) the mean per word was > 800 ms in the total reading time (Pickering, Traxler & Crocker, 2000; Reichle, Rayner & Pollatsek, 2003). All values were corrected using the Holm-Bonferroni Method to reduce the possibility of getting erroneous results (i.e. Type I error) (Holm, 1979). Of the total observations, 1,086 were considered extreme values (10.8% / 15), most of which were due to technical problems related to the eye tracking software.

3 Results

In the following section, firstly, the descriptive of Fixation Time, Look Back and Look From are presented. Secondly, the results of the statistical analyses, considering the main effects and the interaction effects are reported.

Table 3 reports the descriptives for Fixation Time, Look Back and Look From for all experimental conditions on the Ello and PTP AOIs.

Table 3. *Descriptive statistics for Fixation Time, Look Back and Look From in the Ello and PTP AOIs for all conditions*

Measure	Ello AOI								PTP AOI							
	CR				TR				CR				TR			
	Causal		Counter		Causal		Counter		Causal		Counter		Causal		Counter	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Fixation Time	468	272	547	336	514	248	578	309	5620	1935	5973	2242	6714	2317	6251	2005
Look Back	-	-	-	-	-	-	-	-	1657	1821	1255	1306	1624	1644	1926	1693
Look From	-	-	-	-	-	-	-	-	147	626	98	442	329	744	250	697

Neither main effects nor interaction effects were found for Fixation Time and Look From on the Ello AOI and on the PTP AOI. On the other hand, as expected, the linear mixed-effects model revealed an interaction effect between the referent extension and the semantic relation in the Look Back measure (Estimate = -704.8, SE = 283, t value = -2.49, $p = .014$) on the PTP Segment AOI (Table 4).

Table 4. Results of linear mixed effects model predicting Look Back to PTP AOIs

	Estimate	SE	df	t value	$P (> t)$
(Intercept)	1254.6	190.4	180.2	6.588	0.000***
Referent Extension	671.3	200.5	191.6	3.349	0.000***
Semantic Relation	402.8	200.1	144	2.013	0.046*
Referent Extension : semantic relation	-704.8	283	144	-2.490	0.014*

* $p < .05$, ** $p < .01$, *** $p < .001$

The observed differences between TR (Text Reference) and CR (Clausal Reference) on Look Back were remarkably critical when the semantic relation was counter-argumentative. However, for the causal semantic relation, no differences were observed between TR and CR conditions on the Look Back measure (Figure 4).

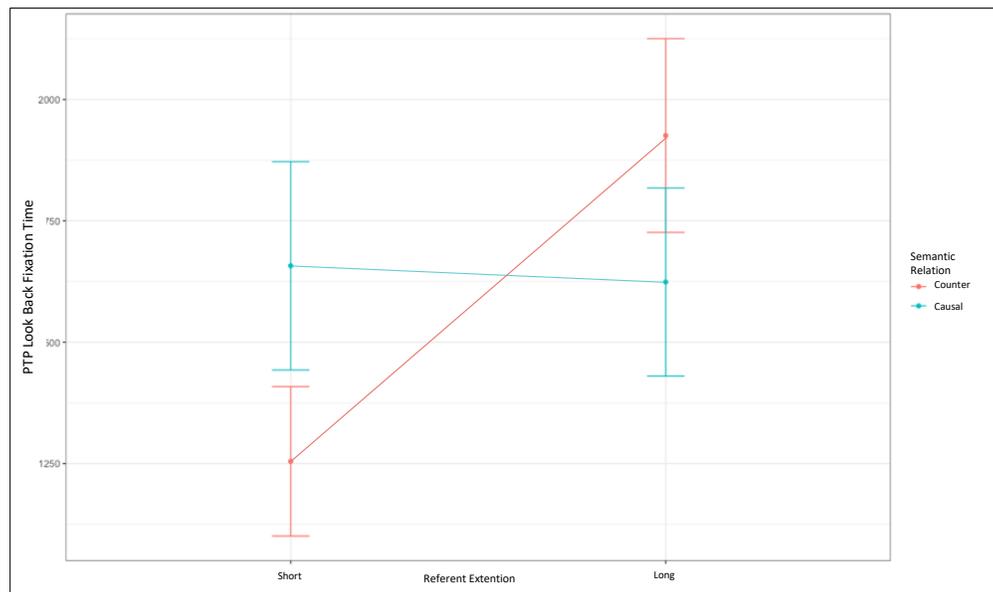


Figure 4. Descriptive plot of the interaction between the referent extension and the semantic relation

4. Discussion and conclusion

As we stated at the beginning of this article, we intended to contribute to widening the present-day panorama concerning referential and relational coherence relations, particularly

focusing on the interaction of the extension of the referent encapsulated by the neuter pronoun *ello* (short and long antecedent) and two semantic relations (counter-argumentative, *a pesar de*; and causal, *por*). The eye tracking evidence provided by online reading points to the fact that readers devote their time and effort to constructing a mental representation that integrates the text information as one coherent discourse (Halliday & Hasan, 1976), and that they are not reading it as a random collection of unrelated pieces. Less expectable semantic marked relations (e.g., counter-argumentative) in the context of complex encapsulated antecedents required a longer time to be processed (Look Back).

Consistent with our own previous study (Parodi et al., 2018) and also with specialized literature (Escandell & Leonetti, 2011; Loureda, Cruz, Rudka, Nadal, Recio & Borreguero, 2015; Wilson & Carston, 2007), we did not find statistically significant differences in the Fixation Time on the Ello AOI regarding the referent extension, that is, between the short discourse segment (CR) and the long discourse segment (TR) conditions. This means that, regardless of whether the antecedent is short or long, the neuter pronoun *ello* remains rather stable in the time devoted to its processing, despite the kind of semantic relation involved. This finding suggests that comprehenders dedicated almost the same time to online reading the neuter pronoun, not being affected neither by the referent extension nor by the semantic relation. It is probable that there are differences in the reading times of the CR and TR conditions that comprise conceptual meaning (premise or causal discourse segment), as opposed to a neuter particle devoid of lexical meaning (Cornish, 2008; Langacker, 2008; Zulaica & Gutiérrez, 2009). Evidence from eye tracking during reading support the stable moment-to-moment reading of instructional particles, compared to conceptual or lexical units (Parodi et al., 2018; Recio et al., 2018).

As is well known, previous studies focusing on the distance of the anaphoric antecedent (Clark & Sengul, 1979; Daneman & Carpenter, 1980; Ehrlich & Rayner, 1983) have found that the ‘antecedent search’ (Graesser, 1981; Rayner & Sereno, 1994; Sanford & Garrod, 1981) is not reflected in the pronoun itself (i.e., gendered and numbered pronouns, such as she or he) (Langacker, 2008). A greater distance to the antecedent generally slows down online processing, but the delay is not shown by more fixations on the pronoun. The increased difficulty of the distance involved is reflected in other areas of the text being read

(Ehrlich & Rayner, 1983; Rayner, Pollasteck, Ashby & Clifton, 2012). In this vein, Recio et al. (2018) state that these types of connective units (*a pesar de ello* and *por ello*), that contain anaphoric elements, do not constitute a focus of attention during the late phase of reanalysis, unlike what happens with grammaticalized connectors of the same paradigm such as *por tanto* (therefore) (Pons & Loureda, 2018). On the contrary, the effects of these phrasal connectives as procedural guides unfold over the other conceptual areas involved, for example, a counter-argumentative relation, in which this occurs towards the premise segments being encapsulated.

Focusing on the general objective of the current study and taking into account the eye tracking measure Look Back for the PTP AOI, a disordinal interaction between the extension of the referent and the semantic relation was observed: the long antecedent in the counter-argumentative condition reveals the highest reinspection times. This means that the extension of the antecedent appears to be particularly significant when the semantic relation is counter-argumentative. This finding provides supporting evidence to claim that the processing of long encapsulated constructions (two independent clauses) in counter-argumentative relations demand more time and cognitive efforts, particularly in late and more strategic integration reading.

In this case, both relational and referential coherence are affected at the same time. This combination of demands forces the readers of the sample to make a greater cognitive effort in order to construct a coherent mental representation of the text. This is, in part, because counter-argumentation has been identified as a more complex discourse relation than, for example, causality. The connector *a pesar de ello* marks a relation of opposition or restrictive refutation: the second argument introduced by the connective suppresses the conclusions that could have been inferred from the first discourse member and redirects the discursive dynamics (Domínguez García, 2007). These are relations that provoke a denial of expectation (Blakemore, 1989), since they force a modification of the expected causal relation by imposing an exception on what would be the usual consequence (Zunino, Abusamra & Raiter, 2012): “The adversative connective induces a new turn of presupposition: the mental operation is that of expecting something new though in deep interrelation with what has been said.” (Rudolph, 1996:49). Several experimental studies (Brehm-Jurish, 2005; Köhne &

Demberg, 2013; Drenhaus et al., 2014; Zunino et al., 2012; Zunino, 2016, 2017) have shown that a process of cancellation of inferences, such as the one that occurs in the discourse operation of counter-argumentation, leads to an increase in cognitive demands on the part of the reader, as opposed to a causal relation that allows the direct path from a premise to a conclusion and is, therefore, more expectable. As stated by Sanders (2005), causality is inferable by default, as is also known: ‘causality by default hypothesis’.

Considering the results of these previous experimental studies, which reveal the difficulty of processing the counter-argumentation, it is not surprising that the greater extension of the referent interacts with this kind of semantic discourse relation. This is associated with the instructional value of the neuter *ello*, which enables the reader to integrate the correct antecedent into a semantic relation, thus supporting the thematic progression and encapsulation requirements. Based on this, a *pesar de ello* is clearly not a grammaticalized connecting unit, but a complex phrasal construction or secondary discourse connective (Rysová & Rysová, 2018), whose value is constructed from two sources: one referential and one relational. In this binary complex construction, there is a double instruction to the reader, signaled concurrently by a neuter anaphoric pronoun and connective particles. The current data provides experimental evidence to the debate regarding the grammatical and pragmatic features of functional categories such as *a pesar de ello* and *por ello* (Pons & Loureda, 2018). The findings yielded by the Look Back eye tracking measure confirms the referential value of the neuter pronoun *ello*, as the extension of the antecedent involved in a counter-argumentative relation clearly influences regression times to the encapsulated long segment.

In this line, the findings of the present study for the Look Back are plausible: the wider the areas for the construction of the counter-argumentative assumption, the longer the reprocessing time required. The working memory demands imposed by the process of constructing referential coherence indicates to the readers that they must recover the semantic content that disambiguates the neuter pronoun in order to establish the connecting relations with the next discourse segment. This retrieval of the anaphoric content was hindered by the increased extension of the antecedent in the late processes of integration in counter-argumentation.

Experimentally, these findings fit with the existing evidence that processing counter-argumentative relations is more demanding than processing causal relations, particularly in late integrative processes. Nevertheless, compared with previous research on the same semantic relations (Köhne & Demberg, 2013; Zunino, 2014, 2016, 2017) and with others focusing on concessive and causal ones (Morera et al., 2017; Xu et al., 2018), the current study has novel implications: the combination of two kinds of coherence, presented conjointly and marked by a phrasal connective unit containing a neuter pronoun in Spanish, revealed higher working memory and cognitive load demands.

In sum, our study has provided empirical evidence to sustain that a disordinal interaction was observed between the referent extension and the semantic relation: the long antecedent and the counter-argumentative relation in the Look Back reading measure were the discourse construction that evidenced longer reading times and exerted more cognitive effort on the sample of university readers. The counter-argumentative semantic relation emerged as more critical to the ‘extension effect’. In other words, the complexity of long encapsulation discourse constructions including a neuter pronoun turned out to be particularly intricate when the involved semantic relation was counter-argumentative. Furthermore, reading the neuter pronoun *ello* was not influenced by the extension of the encapsulated antecedent in any of the conditions under study (short or long).

In general terms, the current findings reconfirm our first and initial hypothesis: the greater the extension of the referent, the greater the reading times of the area that resolves or disambiguates the neuter anaphora in explicitly marked counter-argumentative relations. This tends to occur specifically in the reading stage of late integration as it is identified by the Look Back eye tracking measure. Based on this, our findings are in agreement with the fine-grained linguistic analysis of relational coherence relations (i.e., conceptual and pragmatic) that asserts that counter-argumentative semantic relations are functionally dissociable from causal relations (e.g., counter-argumentation entails a denial of expectations and involves a restrictive refutation) and that, therefore, relative to processing causal relation, when processing a counter-argumentative one encompasses an additional cognitive process, namely the process of inference cancellation. This result is also in line with the pragmatic

and psycholinguistic argument that *por ello* and *a pesar de ello* encode a double procedural instruction. On the one hand, the neuter pronoun *ello* conveys the need for a co-referential disambiguation or anaphoric resolution; at the same time, the particles (*a pesar de* and *por*) guide connections between the discourse segments involved in the semantic relation. This way, the two meanings or instructions (referential and relational coherence) demand that the comprehender displays at the same time cognitive resources in both directions. The current research study demonstrates that the distinctions between processing counter-argumentative and causal meanings holds for Spanish, in addition to other languages such as English, Dutch, German and Chinese.

Our study points to the need for a further examination of the different types of constituting units or entities of the premises and causes as complex antecedents in written discourse (i.e., concrete or abstract referents; coordination or subordination of clauses) and how other kinds of semantic relations may affect the processes of disambiguating neuter anaphors across different experimental tasks. Nevertheless, a future in-depth analysis should take into account the present preliminary findings.

Future eye tracking studies on this cutting-edge research area must explore more ecological scenarios, employing -for example- texts identified as part of disciplinary discourse genres based on corpus studies. This is unequivocally crucial for this line of investigation, in order to explore naturally occurring genres that represent actual written communication in real life interactions. Not only will we understand in this way more about the processing of written discourse encapsulation mechanisms with varying antecedent extensions in different semantic contexts, but we will also better understand how referential and relational coherence work together in the construction of a mental representation in moment-to-moment reading. Despite these possible limitations, the current research has scientific significance as it suggests the potential of a novel approach to combining the two types of coherence conjointly (referential and relational) from a discourse-oriented perspective.

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Appendices

Appendix 1. Comparison between Filler DS and Encapsulated DS within both semantic relations.

Discourse Segment (DS)	Mean	Test	Sig.
DS Filler (Counter-argumentative)	662	Paired t-test	$p = .002^{**}$
DS Encapsulated (Counter-argumentative)	765		
DS Filler (Causal)	694	Wilcoxon Signed-Ranks	$Z = .000^{**}$
DS Encapsulated (Causal)	840		

Appendix 2. Comparison between Encapsulated DS 01 vs. DS 02 within both semantic relations.

Discourse Segment (DS)	Mean	Test	Sig.
01 DS Encapsulated (Counter-argumentative)	834	Paired t-test	$p = .355; n.s.$
02 DS Encapsulated (Counter-argumentative)	862		
01 DS Encapsulated (Causal)	770	Paired t-test	$p = .434; n.s.$
02 DS Encapsulated (Causal)	798		