Always look back: Eye movements as a reflection of anaphoric encapsulation in Spanish while reading the neuter pronoun *ello*

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ABSTRACT

Eye movements constitute an important cue to understanding how readers connect textual information, particularly when an encapsulator pronoun must be anaphorically resolved in order to construct a coherent mental representation of the text being read. While existing research into anaphoric reference has predominantly focused on the distance between pronouns and referents and on their morphosyntactic features, no previously published studies have addressed the effect in causal contexts of varying extensions of the referent being encapsulated by a neuter pronoun. In the present research, we help fill this gap by studying the effects of online processing of the anaphoric neuter Spanish pronoun *ello* ('this' in English) in causally-related texts using two varying referent extensions: short and long antecedent. A one factor repeated measures design was implemented. The results of three eye reading measures showed a fine-grained picture of encapsulation processes for seventy-two Chilean university students as they each read twelve texts. On the one hand, the reading times for processing the neuter pronoun *ello* AOI did not show statistically significant differences between the short and long conditions. On the other, the findings indicate that, in constructing referential and relational coherence in causally-related texts in Spanish, resolution of the neuter pronoun is in fact influenced by the extension of the referent.

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0. Introduction

Discourse comprehension, or the process of constructing a mental representation during reading based partially on textual information, requires, among many other abilities, that the reader be able to connect text-based information. This is not always clearly guided by linguistic resources or signals, which may encompass varying textual distances between, for example, the target word and its previous disambiguating antecedent (Carpenter and Just, 1977; Rayner and Ehrlich, 1983). At the same time, the reader also faces the challenge of not knowing exactly the amount of text information that must be retained in memory when moving forwards or backwards in order to elucidate the referential connection between, for

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example, the neuter Spanish pronoun *ello* ('this' in English) and phrases or sentences that may act as its referent. Consider the following two examples, in which (1) is a short antecedent (one causal clause), and (2) is a long antecedent (two causal clauses):

(1) José y Andrés hacen poco ejercicio. Por ello están gordos.
    (José and Andrés don't take much exercise. As a result of this, they are fat.)
(2) José y Andrés hacen poco ejercicio. Comen muchos dulces. Por ello están gordos.
    (José and Andrés don't take much exercise. They eat a lot of sweets. As a result of this, they are fat.)

In contrast to the extensive literature on the processing or resolution of anaphoric or co-referential links (personal and demonstrative pronouns) (i.e., Brown-Schmidt et al., 2005; Byron and Allen, 1998; Carreiras and Clifton, 2013; De Cock and Kluge, 2016; Ehrlich, 1980; Fretheim et al., 2010; Grosz et al., 1995; Hogeweg and de Hoop, 2015; Mitkov, 2002, 2009; Van Gompel, 2013), neuter pronouns, such as *ello* in Spanish, have received almost no attention as encapsulator anaphors (Sinclair, 1994; Tadros, 1994) in psycholinguistics and computational linguistics studies. This is possibly due to the fact that *ello* is less common than personal pronouns in both written and spoken texts (Fernández, 1999; De Cock, 2011, 2013). It is also surprising that, even though anaphoric discourse relations have been among the most widespread research areas over the last five decades (i.e., Asher, 1993; Clark and Sengul, 1979; Clifton and Ferreira, 1987; Cornish, 1999; Ehrlich and Rayner, 1983; Garnham, 1999), empirical and experimental studies, particularly employing eye tracking techniques, focusing on the processing of neuter pronouns as encapsulators and with varying degrees of referent extension (i.e., number of words or clauses being encapsulated) are nonexistent. Interestingly, there is also limited research on the descriptive or analytical textual approach to the Spanish neuter pronouns *esto, eso, aquello* (this, that, those) (De Kock, 1997; Pérez, 2014; Pomino and Stark, 2009; Zulaica, 2007; Zulaica and Gutiérrez, 2009) and even fewer studies are devoted to *ello* (De Cock, 2011, 2013, 2016; Montolío, 2013; Moreno, 2004).

However, recent findings reported by Parodi and Burdiles (2016, 2017, 2018) in a number of large corpus-based studies on disciplinary written genres have found that these pronouns (*ello, esto, eso* and *aquello*) tend to occur in a much higher proportion in causal contexts and when encapsulating large previous text segments. These segments may include a clause, a clause complex, or even what they have named Clausal Group, which may comprise one or two paragraphs. Their findings indicate that — on descriptive grounds — these pronouns are used regularly across genres in systematic constructions of referential and relational coherence. Yet, it remains unclear whether a uniform dimension such as salience, activation, or expectancy (Ariel, 1988, 1999; Mitkov, 2002) may be independently sufficient to account for how different referring expressions are processed. Evidently, grammatical features associated with pronouns, such as gender and number agreement and selectional restrictions, among others, influence reference resolution (Ariel, 1990; Cornish, 1999; Mitkov, 2009; Rayner et al., 2012).

In this vein, the goal of the present study is to evaluate whether the extension of the referent affects the processing of causally-related texts in Spanish (texts composed of a cause discourse segment and a consequence discourse segment). In particular, our interest lies in exploring a neglected area of research by focusing on whether using a short or long antecedent leads to different reading patterns to do with neuter pronoun *ello* resolution in causally-related texts. In order to achieve this objective, we designed an experimental study with seventy-two Chilean university students employing eye tracking technology.

The article is organized as follows. In the first section, which presents the theoretical framework, we review some relevant issues concerning referential and relational coherence of the pronoun *ello*, and briefly discuss the encapsulation role of pronouns. In Section 2, we describe the methodology, focusing on the experimental design, participants, material, and procedures. Section 3 presents the results. Finally, in Section 4, we summarize the results and discuss the findings, highlighting avenues for further research.

1. Pronoun encapsulation with the neutral pronoun *ello*

Encapsulation is a text mechanism of cohesion and coherence through which the meaning of textual segments is condensed or labeled, establishing a process of reference and substitution by another textual element (Halliday and Hasan, 1976). Encapsulators contribute to textual thematic progression and to referential maintenance. They also guide comprehension by converting the encapsulated information into a shared knowledge available to the reader (Cornish, 1999; Prandi, 2004; Sinclair, 1994). Encapsulated text segments may be presented in preceding or subsequent textual units; consequently, an encapsulator may function cohesively as an anaphora or a cataphora (Halliday and Hasan, 1976).

In his seminal studies, Sinclair (1993, 1994) identifies the mechanism of encapsulation, names it thus, and establishes a distinction between 'encapsulation' and 'prospection', being equivalent to anaphoric and cataphoric relations respectively. Francis (1994) refers to encapsulating nouns in general as 'discourse labels', having previously called them 'anaphoric nouns' (Francis, 1986). In terms of 'prospection', Tadros (1994) puts forward an English language taxonomy of prospective rhetorical elements involved in what she terms 'prediction'.

The specialized literature contains much debate concerning the types of unit that can be grouped together into the category of encapsulators (Ariel, 1988, 1991; Borreguero, 2006; Cornish, 1999; Figueras, 2002; González-Ruiz, 2009; Halliday and Hasan, 1976; Llamas, 2010; López Samaniego, 2011; López Samaniego and Taranilla, 2014; Montolío, 2013, 2014; Prandi, 2004; Schmid, 2000; Sinclair, 1993, 1994). In Spanish, these units may be equal to or greater than a noun phrase or a clause.

Other studies recognize a variety of text fragments, including inter-paraphrastic segments (Borreguero, 2006; Figueras, 2002; González-Ruiz, 2009; Llamas, 2010; López Samaniego, 2011; Montolío, 2013, 2014).

Encapsulation is a mechanism executed by a variety of linguistic forms which cannot be categorized as a class of words per se. This means that the encapsulating role or function of a word or given noun phrase is dependent upon context (Abad, 2015; Borreguero, 2006; Francis, 1986; López Samaniego, 2011; Prandi, 2004; Sinclair, 1993). There are many denominations and categories through which the different types of encapsulating mechanisms are described; however, there is a general consensus that neuter pronouns such as *ello* make up one of these groups.

The neuter personal pronoun *ello* has specific features compared with other pronouns, mainly in terms of semantics. Although morphologically it corresponds to the third person singular, in fact it has no notion of person as it does not refer to any of the participants in the communicative exchange. The pronoun *ello* refers to what Benveniste (1980) calls the non-person. Thus, *ello* does not have the same deictic nature that can be identified in the other personal and neuter pronouns. According to Santos Río (2003), *ello*, along with the neuter *eso*, is a deictic pronoun, but acts exclusively as a phoric element: it can only refer to previously stated content. There is a difference between the situational or exophoric deixis, manifested by the physical presence of the entity or event in the extralinguistic context, and the non-situational or endophoric deixis, through which the text itself becomes the space in which the referenced entity or action is identified (Ersan and Akman, 1994; RAE, 2009). Its condition as a neuter pronoun makes it "an example of a grammatical class of words that express certain abstract notions" (RAE, 2010: 24). In other words, *ello* shares with all of the neuter pronouns the capacity to reproduce groups of "two or more nouns referring to things (not persons)" (Bello, 1911: 80). Because of its lack of conceptual meaning by comparison to other anaphoric resources, the neuter pronoun has greater interpretative dependence, as it refers to "what has just been said" (Zulaica and Gutiérrez, 2009: 59) in the clause or clauses that precede it. According to the RAE (2005) and Fernández (1999), the pronoun *ello* can be preceded by sentences, pronouns or neutral nominal groups, as well as by groups of several related non-personal nouns. Besides, *ello* can be preceded by "abstract, often deverbal names interpreted as events or referring to situations or states of things which would more commonly be represented in sentences" (RAE, 2010: 303).

The syntax of *ello* is restricted to certain specific uses (Fernández, 1999; RAE, 2005), in particular as an 'end of preposition' or as a prepositional expression. In this syntactic structure, it is usual that when it encapsulates, it does so in a context of causality (Parodi and Burdiles, 2016). It does not tend to appear as a direct object (RAE and ASALE, 2010), as for this the atonic pronoun *lo* is used, but it can work as an indirect object. Its use as subject is very limited (RAE, 2005). In some uses, it is similar to the neuter demonstrative pronoun *eso*, and for this reason it generally appears in place of the latter as an anaphoric variant (López Samaniego, 2017), particularly in contemporary — and especially non-literary — language. However, *ello* and *eso* are not always completely interchangeable.

2. Processing of the encapsulator pronoun *ello*

The relevance of the neuter pronoun *ello* as a retrospective encapsulating mechanism is remarkable. Besides operating on the linguistic plane, it also performs an important function on the cognitive level, as observed by Ariel (1991, 1999), Borreguero (2006), Figueras (2002) and López Samaniego (2011), among others. On the one hand, it synthesizes preceding textual information in order to contribute to the cohesive construction of texts. On the other, from a psycholinguistic perspective, it provides procedural meaning (Escandell and Leonetti, 2004, 2011; López Samaniego, 2011; Portolés, 2004), which limits the possible interpretations of the textual segments in which it appears and to which it links. The procedural meaning of *ello* can help extract the necessary contextual information to achieve the relevant interpretation of the 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; Prandi, 2004; Sperber and Wilson, 1995). In short, the encapsulator *ello* contributes both to cohesion, that is, to the textual indications of the consistency of the elements in the text, and to coherence, "the consistency of the elements in the representation in the reader's mind" (Louwerse, 2004: 43).

Coherence is a cognitive process that takes place during the construction of mental representations based on discourse, permitting to infer relations between the informative units of a text, for example, cause-consequence semantic links. Two different types of processes have been identified (Koornneef and Sanders, 2013; Reinhart, 1981; Sanders and Pander, 2006; Spooren and Sanders, 2008): referential coherence, when a connection is made through substitution, and relational coherence, when the connection is achieved through the semantics of adjacent text segments (Louwerse, 2004; Prandi, 2004; Sanders and Pander, 2006).

Anaphoric referential coherence is constructed upon expressions pointing to a antecedent that has previously been named in the text (Halliday and Hasan, 1976; Sanders and Spooren, 2001). It is a form of connecting new information with pre-existing mental representations based on the resolution of anaphoric expressions. Consider, for example, the following text:

(3) Los incendios forestales aumentaron en las últimas dos décadas. Por ello la producción maderera experimentó una severa reducción.
(Forest fires increased in the last two decades. As a result of this, wood production experimented a severe reduction.)

In (3), the neuter pronoun *ello* guides the reader to begin the search for a possible referent, then it helps retrieve the informative causal discourse segment "Los incendios forestales aumentaron en las últimas dos décadas.". Many experimental

studies on reading that have investigated the distance between a nominal referent and personal gendered pronouns (e.g. Carpenter and Just, 1977; Rayner and Ehrlich, 1983) indicate that during the process of coherence construction, readers show a preference for closer referents and that, if the referent does not immediately precede the phoric element, processing becomes more demanding. Similarly, online processing tests demonstrate that the assignment of referents is performed as soon as the personal pronoun is read (Mak and Sanders, 2013).

Relational coherence, on the other hand, is conceptual in nature: two discursive segments may present different types of semantic relations between them, and these can either be inferred from the context or be explicitly indicated by the presence of a connector (Halliday and Hasan, 1976; Prandi, 2004; Sanders and Spooren, 2001). In the previous example (3), the connective unit *por ello*, composed of the preposition *por* and the anaphoric pronoun *ello*, establishes a cause-consequence semantic relation. It introduces a new text segment representing the consequence of what was communicated in the preceding text segment, working as a premise on which the causal relation is built (Martín Zorraquino and Portolés, 1999; Prandi, 2004). In contrast to the process for referential coherence, relational coherence is based on a strategy of discourse integration which is only processed once both segments have been read, as opposed to immediately subsequent to the reading of the connector (Mak and Sanders, 2013).

The connective unit *por ello* is a mixed case involving an instruction intended to establish referential coherence, i.e., the neuter pronoun *ello* which encapsulates a previous clausal or textual fragment. At the same time, this phrasal unit also contributes to the relational coherence: the preposition *por* indicates a consecutive argumentative orientation in which a first segment serves as the premise for achieving and reinforcing the conclusion introduced by the connective unit. In sum, in Prandi's words (2004: 296), "… what makes the link is not grammar but the addressee's previous assumption about coherence.".

3. Experimental study

The objective of this study is to evaluate whether the extension of the referent affects the processing of causally-related texts in Spanish. Our interest is focused on whether use of a Clausal Referent (i.e., short antecedent) versus a Textual Referent (i.e., long antecedent) is reflected in anaphora (neuter pronoun encapsulator *ello*) resolution time, based on eye tracking reading measures.

Therefore, texts involving two different extensions of the referent were presented to the readers: a) short extension of the referent (Clausal Referent, CR), and b) long extension of the referent (Textual Referent, TR). In the case of the CR condition, a filler sentence was introduced to test and balance the identification of the anaphoric preceding antecedent.

3.1. Materials

The experiment aims to analyze the independent variable (intra-subject factor) of referent extension, which has two conditions:

(A) **Clausal Referent (CR):** this is composed of one independent causal segment that is encapsulated by the neuter pronoun *ello*. This may also be referred to as the 'short antecedent'.
(B) **Textual Referent (TR):** this is composed of two independent causal segments that are encapsulated by the neuter pronoun *ello*. This may also be referred to as the 'long antecedent'.

In order to balance the presentation of the critical texts, the Clausal Referent (CR) is introduced by a previous independent clause that is not part of the encapsulated antecedent required by the neuter pronoun *ello*. At the same time, it is not a potential cause to integrate the causal construction marked by the preposition *por*. This addition to the CR provides the reader the same previous co-text to the pronoun *ello* as in the Textual Referent (TR) condition (in quantitative terms); that is, two potential candidates for consideration as disambiguating antecedents of the anaphoric pronoun and two possible causes. However, only the second clause in the CR condition is required to establish referential and relational coherence. The first clause in the CR condition is a filler with no semantic implication in the text (see Fig. 1 for a diagrammatic description of these
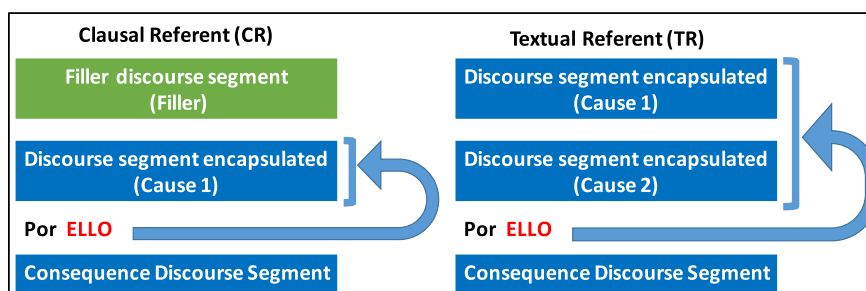

Fig. 1. Diagram of the two experimental conditions.

interactions). This filler segment is not a possible cause nor an encapsulated referent connected by the phrasal unit *por ello* (Halliday and Hasan, 1976; Koornneef and Sanders, 2013; Prandi, 2004; Sanders et al., 1992, 1993).

On the other hand, in the TR condition, the two previous clauses or discourse segments are required to establish anaphoric referential coherence (Reinhart, 1981; Sanders and Spooren, 2001), and both segments are encapsulated by the neuter pronoun *ello*. For this reason, we call it 'long referent'. As mentioned previously, these preceding text-portions (CR and TR) differ in terms of the number of clauses or causal segments that are encapsulated by the anaphoric neuter pronoun *ello*, but are tied by a preposition that reinforces a causal connection between the two main discourse segments.

Fig. 1 shows a diagrammatic representation of the constituent parts of the 'short' and 'long' referent (two experimental conditions), in each case connected by a causal connector *por*.

The areas of interest (AOIs) were segmented manually using Data Viewer (SR Research). They correspond to the Preceding Text-Portion (PTP) and to the neuter pronoun *ello* (Encapsulator). Figs. 2 and 3 show examples of the critical areas (PTP and Encapsulator).
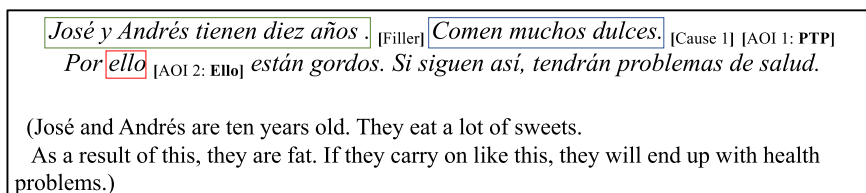
José y Andrés tienen diez años . [Filler] *Comen muchos dulces.* [Cause 1] [AOI 1: **PTP**]
Por ello [AOI 2: **Ello**] *están gordos. Si siguen así, tendrán problemas de salud.*

(José and Andrés are ten years old. They eat a lot of sweets.
As a result of this, they are fat. If they carry on like this, they will end up with health problems.)

Fig. 2. AOIs in the clausal referent.

José y Andrés hacen poco ejercicio. [Cause 1] *Comen muchos dulces.* [Cause 2] [AOI 1: **PTP**]
Por ello [AOI 2: **Ello**] *están gordos. Si siguen así, tendrán problemas de salud.*

(José and Andrés don't take much exercise. They eat a lot of sweets.
As a result of this, they are fat. If they carry on like this, they will end up with health problems.)
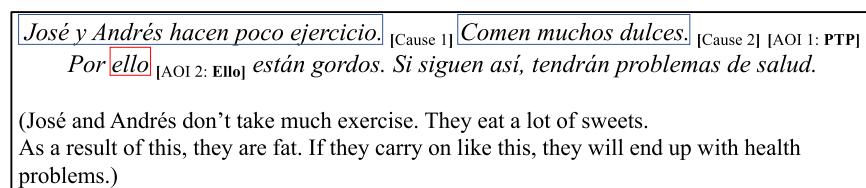
Fig. 3. AOIs in the textual referent.

3.2. Participants

Seventy-two Chilean university students (49 females, 29 males, mean age = 20.04, S.D. = 1.7) took part in the study. All participants were native Spanish speakers in their first or second year at university, guaranteeing a homogenous group. They were all naive participants, meaning that they were unaware of the purpose of the study, and none were researchers in the field of linguistics (Keating and Jegerski, 2014). As required by the National Commission for Scientific and Technological Research in Chile (CONICYT), they all gave their permission to be included in the study. None of the participants presented vision disorders that could interfere with the eye tracker, and the individual reading-speed of each participant was controlled using statistical methods.

3.3. Design and measures

The study implemented a within subjects design. The intra-subject factor was represented by the extension of the referent, which had two levels: short (Clausal Referent: CR) and long (Textual Referent: TR). The target texts focused on general knowledge topics. Each text was designed to display one of the two experimental conditions of the study, based on previous corpus description of the most common extensions identified (Parodi and Burdiles, 2016, 2017). The experimental conditions were counterbalanced in order to avoid carry-over and order-learning effects and to prevent the participants from developing specific reading strategies (Duchowski, 2007; Seltman, 2015). Therefore, participants randomly received one of the two possible conditions (i.e., short-long or long-short). All participants read all critical items in all conditions, and each condition was read – in different versions – four times by each participant. Filler items were added to the critical stimuli in a 2:1 ratio. The texts were presented using Experiment Builder (SR Research).

Three eye-movement measures were computed as dependent variables: a) Fixation Time (Holmqvist et al., 2011; Hyönä et al., 2003; Rayner, 2009); b) Look Back time, and c) Look From time (Hyönä et al., 2002, 2003; Mikkilä-Erdmann et al., 2008).

Fixation Time or Fixation duration (also Total reading time) amounts to the total time spent on an AOI, including rereading the same AOI or all reinspections of the target region (Hyönä et al., 2003; Rayner et al., 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 previous AOI (in this study PTP AOI), having a specific AOI as the origin (in this study, from *ello* AOI) (Ariasi and Mason, 2014; Hyönä et al., 2002; Mikkilä-Erdmann et al., 2008).

We selected these measures because they are considered the appropriate reading indicators for anaphoric processing (Holmqvist et al., 2011; Hyönä et al., 2002, 2003; Mikkilä-Erdmann et al., 2008), and may help identify difficulties in the reading process. According to Mikkilä-Erdmann et al. (2008), regressions in text processing might occur when the reader rereads a critical text segment that causes cognitive problems and has content that needs to be elucidated ('look backs'). On the other hand, when the reader departs from a text segment to read previous text again, there is always a starting point for this moving back ('look froms').

3.4. Apparatus and procedure

Eye movements were recorded using an Eye-Link 2 eye tracker (SR Research). The Eye-Link 2 is a head-mounted video-based eye tracker. It consists of three miniature cameras mounted on a headband: one camera is directed at each eye to enable binocular eye tracking, and an optical head-tracking camera is integrated into the headband, allowing accurate tracking of the participant's point of gaze. The eye tracker captures gaze data at 500 Hz. The data was obtained monocularly, always selecting the dominant eye of the participant. The accuracy of the system is to less than .5° in optimal conditions.

Participants were seated in a chair in a quiet room, at a distance of approximately 70 cm from a computer monitor. A chin rest was used to minimize head movements. The position of the eye tracker was adjusted for optimal tracking. An initial calibration pattern was displayed to participants before running the eye tracker session. To avoid miscalibration, a drift correction was performed between each target stimulus.

Participants were told that they would be shown a series of texts on the computer monitor, while their eye position would be 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 pace, participants moved to the next screen by pressing a key on the keyboard. Each participant decided independently when to go on to the next stimulus.

Practice items were displayed for the participants prior to the main target texts. The entire session took approximately 15 min.

4. Results

4.1. Comparison between clausal vs. textual referents

Considering the different constituent discourse segments of the Preceding Text-Portion (Clausal vs. Textual referents: see Fig. 1) as a possible source of variability, prior to the specific analyses of the experimental conditions, we conducted both paired t-tests and Wilcoxon signed-ranks tests. Firstly, the total reading times (Filler Discourse Segment and Discourse Segment Encapsulated) were compared, with results showing that total reading times were greater on the Discourse Segment Encapsulated than on the Filler Discourse Segment. All differences were statistically significant (see Appendix 1).

Secondly, the total reading time (Cause 1) and the total reading time (Cause 2) were compared, with no statistically significant differences being observed (see Appendix 2). These results allow us to conclude that the two Preceding Text-Portion AOIs are comparable across all conditions.

4.2. Impact of the referent extension on the pronoun ello

Table 1 reports descriptives of Fixation Time for the two experimental conditions (CR and TR) on the *Ello* AOI.

For Fixation Time, a paired samples t-test analysis was conducted for the *Ello* AOI. The analysis included estimates of effect size and statistical power. The effect of the extension of the referent on Fixation Time for the pronoun *ello* showed no statistically significant differences (t(71) = −1.24, p = .221; dz = .17). This means that the effect, if any, would be very subtle to exert an important influence on the reading times to process the neutral pronoun *ello*, no matter what the extension of the causal antecedent be (short or long). According to the statistical analyses, no differences were observed in the processing of the pronoun *ello* AOI in both conditions.

Table 1
Mean and standard deviation for Fixation Time on *Ello* AOI.

Measure	Conditions	M	SD
Fixation Time	Ello-CR	1015 ms	459 ms
	Ello-TR	1092 ms	435 ms

4.3. Impact of the referent extension on the PTP: Fixation Time, Look From, and Look Back measures

Descriptives on Fixation Time, Look From, and Look Back for the PTP AOI in the two experimental conditions (CR and TR) are presented in Table 2.

Table 2
Mean and standard deviation for Fixation Time, Look Back and Look From for the PTP AOIs.

Measure	Conditions	M	SD
Fixation Time	CR	11,593 ms*	3702 ms
	TR	12,964 ms	3734.81 ms
Look Back	CR	2911 ms*	2678 ms
	TR	3549 ms	2856 ms
Look From	CR	245.1 ms**	747.3 ms
	TR	578.6 ms	936 ms

*statistically significant, ** highly statistically significant.

For Fixation Time, a paired samples t-test analysis was conducted on the PTP AOI. Results showed statistically significant differences. Fixation Time ($t(71) = -3.36$, $p = .001$; $dz = .39$) showed differences between the extension of the referent. Reading times were lower in the Clausal Referent (CR) condition.

For Look Back time, a paired samples t-test analysis was conducted. Analysis showed statistically significant differences for Look Back time ($t(71) = -2.23$, $p = .029$, $dz = .26$) in the PTP AOI. The observed values were lower for the Clausal Referent (CR) condition.

For Look From time, a Wilcoxon signed-ranks test was conducted, since the normality assumption was not met. In this case, a median-based procedure might better represent the central tendency of the distribution instead of the arithmetic mean. Results showed statistically significant differences for Look From time ($Z = -3.08$; $p < .002$) in the PTP AOI. As observed in all PTP AOI analyses, the CR condition showed the lowest times.

5. Discussion and conclusion

The aim of this article was to investigate the impact of the reference extension variation in the resolution of the neuter pronoun *ello* in causally-related texts in Spanish. We studied two extensions of the antecedent, in which the number of independent clauses expressing cause might influence processing ease in a semantic construction of causality. We claimed that texts that are anaphorically related with short antecedents would be easier to integrate, and lead to shorter processing reading times.

For decades, research into the psycholinguistics of pronoun interpretation has argued that readers employ diverse interpretation preferences or routes associated with the specific linguistic properties of the antecedents, particularly focusing on third person gender-specific pronouns and on distance variables (i.e., Ehrlich, 1980; Duffy and Rayner, 1990; Kehler et al., 2008; Stewart et al., 2007). However, there is limited literature available focusing on the processing of neuter pronouns; to our knowledge, the only exceptions are on Spanish (Loureda et al., 2015; Recio et al., 2018), and on English (Brown-Schmidt et al., 2005; Schuster, 1988).

The general results confirm our hypothesis: the greater the extension of the referent, the greater the reading times of the area which resolves or disambiguates the neuter anaphora. Recordings of participants' eye movements were analyzed in terms of total reading times and Look Back and Look From measures for the relevant regions of the experimental stimuli. The analyses of these three reading measures revealed supporting evidence for the faster processing of the CR condition compared to the TR condition. This indicates that the readers in the sample retrospectively explore the text in search of the antecedent to the neuter anaphora, identifying and spending a longer period reading and re-reading the encapsulated textual portion that effectively acts as the referent to the neuter pronoun. When the extension of the preceding encapsulated textual portion is smaller, although the potentially available text may contain a non-causal distractor, the readers in the sample only identify that which is actually encapsulated. Consequently, they concentrate − almost exclusively − on the text segment that acts as the causal antecedent of the pronoun *ello*. When the encapsulated textual portion involves both causal antecedents (long extension), the readers focus for a greater time and explore the whole PTP, leading to significantly longer reading times.

These findings also show that this group of university students clearly discriminated between the available preceding textual information, and integrated only the sentences that expressed causes into the subsequent causal construction. The results, and in particular those based on the Look From data, showed statistically significant differences that revealed that the readers spent longer rereading both of the causes required to interpret the anaphoric neuter particle. In other words, they interpreted anaphorically the connecting unit *por ello*, and concentrated predominantly on the two available causes that act as causal antecedents. Interestingly and more importantly, they paid occasional attention to the filler sentence, which −at the same time- displays a double role. On the one hand, it does not express a possible cause for the discourse construction; on the other, the filler sentence acts as a non-encapsulated discourse segment. The group of readers in this

study realize both roles by not concentrating on this filler segment, showing with their behavior that they only integrate the actual encapsulated causes and thus construct a coherent discourse. In fact, this reading behavior reveals that the readers are able to discriminate between the different types of available information in order to construct both referential and relational coherence.

At the same time, the preliminary and exploratory results obtained from this study show that there are no significant differences in the processing of the pronoun *ello* between the two conditions studied (short and long antecedents). This fact had also been reported in earlier studies that have investigated the influence of the distance between the antecedent and gendered personal pronouns. The process of searching for and assigning the referent begins when the pronoun is fixated. But it is not completed with this fixation, it continues in order to resolve the anaphora. This is empirically observed in the reading times on the antecedents. The increase is proportional: as the distance to the antecedent increases, so the search for allocation becomes longer. A greater distance to the antecedents generally slows down processing, but the delay is not evidenced on the pronoun itself. The increased difficulty is reflected in reading times in other areas of the text (Clark and Sengul, 1979; Daneman and Carpenter, 1980; Ehrlich and Rayner, 1983).

> "In fact, it takes longer to read a sentence that refers to information introduced several sentences earlier than one that refers to recently introduced information." (Carpenter and Just, 1977: 343)

The process of establishing a connection between an anaphoric discourse segment (neuter pronoun, in this study) and its antecedent in a text has been named as 'antecedent search' (Graesser, 1981; Sanford and Garrod, 1981; Ehrlich and Rayner, 1983; Rayner et al., 1994). In the case of gendered and numbered pronouns (*he* or *she*), when they are encountered in the course of reading a passage, the reader must identify an antecedent that matches in these two categories that presumably facilitate the anaphora resolution (Ehrlich and Rayner, 1983; Clifton and Ferreira, 1987). Just as this personal pronoun requires an antecedent, so does the neuter pronoun *ello,* but it does not have similar contextual explicit morphosyntactic features that help guide the process of disambiguating the anaphora. Pronouns such as *ello* does not carry semantic or lexicogrammatical information that may facilitate the reading process. Thus, when the reader encounters a neuter pronoun *ello*, an extensive search for an appropriate coreferring antecedent must be initiated extending over several fixations. This process might become substantially more difficult than with other pronouns or even anaphoric noun phrases (ANPs) that typically have more semantic content (Duffy and Rayner, 1990). To the best our knowledge, there are no available studies comparing the reading processes of neuter pronouns such as *ello* with personal gendered and numbered personal pronouns, nor comparing with ANPs.

Besides, the fact that the processing of the pronoun *ello* did not show differences between the two conditions could be connected to other experiments with similar results, where different Spanish connectives (*por tanto* and *por eso*) were studied (Recio et al., 2018). Since these connecting units have fundamentally procedural meaning, they require other elements with conceptual meaning through which they can fulfill their instruction. They constrain the inferential processes in communication, aiming to guide the reader by distributing processing efforts to the expected assumptions (Blakemore, 1987, 1992, 1997; Carston, 2002, 2004; Escandell and Leonetti, 1997, 2004, 2011; Murillo, 2010; Portolés, 2001; Sperber and Wilson, 1995). Therefore, they impose certain conditions on the respective discourse segments, and force the reader to fulfill the instruction to understand the presented assumption.

In the present study, *por ello* requires other conceptual textual elements (the antecedents) to enforce its causal instruction and fulfill the interpretation process (referential and relational coherence). It is for this reason that the increased processing effort generated by the textual referent is not reflected directly on the element with procedural meaning, but it can be clearly observed on the antecedents (Cause 1 and Cause 2). *Por ello* operates on the conceptual elements of the previous discourse segments, forcing them to modify the mental representations. The asymmetry between the procedural and conceptual meaning within an utterance is also connected with the main characteristic of the procedural meaning: its stable instruction. According to Escandell and Leonetti (2011), the conceptual representations are primarily flexible and malleable, meaning that they can be enriched and adjusted, whereas the instructions are stable (Escandell and Leonetti, 1997, 2004; Loureda et al., 2015; Wilson and Carston, 2007).

> ".. [ ] they cannot enter into mutual adjustment processes, nor can they be modulated to comply with the requirements of conceptual representations, either linguistically communicated or not. The instruction encoded by an item must be satisfied at any cost for interpretation to succeed." (Escandell and Leonetti, 2011:85—86)

Focusing on the present results, regardless of whether the antecedent is short or long, the instruction of *por ello* remains relatively stable, i.e., there are no differences between the conditions in the processing times of the element with procedural meaning. The differences between the conditions are reflected on the AOIs with conceptual components (causal encapsulated discourse segments), since these are the elements that have to be modified and adjusted to the instruction.

Thus, the present study contributes experimental eye measures data to the debate concerning the limits of functional categories such as *por ello, por eso* and *por tanto*. The data from the present study confirm the referential value of the neuter pronoun *ello*, as the extension of the antecedent clearly influences regression times (Look Back) to the encapsulated segment. This is associated with the instructional value of the neuter pronoun *ello*, which enables the reader to integrate the correct

antecedent into a causal relation expressed by the preposition *por*. In this sense, *por ello* is not a grammaticalized unit, but a complex structure comprising preposition + term, whose value is constructed from two sources: one referential and one relational. In this hybrid complex construction, there is a double instruction to the reader, signaled at the same time by a neuter anaphoric pronoun and a causal-consequence connective.

Earlier studies have reported that personal referential coherence markers tend to be processed immediately (Koornneef and Sanders, 2013; Mak and Sanders, 2013), based on the immediacy assumption originally proposed by Just and Carpenter (1980). Other studies have disputed this hypothesis, proposing alternative explanations (Carroll and Slowiaczek, 1987; Rayner et al., 2012). Those results were obtained based on the processing of gender- and number-specific personal pronouns (i.e., he, she), however the empirical data contributed by the current study present a somewhat different scenario. They indicate that the neutrality of a pronoun like *ello* requires slower, parsimonious, and more demanding processing, which involves greater cognitive load. This could be explained by two different but complementary arguments. Structurally speaking, the processing of such a neuter pronoun normally implies the potential to refer to complex text segments (Parodi and Burdiles, 2016, 2017, 2018) — that is, antecedents of a varying extension greater than a phrase or a clause — which do not refer to a single proper noun or proper name (i.e., Juan, María). On the other hand, and semantically speaking, the neuter pronoun involves the processing of abstract entities, as those usually represented by a complex nominalization or a whole paragraph or even paragraphs. Until now, there is no complete or well-defined taxonomy available of such discursive abstract anaphoric entities. What is more, researchers have not reached consensus on which entities should be consider abstract or under what conditions. In fact, Parodi and Burdiles (2016, 2017, 2018) have acknowledged the crucial lack of orientations in order to identify these abstract antecedents, not only due to a lack of a proper semantic and syntactic characterization, but also in terms of delimitating antecedents that extend beyond the sentential or clausal limits. The findings reported in the present study (extension effect) therefore would not coincide with those concerning the processing of gender- and number-specific personal pronouns.

In conclusion, this study represents the first of its kind to explore the variable extension of the referent in any language. The preliminary evidence contributed by our study showed that the extension of the referent affected the university students' reading behavior, depending on a short or long antecedent that needed to be disambiguated in the context of causal coherence relations. Based on the empirical findings reported in this paper, we observed longer processing times in three reading measures (Total Reading Time, Look Back, and Look From), when the antecedent of the neuter pronoun *ello* was composed of two independent causal clauses, compared to a shorter referent comprising only one causal clause. In this light, we identified 'an extension effect' in the processing of a combined relation, referential and relational (neuter pronominal anaphor and causal-consecutive). Furthermore, the processing times of the neuter pronoun itself did not reveal statistically significant differences in either of the two conditions.

Future eye tracking research on this promising topic must explore more ecological scenarios, using texts identified as part of disciplinary genres based on corpus studies. This is crucial for this line of research, in order to allow for genuine conclusions to be drawn regarding written texts that appear in every day practice, and that are used in real life communicative interactions.

Not only will we understand in this way more about the processing of written discourse encapsulation mechanisms with differing degrees of extension of the textual referents, but we will also better understand how referential and relational coherence work together in the construction of a mental representation during online reading. At the same time, we should consider the diverse semantic relations in which the encapsulation processes occur, advancing for example into counter argumentative semantic relations such as those signaled by 'in spite of' and 'however'. It would also be remarkable to look into other phrasal causal connectors in which grammaticalization processes have taken place, such as *por tanto* ('therefore' or 'thus' in English), allowing for comparisons with hybrid constructions such as the one studied in the present research (*por ello*).

Furthermore, as this research area is entirely new, there are no well-established eye tracking measures available to account for the varying extensions of long referents in ecologically identified relations of referential and relational coherence based on written genres (Parodi et al., 2018). The process of identifying suitable measures to account for the mechanisms under study must not only be driven by what has already been designed by manufacturers. Instead, it is vital that we operationalize complementary measures appropriate to our research questions and challenges.

Ethics and conflict of interest

Acknowledgements

Appendix

Appendix 1

Discourse Segment (DS)	Mean	Test	Sig.
DS Filler	694 (ms)	Wilcoxon	Z = .000**
DS Encapsulated (Cause 1)	840 (ms)	Signed-Ranks	

** highly statistically significant.

Appendix 2

Discourse Segment (DS)	Mean	Test	Sig.	
Cause 1	770 (ms)	Paired t-test	$p = .434$;	n.s.,
Cause 2	798 (ms)		$dz = .09$	

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