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Italian Journal of Linguistics

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Processing coherence: An experimental study on the Italian connective *pertanto*

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Connectives limit the potential ambiguity of discourse by offering interpretive guides that optimize processing. In this study, we propose an eye-tracking study of the Italian argumentative connective *pertanto* (Eng. ‘therefore’) to verify if the semantic and pragmatic features of this unit influence the way in which native speakers process the structures on which it operates. *Pertanto* is one of the most frequent connectives with causal, conclusive meaning in Italian. It marks causal relationships and usually appears in formal registers. As is the case with connectives in general, *pertanto* is neither sufficient nor indispensable to express causality. For a causal reading to be possible, two or more segments joined together must be semantically co-oriented, that is, the first member must lead to the meaning expressed in the second through its argumentative orientation. Otherwise, the presence of this connective will result in a highly implausible utterance and could be evidenced by an increase in processing costs. After performing a reading eye-tracking experiment with Italian native speakers, data analysis confirmed that highly implausible relationships required higher processing costs. This finding replicates the results obtained in other languages that reinforced the idea defended by relevantist studies on the rigidity of the procedural meaning of connectives.

KEYWORDS: connectives, causality, discourse processing, eye-tracking, experimental pragmatics.

1. Introduction

Causation is an essential concept in human cognition. All languages have a series of mechanisms to express it. Connectives provide the reader with instructions for the correct interpretation of discourse by making explicit the argumentative relationships between the propositional segments they connect, which eventually may result in processing effort reduction (cf. procedural meaning,¹ see Blakemore 1987; Sperber & Wilson 1995; Wilson & Sperber 2002). A cause-consequence connective like the Italian *pertanto*² (Eng. ‘therefore’) introduces a member of the discourse “by indicating that it is relevant as a premise for the deduction of the proposition [it] introduces” (Blakemore 1987: 84). In (1),

- (1) Leonardo e Cassandra dirigono film molto interessanti. Pertanto ricevono tanti premi.
'Leonardo and Cassandra direct very interesting films. Therefore, they receive many awards.'

pertanto connects two argumentatively co-oriented arguments ('direct very interesting films' and 'receive many awards') so that the second segment is integrated into the mental representation created by the first segment, presenting it as a plausible conclusion.

Cause-consequence connectives guide communicative expectations by signaling a relationship between discourse segments as part of an argumentation following a specific orientation (Anscombe & Ducrot 1976, 1983, 1986; Blakemore 2004; Pander Maat & Sanders 2006). The argumentative orientation is achieved from the integration of the words with conceptual meaning and the world knowledge stored in speakers' minds (Carston 2002). An expression like *film molto interessanti* will most likely trigger mental representations such as 'being appreciated by the public' or 'getting recognition' (Anscombe & Ducrot 1976, 1983). For this reason, a discourse segment such as *dirigono film molto interessanti* orients readers towards the discursive continuation *ricevono tanti premi*. In other words, the fact of receiving awards can be understood as a conclusion that logically derives from the premise of directing very interesting films (Ducrot 1983). The mental representation generated by the collocation *film interessanti* is argumentatively sufficient to reach the conclusion presented in the second discourse member. The presence of the connective simply confirms the pre-established argumentative orientation of discourse segments.

If, on the other hand, the first segment of the premise introduces a mental representation contrary to the previous one as in (2),

- (2) #Leonardo e Cassandra dirigono film poco interessanti. Pertanto ricevono tanti premi.
'Leonardo and Cassandra direct uninteresting films. Therefore, they receive many awards.'

the argumentative orientation of the utterance is reversed, and the premise introduced in the first segment ceases to be argumentatively sufficient. In this case, the presence of the procedural unit *pertanto* no longer supports the orientation marked by the conceptual units that make up the segments, but it rather contradicts it.

When *pertanto* connects two argumentatively anti-oriented segments, the utterance is likely to be rejected by the reader and lead to higher processing costs. Conversely, when inserted in co-oriented utterances, cause-consequence relationships meet readers' argumentative expectations. A connective like *pertanto* in an utterance like (1) imposes

certain processing strategies and allows an anticipatory effect. This accelerates the processing of the second segment, as several experimental studies have shown (Loureda *et al.* 2016a; Nadal & Recio Fernández 2019; Loureda *et al.* 2020; Narváez García 2019; Narváez García & Torres 2019; Recio Fernández 2020). This article presents the results of an eye-tracking reading experiment that compared the processing costs generated by reading utterances such as those presented in (1) and (2), to verify whether argumentative insufficiency³ required an increase of cognitive effort during reading.

2. Coherence and discourse relations

Discourse is more than a progression of utterances; it is an association of meaningful connections among information units, where every step builds on the preceding one and the interpretation of the whole lot is mutually dependent (Halliday & Hasan 1974: 4). Information units are connected through various types of lexical, semantic, and pragmatic relations. Their role becomes essential in discourse understanding and production, as only the fusion of all parts can provide successful communication. Coherence provides connectedness between discourse units and enables the creation of mental representations based on inferences (Sanders & Pander Maat 2006). Coherence may be achieved lexically through, in particular, pronouns and demonstratives that tie units with the same referent (referential coherence) or through devices like connectives that provide relational instructions among discourse units (relational coherence; Sanders *et al.* 1992; Givón 2005; Sanders & Pander Maat 2006; Pander Maat & Sanders 2006; Spooren & Sanders 2008; Recio Fernández *et al.* 2021). Thus, (3)

- (3) Please bear in mind when looking through this brochure that, at the time of going to press, the Euro Disneyland Theme Park was still under construction. *Therefore*, all pictorial content is intended to be merely representative of the entertainment themes available within the Euro Disneyland complex and not specific.⁴

does not simply account for the pictorial content of the Euro Disneyland Theme Park contained in the brochure and the time of construction of the park, but for the more complex relation between these two facts connected in a causal, coherence relation. In other words, what is meant in (3) is the unfinished construction of the Euro Disneyland Theme Park at the time of edition of the brochure caused the merely representative nature of the pictorial content in it. Connectives, or conjunctions in the

Hallidayan tradition (Halliday & Hasan 1974) are “one-word items or fixed word combinations that express the relation between clauses, sentences, or utterances in the discourse of a particular speaker” (Pander Maat & Sanders 2006). They may convey explicit relations, as in (1) and (3). Coherence relations, however, can also be held in the absence of a connective. In (4),

- (4) Please bear in mind when looking through this brochure that, at the time of going to press, the Euro Disneyland Theme Park was still under construction. All pictorial content is intended to be merely representative of the entertainment themes available within the Euro Disneyland complex and not specific.

even without linguistic marking, a causal interpretation can be easily decodified. Implicit discourse relations are the manifestation of speakers’ “mutually manifest cognitive environment” (Recio Fernández *et al.* 2021: 1013). As Recio Fernández (2020: 79) put it, “[b]y producing an implicit causal relation, a speaker does not aim at reducing the complexity of his discourse. Instead, he seeks to achieve optimal relevance in terms of what is said and how it is said to generate the largest contextual effects in his interlocutor.” A growing number of empirical studies has shown that implicit and explicit discourse relations trigger different processing paths and lead to different mental representations (Haberlandt 1982; Sanders & Noordman 2000; Degand & Sanders 2002; van Silfhout *et al.* 2015; Nadal *et al.* 2016; Zunino *et al.* 2016; Drenhaus *et al.* 2014; Narváez García 2019, Narváez García & Torres 2019, Recio Fernández 2020; Loureda *et al.* 2021; Recio Fernández *et al.* 2021). Implicit addition and causality have been proved to be easier to process (Mak & Sanders 2013; Zunino 2014, 2017; Loureda *et al.* 2016a; Nadal *et al.* 2016), whereas in counter-argumentative relations, the presence of a connective eases processing and comprehension (Murray 1995, 1997; Asr & Demberg 2012; Moncada 2018; Nadal 2019; Sanders & Evers-Vermeul 2019), as it triggers the application of accommodation strategies that maximize processing (Murray 1997; Brehm-Jurish 2005; Köhne & Demberg 2013; Drenhaus *et al.* 2014; Nadal 2019).

Concerning causal relations, connectives are non-essential to build argumentation, as both juxtaposition and semantic explicitness may also be used to convey the relation, as expressed in the Continuity Hypothesis (Segal *et al.* 1991), according to which that receivers expect adjacent segments to be temporally continuous and causally connected, as well as the Causality-by-Default hypothesis (Sanders 2005), which proposes that receivers expect two segments in a discourse to be causally related by default. In this case, coherence becomes a feature that

can be derived directly from the text and is “cognitive in nature” (Recio Fernández *et al.* 2021: 1013). The cognitive nature of implicit causal discourse relations does not preclude, however, the role of causal connectives in discourse. Even if they are less frequent than other types of connectives (Bello Viruega & Narváez García 2021), they still play a role limit the potential ambiguity of the utterances and guide inferential processes in communication, maximizing the cognitive effort invested in processing (Blakemore 1987; Sperber & Wilson 1995, 2002; Wilson & Sperber 2002). In this sense, they facilitate the construction of an argumentative orientation between adjacent segments, which could also be inferred in the absence of a connective, but probably after investing a higher processing effort and as shown by several experimental studies (Loureda *et al.* 2016a; Nadal & Recio Fernández 2019; Loureda *et al.* 2020; Narváez García 2019; Narváez García & Torres 2019; Recio Fernández 2020).

3. *The rigidity of procedural meaning*

Utterances can be broken down into conceptual and procedural units. Whereas the first establish a direct link with reality, the latter encode a set of instructions on how to process conceptual units (Carston 2016). In (1),

- (1) Leonardo e Cassandra dirigono film molto interessanti. Pertanto ricevono tanti premi.
'Leonardo and Cassandra direct very interesting films. Therefore, they receive many awards.'

the procedural instruction encoded in *pertanto* triggers the search for world knowledge that allows the integration of the conceptual information contained in the two information units it connects by marking an explicit cause-consequence relation. The words with conceptual meaning that make up the discourse units, such as *to direct* or *films*, allude to reality and gives us access to an encyclopedic entry that triggers a series of assumptions stored in our long-term memory that are commonly accepted and integrated into our cultural background (Carston 2002: 321-322). Conceptual meaning is flexible and can be easily adapted to the context, which makes mental representations richer and more complete (Escandell Vidal & Leonetti 2004: 1732).

Conversely, procedural units do not establish a direct link with reality. Their role is to offer a set of processing instructions to perform logical operations that influence emerging mental representations⁵

(Escandell Vidal & Leonetti 2000: 365). In (1), the procedural instruction included in *pertanto* invites readers to relate the information units in a specific way to build an additional inference: ‘People who direct interesting films normally receive many awards’, at least compared to those who direct uninteresting films. Thus, connectives serve as guides for the construction of coherent discourse (Spooren & Sanders 2008: 2005).

Procedural meaning in connectives has usually been labeled as asymmetric and rigid (Portolés 2001[1998]; Escandell Vidal & Leonetti 2004; Escandell-Vidal & Leonetti 2011; Nadal *et al.* 2016). This is so because procedural instructions require the presence of conceptual content on which to act. At the same time, procedural units are described as rigid because, unlike conceptual units, their meaning cannot be blended to fit the context. In other words, the conditions they impose on the context in which operate are non-negotiable and suggest the activation of appropriate, specific logical operations. For example, the presence of *pertanto* in (2)

- (2) #Leonardo e Cassandra dirigono film poco interessanti. Pertanto ricevono tanti premi.
‘Leonardo and Cassandra direct uninteresting films. Therefore, they receive many awards.’

forces readers to build an implicature like ‘people who direct uninteresting movies usually get lots of awards.’ This implicature is probably contradictory to the assumptions stored in most speakers’ long-term memory. However, the instruction of the connective to connect units following a cause-consequence relationship cannot be canceled. The rigidity of its procedural meaning does not allow a coherent context integration. Faced with an utterance like (2), readers will either initiate an accommodation process that will make them build new assumptions that could fit the context and increase the cognitive effort invested in processing the utterance or they will give up trying to continue processing (Recio *et al.* 2022; Nadal *forthcoming*).

In this study, we aimed at delimiting the effect of the interaction between the rigidity of procedural meaning contained in the causal connective *pertanto* and the argumentative orientation of discourse. Based on this, we formulated the following hypotheses:

H1. Argumentative insufficiency: In utterances containing an implausible relationship (that is, two argumentatively anti-oriented discourse segments), higher reading times are expected, especially in the conclusion (second discourse segment).

H2. Argumentative sufficiency: In utterances containing a highly plausible relationship (that is, two segments argumentatively co-oriented according to their conceptual meaning), it is expected that the con-

nective facilitates processing (evidenced by lower reading times), especially in the conclusion (second discourse segment).

4. The experiment

An eye-tracking reading experiment was carried out to test the effects of different degrees of plausibility in the processing of utterances containing the connective *pertanto*. The eye-tracking technique provides temporal and spatial measurements of the cornea when the eyes visit a given stimulus (Keating & Jegerski 2015; Conklin *et al.* 2018; for a more in-depth description, see Holmqvist *et al.* 2011). Based on the Eye-Mind Hypothesis (Just & Carpenter 1980), which assumes that eye movements and cognitive processes are inextricably linked, this technique gives us a window into the reader's mind and provides information critical to language processing.

4.1. Independent variables

The independent variables aimed to verify the impact of the interplay of the presence of the connective *pertanto* and the degree of argumentative sufficiency of the utterance in which the connective is inserted, expressed through the argumentative orientation of its discourse segments. Two conditions were considered in this study. They differed in their degree of argumentative sufficiency: argumentatively sufficient (or highly plausible), as in (1), and argumentatively insufficient (or scarcely plausible), as in (2).

(1) Leonardo e Cassandra dirigono film molto interessanti. Pertanto ricevono tanti premi.
'Leonardo and Cassandra direct very interesting films. Therefore, they receive many awards.'

(2) #Leonardo e Cassandra dirigono film poco interessanti. Pertanto ricevono tanti premi.
'Leonardo and Cassandra direct uninteresting films. Therefore, they receive many awards.'

The reading times (in milliseconds) were computed for five areas of interest (henceforth AOI):

- the whole utterance, i.e. all the words making up the experimental utterance;
- the lexical mean, i.e. a calculation of the mean reading time of all the words with conceptual meaning contained in the utterances, thus excluding the connective;⁶
- the first discourse segment (henceforth M1), which constitutes the premise of the argumentation;

- the connective *pertanto*;
- the second discourse segment (henceforth M2), which includes the conclusion.

All values were estimated considering the mean per word to ensure that all AOIs were comparable (Loureda *et al.* 2020).

4.2. *Dependent variables*

In this study, fixations were taken as the basic measure to assess the processing effort. Data was analyzed according to three dependent variables: (i) Total Reading Time (henceforth TRT), which is the sum of all fixations in an AOI; (ii) the First-pass Reading Time (henceforth FRT; Pickering *et al.* 1997; Holmqvist *et al.* 2011: 390), which is the sum of the duration of all fixations in an AOI before the reader's eyes move to another AOI; and (iii) the Re-Reading Time (henceforth RRT), which is equivalent to all the fixations in an AOI after the reader's eyes revisit the area (Hyönä *et al.* 2003). Whereas the TRT outlines the global processing of the utterance, the FRT and the RRT inform about different processing stages: FRT accounts for the construction of a first communicated assumption, which is formed from the available lexical-semantic and morphosyntactic information contained in the stimuli and complemented with pragmatic knowledge. Then the RRT is an optional stage that serves to confirm, reject, enrich, or modify the initial assumption, created during the first reading.

4.3. *Experimental utterances and design*

Critical utterances were distributed in two counterbalanced lists according to a Latin square design (Sandra 2009; Raney *et al.* 2014; Loureda *et al.* 2020) to avoid repetition effects that might raise participants' awareness regarding the object of study. Conditions were replicated eight times so that each list was made up of stimuli on different topics that responded to each of the conditions considered. Each experimental list was read by a different group of participants. Critical utterances were inserted in short stories that were presented pseudorandomly so that the same condition would not always occupy the same order in the sequence to control possible effects derived from order of presentation of experimental materials (Cowart 1997; Gries 2013). These stories were alternated in a 2:1 ratio with distractors, which in this case were other stories that presented a reasonable resemblance with the critical utterances in this study but did not necessarily contain the same structure and whose purpose was that of preventing participants from altering their reading behavior after knowing the purpose of the investigation

(Keating & Jegerski 2015). Likewise, filler utterances and images were used with a two-folded objective: they aimed at diverting the reader's attention from the object of the research and at the same time they provided a thematic context for experimental utterances.

All critical utterances followed an SVO pattern, they had a plural subject and a conjugated verb in the present simple, as recommended by Conklin *et al.* (2018: 36).⁷ All the words contained in them had approximately the same number of letters. Additionally, word frequency and register were controlled, and polysemy was avoided (Clifton *et al.* 2007; Staub & Rayner 2007; Rayner 2009). A third segment was introduced after the second discourse segment in every critical utterance to control the so-called wrap up effect, which is the tendency of readers to fixate for a longer time the words found at the end of a text due to the semantic integration processes taking place at that point (Just & Carpenter 1980; Rayner *et al.* 1987, 1989, 2000).

4.4. Participants and procedure

A total of 40 native speakers of Italian participated in the study. They were all university students (19 women, age range 18-22 years). The data were recorded using an Eye Link DM-890 eye-tracker that registered eye movements at a speed of 1,000 Hz. To carry out the study, the participants sat at about 65-70 cm from the screen. The reading times of both eyes were recorded, and an average was automatically calculated. At the beginning, participants read a set of instructions displayed on the screen as well as a mock-experiment to familiarize themselves with the task. No time restriction was imposed. Still, most participants completed the task in less than 10 minutes. Participants performed a silent reading rather than hearing an oral explanation, in order to avoid any bias caused by the research team.

4.5. Statistical treatment of data

Data were statistically analyzed using linear mixed regression models (Fahrmeier *et al.* 2013) in which reading time was taken as an indicator of processing costs. This method allows incorporating the influence of various variables as fixed effects and integrating random effects (Fahrmeier *et al.* 2013; Keating & Jegerski 2015: 25). For the interpretation of the models, the magnitude of the effects obtained in the differences between reading times was observed. The AOIs in each condition were considered as fixed effects: M1, connective, M2, and mean of the utterance. The topics of the utterances and the participants were integrated as random effects. On the other hand, word length was

also considered. In fact, although all the words in the experiment had a similar number of characters, word length was calculated considering the number of characters and words in the entire experiment.

The data obtained in the experiment were analyzed using the ‘*gamm*’ and ‘*predict_gam*’ functions of the ‘*mgcv*’ and ‘*tidymv*’ packages (Wood 2011, 2017; Coretta 2020) using the R software (R Core Team 2020). This analysis focuses on the magnitude of effects. Thus, in this study, information about *p* values is complemented with information about magnitude of effect: Differences inferior to 3.99% were considered residual effects; those between 4% and 4.99%, small effects; between 5% and 9.99%, medium effects; between 10% and 19.99%, large effects; and finally, differences greater than 20% were considered very large effects (Loureda *et al.* 2020).

Outliers that fell in one the following groups were discarded: (a) if the first reading was equal to 0 for the first or second discourse segment, for the lexical mean or the total mean of the utterance (any first skip); (b) if both the first and the re-reading had an average per word lower than 80 ms for the complete utterance (fast readers, Pickering *et al.* 2000; Reichle *et al.* 2003); (c) if the total reading time had an average per word higher than 800 ms (slow reader) for the complete utterance (slow readers); or (d) if the processing times per word was 2 standard deviations higher or 2 standard deviations lower than the mean (atypical). Of the 400 observations collected, 71 (17.75%) were discarded, of which: 2 observations (0.5%) corresponded to first skips, 1 (0.25%) to slow readers, and 68 (17.75%) were deemed atypical.

5. Data analysis

In this experiment, the processing of utterances that were joined together by the causal-consecutive *pertanto* and whose elements showed varying degrees of pragmatic plausibility resulting in different argumentative orientations was assessed. In the first condition (argumentative sufficiency), discourse members were co-oriented and agreed with the procedural instruction of cause-consequence embedded in the connective. Conversely, the second condition (argumentative insufficiency) contained anti-oriented segments, which clashed with the instruction of *pertanto*. The analysis below shows a generalized increase in processing times for the second condition (pragmatic implausibility) in all three dependent variables.

5.1. Total reading time

First, the mean processing time per word for the complete utterance (in milliseconds) showed a non-significant increase in processing costs in the case of argumentative insufficiency considering the total time of reading invested in both conditions. This applies to the processing of the whole utterance, as shown in Table 1, as well as the processing of conceptual elements in the utterance, as displayed in Table 2.

	Word-processing	Standard error
Argumentative sufficiency	281.12	14.62
Argumentative insufficiency	333.97	21.44
Difference	18.8%	
<i>p</i> value	1.0	

Table 1. Processing the whole utterance (TRT).

	Word-processing	Standard error
Argumentative sufficiency	279.03	8.98
Argumentative insufficiency	322.45	22.95
Difference	15.56%	
<i>p</i> value	0.12	

Table 2. Processing the whole utterance (conceptual meaning, TRT).

The increase in processing time registered for utterances holding an argumentatively insufficient relation was 18.8% for the whole utterance and 15.56% for the conceptual elements in the utterances, which is considered a large effect. Implausible relations required more processing time. An anti-oriented conclusion may have caused a surprise effect on readers, who needed more time to process information before terminating the reading.

The processing patterns followed in the TRT for both discourse segments and connective in both experimental conditions is shown in Table 3.

	M1	Connective	M2
Argumentative sufficiency	300.06	294.16	281.18
Argumentative insufficiency	346.53	327.36	325.03
Difference	15.49%	11.29%	15.59%
<i>p</i> value	0.55	1.0	0.64

Table 3. Processing the AOIs (TRT).

The increase in processing time observed for the mean of the utterance did not come from a specific area: The three AOIs required greater cognitive effort when the instruction of the connective was opposed to the argumentative orientation offered by the words with conceptual content. This finding might be related to the rigidity of procedural meaning: procedural content is considered a first-order instruction that is imposed on the orientation marked conceptually by the lexical content encoded in the segments (Escandell-Vidal & Leonetti 2011; Loureda *et al.* 2019). The magnitude of the differences registered was greater than 10% in all AOIs, which is considered a large effect.

After having observed TRT results, it is necessary to establish a distinction between a first processing phase, in which the construction of an assumption begins, and a second re-reading phase, whose purpose is the verification of the previously formed assumption.

5.2. First pass reading time

During the first reading, the mean processing showed an increase in processing costs in the insufficiency condition. This was found both in the processing of the whole utterance, as revealed in Table 4, and in the reading times obtained for the elements with conceptual meaning, shown in Table 5.

	Word-processing	Standard error
Argumentative sufficiency	271.62	14.8
Argumentative insufficiency	322.12	21.74
Difference	18.59%	
<i>p</i> value	0.06	

Table 4. Processing the whole utterance (FRT).

	Word-processing	Standard error
Argumentative sufficiency	272.48	8.77
Argumentative insufficiency	313.35	23.21
Difference	15%	
<i>p</i> value	0.14	

Table 5. Processing the whole utterance (conceptual meaning, FRT).

The construction of a first assumption that combines semantic and syntactic information with the knowledge stored in readers' mind (Escandell Vidal 2005) enables the identification of the incongruity that arises from the mismatch of the instruction provided by *pertanto* and the causal orientation established between the discourse segments. This can be spotted in the large effect (15%) which might have been produced by the increase in cognitive effort needed to process both conditions.

The processing pattern drawn by the three AOIs in the utterance indicated that during the first reading not all areas contributed equally to the increase in total processing costs in the utterance (as happened in the TRT). As shown in Table 6, the higher reading times recorded in the second discourse segment and in the connective can be held accountable for the increase in the total processing times of the whole utterance.

	M1	Connective	M2
Argumentative sufficiency	263.81	281.54	276.53
Argumentative insufficiency	267.88	225.73	306.93
Difference	1.54%	24.72%	10.99%
<i>p</i> value	1.0	1.0	0.93

Table 6. Processing the AOIs (FRT).

The processing times recorded for the M1 in the first reading did not reveal big differences. Indeed, the 4-ms difference across conditions in M1 represents a very small effect (1.54%). This may be so because during the first reading of this segment the reader has not yet been able to perceive any pragmatic anomalies.

However, as the reading proceeds, differences between conditions become evident. In the AOI of the connective, there seemed to be a preview effect over the discourse segment introduced by *per-tanto*. Readers might have had accessed information parafoveally to be able to advance the content transmitted in the conclusion (Rayner 1998). Only in this way may it be possible to explain the strong increase (24.72%) in reading time registered in the AOI of the connective in the sufficient condition. This is aligned with the expected processing pattern as it has been shown that when inserted in a normal context, the instruction of the connective preserves its guiding role more clearly (Narváez García 2019) and this triggers a strategic reading to obtain greater cognitive effects in a more effective way (Recio Fernández 2020): as readers consider that dwelling on the procedural meaning can save cognitive effort, they invest more time in this area.

Faced with an abnormal situation like the lack of sufficiency presented in condition 2, readers can decide to focus more attention on the conclusion, in an attempt to understand the dissonance between world knowledge and the instruction provided by the connective. Hence, the M2 required a processing time of 276.53 ms in plausible utterances, while for the insufficiency condition, reading times amounted to 306.93 ms, which translates into a difference of 10.99%. This strategic behavior may serve as a confirmation of the rigidity of procedural meaning (Escandell-Vidal & Leonetti 2011; Loureda *et al.* 2019). Conceptual words are susceptible to introspection because they are associated with stored mental representations. As a result, given the combination of conceptual units in an utterance like *Leonardo e Cassandra dirigono film molto interessanti*, we might expect a continuation such as *ricevono tanti premi*. It may be possible to confirm that a conflict between the argumentative orientation provided by conceptual elements and the procedural information contained in utterances results in an increase in the cognitive effort needed to build assumptions (Nadal 2019: 53).

5.3. Re-reading time

In the last subsection, re-reading times are addressed. Overall, both conditions generated low reprocessing rates, which shows that, regardless of the condition, causality was processed effectively already during the first reading. Re-reading times recorded for the whole utterance and for the conceptual meaning contained in the utterances are shown in Tables 7 and 8, respectively.

	Word-processing	Standard error
Argumentative sufficiency	46.55	12.22
Argumentative insufficiency	57.61	19.14
Difference	23.76%	
p value	1.0	

Table 7. Processing the whole utterance (RRT).

	Word-processing	Standard error
Argumentative sufficiency	50.82	17.24
Argumentative insufficiency	63.01	29.25
Difference	23.99%	
p value	1.0	

Table 8. Processing the whole utterance (conceptual meaning, RRT).

Even if reading times were higher in implausible utterances, the mean time needed to process a word was inferior to 80 ms in the two conditions analyzed and considering the whole utterance or only conceptual elements. It is therefore not possible to acknowledge an effective reprocessing strategy as far as the whole utterance is concerned. A more detailed analysis according to the different AOIs is offered in Table 9.

	M1	Connective	M2
Argumentative sufficiency	115.66	237.29	125.86
Argumentative insufficiency	158.34	227.39	96.25
Difference	36.9%	4.35%	30.76%
p value	0.78	1.0	0.1

Table 9. Re-Reading Time for the AOIs.

The reprocessing pattern of argumentative insufficiency led to an increase in re-reading times for the first discourse segment. When encountered with insufficiency, once the first reading is finished, readers

aim to find the cause of the processing ‘error’ that arose from previously read fragments (cf. Nadal & Narváez García 2021). In utterances holding a plausible relation with co-oriented discourse segments, the re-reading times for the M1 amounted to 115.66 ms. The change in argumentative orientation of utterances and the introduction of an unexpected conclusion has a very large effect, as it causes an increase of 36.9% in the re-analysis of the first discourse segment.

A small effect (4.5%) was observed when re-reading times in the AOI of the connective were compared. Faced with a causal relation that meets expectable plausibility conditions, it seems that readers may decide to trust more the instruction provided by the connective, as was already observed in the first reading. However, the difference in re-reading was small. Moreover, the connective was the area that generated the highest processing costs in both conditions. It controls the re-reading processing path imposing a causal-consecutive argumentative orientation between the segments (Escandell-Vidal & Leonetti 2011; Loureda *et al.* 2019).

Contrary to what was observed for the first discourse segment, the second segment has considerably higher reading times in the neutral (sufficient) condition. The effects that arose from the comparison across conditions were large (30.76%). When the argumentative orientation of the premise and the conclusion were aligned and agree with the procedural information of the connective, readers seemed to focus on the conclusion to finalize the construction of the assumption that was started during the first reading (Nadal & Recio 2019). If, on the contrary, the conclusion canceled their expectations by contradicting the procedural instruction, the cognitive effort may be invested in detecting the error, which would cause the re-reading of the first discourse segment (Narváez García 2019).

6. Conclusions

This paper presented a comparison between two minimal causal structures joined by the connective *pertanto*. One of them met the requirements of pragmatic plausibility, as the conceptual meaning contained in the utterances was argumentatively co-oriented and it was aligned to the procedural instruction of the connective. The other structure challenged normal pragmatic plausibility conditions. In these utterances, there was a clash between the causal-consecutive instruction contained in *pertanto* and the lack of argumentative co-orientation achieved

with the introduction of an unexpected conclusion that counter-argued the premise included in the first part of the utterance.

According to our data, the first of the proposed hypotheses can be confirmed: in global terms, the dissonance between procedural instruction and argumentative orientation leads to an increase in processing times. The implausible condition requires a greater processing effort, considering the TRT and FRT variables and considering the average reading time per word for the entire utterance. In TRT, the increase in processing effort is reflected in all areas of interest (M1, connective, and M2). In contrast, in the first reading, the overweight caused by pragmatic implausibility is reflected on the conclusion. A similar effect was found in Spanish by Nadal & Recio (2019). The ‘surprise factor’ triggered by the anti-orientation of the conclusion after readers have processed the causal-consecutive instruction of *pertanto* turns the second discourse segment into the most cognitively demanding area in the utterance. On the contrary, the connective triggered higher processing times during the first reading in the neutral condition, as the agreement between the procedural and conceptual meanings forced readers to pay more attention to the instruction that marked the argumentative orientation.

In the re-reading generated in both conditions, the first discourse segment receives extra costs when pragmatic plausibility is challenged. After considering that the assumption generated after the first reading is faulty, the reader decides to read the utterance again and focus on detecting the error (Narvez Garcıa 2019). According to this, the second hypothesis can be confirmed only partially, as the conclusion is indeed the most affected area when plausibility is altered, although this applies only to the construction of the first assumption in the first reading.

These results agree with previous experimental studies carried out for causal-consecutive Spanish connectives (Loureda *et al.* 2016a; Narvez Garcıa 2019; Narvez Garcıa & Torres 2019; Nadal & Recio 2019). The comparison presented in this study also serves as an experimental confirmation that the rigidity of procedural meaning encoded by units such as argumentative connectives also applies to the Italian connective *pertanto*. In this sense, we agree with Loureda *et al.* (2019), who pointed out at a possible universal feature of these units. These results may also serve to confirm the asymmetry of procedural over conceptual meaning: in cases in which these two elements clash, as in the case of argumentatively anti-oriented utterances joined by a causal-consecutive connective, the procedural instruction takes precedence and controls the processing strategy adopted by the reader. Although these are expected

results based on intuition, until now there was no experimental evidence in this regard for Italian language users.

The present study assessed the effect that argumentative sufficiency and insufficiency have on processing to determine if the argumentative orientation of utterances and the conceptual assumptions that support it are decisive during reading and prevail over the procedural instruction. However, it should be complemented with a study on the processing of marked and unmarked causality. The same experimental items could be used to run a different reading experiment in which the effect of the presence or absence of the connective was verified. Additionally, similar experiments in other (Romance) languages would help us understand how human cognition benefits from the presence of this type of units in information processing and discourse comprehension.

Abbreviations

AOI = area of interest; BNC = British National Corpus; FRT = First-pass Reading Time; M1 = first discourse segment; M2 = second discourse segment; RRT = Re-Reading Time; TRT = Total Reading Time.

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Notes

¹ The conceptual/procedural distinction should not be understood as an absolute dichotomy where some words encode a merely representational meaning and others, procedural instructions that help to relate the concepts; it is rather a gradual relationship. On the one hand, fundamentally procedural units may still contain traces of their original conceptual meaning (such as *in primo luogo*, *addirittura*, or *al contrario* (Eng. 'first', 'also', 'on the contrary') and, on the other, concepts always act as instructions for processing insofar as they are clues that help the listener/reader to build an ad hoc concept, that is, a precise meaning adapted to a specific context and conditioned by the previous background of the person who interprets it (Carston 2016; Wilson 2017).

² *Pertanto* is one of the most frequent connectives with causal, conclusive meaning in Italian (Serianni 1989; Samardžić 1995). It marks causal relationships and usually appears in formal register (Sainz 2015). Scholars have provided detailed studies concerning its semantic and pragmatic functions. Thus, whereas Berretta (1984) studied the value of connectives in discourse structure, Serianni's (1989) seminal study, in line with Halliday & Hasan (1974), focused on their properties as cohesion and coherence boosters. Bazzanella (1995, 2001, 2006, 2010) summoned Berretta's and

Serianni's teachings and added the interpersonal dimension to highlight the advent of the cognitive component, in compliance with relevance studies (Blakemore 1987; Fischer 2006).

³ The expression 'argumentative insufficiency' is used as an equivalent of 'logically incoherent', following Portolés (2001 [1998]). It indicates that the first segment of the utterance does not hold enough argumentative force to serve as a premise of the conclusion.

⁴ This example was retrieved from the British National Corpus. Examples of usage taken from the British National Corpus (BNC) were obtained under the terms of the BNC End User Licence. Copyright in the individual texts cited resides with the original IPR holders. For information and licensing conditions relating to the BNC, please see the website at < www.natcorp.ox.ac.uk > .

⁵ The present study adopts a synchronic perspective since the experimental items used reflect a current use of the connective *pertanto* and its value as an eminently procedural unit. However, we also acknowledge that, from a diachronic point of view, the lexical context that accompanies the connective may be responsible for a gradual change in meaning. Thus, certain contexts have led connectives such as *tuttavia* (Eng. 'however') or *mentre* (Eng. 'while') to evolve from a temporary meaning to a counterargumentative sense (Giacalone Ramat & Mauri 2012) or to undergo a process of subjectivization that has resulted in the addition of a scalar value to units like *addirittura* or *perfino* (Eng. 'also', 'even') (Visconti 2005).

⁶ An anonymous reviewer asked why we compute the mean per word as a criterion for assessing differences in reading times. We follow the model proposed by Loureda *et al.* (2020). The advantage of working with averages per word is that intra-sentence comparisons can also be made. It is possible to compare the costs of processing on average a lexical word compared to the costs of processing the connective. The mixed models were calculated under the assumption that all the words in the experiment had the same length.

⁷ The real importance of these criteria is not related to their specific nature but to the fact that all the experimental items are fully homogeneous.

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Appendix. Example of token set
Token set 1 – Condition 1

Context	Leonardo e Cassandra sono giovani registi. Hanno studiato cinema a Roma e adesso vivono a Londra. 'Leonardo and Cassandra are young directors. They studied cinema in Rome and now live in London.'
Filler	Il regista preferito di Cassandra è Kubrick. Leonardo invece preferisce Fellini. 'Cassandra's favorite director is Kubrick. Leonardo prefers Fellini instead.'
Critical utterance	Leonardo e Cassandra dirigono film molto interessanti. Pertanto ricevono tanti premi. 'Leonardo and Cassandra direct very interesting films. Therefore, they receive many awards.'
Filler	A volte portano i loro genitori alle cerimonie di premiazione. 'Sometimes they take their parents to award ceremonies.'

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