CAUSALITY, ICONICITY AND CONTINUITY: THE EFFECTS OF PRIOR WORLD KNOWLEDGE ON THE UNDERSTANDING OF CAUSAL RELATIONS

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- ABSTRACT: This paper studies the involvement of world knowledge and its interaction with linguistic (semantic) knowledge in the understanding of causal relations. We will attempt to determine to what extent the iconicity principle and the Continuity Hypothesis – see especially Murray (1997) – apply in Spanish and whether they are subject to restrictions attributable to the type of information processed. We also discuss Sanders' (2005) causality-by-default hypothesis and provide relevant evidence for assessing its correctness. To test our hypotheses, we investigate the comprehension of two-sentence texts of two types (in "everyday" and in "technical" language) under four conditions: normal and inverted order (cause–effect vs. effect–cause); with and without connective. We predict that our "type of information" variable, one of the core elements of this study, will condition causal relations processing and modify to some extent the classical claims of iconicity and Continuity Hypothesis. The results show that lack of prior knowledge, indeed, can affect the predictions and assumptions of the iconicity principle and the Continuity Hypothesis and that, if there is no prior knowledge, the introduction of linguistic clues (connectives) facilitates and even becomes indispensable for understanding.

- KEYWORDS: Causality. Iconicity. Continuity. World knowledge. Connectives.

Introduction

This research is part of a broader investigation intended to study the conceptual and semantic dimensions of *causality* and *counter-causality*, especially the linguistic processing in which speakers engage when they linguistically produce and understand this type of relation (ZUNINO, 2012; ZUNINO; RAITER, 2012; ZUNINO; ABUSAMRA; RAITER, 2012a; 2012b; 2012c). We will employ a

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psycholinguistic (and, therefore, experimental) approach and, in this regard, our perspective distinguishes elements that are put together by theoretical grammatical studies (GALÁN RODRÍGUEZ, 1999; PORTOLÉS, 1998), by discourse analysis studies (ANSCOMBRE; DUCROT, 1994; MARTIN ZORRAQUINO; PORTOLÉS, 1998) or by pragmatic approaches (SPERBER; WILSON, 1995) and groups other elements which, sometimes, have been analyzed separately. It should be stressed that, in our proposal, the global dimension of *causality* will comprise both consecutive and causal structures (two linguistic ways of expressing the same cause-effect relation) and will not make *a priori* differences between physical and mental causality. Thus, real/natural causes, causes arising from world knowledge (beliefs), and causes arising from personal expectations (reasons) will all depict the same basic general notion, the cause-effect relation.

In this particular case, we propose articulating two central issues in relation to *causality* and its linguistic processing: on the one hand, the assumptions of the Continuity Hypothesis (MURRAY, 1997) and, on the other hand, the intervention of two types of knowledge in the discursive processing of causal relations, namely world knowledge and linguistic knowledge. This distinction is particularly relevant because it enables to analyze the extent to which the former type influences the understanding of causal relations, presented in their two syntagmatic forms (cause-effect versus effect-cause), and how it is articulated with the latter type, by examining the role of semantically meaningful connectives (conveying linguistic information). A first aim of this paper is to verify to what extent the Continuity Hypothesis applies in Spanish.

In order to explore these issues, we have designed a test to examine the understanding of causal relations between two sentences and have analyzed its results. For each type of stimulus –everyday and technical stimuli– the following conditions were evaluated: (a) without a connective, in habitual order (cause-effect) and in inverted order (effect-cause) and (b) with connective *entonces* ("so") in habitual order and *porque* ("because") in inverted order.

Theoretical Framework

Since this research falls within the scope of psycholinguistic studies, it is based upon basic notions that have led us to adopt our approach to the problem: (1) *processes* rather than results must be studied in order to inquire into the production and understanding of any language; (2) grammar is deemed to be an *ability* of the speaker/listener and not a theoretical construct that can be observed to a lesser or greater extent by any given statement[1]; (3) to have true explanatory power, a theoretical model must be supported by a mental correlate which has been experimentally tested.

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[1]　In this respect, speakers/listeners need not be cognizant of –have reflected upon– grammatical rules and syntactic structures proper to their languages to handle –*i.e.* to produce and understand– well-formed sentences/statements.

Causality in Language

Causality has been most consistently analyzed in two linguistic areas: in the first place, *verbs* and their capacity for containing in their conceptual structure (JACKENDOFF, 1990), and transmitting to the sentence predication, the so-called "implicit causality", and, in the second place, *connectives* as instructions for discursive processing (PORTOLÉS, 1998; among others).

"Implicit causality" is usually defined as the causal interpretation that may be derived or projected from the meaning of certain verbs. Some studies have focused on the tendency of listeners/readers to construct a causal or consecutive phrase after sentences like "The lawyer interrogated the suspect […]"[2], which might arise from the event structure of the verb (PICKERING; MAJID, 2007). Other studies revolve around lexical causative verbs ("Mary broke the eggs on the mixture") and around the so-called periphrastic causatives ("Carlos caused his dog to sit") in relation to the Theory of Force Dynamics (TALMY, 1988, 2000).

With a more discursive or textual point of view, these studies discuss causal connectives and their primary role in achieving local and global coherence. One of the first lines of psycholinguistic research that have centered on the discursive level intends to study and account for the complex processes implied in text comprehension[3] (ABUSAMRA et al., 2010; GERNSBACHER, 1991; GOLDMAN; GRAESSER; VAN DEN BROEK, 1999; MOLINARI MAROTTO, 2000). One of lines that has been most developed postulates that, during this process, a reader constructs a *mental representation* of the situation described: successfully remembering and handling the information processed hinge on a correct retrieval of the information organized in that mental representation. Since Van Dijk and Kintsch´s (1983) and Johnson Laird´s (1983) proposals, the *Situation Models Theory* presented original and productive approaches, whose premises and assumptions have been revisited and reformulated.

The studies on text comprehension (conducted mainly in English) provide plentiful evidence that readers routinely direct attention to the *causal* information of a text during the process of reading/understanding. Many authors (CARON; MICKO; THURNING, 1988; HABERLANDT, 1982; GOLDMAN, et al., 1999; MILLIS; JUST, 1994; MURRAY, 1997; TRABASSO; SECCO; VAN DEN BROEK, 1985; ZWAAN; RADWANSKY, 1998; among others) maintain that causal relations form the "backbone" of situation models and are essential for achieving coherence, both locally and globally. Investigations largely propose that one of the fundamental determinants for this process to be successfully carried out is the capacity of adequately handling a given type of lexeme, known as connectives. These particles are considered to structure, for the most part, the text temporal-causal configuration, to give instructions for the specific

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[2] Where the sentence might be followed by "[…] because he wanted to find out the truth.", for instance.

[3] In general, the study of discourse production has been set aside due to methodological difficulties (DE VEGA; CUETOS, 1999).

conceptual and semantic processing, and to largely enable to make inferences and to establish relationships between textual information and world knowledge. Opposed to causal and consecutive connectives (specific to the causal dimension) are the ones that suspend or deny a causal relation expected, that is, adversative and concessive connectives (considered "counter-causal" in the present research).

Most studies on this type of conceptual/semantic relation (CEVASCO; VAN DEN BROEK, 2008; HABERLANDT, 1982; KUPERBERG et al., 2006; KUPERBERG; PACZYNSKI; DITMAN, 2011; MILLIS; JUST, 1994; MURRAY, 1997; SINGER; GRAESSER; TRABASSO, 1994; among others) may be divided into two broad areas of research Some of them analyze the explicit discursive/textual relations and the role of connectives for adequately establishing and/or understanding these relations and others attempt to analyze the creation of relationships through inferential mechanisms. All of them research into the interrelations between the (superficial) discursive/textual information, world knowledge, and the mental models constructed to interpret and understand a piece of discourse.

Iconicity, continuity and causality

Iconicity and causality

The notion of *iconicity* (usually related to isomorphism,[4] but not fully discernible to it) is a fundamental part of the classical debates, such as the discussion about the relationship between language, world and thought (ESCAVY ZAMORA, 2001; HAIMAN, 1983; SIMONE, 1995). In opposition to the thesis about arbitrariness of the linguistic sign and linguistic relativism (CARRUTHERS, 1996; MALT; WOLFF, 2010; SAPIR, 1921), *iconicity* supposes the existence of a relation of influence between world (physical or its conceptual representation) and the way we verbalize it. The direction of that relation would be world-language ("motivation" is the term generally used). At a discursive level, this suggests that statements are structured in correspondence with the events to which they refer and that the existing relationship between them is the same as the one between the referred events: statements substitute events, because they are their reflection (SIMONE, 1995). From the three classical principles taken into consideration when analyzing *iconicity*[5] (quantity, proximity and sequential order), the one studied the most in regard to discourse comprehension is the sequential order

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[4]   It refers only to the concrete correspondence between "natural order" (facts of the world) and "figurative order" (linguistic expression); while *iconicity* in a broader sense involves more abstract ideas such as motivated language, pragmatic perspectivism and conceptual organization, among other issues (ESCAVY ZAMORA, 2001; HAIMAN, 1983).

[5]   It is also considered as a gradual notion: the relationship between a certain language and the world can be more or les iconic in comparisson to the one between another language and world; or even have different degrees of inconicity in the different componentes of the linguistic structure (lexicon, syntax, discourse) (MARCUS; CALUDE, 2010).

principle:[6] the order of the events in the world (real or represented) is reflected in the syntagmatic order of the clauses describing it verbally (MARCUS ; CALUDE, 2010).

In regard to *causality,* it can function as a model to analyze the idea of *iconicity* (cause-effect order vs. effect-cause order is paradigmatic) but it is also a conceptual dimension in which another theoretical and philosophical debate can be observed. Since neither the debate about causal realism or conceptualism (DAVIDSON, 1985, 1992; KIM, 2007; VIALE, 1999; SEARLE, 1983) is not settled and neither is the one about the relation between perception of physical causality and reasoning, causal judgmental and mental causation (LESLIE; KEEBLE, 1987; SLOMAN, 2005) are settled, it is not possible to determine which is the direction of influence in the case of causal dimension. Therefore, it would not be possible to define *iconicity* for all the cases of causal judgments or reasonings. On the other hand, it would be possible to assume the existence of some conceptual organization of causal relations (whatever be the relation of that representation with the physical world) and to evaluate psycholinguistically the processes interplaying in each case, and infer, according to those results, which could be that organization (NOORDMAN; VONK, 1998; SANDERS, 2005). This, of course, would keep the notion of *iconicity* in terms of the bond between conceptual representation and language, but it would not clarify much about the relation of either with the physical world. Nevertheless, it would mean a step forward in relation to to some of the aforementioned questionings.

There are several studies that have empirically analyzed the effect of iconicity in discourse processing (ABUSAMRA, 2011; FENKER; WALDMANN; HOLYOAK, 2005; WALDMANN, 2001; WALDMANN; HOLYOAK, 1992): keeping the iconic order (temporal as well as causal) facilitates consistently the processing. However, it is not clear what interaction this variable can have with the absence/presence of prior world knowledge. Since the notion of *iconicity* itself requires to be contrasted with the world or its mental representation, it seems fundamental to know the nature of this bond. The question would be: what is the effect of the iconic order inversion in a text when the reader cannot involve his/her prior world knowledge in the comprehension process?

Continuity and causality

Until the early 1990's, few studies dealt with the role of connectives during reading and text comprehension (CARON; MICKO; THURING, 1988; HABERLANDT, 1982). Throughout that decade, a considerable number of studies (most in English) focused on this issue and demonstrated, somewhat uniformly, that connectives facilitated reading and comprehension (MILLIS; JUST, 1994; among others). Nevertheless, it became necessary to refine that information and determine whether all connectives (even those belonging to the same semantic dimension) exerted the same influence on processing.

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[6]   Also known as Semantic Principle of Linear Order (GIVÓN, 1995).

Murray (1994) showed that, both in terms of memory (off-line) and in terms of reading times (on-line), only adversative connectives had a truly facilitatory role. Murray (1997) came back to the issue and explicitly formulated his Continuity Hypothesis. This proposal has at least two basic assumptions: (1) readers tend to represent textual information according to the sentence order (that is, they assume that events will occur in a linear fashion and in the order in which they are presented: iconicity principle) and (2) continuity is the text organization strategy by default, so a text based on continuity relations will be more quickly and easily processed. Based on these assumptions, Murray (1997) analyze the role of connectives and tests two hypotheses: (a) connectives work as processing semantic instructions and are critical during the on-line reading process (readers are sensitive to the nuances of meaning conveyed by specific connectives and not all connectives work in the same manner); (b) in effect, textual *continuity* seems to be established by default; and (c) connectives signaling a break in continuity have a higher (facilitatory) impact than connectives that only reinforce a continuity relation.

Still, Murray (1997) also refers to certain lines of investigation that may be pursued in the future and are chiefly related to *causality*. On the one hand, Murray himself recognizes the need to analyze the role of specific connectives and compare them within the same dimension: for example, "because" and "so", since the former would be discontinuous (in its most frequent use), while the latter would signal continuity. Yet, on the other hand, an effect should be pointed out that can be observed in his third experiment and is not discussed afterwards. The author analyzes the differences stemming from the processing of sentence pairs with no connective and with semantic inappropriate connectives. With casual connectives, the findings show that the inappropriate connective condition was not any more disruptive than the no connective condition.

Sanders (2005), in a similar vein to which we propose here, has postulated a "causality-by-default hypothesis" to resolve what he defines as the "causal complexity paradox": despite casual structures are considered complex (more than additive, for example), empirical evidence shows that their processing is privileged and easier (faster and more effective to construct mental representations of discursive information). The causality-by-default hypothesis explains this by stating that:

> Because readers aim at building the most informative representation, they start out assuming the relation between two consecutive sentences is a casual relation […]. 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, p. 113).

Some of those lines of investigation will be pursued in this paper.

Experiment

The main objectives of the present research were: 1) to test up to what extent the Continuity Hypothesis (MURRAY, 1997) can be confirmed when understanding causal relations in two types of text (everyday and technical texts[7]) and applying two variables in each case: (a) habitual order (cause-effect) versus inverted order (effect-cause)[8]; (b) absence versus presence of a causal connective; 2) to relate our results with the *Causality by default Hypothesis* (SANDERS, 2005).

The following hypotheses will be examined:

1) In absence of a connective, readers tend to process *causality* by iconicity: cause-effect (causal order by default or unmarked).
2) If the stimuli are technical, owing to the impossibility of using prior world knowledge, the situation described in (1) will become more evident.
3) If a connective is used: (a) the situation described in (1) will tend to disappear and (b) technical stimuli will be processed in the same manner as everyday stimuli.
4) The connective inserted will be consistent with the predictions made by the Continuity Hypothesis: *porque* ("because"), which signals discontinuity, will have more beneficial effect than *entonces* ("so"), which signals continuity.

Method

Participants

Forty-four subjects (32 women and 12 men), aged 39.29 on average (Standard Deviation –SD-: 13.78), between 21 and 69 years of age, participated in this experiment. All of them speak Spanish as first language and received formal education for 12-18 years. For methodological purposes (*matched subjects* design: (GRAVETTER; WALLNAU, 2009)), the 44 participants were grouped in 22 pairs according to their ages, education levels and sexes, so as to analyze the results statistically as repeated measures from the same subject (Group 1: mean age=38.7, SD=12.97; Group 2: mean age=39.9; SD=14.83). Using this distribution, we obtained data from 22 participants per condition assessed.

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[7]   For a description of the types of stimulus, see Section *Materials.*

[8]   We consider the habitual order unmarked and the inverted order marked.

Materials

The stimuli presented have two clauses. Under the first condition, they make up two sentences and, under the second, they make only one sentence where the two clauses are linked by a causal connective. Each text is followed by a question in the form of "Does A generate B?"

Concerning the syntactic structure of the sentences used and other grammatical restrictions, it should be noted that: (a) they have the usual S-V-O structure and, sometimes, a simple adjunct (for example, "*Hoy a la mañana*" [today in the morning]); (b) short sentences were provided and, insofar as possible, compound sentences were avoided; (c) verbs are always in indicative either in present or past tense (both types of past tense are used, according to the stimulus); (d) there are no cleft sentences, (defining or non-defining) relative clauses, adverbial clauses, or noun clauses; (e) explicit negatives were avoided, both in stimuli and in questions (lexical negatives were used only when strictly necessary).

With respect to the distinction between "everyday" stimuli and "technical" stimuli, it should be pointed out that the so-called "everyday" stimuli are texts that express (narrate or describe) everyday situations/events where the subject therefore can (and often automatically does) use his world knowledge during the comprehension process. In these cases, participants must deal with familiar information like "water puts out fire". The so-called "technical" stimuli are texts that express situations/events unfamiliar to most participants[9] because they belong to very specific fields of knowledge of certain scientific disciplines, so they are unlikely to use their world knowledge to process such texts. These cases contain information like "the enzyme calmodulin generates the process of phosphorylation of synapsin I".

The length of the stimuli was controlled according to their number of words. Since no time comparisons would be made between everyday and technical stimuli, only within-group length ("everyday" and "technical") was controlled. The result of this design (taking into account that the experiment was conducted in Spanish) was the following:

a) All the stimuli have between 12 and 24 words; the average number of words in "everyday" stimuli is 14.3 and, in "technical" stimuli, 19.5.
b) Questions have between 7 and 14 words; the average number of words in "everyday" stimuli is 9.4 and, in "technical" stimuli, 12.4.

The variable "time" (either in a verb or in any other linguistic element) was balanced such that half of the stimulus would represent a structure with two specific chronologically successive events (T1–T2: "*El secuestrador los amenazó con su arma.*

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9   Since we knew the participants' professions and/or fields of expertise, we excluded the possibility that any of them may have specific scientific information on any of the disciplines chosen to draft the stimuli.

Los rehenes entraron en pánico.[10]" [The kidnapper threatened them with his weapon. The hostages panicked.]) and the other half would express two events in a temporally generic manner, where no elements would explicitly indicate the temporal factor (T1: "*Camila tiene sensibilidad dental. Evita comer cosas muy frías o muy calientes.*" [Camila hastooth sensivity. She avoids eating too cold or too hot food]).

In "technical" stimuli, the number of technical lexemes or phrases was controlled: they all contain 2-4 technical words or phrases, with an average of 3.

Examples of the stimuli used:

Table I – Examples of stimuli in all evaluated conditions

Type of information	Order	Connective	Stimulus
Everyday	Habitual	Absent	*Guadalupe goes swimming every day. She is getting fitter and fitter.* Is swimming getting Guadalupe fitter?
		Present	*Guadalupe goes swimming every day, so she is getting fitter and fitter.*
	Inverted	Absent	*Guadalupe is fitter and fitter. She goes swimming every day.*
		Present	*Guadalupe is fitter and fitter because she goes swimming every day.*
Technical	Habitual	Absent	*The calcium activated the enzyme calmodulin. The process of phosphorylation of synapsin I started.* Did the enzyme calmodulin provoke the phosphorylation of synapsin I?
		Present	*The calcium activated the enzyme calmodulin, so the process of phosphorylation of synapsin I started.*
	Inverted	Absent	*The process of phosphorylation of synapsin I started. The calcium activated the enzyme calmodulin.*
		Present	*The process of phosphorylation of synapsin I started because the calcium activated the enzyme calmodulin.*

Source: Zunino (2014).

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[10] Even though there exist some stimuli in anaphoric and cataphoric cases that can make the processing more complex, their elimination was impossible for two reasons: a) the methodological decision for the evaluation of the variable "habitual causal order vs. inverted causal order" was to maintain both sentences lexically and syntactically unaltered, so that the only difference in condition was order; b) research in the discursive level and with abstract conceptual relations makes it impossible to control exhaustively all the morphosyntactic and lexical elements intervening without an excessive reduction of the texts that could work as valid stimuli.

Procedure

All tests were designed and run with SuperLab 4.0. Both the adequacy or type of answer and times (RT) taken to read the stimulus and to answer or solve the task were assessed. Stimuli were presented at random in all cases. Tests were taken individually, with an examiner present (to avoid any inconvenience). Where the same stimuli were assessed, differing only in the order or in the presence or absence of the connective, sessions were held at least 7 days apart to avoid any bias.

The instructions were provided both in writing on the computer screen and orally: the examiner explained everything necessary to reinforce the written instructions and ensure the dynamics of each test would be comprehended. After the instruction, informants could do an example to practice and verify whether they had any question about any exercise. They were especially requested to ask any question before beginning or at the end of each block. At the end of each block, participants could decide to go ahead or take a break, according to how demanding they had found the task.

In each block, 40 stimuli were presented (20 were "everyday" stimuli and 20 were "technical"). In each group, a half contained a causal relation and the other half contained a counter-causal relation (adversative or concessive)[11]. That is, 10 stimuli under each condition: 10 everyday causals, 10 technical causals, 10 everyday counter-causals, 10 technical counter-causals. We will discuss here only the results of the causal dimension.

Besides, two distracting stimuli (fillers) were presented at the outset of the block and discarded afterwards, so that the measurement of the mean times (RT) would not be affected by problems unrelated to the studied process (such as the habituation to the task). The other stimuli were presented randomly.

Participants pressed the space bar and the text would show up in black type on a white screen. They were expected to read it at their own pace and then press the space bar again. A yes-no question also in black type, but in bold and italics, then popped up below the text, which remained on screen. The question (in the form "Does A generate B?") was always intended to expressly state or actualize the mental representation of a causal relation, which might or might not appear in the stimulus. Thus, stimuli in the causal modality were expected to be answered "yes" (while stimuli in the counter-causal modality were supposed to be answered "no", so the type of answer expected was also balanced within each block). Informants should respond by pressing the "s" key for "Yes" o the "n" key for "No" (they were instructed to place their finger in each key to make measuring RTs as accurate as possible). They were allowed to refrain from answering by pressing the space bar if they did not know the answer or believed they were unable to answer saying only "yes" or "no".

Finally, it should be noted that the variable "order" (habitual versus inverted) and the variable "type of information" (everyday versus technical) were evaluated in a

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[11] This organization allowed us to avoid adding fillers, with the subsequent excessive extension of each list of stimuli: counter-factual stimuli functioned as fillers for the causal ones, and vice-versa.

Confounded Factorial Design (KIRK, 2009) as follows: one block presented "everyday" stimuli in habitual order and "technical" stimuli in inverted order and the other presented the opposite combination. This precludes participants from giving automatic answers or becoming accustomed to the test dynamics, since they cannot see a clear uniformity in the form of presenting stimuli.

Each member of the participating pairs (see Section *Participants*) was placed in a different group. The total design involved 4 lists and 2 groups of subjects. Lists 1 and 2 were assigned to the first group of subjects; list 3 and 4 to the second group. Thus, Group 1 performed the task under the following conditions: everyday stimuli without connective in habitual order and with connective *porque* ("because"); technical stimuli without connective in inverted order and with connective *entonces* ("so"). Group 2 performed the task under the following conditions: everyday stimuli without connective in inverted order and with connective *entonces*; technical stimuli without connective in habitual order and with the connective *porque*.

Results

Both reading times (RRT) and answering times (ART) were observed, as well as the type and adequacy of the answers.

Firstly, an analysis was conducted to spot extreme cases and to refine the raw data. We used a detection method that factors in sample size (COUSINEAU; CHARTIER, 2010; THOMPSON, 2006) and does not generate lost cases by eliminating extreme values (RATCLIFF, 1979, 1993). For that purpose, means and deviations of every subject under each condition were calculated (these calculations only included the RTs of the items correctly answered) and it was verified whether there was any case outside 2 SD of the mean per subject per condition. According to this criterion, no cases liable to be eliminated were found either for the RRTs or for the ARTs.

The first step to analyze the results was to compute the frequency of each type of answer. To examine the type of answer (level of adequate answers) with the analysis of variances[12], the proportion of adequate answers of every subject under each condition was logistically transformed. Each correct answer represented one point, so any given subject could have 5/10, that is, 0.50 of adequate answers under a given condition. Hence, every subject had a score (and a proportion associated with that score) under each condition analyzed. After the logistic transformation, these data were used to make the relevant comparisons with repeated measures tests or ANOVA, for independent samples, as appropriate. Secondly, cases answered adequately were used to calculate the RTs means per subject and to perform different tests. In order to avoid unnecessarily multiple comparisons (and the ensuing restrictiveness in p-values), were performed: a) a full factorial analysis to verify main effects and interactions; b) only relevant

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[12]   With percentages or proportions it is not possible to perform this type of test: (WOODS; FLETCHER; HUGHES (1986)).

comparisons of RTs means. As suggested by Clark, 1973, et al., the calculations were made for F1 (analysis per subject), F2 (analysis per item), and min F' (quasi F-ratio for the generalization of both effects). The data of frequencies, RT means, and standard deviations are shown on Tables II and III.

Table II – Answers: percentages and scores
(adequate answers after the logistic transformation).

		Adequate (%)	Inadequate (%)	No Answer (%)	Adequacy Score
Everyday Stimuli	w/o a connective, in habitual order	96.3	2.3	1.4	4.94
	w/o a connective, in inverted order	90.7	6.9	2.3	4.28
	Entonces ("so")	96.8	1.4	1.8	5.59
	Porque ("because")	99.1	0.5	0.5	6.61
Technical Stimuli	w/o a connective, in habitual order	72.8	19.7	7.5	2.05
	w/o a connective, in inverted order	46.5	42.3	11.3	-0.02
	Entonces ("so")	94.5	4.1	1.4	4.98
	Porque ("because")	77.6	19.2	3.3	2.20

Source: Zunino (2014).

Table III – Reading Times (RRT), Answer Times (ART)
and standard deviations (SD) per condition.

		RT (ms)	SD (ms)	AT (ms)	SD (ms)
Everyday Stimuli	w/o a connective, in habitual order	4674,14	1456,25	5421,38	1795,75
	w/o a connective, in inverted order	5012,13	1351,13	6446,00	2498,25
	Entonces ("so")	4591,44	1445,45	5205,24	1795,75
	Porque ("because")	4096,48	1013,28	3528,59	938,82
Technical Stimuli	w/o a connective, in habitual order	9851,44	3022,57	18626,96	7476,92
	w/o a connective, in inverted order	9279,66	7701,04	15880,57	7235,27
	Entonces ("so")	6946,48	2063,67	8909,81	3898,19
	Porque ("because")	7798,56	2845,29	14065,17	7197,67

Source: Zunino (2014).

For both the treatment of answers and RTs, a full factorial analysis 2x2x2 was performed. It had two factors between subjects (TYPE OF INFORMATION and ORDER) and a within subject/repeated measures (presence/absence of CONNECTIVE) factor[13].

For answers, in the within-subject analysis, the only effect found was the effect of the factor presence/absence of CONNECTIVE ($F_{(1,84)}$=27,48; p=,000), while none of the interactions were significant. For the analysis of between subjects, both factors (TYPE OF INFORMATION and ORDER of the causal relation) showed significant effects, as well as its interaction. TYPE OF INFORMATION: $F_{(1,84)}$=50,66; p=,000; ORDER: $F_{(1,84)}$=6,85; p=,010; TYPE OF INFORMATION * ORDER $F_{(1,84)}$=9,22; p=,003).

Afterwards, the contrasts specifically relevant for this research were conducted. The first set of within-group comparisons for each type of stimulus (everyday and technical) comprised the following: (1) no connective in habitual order versus with connective "*entonces*" ("so"); (2) no connective in inverted order versus with connective *porque* ("because"). A second set of between-group comparisons was made to compare the between-group factors. ORDER factor in everyday stimuli: (3) no connective in habitual order versus no connective in inverted order. Everyday and technical stimuli under the different conditions of ORDER and presence/absence of a CONNECTIVE: (4) no connective in habitual order; (5) no connective in inverted order; (6) with connective *entonces*; (7) with connective *porque*. From the first set, the first two contrasts proved statistically significant for technical stimuli (contrast 1: $F_{(1,21)}$=11,69, p=,003), but not for everyday stimuli. The second contrast was significant for both types of stimulus (everyday: $F_{(1,21)}$=9,93, p=,005; technical: $F_{(1,21)}$=54,66, p=,010). This demonstrates that, for the technical stimuli, both the order of causal presentation and the inclusion of the connective seem to be conditioning factors for comprehension. From the second set of between-group comparisons, the ORDER factor proved to be significant just for technical stimuli (contrast 3: $F_{(1,42)}$= 7,96; p=,007). For the TYPE OF INFORMATION factor, all contrasts were significant except for 6 (contrast 4: $F_{(1,42)}$=10,79, p=,002; contrast 5: $F_{(1,42)}$=29,64; p=,000; contrast 7: $F_{(1,42)}$=35,36, p=,000). Only in the case of the condition with *entonces* ("so") the connective showed enough impact to assimilate the levels of adequate answers in technical and everyday stimuli. In the other cases, the possibility/impossibility of intervention of prior world knowledge continued to be a determinant factor in performance.

In order to analyze processing times, an initial full factorial analysis was performed. For RRT, in the within-subject treatment it was observed an effect of the factor presence/absence of CONNECTIVE ($F_{(1,84)}$=7,97; p=,005), while interactions were not significant. For the variables between subjects, only TYPE OF INFORMATION showed a significant effect ($F_{(1,84)}$=53,48; p=,000). Neither the variable ORDER of the relation nor its interaction (TYPE OF INFORMATION * ORDER) were significant. For ART, on the other hand, in the within-subject analysis, both the presence/absence

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13   Multiple comparisons were made with Bonferroni adjustment.

of CONNECTIVE factor and its interactions were significant. CONNECTIVE: $F_{(1,84)}= 35,59$; p=,000; CONNECTIVE*TYPE OF INFORMATION: $F_{(1,84)}=11,67$; p=,001; CONNECTIVE*ORDER: $F_{(1,84)}=4,48$; p=,037; CONNECTIVE*TYPE OF INFORMATION*ORDER: $F_{(1,84)}=18,60$; p=,000. For the analysis between subjects, the only significant effect was for the variable TYPE OF INFORMATION: $F_{(1,84)}=120,45$; p=,000.

In this framework, basically three specific contrasts were relevant to each type of stimulus (everyday and technical):

1) No connective in habitual order versus no connective in inverted order[14]. For everyday stimuli, in the RT analysis per subject (F1), there were no statistically significant differences for RRT ($F_{(1,42)}=,637$; p=,429) or for ART ($F_{(1,42)}=2,44$; p=,126). In the analysis per item (F2), there were not statistically significant differences for RRT ($F_{(1,18)}=,387$; p=,541) or for ART ($F_{(1,18)}=1,38$; p=,256) either. For technical stimuli, the comparison per subject (F1) did not prove statistically significant for either time measure (for RRT, $F_{(1,42)}=,105$; p=,747; for ART, $F_{(1,42)}=1,53$; p=,223). However, in the comparison per item (F2), the RRT comparison was statistically significant ($F_{(1,18)}=4,41$; p=,05), although min F' was not ($F_{(1,34)}=,11$). The ART comparison was not statistically significant. Thus, the on line measures did not show significant differences for the variation in the order of the causal relation in neither stimuli group. Even in the case of technical stimuli, the condition of presentation of inverted-order (effect-cause) implied lower RTs than the condition in habitual order (see Section 4.3).

2) No connective in habitual order versus with connective *entonces*[15]. For everyday stimuli, in the RT analysis per subject (F1), there were statistically significant differences for neither time (for RT, $F_{(1,21)}=,031$, p=,863; ART: $F_{(1,21)}=,151$, p=,701). The analysis per item (F2) did not show statistically significant differences between the RRT ($F_{(1,21)}=,196$; p=,668) and ART means ($F_{(1,21)}=,088$; p=,774). The value of min F' was not significant either. For technical stimuli, however, all contrasts proved statistically significant. Comparisons per subject (F1): for RRT, $F_{(1,21)}=14,59$; p=,001 and for ART, $F_{(1,21)}=27,56$; p=,000. Comparisons per item (F2): for RRT, $F_{(1,21)}=38,12$; p=,000 and, for ART, $F_{(1,21)}=52,63$; p=,000. The calculation of min F' was also significant: for RRT, min F'$_{(1,32)=}10,55$; p<,05 and for ART$_{(1,32)}=18,09$; p<,05. Thus, for the cases of causal presentation of cause-effect order, the inclusion

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[14] Everyday: "Guadalupe goes swimming every day. She is fitter and fitter." vs. "Guadalupe is fitter and fitter. She goes swimming every day."
Technical: "The calcium activated the enzyme calmodulin. The process of phosphorylation of synapsin I started." vs. "The process of phosphorylation of synapsin I started. The calcium activated the enzyme calmodulin."

[15] Everyday: "Guadalupe goes swimming every day. She is fitter and fitter." vs. "Guadalupe goes swimming every day, so she is fitter and fitter."
Technical: "The calcium activated the enzyme calmodulin. The process of phosphorylation of synapsin I started." vs. "The calcium activated the enzyme calmodulin, so the process of phosphorylation of synapsin I started."

of the connective only accelerated the reading and answering processes in the case of technical stimuli. In contrast, if there existed the possibility of involving prior world knowledge during comprehension, the impact of the connective was not significantly beneficial.

3) No connective in inverted order versus with connective *porque*[16]. In this case, all contrasts for everyday stimuli were significant. Contrasts per subject (F1): for RRT, $F_{(1,21)}=5,19$; p=,033 and for ART, $F_{(1,21)}=26,09$; p=,000. Contrasts per item (F2): for RRT, $F_{(1,21)}=35,71$; p=,000 and for ART, $F_{(1,21)}=82,82$; p=,000. Given these results, min F' was computed for both measures and both were significant: for RRT, min $F'_{(1,30)}=4,53$; p<,05; for ART, min $F'_{(1,30)}=19,84$; p<.05. However, for technical stimuli, neither contrast was statistically significant. Contrasts per subject (F1): for RRT, $F_{(1,21)}=,866$; p=,363 and for ART, $F_{(1,21)}=1,66$; p=,211. Contrasts per item (F2): for RRT, $F_{(1,21)}=,298$; p=,598 and for ART, $F_{(1,21)}=4,25$; p=,069. As follows, the condition of inverted causal relation showed a pattern of processing times inverse to the previous one. The inclusion of the connective accelerated the reading and answering processes only for everyday stimuli. The impossibility of involving prior world knowledge, combined with the inversion of causal order, could not be eluded by the inclusion of a connective.

Discussion

Types of Answer

To begin with, it is essential to discuss the types of answer. As shown in Table II, the most outstanding information is the degree of randomness of the answers under the no-connective condition in inverted order to technical stimuli. However, this is not the case in everyday stimuli, where the inverted order of the causal relation seems to only slightly hinder comprehension without statistical significance. Moreover, it should be noted that, under the no-connective habitual-order condition, there is a significant difference between everyday and technical stimuli, but it is not so striking and, of course, it is not in the degree of randomness. That is, although both cases show statistically significant differences, it is only under the inverted order condition that the type of answer does not display a clear tendency. This seems to show, at least, two facts: (a) the lack of prior world knowledge as an element of the comprehension process is in itself significant for this process and (b) the order of presentation of the causal relation seems to have some bearing on processing in all cases, although, when combined with the lack of prior world knowledge, it might become an effective barrier

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[16] Everyday: "Guadalupe is fitter and fitter. She goes swimming every day." vs. "Guadalupe is fitter and fitter because she goes swimming every day."
Technical: "The process of phosphorylation of synapsin I started. The calcium activated the enzyme calmodulin." vs. "The process of phosphorylation of synapsin I started because the calcium activated the enzyme calmodulin."

to comprehension. Nevertheless, the degree of randomness under the no-connective condition in technical stimuli is interesting for another reason and essential in reference to the iconicity principle. According to this principle, there is a tendency to understand that the syntagmatic order of clauses follows the order of events. If it were invariably observed, participants under the no-connective condition in technical stimuli, in absence of prior knowledge about the "order of events", would be expected to understand the sentences regarding the first clause as the *cause* of the relation and the second as the *effect*. This would result in a far higher level of error than the degree of randomness: an inverted pattern with respect to the same condition but in habitual order. Still, the results indicate that subjects, in the absence of previous information about the events in question, do not indiscriminately use the syntagmatic order as a criterion, but they give ambivalent answers: randomness may be read as "both may be correct" or "I don't really know".

Furthermore, the effect of inserting the connective must be discussed in each case. For technical stimuli, the presence of the connective (that is, inserting a semantic instruction, in linguistic terms) begot a statistically significant improvement in the understanding process under all conditions. Yet, it should be highlighted that introducing "*entonces*" (so) under the habitual-order condition enhances comprehension but reflects the same tendency. In contrast, introducing *porque* ("because") under the inverted-order condition eliminates the randomness level and, for the first time, determines the tendency of the answers. Once again, it is possible to point out, at least, two facts based on these data: (a) absent the prior world knowledge, the presence of linguistic elements that work as semantic instructions for processing is relevant in all cases, regardless of order or the continuity/discontinuity condition between clauses and (b) in the case of unfamiliar causal relations (which cannot be figured out with the prior world knowledge) presented in inverted order, the connective seems not only to facilitate, but also to be indispensable for, successful comprehension[17].

Finally, it is noteworthy that each connective (*entonces* versus *porque*) brings about different effects in both types of stimulus. Whereas *entonces* did not substantially facilitate understanding in everyday stimuli but it did in technical ones, *porque* proved substantially facilitatory in both cases, causing nearly 100% of everyday stimuli answers to be adequate. In turn, a comparison of adequate answers to stimuli of both types with the same connective will show that there are no significant differences between everyday and technical texts containing *entonces*, while everyday stimuli containing *porque* are significantly better understood than technical ones (which are still more difficult to understand) with the same connective. Probably, understanding this pattern might require simultaneously articulating all the variables discussed: (a) if the Continuity Hypothesis is accepted, inserting *entonces* into everyday stimuli should not be expected

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[17] This might be understood as an extreme case of the Continuity Hypothesis: in this case, the connective is not only "more beneficial", but it enables the reader to understand. Still, in the discussion of the processing times, it will be demonstrated that the condition containing *entonces* is the most beneficial one.

to produce a major impact; on the other hand, inserting *porque* is expected to bring about more significant effects, which is evidenced by the results presented here: it equalize results in everyday stimuli under both order-related conditions (or, said another way, it eliminates the differences arising from the inverted-order clauses); (b) in the case of technical stimuli, the lack of prior world knowledge seems to be more influential than the inversion of clause order (even though, of course, if both are combined, it becomes the most complex condition) so, in any event, adding linguistic information to compensate for the lack of prior knowledge will have important consequences; (c) as has been stated, the combination of both variables (world knowledge and order) results in a "scale" of difficulty where technical stimuli in inverted order are the most complex ones and never prompt answers as adequate as do everyday stimuli. Inserting the connective apparently enables to overcome the difficulty presented by one of the variables but not by both at the same time. Thus, technical stimuli in habitual order receive as many adequate answers as do everyday stimuli, since one "barrier" (order) would seemingly be lifted and the connective appears to compensate for the lack of prior world knowledge. In technical stimuli in inverted order, on the other hand, the connective (*porque*) can break down only one barrier, so those stimuli are not understood to the same extent as everyday stimuli under the same condition (which, besides, receives the highest level of adequate answers of all the conditions analyzed). Owing to this pattern, the Continuity Hypothesis would become more complex and come under scrutiny: the presence/lack of prior world knowledge constitutes a variable that might modify some predictions made through that hypothesis.

Processing Times

First, it should be underscored that, in online measures of processing times (both reading times –RRT– and answer times –ART–), under neither type of stimulus was there a statistically significant facilitation of the habitual-order condition. Nonetheless, one fact is worthy of mention: in the case of everyday stimuli, in line with the predictions of the Continuity Hypothesis and the iconicity principle, reading and answering times were shorter (not significantly shorter though) under the habitual-order condition. Nevertheless, in technical stimuli, this pattern is the opposite (although it is not statistically significant either). Then again, the iconicity principle does not seem to work in an unrestricted fashion, but only when the prior world knowledge may come into play as a variable. It may be thought that, in reality, there is a correspondence between the textual representation of the causal relation and the mental representation of the causal structure of the events already stored and that, in such case, the condition under which both coincide is facilitatory; but this would not be the case if the causal relation were not previously stored. In other words, the syntagmatic order does not impose the order in which events will be represented in a new casual relation, nor does it facilitate understanding unfamiliar relations.

Second, the effects of inserting the connective in each case must be discussed. It should be pointed out that the pattern traced is similar to that discussed in the previous section. The connective *entonces* significantly accelerates the process only in technical stimuli, concerning both RRTs and ARTs. Inserting *porque*, in constrast, significantly accelerates the process only in everyday stimuli; in technical stimuli, there is facilitation, but it does not lead to significantly shorter RRTs or ARTs. This pattern spotlights certain limitations of the Continuity Hypothesis. Its predictions are supported again in the case of everyday stimuli, which involve prior world knowledge and are understood, to a certain extent, by recognizing/identifying a previously stored causal relation. Nonetheless, the same predictions would turn out to be incorrect whenever the lack of prior knowledge about the causal relation bars that "recognition" and, instead, requires a novel construction. Put another way, in the case of technical stimuli, a marker of discontinuity (such as *porque*) did not prove more beneficial than a marker of continuity (like *entonces*). This pattern is presumably repeated exclusively when it is only the continuity/discontinuity of familiar relations that must be compensated for, rather than the continuity/discontinuity of relations that require construction "from scratch" in the same reading/comprehension process. In this regard, continuity/discontinuity might refer not so much to discursive relations *per se* as to the way in which familiar relations are stored and their correspondence with textual relations. Whenever the causal relation is not previously known, the least difficult condition is habitual order with connective (*entonces)* and in this case the reinforcement of the connective does appear to confer a significant benefit, although it is a continuity relation. On the contrary, *porque* (which provides a significant benefit in inverted-order familiar relations) does not facilitate comprehension enough to surmount two obstacles at the same time: the lack of prior knowledge and the inverted order.

Conclusions

In conclusion, and in view of the results obtained, the hypotheses formulated at the beginning should now be reviewed.

The first hypothesis proposed that, in the absence of a connective, readers tend to process *causality* by iconicity: cause-effect (causal order by default or unmarked). This was confirmed in everyday stimuli, although it is not so evident in technical stimuli, which do not entail prior world knowledge. This information leads to the second hypothesis, which suggested that, if the stimuli are technical, owing to the impossibility of using prior world knowledge, the situation described in the previous hypothesis will become more evident. The study of the "type of information" variable constitutes one of the main concerns of this paper. The results of this Experiment support our initial prediction and exhibit the limits of the *iconicity principle* assumptions. It was noticeable that, as far as technical stimuli are concerned, two facts should be stressed:

(a) the no-connective inverted-order condition leads to random answers rather than to a pattern opposite to that observed under the habitual-order condition, which appears to demonstrate that the iconicity principle does not invariably apply; (b) there are not statistically significant differences between processing times, although they are shorter under the inverted-order condition. On the other hand, in everyday stimuli, the iconicity principle does seem to apply, in keeping with the Continuity Hypothesis, which proposes that the default case is cause-effect in the habitual order and is processed more quickly and more successfully.

The third hypothesis posits that, if a connective is used: (a) the tendency to process the relation by iconicity will gradually disappear, on account of the influence of the accurate semantic instruction given by the connective (and in line with the Continuity Hypothesis, whereby the most substantial benefit would be obtained with connectives signaling discontinuity) and (b) technical stimuli will be processed in the same manner as everyday stimuli. The former part of this hypothesis would be corroborated in everyday stimuli, because inserting *porque* greatly facilitates understanding, causing almost 100% of the answers to be adequate and significantly shortening processing times. This does not hold true in technical stimuli, and we see again how the type of information involved conditions the process: the most considerable benefits are gained by introducing *entonces*. In this respect, the latter part of the third hypothesis is verified only under the condition containing *entonces*, in which everyday stimuli and technical stimuli receive the same level of adequate answers. On the contrary, in the condition containing *porque*, adequate answers to technical stimuli are significantly lower than adequate answers to everyday stimuli. In reference to the last hypothesis (according to which the effects of inserting the particle would be consistent with the Continuity Hypothesis), it might be noted that, based on the results obtained in this experiment, it may be necessary to narrow the scope of the Continuity Hypothesis put forward by Murray (1997) to causal relations that the speaker knows before linguistically processing them. That is, this hypothesis is presumably confirmed for *causality* presented in habitual order and in inverted order, as long as familiar causal relations come into play (this means that the speaker has the events stored as *cause* and *effect*). Here, the process entails retrieving information previously stored and contrasting it with the textual information. In these cases, where comprehension seems to be inevitably affected by the prior world knowledge, both the iconicity principle and the Continuity Hypothesis are confirmed for causal relations. Yet, it does not seem straightforward to extend the predictions implied by these proposals to new causal relations, which must be constructed "from scratch" during the understanding process.

Lastly, it is important to mention that, beyond the specific results and their particular relations with the assumptions and predictions of Murray (1997) and Sanders (2005) Hypotheses, this article falls within a series of studies with broader questions and interests (FRANK et al., 2007; HAGOORT et al., 2004; KUPERBERG

et al., 2006, MCNAMARA et al., 1996; NOORDMAN; VONK, 1998; SANDERS, 2005; among other). How do our mental representation of the world and the conceptual structures stored in long term semantic memory intervene in the comprehension of discourse? How does that information articulate with textual information and the linguist knowledge of the listener/reader? Is it possible to establish some seriality of processing (be it top-down or bottom-up)? Or are they processes that can exist simultaneously and in strategic terms depending of each text and each listener/reader and his/her objectives?

In this particular article, it becomes clear that the possibility to involve our world knowledge during comprehension is a fundamental element for the process and, even if it is not possible to define the exact characteristics of the conceptual organization of that knowledge, it is possible to affirm that the notions of *iconicity* and *continuity* seem to show some possible criteria for that organization. The experiments currently being conducted (ZUNINO; ABUSAMRA; RAITER, 2012b, 2012c), with relations that suspend expected causality bonds (for instance, through adversative or concessive structures) will allow us to define with greater detail if *causality* could also be a criterion of conceptual organization and which relation it could establish with the previous ones. In the line of Sanders (2005), we think that *causality* constitutes a privileged dimension to study and discuss the complex relationship between thought and language, and even, between thought, language and real world. Within this framework, it is our intention to continue studying the articulation between that potential causal conceptual organization, the causal organization of discourses and the psycholinguistic processes involved in their comprehension.

Acknowledgement

- *RESUMEN: Este trabajo estudia la intervención del conocimiento previo sobre el mundo y su articulación con el conocimiento lingüístico (semántico) durante la comprensión de relaciones causales. Se intenta verificar hasta qué punto el principio de iconicidad y la hipótesis de continuidad – especialmente, a partir de la propuesta de Murray (1997) –, se confirman en español. Esperamos, también, relacionar nuestros resultados con la propuesta de Sanders (2005): Hipótesis de causalidad por defecto. Para ello, se evalúa la comprensión de textos bioracionales de dos tipos ("cotidianos" y "técnicos"), en cuatro condiciones: orden habitual e invertido (causa-efecto vs. efecto-causa); sin y con partícula conectiva presente. Esperamos*

que la variable "tipo de información", uno de los elementos centrales de este trabajo, genere un condicionamiento notable durante el procesamiento de relaciones causales y modifique de algún modo las predicciones del principio de continuidad e iconicidad. Los resultados obtenidos muestran que la ausencia de conocimiento previo, en efecto, puede alterar las predicciones y supuestos del principio de iconicidad y de la hipótesis de continuidad; y que, en casos de ausencia de conocimiento previo, la introducción de pistas lingüísticas (partículas conectivas) no sólo es facilitadora del proceso de comprensión sino imprescindible para poder llevarlo a cabo exitosamente.

▪ *PALABRAS CLAVE: Causalidad. Iconicidad. Continuidad. Conocimiento de mundo previo. Partículas conectivas.*

REFERENCES

ABUSAMRA, V. **Comprensión de textos**: el papel de la información sintáctico-semántica en la construcción y disponibilidad de representaciones mentales: un estudio experimental. 2011. Thesis (Doctorate in Letters) - Facultad de Filosofía y Letras, Universidad de Buenos Aires, Buenos Aires, 2011.

ABUSAMRA, V. et al. **Leer para comprender**: test para la evaluación de la comprensión de textos. Buenos Aires: Paidós, 2010.

ANSCOMBRE, J. C.; DUCROT, O. **La argumentación en la lengua**. Madrid: Gredos, 1994.

CARON, J.; MICKO, H. C.; THURING, M. Conjunctions and the recall of composite sentences. **Journal of Memory and Language**, New York, n. 27, p. 309-323, 1988.

CARRUTHERS, P. **Language, thought and consciousness**: an essay in philosophical psychology. Cambridge: Cambridge University Press, 1996.

CEVASCO, J.; VAN DEN BROEK, P. The importance of causal connections in the comprehension of spontaneous spoken discourse. **Psicothema**, Oviedo, v. 4, n. 20, p.801-806, 2008.

CLARK, H. The language-as-fixed-effect fallacy: a critique of language statistics in psychological research. **Journal of Verbal Learning and Verbal Behavior**, New York, n. 12, p.335-359, 1973.

COUSINEAU, D.; CHARTIER, S. Outliers detection and treatment: a review. **International Journal of Psychological Research**, Medellín, v.1, n.3, p. 58-67, 2010.

DE VEGA, M.; CUETOS, F. **Psicolingüística del Español**. Madrid: Trotta, 1999.

DAVIDSON, D. **Essays on actions and events**. Oxford: Clarendon Press, 1985.

DAVIDSON, D. Thinking causes. In: HEIL, J; MELE; A. (Ed.). **Mental causation**. Oxford: Oxford University, 1992. p. 3-17.

ESCAVY ZAMORA, R. Iconicidad y orden de los constituyentes sintácticos. **Revista de Investigación Lingüística**, Murcia, v.IV, n.I, p. 5-28, 2001.

FENKER, D.; WALDMANN, M.; HOLYOAK, K. Accessing causal relations in semantic memory. **Memory & Cognition**, Austin, v. 6, n. 33, p. 1036-1046, 2005.

FRANK, S. et al. Modeling multiple levels of text representation. In: SCHMALHOFER, F.; PERFETTI, C. A. (Ed.). **Higher level language processes in the brain**: inference and comprehension processes. Mahwah, NJ: Erlbaum, 2007. p. 133-157.

GALÁN RODRÍGUEZ, C. La subordinación causal y final. In: BOSQUE I.; DEMONTE, V. (Ed.). **Gramática descriptiva de la lengua española**. Madrid: Espasa Calpe, 1999. p.3579-3642.

GERNSBACHER, M. A. Cognitive processes and mechanisms in language comprehension: the structure building framework. In: BOWER, G. H. (Ed.). **The psychology of learning and motivation**. New York: Academic Press, 1991. p.217-264.

GIVÓN, T. Isomorphism in grammatical code: cognitive and biological consideration. In: SIMONE, R. (Ed.). **Iconicity in language**. Amsterdam: John Benjamins, 1995. p. 47-76.

GOLDMAN, S.; GRAESSER, A.; VAN DEN BROEK, P. **Narrative comprehension, causality, and coherence**: essays in honor of tom trabasso. London: Lawrence Erlbaum, 1999.

GRAVETTER, F.; WALLNAU, L. **Statistics for the behavioral sciences**. Belmont: Wadsworth, 2009.

HABERLANDT, K. Reader expectations in text comprehension. In: LE NY, J. F.; KINTSCH, W. (Ed.). **Language and comprehension**. Amsterdam: North Holland, 1982. p. 239-250.

HAGOORT, P. et al. Integration of word meaning and world knowledge in language comprehension. **Science**, [S.l.], v. 5669, n.304, p. 438-441, 2004.

HAIMAN, J. Iconic and economic motivation. **Language**, Washington, n. 59, p.781-819, 1983.

JACKENDOFF, R. **Semantic structures**. Cambridge: MIT Press, 1990.

JOHNSON-LAIRD, P. **Mental models**: toward a cognitive science of language, influence and consciousness. Massachusetts: Harvard University Press, 1983.

KIM, J. Causation and mental causation. In: MCLAUGHLIN, B.; COHEN, J. (Ed.). **Contemporary debates in philosophy of mind**. Singapur: Blackwell, 2007. p. 227-243.

KIRK, R. E. Experimental design. In: MILLSAP, R.; A. MAYDEU-OLIVARES, A. (Ed.). **Sage handbook of quantitative methods**. Thousand Oakes, CA: Sage, 2009. p. 23-45.

KUPERBERG, G.; PACZYNSKI, M.; DITMAN, T. Establishing causal coherence across sentences: an ERP study. **Journal of Cognitive Neuroscience**, Cambridge, v.5, n.23, p.1230-1246, 2011.

KUPERBERG, G. et al. Making sense of discourse: an fMRI study of causal inferencing across sentences. **NeuroImage**, Orlando, n. 33, p. 343-361, 2006.

LESLIE, A.; KEEBLE, S. Do six-month-old infants perceive causality? **Cognition**, [S.l.], n.25, p. 265-268, 1987.

MALT, B.; WOLFF, P. (Ed.). **Words and the mind**: How words capture human experience. Nueva York: Oxford University Press, 2010.

MARCUS, S.; CALUDE, A. Syntactic iconicity, within and beyond accepted principles. **Revue Roumaine de Linguistique**, Bucarest, n. 4, p. 19-44, 2010.

MCNAMARA, D. et al. Are good texts always better? interactions of text coherence, background knowledge, and levels of understanding in learning from text. **Cognition and Instruction**, Mahwah, v.1, n.14, p.1-43, 1996.

MILLIS, K.; JUST, M. The influence of connectives on sentence comprehension. **Journal of Memory and Language**, New York, n. 33, p. 128-147, 1994.

MOLINARI MAROTTO, C. **Introducción a los modelos cognitivos de la comprensión del lenguaje**. Buenos Aires: Eudeba, 2000.

MURRAY, J. D. Logical connectives and local coherence. In: LORCH, R. F.; O'BRIEN, E. (Ed.). **Sources of cohesion in text comprehension**. Hillsdale, NJ: Erlbaum, 1994. p.107-125.

MURRAY, J. D. Connectives and narrative text: the role of continuity. **Memory & Cognition**, Madison, v.2, n.25, p. 227-236, 1997.

NOORDMAN, L.; VONK, W. Memory-based processing in understanding causal information, **Discourse Processes**, Minnesota, v.2-3, n.26, p. 191-212, 1998.

PICKERING, M.; MAJID, A. What are implicit causality and consequentiality? **Language and Cognitive Processes**, London, v.5, n.22, p. 780-788, 2007.

PORTOLÉS, J. **Marcadores del discurso**. Barcelona: Ariel, 1998.

RATCLIFF, R. Group reaction time distributions and an analysis of distribution statistics. **Psychological Bulletin**, Washington, n. 86, p. 446-461, 1979.

RATCLIFF, R. Methods for dealing with reaction time outliers. **Psychological Bulletin**, Washington, v.3, n.114, p. 510-532, 1993.

SANDERS, T. J. M. Coherence, causality and cognitive complexity in discourse. In: INTERNATIONAL SYMPOSIUM ON THE EXPLORATION AND MODELLING OF MEANING, 1., 2005, Toulouse. **Proceedings...** Toulouse: University of Toulouse-le-Mirail, 2005. p.105-114.

SAPIR, E. **Language**: an introduction to the study of speech. New York: Harcourt, 1921.

SEARLE, J. **Intentionality**: an essay on the philosophy of mind. Cambridge: University Press, 1983.

SIMONE, R**. Iconicity in language**. Amsterdam: John Benjamins, 1995.

SINGER, M.; GRAESSER, A.; TRABASSO, T. Minimal or global inference during reading. **Journal of Memory and Language**, New York, n.33, p. 421-441, 1994.

SLOMAN, S. **Causal models**: How people think about the world and its alternatives. New York: Oxford University Press, 2005.

SPERBER, D.; WILSON, D. **Relevance**: communication and cognition. 2nd ed. Oxford: Blackwell, 1995.

TALMY, L. Force dynamics in language and cognition. **Cognitive Science**, Austin, v.1, n.12, p. 49-100, 1998.

TALMY, L. **Toward a cognitive semantics**. Cambridge: MIT Press, 2000.

THOMPSON, G. An SPSS implementation of the nonrecursive outlier deletion procedure with shifting z score criterion (Van Selst & Jolicoeur, 1994). **Behavior Research Methods**, Madison, v.2, n. 38, p. 344-352, 2006.

TRABASSO, T.; SECCO, T.; VAN DEN BROEK, P. Causal cohesion and story coherence. In: MANDL, H.; STEIN, N. L.; TRABASSO, T. (Ed.). **Learning and comprehension of text**. Hillsdale, NJ: Erlbaum, 1985. p.83-111.

VAN DIJK, T.; KINTSCH, W. **Strategies of discourse comprehension**. New York: Academic Press, 1983.

VIALE, R. Causal cognition and causal realism. **International Studies in the Philosophy of Science**, [S.l.], n. 2, p. 151-196, 1999.

WALDMANN, M. R. Predictive versus diagnostic causal learning: evidence from an overshadowing paradigm. **Psychonomic Bulletin and Review**, Madison, v. 3, n. 8, p.600-608, 2001.

WALDMANN, M. R.; HOLYOAK, K. J. Predictive and diagnostic learning within causal models: asymetries in cue competion. **Journal of Experimental Psychology: General**, Washington, n.121, p. 222-236, 1992.

WOODS, A.; FLETCHER, P.; HUGHES, A. **Statistics in language studies**. Cambridge: Cambridge University Press, 1986.

ZUNINO, G. **Procesamiento psicolingüístico de relaciones semánticas**: causalidad y contracausalidad. 2014. Tesis (Doctorado en Lingüística) - Facultad de Filosofía y Letras, Universidad de Buenos Aires, Buenos Aires, 2014.

ZUNINO, G. M. Producción y comprensión de relaciones contracausales. In: GARCÍA, O.; JAICHENCO, V.; WAINSELBOIM, A. (Ed.). **Lenguaje, cognición y cerebro**. San Luis: Universidad Nacional de Cuyo, 2012. p.109-126.

ZUNINO, G. M.; RAITER, A. Construcción de coherencia textual: un estudio preliminar sobre la causalidad y sus implicancias neuropsicolingüísticas. **Revista Neuropsicología Latinoamericana**, Quebec, v.1, n. 4, p. 1-15, 2012.

ZUNINO, G. M.; ABUSAMRA, V.; RAITER, A. Concesividad y adversatividad: ¿Relaciones de contracausalidad? **Ex Libris**, Buenos Aires, n. 1, p. 311-331, 2012a.

ZUNINO, G. M.; ABUSAMRA, V.; RAITER, A. Articulación entre conocimiento de mundo y conocimiento lingüístico en la comprensión de relaciones causales y contracausales: el papel de las partículas conectivas, **Forma y Función**, Bogotá, v.1, n.25, p.15-34, 2012b.

ZUNINO, G. M.; ABUSAMRA, V.; RAITER, A. Causalidad: relación entre conocimiento de mundo y conocimiento lingüístico. **Pragmalingüística**, Cádiz, n. 20, p.200-219, 2012c.

ZWAAN, R.; RADWANSKY, G. Situation models in language comprehension and memory. **Psychological Bulletin**, Washington, n. 123, p.162-185, 1998.