

Reading Argumentative Texts: Effects of the Presence-Absence of Connectives in Reading Comprehension and Cognitive Effort

Leer Textos Argumentativos: efectos de la presencia-ausencia de conectores en la comprensión lectora y esfuerzo cognitivo

Hector Limón-Fernández,
Luis M. Sánchez-Loyo
Luis A. Mayoral-Gutiérrez

Universidad de Guadalajara, México

Abstract

Recent studies prove a strong association between reading and eye movements. Few investigations report the role of connectors and prior knowledge during reading in Spanish, as well as their association with eye movements. The present study aims to evaluate the effects of the presence-absence of connectors in two argumentative texts on cognitive effort and reading comprehension. Forty-one psychology undergraduate students participated in a reading comprehension task, while their eye movements were recorded. The condition with connectors was related to prior knowledge, the slide time fixation, the slide number fixations, and the slide return fixations. The condition without connectors was related to the return fixations, the time fixation, and the number of fixations. Prior knowledge was correlated with the total time fixation, the total return fixations, and comprehension. This suggests that during reading without connectors more cognitive effort is required, observed in the return fixations; moreover, prior knowledge has an important role in the visual strategies required to process and obtain a representation of text. But participant performance was still good as observed in the scores of the reading comprehension task

Keywords: Reading Comprehension, Connectors, Eye Movements, Eye-Tracking

Héctor Adrián Limón-Fernández. Department of Health Sciences, University Center of Los Altos, Universidad de Guadalajara. Tepatitlán de Morelos, México; Luis Miguel Sánchez-Loyo, Department of Indigenous Language Studies. University Center for Social Sciences and Humanities, Universidad de Guadalajara. Guadalajara, México; Luis Alfredo Mayoral-Gutiérrez. Department of Education, University Center for Social Sciences and Humanities, Universidad de Guadalajara. Guadalajara, México.

Corresponding author: Luis Miguel Sánchez Loyo. Departamento de Estudios en Lenguas Indígenas, Centro Universitario de Ciencias Sociales y Humanidades, Universidad de Guadalajara, México. Address: Prolongación Avenida José Parres Árias 150, Col. San José del Bajío, Zapopan, Jalisco, México, C.P. 45100. E-mail: luis.sloyo@academicos.udg.mx



Resumen

Estudios prueban una asociación entre lectura y movimientos oculares al reportar el efecto de los conectores en el procesamiento textual. Pocas investigaciones revelan el papel de los conectores, el conocimiento previo y los movimientos oculares en la lectura de textos en español. El objetivo fue evaluar los efectos de la presencia-ausencia de conectores en dos textos argumentativos sobre el esfuerzo cognitivo y la comprensión lectora. Participaron 41 universitarios en una tarea de lectura con registro de sus movimientos oculares. La comprensión en la condición con conectores estuvo relacionada con conocimiento previo, tiempo y número de fijaciones por diapositiva, además del número de regresos en la lectura por diapositiva. Mientras la comprensión de textos sin conectores estuvo relacionada con conocimiento previo, regresos, tiempo y número de fijaciones, el conocimiento previo se correlacionó con tiempo y número fijaciones, regresos en la lectura y la comprensión. Se sugiere que la lectura de un texto sin conectores requerirá mayor esfuerzo cognitivo observado en los regresos en la lectura; además, el conocimiento previo afecta las estrategias visuales para procesar y representar mentalmente un texto. Pero, el desempeño de los participantes sigue siendo bueno, según lo observado en los puntajes de la tarea de comprensión lectora.

Palabras clave: comprensión lectora, conectores, movimientos oculares, rastreo ocular

For a text to be effective, it must comply with basic textuality norms: cohesion, coherence, intentionality, acceptability, informativeness, situationality, and intertextuality (Beaugrande & Dressler, 1997). Connectors are a cohesion strategy that facilitates coherence in the formation of a text (Cuetos et al., 2015; Nadal et al., 2016), since their function is to logically and semantically relate the segments of the text that are intended to be related (Calsamiglia & Tusón, 1999) and form a hierarchy of semantic importance concerning the topic, as part of the textual macrostructure (Pons, 1998).

The inter-sentence connectors used in this study facilitate the construction of compound sentences (Tallerman, 2011) and relate two contiguous events to each other in a text (Gómez & Ramos, 2016), creating a subordinative or coordinate relation, but in terms of cognitive processing, this is not relevant (Zunino, 2017). Likewise, the connectors have an instructional meaning (Montolío, 2001) activating information in the reader's lexicon and operating with the information that appears later (Givón, 1992).

Adversative and causal connectors have a particular instructional meaning. On the one hand, the meaning of the adversative-type connectors guides the reader to interpret the information previously provided in the opposite direction (Calsamiglia & Tusón, 1999), that is, its fundamental semantic characteristic is contrast (Garrido, 2006), including concessive connectors (Calsamiglia & Tusón, 1999) recognized as synonyms of adversative connectors (Zunino & Raiter, 2012). On the other hand, causal connectors indicate cause-consequence relationships between two clauses (Calsamiglia & Tusón, 1999). Therefore, connectors are expected to impact cognitive processes (Cuetos et al., 2015; Givón, 1992) and the measurements related to these processes (Loureda et al., 2016b; Nadal & Recio, 2019), in a way that facilitates the construction of a mental representation of the read text (van Silfhout et al., 2015).

Eye-tracking on reading tasks is a measure of cognitive effort (Cook & Wei, 2019; Nadal et al., 2016; Nadal & Recio, 2019), establishing which visual strategies are preferred for processing texts (Rayner & Pollatsek, 2006) or visual stimuli (King et al., 2019). Similar measures to eye-tracking report

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that struggling readers invest more cognitive effort in processing a text, resulting in poor comprehension (Ng et al., 2017, 2018) in contrast with normal readers (Demberg et al., 2013; Ng et al., 2017).

Several studies have tried to prove how eye movements are related to online reading processing and connectors. For example, Knoerferle (2014) explored the relationship established by coordinating conjunctions that can have constituent order parallelism effects in German clausal coordination. The study showed more fixation time in subject and verb zones when the order of constituents was marked compared to non-marked order; also, the conjunction *und* (and) in parallel sentences was processed slower than *aber* and *während* (but and while, respectively), these two being marks that make a semantic processing constraint in coordination. Another study carried out by Lyu et al. (2020) aimed to examine the plausibility effect of concession and causality in Mandarin Chinese native speakers. The results of the eye-tracking experiment demonstrated higher accuracy in detecting plausible than implausible sentences, both for concession and causality. In the precritical region (before connector), they found an effect of more time spent processing implausible sentences. Then, for the critical region (the connector), they found the shortest time to read for implausible concession sentences. Also, greater probability of return fixations was observed for implausible sentences. In the postcritical region, they found an effect on more time spent reading implausible than plausible sentences.

There are several studies in Spanish about reading. De Vega (2005) studied the effects of causal and adversative connectors in sentence processing by native Spanish speakers; the study showed that cognitive processing of sentences in Spanish was performed at the sentence's end; moreover, causal and adversative connectors are semantically specific, and causal connectors are easier to process than adversative connectors. In another study, Loureda et al. (2016b) analyzed the Spanish counter-argumentative connector *sin embargo* (however, nevertheless) as an inferential processing constraint. Their findings confirm that this connector gets lower processing costs for sentence integration and discursive particles as *sin embargo* tends to mark and facilitate sentence processing.

Another study focused on the judgement of emotional valence guided by causal and concessive connectors (Morera et al., 2017). It demonstrated that responses to the task were more efficient for causal than concessive sentences. Also, causal antecedents were associated with positive valence and less cognitive effort, suggesting an emotional bias from causal relations. Both causal and concessive relationships modulated emotional valence, inducing expectations of content next to connectors.

Other studies in line with text and connector processing, like van Silfhout et al. (2015) and van Silfhout et al. (2014) are important. The first study showed how coherence markers improve online processing and reading comprehension in narrative and expository texts; also, comprehension was better in a text with connectors which, in turn, guide the reader to draw better inferences from the text. The second study showed the effects of 'therefore' and 'furthermore' in reading processing and the text's mental representation; the study concluded that the presence of connectors speeds up the reading, especially in a continued design. Moreover, additive and causal connectors constituted a restriction on the possible interpretations given to the sentence below.

Finally, there are no studies for connectors and text-processing in Spanish, most studies have used sentences as stimuli to assess reading. The hypothesis of this study proposes that connectors improve

reading comprehension through participants' reduced cognitive effort in processing texts. Therefore, the present study aims to assess the effects of the presence or absence of connectors in argumentative texts on measures associated with cognitive effort (the time fixation, the number fixation, and return fixation) and reading comprehension measures in Spanish reading.

Method

This was a comparative cross-section of repeated study design measures, and between subjects, comparisons were applied.

Participants

Forty-one volunteer undergraduate psychology students (34 females) from the University of Guadalajara (21.72 years old, $SD = 3.364$) participated in the study. Non-probability sampling was used. The participants were recruited by an announcement in their classrooms, and they participated voluntarily. All of them were native Spanish speakers. All had a normal or corrected vision. They received course credits for their participation in the study.

Independent variables

Two independent variables were employed in the study: argumentative texts, and causal and adversative connectors.

First, argumentative texts have the aim to persuade the reader and are organized by a sequence of arguments or ideas to prove an idea (Instituto Cervantes, 2022).

Connectors are grammatical categories employed to relate two or more events to each other (Gómez & Ramos, 2016). Particularly, causal and adversative connectors add specific information that restricts the possible interpretation of the relation between sentences and reduce cognitive effort (de Vega, 2005; Loureda et al., 2016b).

For this study, two argumentative texts were written in Spanish about general topics: Mexico's Olympic results in Rio 2016 and Donald Trump's campaign, using 5 causal connectors and 5 adversative connectors in each text (for the "with connectors" version, see more detailed in the section "2.5. Materials and method"). Argumentative texts were selected because the grammatical conventions (Raible, 1980) for writing this type of text include the use of causal and adversative connectors.

Dependent variables

The dependent variables taken into account in this study were: reading comprehension and cognitive effort (measured through eye-movements measures).

Reading comprehension is defined as a mental representation of a text (Kintsch, 1988). This variable was operationalized in two ways: (a) 'the global reading comprehension percentage' was the frequency of right answers in the entire questionnaire; then, (b) 'the local reading comprehension score' was implemented to explore the comprehension between each pair of sentences related by causal or adversative connectors, and this was the frequency of right answers for the questions per paragraph/per slide (each slide contained two paragraphs with at least one causal or adversative connector).

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Eye-tracking during reading is used to infer how the reader invests more cognitive effort to build a mental representation of a text, through knowing which parts of a text require more or less effort and which visual strategies facilitate an adequate comprehension of text (de Vega, 2005; Rayner, 2009).

Eye-movement measures are the number of fixations, the length of fixation, and the return fixations as reported in other studies (Knoeferle, 2014; Yang et al., 2013). A fixation is defined as the moment that “our eyes remain still”, for 200 to 300 milliseconds (ms) (Rayner, 1998, p. 373). The number of fixations is related to the sum of fixations spent on each interest zone (like sentence or connector in our study) (King et al., 2019). The time of fixation is the time spent on each interest zone (King et al., 2019). The return fixations are the eye-movements on the way back during reading. The “total” measures are related to the mean of the number, time, or return fixations spent on texts, while the “slide” measures are related to the mean of the number, time, or return fixations spent on each slide.

Intervening variable

Only prior knowledge is intended as an intervening variable. Prior knowledge is understood as previous information about a topic. When the readers know previous information about text content, it may facilitate the elaboration of text structure, thus this information induces better results in comprehension versus non-well-informed readers (Cevasco et al., 2020; Kintsch, 1988; McNamara, 2013; van den Broek & Kendeou, 2008; Zunino, 2017).

We operationalized the prior knowledge score through participants answering a Likert-like question (prior knowledge score), exploring their perception of prior knowledge on each text topic employed in the study.

Materials and design

Reading Task. Two argumentative texts were written in Spanish (about general topics: Mexico’s Olympic results in Rio 2016 and Donald Trump’s campaign) using 5 causal connectors and 5 adversative connectors in each text. Two versions of each text were designed: a version with causal and adversative connectors (the condition with connectors) and another version without causal and adversative connectors (the condition without connectors). In texts with connectors, the connectors were presented in the first position in the sentence related to a previous one. In text without connectors, the sentences were presented as juxtaposed sentences, i.e. separated only by a period ‘.’ (van Silfhout et al., 2014).

- a) Ha terminado la justa olímpica de Río 2016 y México se quedó con 3 platas y 2 bronce, dos medallas menos que en Londres 2012. *A causa de ello*, los reporteros han comenzado la búsqueda de los responsables de estos resultados negativos. [The Rio 2016 Olympic Games have ended, and Mexico was left with 3 silvers and 2 bronzes, two medals less than in London 2012. *Because of this*, the reporters have begun the search for those responsible for these negative results].

The causal relation observed in the connector ‘*a causa de ello*’ (because of this) explains a result from the sentence before the causal connector. We contrasted the presence of causal connection with the absence of connectors, as in b):

b) Ha terminado la justa olímpica de Río 2016 y México se quedó con 3 platas y 2 bronce, dos medallas menos que en Londres 2012. Los reporteros han comenzado la búsqueda de los responsables de estos resultados negativos.

Here we observe no connection between sentences, only a juxtaposition marked by a period ‘.’. This same design was applied to adversative connectors (*sin embargo/however, pero/but, aunque/although*), which are defined as a contrast or opposition relation between sentences (Calsamiglia & Tusón, 1999).

Reading comprehension questionnaire. A multiple-choice inference questionnaire was designed to assess reading comprehension for each text. Questions are referred to the specific paragraphs where the connectors were operating. For text 1 (Mexico’s Olympic results in Rio 2016) a 6-item questionnaire was applied, and for text 2 (Donald Trump’s campaign) an 8-item questionnaire was applied (text and questionnaire are available online for readers as supplementary material here: <http://dx.doi.org/10.13140/RG.2.2.12077.54244>).

Examples of questions are:

1. ¿A qué se debe que los resultados de los deportistas mexicanos, medidos en medallas obtenidas, se califiquen como negativos por los reporteros?
 - a. México ganó las mismas o más medallas en las olimpiadas pasadas.
 - b. México obtuvo más medallas que en la olimpiada pasada.
 - c. Las medallas obtenidas son pocas para la cantidad de deportistas mexicanos.
 - d. Los deportistas mexicanos son los mejores en su disciplina.
 - e. Los espectadores mexicanos querían más medallas.
2. Las carencias de infraestructura y financiamiento causaron que el nivel del deportista mexicano fuera:
 - a. Poco óptimo para competir.
 - b. Nada óptimo para competir.
 - c. El requerido para competir.
 - d. Muy bueno para competir.
 - e. Totalmente aceptable para competir.

Prior knowledge scale. A Likert-like question from 1 to 10 ranges (“I don’t know anything” to “I have extensive knowledge of the subject”) was designed to evaluate the prior knowledge regarding the topic of each text. The question made for this purpose was: On a scale from 1 to 10 where 1 is “I don’t know anything” and 10 is “I have extensive knowledge of the subject”, how informed are you about Mexico’s participation in the 2016 Rio de Janeiro Olympic Games/Donald Trump’s campaign?

Eye tracking equipment. Eye-Track 6 from ASL eye tracker equipment was used, at 240 Hz of time resolution to assess the eye movements and the pupil diameter during the reading process. This eye-tracker only registers the left eye’s movements.

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The stimuli were presented by means of the Paradigm software on a 15" monitor. All participants sat one meter away from the monitor. A calibration process was performed with 9 points on the monitor as suggested by Ronderos et al. (2018) for reading studies. After that, the participant learned to use the spacebar to change slides, then the participant read 9 groups of 6 number and letter sequences (like 1a1a1a1a1a) on the monitor. The texts were presented on 3 slides each (participants read a total of 6 slides). Every change of slide had to be marked manually by the computer for the eye-tracker record.

Procedure

The study was conducted in a cubicle at the facilities of the Universidad de Guadalajara, *Centro de Estudios e Investigaciones en Comportamiento* (CEIC). During the tasks and instrument application, a member of the research team was present to administer the entire test and experimental tasks. First, the prior knowledge scale was applied to the participant. Second, the calibration process was carried out, and later the participant started to read a self-administered text. Third, the participant performed a distracting activity (block design from WAIS), and then the participant proceeded to answer the comprehension questionnaire for the text. The same procedure was repeated with the other text. Each participant read the two texts, one with connectors and another without connectors (each text was presented on 3 slides). A counterbalanced presentation of the texts and the conditions (with or without connectors) was used for each participant.

Ethical aspects

Before the experiment started, participants were informed about the objectives of the study, and the procedure and were asked to follow instructions carefully. They gave verbal consent to participate and received course credits for their participation. Participation was voluntary.

Data analysis

For statistical analysis, SPSS v.23 software was employed. The statistical tests were employed according to normality and homogeneity of variance assumptions that indicated the use of non-parametric tests.

A non-parametric test was used for all measures: global reading comprehension, local reading comprehension, prior knowledge, number of fixations, length of fixation, and return fixation in all conditions (with and without connectors; global and local reading analysis).

A Mann-Whitney test was performed to compare groups by text condition: with and without connectors (for the global reading comprehension, the local reading comprehension, the prior knowledge, the number of fixations, the length of fixation, and the return fixation). The Spearman correlation test (two tails) was applied to data (to correlate eye-tracking measures with the global and local reading analysis by text condition).

Results**Assessment of Global Reading Comprehension**

First, no significant difference in the Global reading comprehension percentage was observed between with (87.83%, $SD = 7.86$) and without connectors (88.05%, $SD = 9.34$) conditions, as Table 1

shows. Also, there was no significant difference in the mean prior knowledge score between conditions with ($M = 3.48$, $SD = 2.21$) and without ($M = 3.36$, $SD = 2.05$) connectors.

Table 1

Mean values of measures related to reading comprehension and eye movements

| | With connectors | | | Without connectors | | | <i>U</i> | <i>Z</i> | <i>p</i> |
|---|-----------------|-----------|--------|--------------------|-----------|--------|----------|----------|----------|
| | <i>M</i> | <i>SD</i> | Median | <i>M</i> | <i>SD</i> | Median | | | |
| Global reading comprehension percentage | 87.83% | 7.86 | 90.62% | 88.05% | 9.34 | 87.5% | 793 | -.44 | .658 |
| Local reading comprehension score | 7.05 | 1.09 | 8 | 7.1 | 1.15 | 7 | 9855 | -.67 | .499 |
| Prior knowledge score | 3.48 | 2.21 | 3 | 3.36 | 2.05 | 3 | 8 | -.17 | .858 |
| Total number of fixations | 366.41 | 61.48 | 344 | 349.58 | 64.78 | 366 | 682.5 | -1.46 | .143 |
| Total length of fixation (ms) | 97.14 | 24.34 | 88.9 | 94.88 | 27.52 | 95.04 | 755 | -.79 | .428 |
| Total return fixations | 57.46 | 26.09 | 44 | 50.19 | 23.22 | 44 | 821 | -.18 | .856 |
| Slide number of fixations | 105.05 | 20.13 | 104 | 99.53 | 24.09 | 96 | 8787.5 | -2.14 | .032* |
| Slide length of fixation (ms) | 27.85 | 9.02 | 26.56 | 27.01 | 9.96 | 25.36 | 9411.5 | -1.25 | .208 |
| Slide return fixations | 15.04 | 8.03 | 14 | 14.29 | 8.38 | 12.5 | 9589.5 | -1.01 | .314 |

* $p < .05$

Second, positive correlations between the prior knowledge score and the global reading comprehension percentage in the condition with connectors ($\rho = .369$, $p = .017$) and without connectors ($\rho = .386$, $p = .013$) (see Table 2) were observed.

No correlation between the global reading comprehension percentage and the total time of fixation by condition with connectors ($\rho = -.098$, $p = .792$) and without connectors ($\rho = -.212$, $p = .183$) was observed. Neither was correlation observed between global reading comprehension percentage and the total number of fixations on each condition, with connectors ($\rho = -.01$, $p = .949$) and without them ($\rho = -.167$, $p = .296$).

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Table 2

Correlation values from values related to reading comprehension and eye movements

| | With connectors | Without connectors |
|---|-------------------|--------------------|
| | Correlation level | Correlation level |
| Prior knowledge score and Global reading comprehension percentage | .369* | .386* |
| Prior knowledge score and Local reading comprehension score | .201* | .208* |
| Prior knowledge score and Total number of fixations | .029 | .024 |
| Prior knowledge score and Total time of fixation | -.042 | -.105 |
| Prior knowledge score and Total return fixations | .146 | -.025 |
| Prior knowledge score and Slide number of fixations | -.286** | -.23** |
| Prior knowledge score and Slide length of fixation | -.250** | -.29** |
| Prior knowledge score and Slide return fixations | .05 | -.083 |
| Total number of fixations and Global comprehension percentage | -.01 | -.167 |
| Total time of fixation and Global comprehension percentage | -.098 | -.212 |
| Return fixations and Global comprehension percentage | .23 | -.392* |
| Slide number of fixations and Local comprehension score | .017 | -.236** |
| Slide time of fixation and Local comprehension score | -.041 | -.289** |
| Slide return fixations and Local comprehension score | .096 | -.26** |

* $p < .05$. ** $p < .01$

The study showed a significant negative correlation between the global reading comprehension percentage and the total return fixations, in the condition without connectors ($\rho = -.392, p = .011$), nevertheless, no correlation was found in the condition with connectors ($\rho = .23, p = .147$).

Assessment of Local Reading Comprehension.

The specific effect of causal and adversative connectors in Spanish occurs in textual local passages and, of course, in the local reading comprehension score. No difference was observed between the local comprehension score on measures at each condition (with connectors $M = 7.05, SD = 1.09$; without connectors $M = 7.10, SD = 1.15$).

Positive correlation between the prior knowledge score and the local reading comprehension score in the conditions with connectors ($\rho = .201, p = .016$) and without connectors ($\rho = .208, p = .012$) were observed. Furthermore, a negative correlation was observed for the local reading comprehension score and the slide length of fixation in the condition without connectors ($\rho = -.289, p = .001$); but no correlation was observed in the condition with connectors ($\rho = -.041, p = .624$). Additionally, a negative correlation between the local reading comprehension score and the slide number of fixations was observed for the condition without connectors ($\rho = -.236, p = .004$); while no correlation was observed for the condition with connectors ($\rho = .017, p = .839$).

Finally, no correlation was observed between the slide return fixations and the local reading comprehension score in the condition with connectors ($\rho = .096, p = .254$). However, in the condition without connectors, a negative correlation ($\rho = -.26, p = .002$) was observed.

Length of fixation, number of fixations and return fixations in text reading.

No differences were observed in the comparison between each condition in the total time of fixation, the total number of fixations, and the total return fixations. Also, no difference was observed between conditions in the slide length of fixation, and the slide return fixations (see Table 1), but for the slide number of fixations we observed a difference between with connectors condition ($Mdn = 104$) and without connectors condition ($Mdn = 96, U = 8787.5, Z = -2.146, p = .035$).

Regarding the correlation values, no correlations between the prior knowledge score and the total time fixation or the total number of fixations on each condition were observed (see Table 2). However, there were negative correlations between the prior knowledge score and the slide length of fixation in both the conditions with connectors ($\rho = -.25, p = .003$) and without connectors ($\rho = -.29, p = .001$). Also, negative correlations between the prior knowledge score and the slide number fixations for the conditions with connectors ($\rho = -.286, p = .001$) and without connectors ($\rho = -.23, p = .006$) were observed.

Discussion

The effects of connectors on Global comprehension percentage and Local comprehension score

The findings in this study are contrary to our hypothesis; we expected a differentiated performance in reading comprehension by participants reading texts with connectors versus texts without connectors which was observed in studies with other methodologies (Wetzel et al., 2022). The performance of participants in the reading comprehension assessment did not show differences between the text

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conditions. This finding does not accord with van Silfhout et al. (2015), who observed that eighth graders were affected in global reading comprehension when connectors are present or not. In the case of presence, the connectors were favored in global reading comprehension, but without them, global reading comprehension was poorer. This difference must be nuanced since the populations of their study are not comparable to those in this study. Even so, a recent study found no effects of connectors on reading comprehension scores in a sample of children (aged between eight and ten years old) (van den Bosch et al., 2018).

The relation between connector usage and age was explored in other studies, finding that children should use connectors in a polyfunctional manner, rather than specific function (Gómez & Ramos, 2016), and it is reported that knowledge of connector functions increases with age (Tskhovrebova et al., 2022); leading us to think that adolescent and adult populations may use and recognize connectors more effectively. One might think that differences in younger populations can be observed since their abilities to draw inferences during reading have not been fully trained and developed; besides the case of our population, it was hoped that those skills would already be developed.

Meanwhile, the findings presented by de Vega (2005) are in line with the findings in the present study, since de Vega did not find any difference in the comprehension tests between the presence or absence of connectors in Spanish native readers. Likewise, they agreed with the findings of Rayner (2009) who did not find differences between the tests of reading comprehension and the difficulty of the texts read. This leads us to anticipate that the present difficulty in the manipulation of connectors was not an impediment for the readers to perform adequately in the task of reading and later in the questionnaire on reading comprehension.

Like the global reading comprehension percentage, we found that the local reading comprehension score did not show differences, which implies that the connector conditions did not affect the elaboration of the mental representation of the text during the textual passages. The absence of differences in the global and local comprehension between conditions can be due to structural issues of the text since there are other textual mechanisms to obtain information and elaborate inferences (Bernárdez, 1995), for example, the sequences of topicality, the deixes (Givón, 1992), the reader's knowledge of the prototypical or iconic features of the textual genre that the reader faces (Goedecke et al., 2015; Kendeou et al., 2014; Raible, 1980).

Also, Kintsch (1988), McNamara (2013), van den Broek & Kendeou (2008), Zunino (2017), and Cevasco et al. (2020) point out that prior knowledge is a fundamental element to ensuring adequate mental representation of the text. In this study, it can be observed that the correlations between prior knowledge score and global reading comprehension percentage dictate that knowing more about a subject will facilitate performance for the elaboration of a mental representation of the text.

Meanwhile, the correlation between the prior knowledge score and the local comprehension score was significant in the conditions of presence and absence of connectors, since the participants required greater use of world knowledge to adequately elaborate a mental representation of the text. These findings are not in line with those obtained by Ariasi and Mason (2011), who found a greater probability of learning refutational texts if one has a better knowledge of the subject, because we found no differences

between conditions and prior knowledge. Also, it can be said that prior knowledge replaces the role of connectors by improving the inferences about the relationships existing in the text, avoiding the need to use extraordinary resources to corroborate the reader's hypothesis elaborated during the reading of the text. It could contradict the idea that connectors can improve inferences by self and guide to a proper interpretation of textual segments (Loureda et al., 2016a). More research on prior knowledge and connectors must be done.

Other important aspects to highlight are the characteristics of the instrument implemented for the assessment of reading comprehension. The instrument was elaborated according to the idea of the base text proposed by Kintsch (1988), trying to reflect the local reading comprehension score in each slide, besides assuming the situational model. Despite the careful procession in the wording of the questions; the options might have guided the participant to replace their answer according to a subjective criterion of coherence. Questions were designed for inference-making that could only be obtained through an adequate reading of the text. Additionally, there is no better method to assess reading comprehension, a closed questionnaire with options was chosen instead of making abstract, open questions, or conceptual maps; each of these methods has pros and cons for their aims.

Effects of connectors on Length of fixation and Number of fixations

It was expected in our hypothesis that the total time of fixation and the total number of fixations related to text processing present differences in each condition because this aspect of ocular behavior leads us to observe the elaboration of the situational model (Kintsch, 1988), the low-level processes such as decoding, lexical access and reading fluency (Kendeou et al., 2014) or higher processes like inference making and attentional distribution (Kendeou et al., 2014; van den Broek & Helder, 2017). Nevertheless, we did not find any differences between the mean on each measure (except for slide number fixations), as can be seen in other similar studies (Knoeferle, 2014; Metzner et al., 2016).

Our results are not in line with Rayner et al. (2009) findings, they argue that text difficulty tends to increase the time of fixation in text by participants. In our case, we do not find greater measures of the total length of fixation and the total number of fixations in the condition without connectors, which is apparently more complex than the condition with connectors. However, this finding is not statistically relevant; we observe consistency in the measures for each condition. This led us to think that these measures related to ocular behavior were not the key to solving the challenges for reading comprehension (presence or absence of connectors in reading tasks). Also, the values on correlations between global reading comprehension percentage and total time of fixation/total number of fixations were not statistically significant. This means that, despite the total time of fixation and the total number of fixations, these are not a crucial fact to decide the quality of the mental representation of our participants.

Particularly, the findings on total length of fixation are similar to what Loureda et al. (2016b) report. They evidenced that adversative connector *sin embargo* (however) speeds up the processing time of sentence reading. Although our findings do not reach statistical significance, there is consistency in how the participants tend to use total time and number fixations under each condition.

The slide length of fixation did not show differences between conditions. The negative correlations between the slide time fixation and the slide number fixations with the local comprehension score were

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observed only for the condition without connectors. This finding shows the importance for the reader, to decode textual passages with more precision when local cohesion is slightly affected. Also, the idea that a longer fixation favors processing of cohesion ruptures on textual passages (de Vega, 2005) was contradicted by our findings.

All these findings point to the idea that detailed decoding of words (Perfetti & Stafura, 2014) for texts with a normal cohesion is not so important in comparison to texts with an affected cohesion, because decoding gets more relevance. Another possible explanation is that decoding through textual passages becomes more precise to produce inferences (Kintsch, 1988; McNamara, 2013; van den Broek & Kendeou, 2008) using deictic resources in text, also, stricter monitoring of cohesion (Givón, 1992) and coherence through semantic restrictions imposed by context (Ferreira et al., 2002; Rayner, 1998). Also, we partially failed to prove that connectors have a cohesion role (Givón, 1992; Montolio, 2001) and provide restrictions on the meaning between clauses and statements (Loureda et al., 2016a, 2016b; Nadal & Recio, 2019), improving text comprehension through the restriction of possible interpretations. Instead, we probed the role of individual characteristics of the reader acting in text processing, which is the case of prior knowledge recently discussed.

Effects of connectors in Return fixations

No differences between conditions in return fixations were observed as expected. The correlations between global comprehension percentage and return fixations showed a negative correlation in the condition without connectors. This correlation guided us to think that return fixations were not enough to solve the affected cohesion, but it was enough for coherence standards in the condition with connectors (Cook, 2014; Crossley et al., 2014). At the same time, the comparison between the slide return fixations was the only one statistically significant, while a correlation between the slide return fixations and the local comprehension score in the condition without connectors was observed.

These results are similar to van Silfhout et al. (2015). They found that the presence of a connector meant that participants avoided using more return fixations for a second read, as the absence of connectors leads to the loss of effectivity in return fixations. But they did not find any correlation between this measure and reading comprehension measures, as was observed in the present study.

It was expected for return fixations to have a strategic role in text processing when something went wrong with standards of coherence or the text had a high level of difficulty, particularly Metzner et al. (2016) pointed out that this kind of fixations are a conscious strategy and a reaction to semantic and syntactic violations. Also for return fixations, the reader identifies the particular needs of information extraction and attends to the coherence standards (van den Broek & Helder, 2017). In the present study, the violation of cohesion through the absence of connectors may result in a syntactic violation, and this leads to wrong inferences about reading comprehension and standards of coherence or a late representation was generated after the juxtaposition was presented (the region was the connector it was expected to be), expecting more information ahead in the text (Lyu et al., 2020). As Rayner (1998) states, return fixations are a strategy of verification for information search to improve the mental representation of a text, and the present results lead us to think that the absence of connectors made return fixations insufficient for the construction of a mental representation of the text.

Effects of Previous knowledge on Length of fixation, Number of fixations, and Return fixations

Greater previous knowledge scores showed a negative correlation with slide number fixations, slide time fixation, and slide return fixations in both experimental conditions. This finding points out the importance of prior knowledge (or world knowledge) on cognitive resources and visual strategies for reading comprehension (Kintsch, 1988).

This suggests that prior knowledge is a key to decoding the text and distributing cognitive effort in the reading comprehension process, as it does in other studies (Cevasco et al., 2020; McNamara, 2013; van den Broek & Kendeou, 2008; Zunino, 2017).

Conclusions

Our results inform that a sample of adolescents and young adults (university students) can comprehend a text by inferring relations between parts of texts by using resources like prior knowledge, or investment of slide time and number fixations for probably better word decoding. The absence of connectors only partially influences ocular behavior (like return fixations) and requires other cognitive resources.

It is also important to highlight the role of prior knowledge score on global reading comprehension percentage and local reading comprehension score, because it demonstrates the importance of prior knowledge in text comprehension, as noted by other authors (Cevasco et al., 2020; Kendeou et al., 2014; Kintsch, 1988).

Additionally, on one hand, the scope of the present study includes control of prior knowledge variable through a Likert-like questionnaire. Also, the common topics of texts are important to control prior knowledge variation in individuals. Highlight the combination of online and offline measures: together eye-tracking measures and reading comprehension questionnaires are important to ensure the construction of a mental representation of text as recommended by Ferreira and Yang (2019). The homogeneity of participants in age and academic grade is also important for comparisons because learning and better use of connectors increase with age and academic grade (Tskhovrebova et al., 2022).

On the other hand, the limitations of the study are related to the reading comprehension assessment method. Our method has failures (as the possibility of randomly choosing the answer or the same item provides information to make an inference) and there are different methods (like making abstract or open questions), but no one is the best for measuring reading comprehension. Another limitation goes on stimulus presentation; for a better registry, we should employ our target sentences starting on the same row. Finally, long texts should probably be greater for better comparisons with other studies; short texts were employed in our study.

For future studies, the influence of age and connector processing in Spanish speakers could be explored. Also, more research on prior knowledge and connectors could be carried out to establish the weight of connectors in the construction of a mental representation.

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About the authors

Héctor Adrián Limón-Fernández has a Licentiate in Psychology, Master's in Applied Linguistics and is finishing his Doctorate in Biosciences. He is Professor of Core Matter B at the Universidad de Guadalajara (México). Member of the Municipal Health Committee for the Municipality of Arandas, Jalisco, México (2021-2024). Serves as an independent promoter of reading and writing. He has 7 publications, communications and conferences in national congresses.

Luis Miguel Sánchez-Loyo has a Licentiate in Psychology, Master's in Applied Linguistics, Doctorate in Behavioral Science. He is a Chaired Research Professor at the Universidad de Guadalajara (México) and participates in the Psycholinguistic line of research. A member of the non-governmental Witsilli Association for the preservation of original languages of Mexico. Member of CONACYT National Researcher System, level I (Mexico). Member of the Mexican Association of Applied Linguistics. He has authored more than 65 scientific articles and book chapters and has dictated more than 170 conferences and workshops.

Luis Alfredo Mayoral-Gutiérrez holds a Doctorate in Education, is a Professor of the Universidad de Guadalajara (México) and is responsible for of the line of research on "Cognitive Processes and Learning". He is a Research Professor in the Department of Educational Studies. Acting as director and co-director of theses in the postgraduate programs of "Educational Research" and "Cognition and Learning". He has more than 20 publications, communications and conferences in national and international congresses.

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