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Construction of coherence in the comprehension of narratives: Studies on the importance of the establishment of causal connections, gaps in current research and future directions

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ABSTRACT

The establishing of causal connections is key to the construction of discourse coherence. The aim of this narrative review is to present research that has examined the establishment of these connections in the construction of narrative discourse coherence, in order to highlight gaps in current research and suggest future directions. Among these gaps, we will highlight that prior research has not tended to examine the role of the modality of presentation of the materials, or to present spontaneous discourse, or materials about current social problems. In order to review these topics, we introduce the causal chain model, causal network model, causal inference maker model, landscape model, and contributions from constructionist theory and the event-indexing model. We also present studies that support their claims. Finally, we present conclusions and discuss future directions. The presentation of these studies will allow us to underscore the crucial need for research to examine the comprehension of discourse that students process in academic settings, everyday interactions, and that focuses on relevant current social issues.

Construcción de la coherencia en la comprensión de narrativas: Estudios acerca de la importancia del establecimiento de conexiones causales, brechas en la investigación actual y futuras direcciones

RESUMEN

El establecimiento de conexiones causales es central para la construcción de la coherencia del discurso narrativo. El objetivo de esta revisión narrativa es realizar un recorrido por la investigación acerca del establecimiento de estas conexiones, con el fin de destacar brechas en la investigación actual y preguntas pendientes. Se destacará que investigaciones previas no han tendido a examinar el rol de la modalidad de presentación del material, ni a presentar materiales que involucren discurso espontáneo, o que traten acerca de problemáticas sociales actuales. Para realizar este análisis, se relevarán las propuestas del: Modelo de Cadena Causal, Modelo de Red Causal, Modelo Generador de Inferencias Causales, Modelo de Paisaje, y contribuciones de la Teoría Construcionista y del Modelo de Indexación de Eventos. A su vez, se presentarán investigaciones a partir de ellos. Finalmente, se presentarán conclusiones y futuras direcciones. Se espera que este trabajo contribuya a destacar la importancia de que la investigación actual se acerque al estudio del discurso que los estudiantes procesan durante el dictado de clases, su participación social en el ámbito cotidiano, y que traten acerca de temas de relevancia social actual.

Palabras clave

Coherencia; Narrativas
Conexiones causales
Inferencias
Comprensión

Understanding narratives involves constructing a coherent representation of the discourse in memory (Carlson et al., 2022; Cevalco & van den Broek, 2017; Karlsson et al., 2018; Kraal et al., 2017; Tibken et al., 2022). Previous studies suggest that the construction of this representation involves establishing causal connections among the described events (Fichman et al., 2021; Paviás et al., 2016; van den Broek, 2010). These connections are considered necessary for comprehension (Bruñe et al., 2021; van Moort et al., 2021; Wei et al., 2021). Considering the importance of discourse comprehension for learning, the aim of this narrative review is to present research on the role of establishing these connections, in order to highlight gaps in the research and significant unanswered questions for further study. To carry out this analysis, models that have focused on the establishing of these connections in comprehension will be presented: causal chain model, causal network model, causal inference maker model, landscape model, and contributions from constructionist theory and the event indexing model. We will also present a review of the studies that have examined comprehension based on these models, in order to highlight the evidence about the psychological validity of their proposals, and to point out convergences and differences among the studies. Among the research gaps, it will be highlighted that previous studies have not tended to examine the role of the modality of presentation of the material, nor to present materials involving spontaneous discourse, or dealing with current social issues.

In relation to these objectives, the questions guiding this work are: *what role does the establishment of causal connections play in the construction of the product of comprehension? What are the processes involved in the generation of causal inferences during comprehension? What is the interplay between cognitive processes and the construction of the product of comprehension? What tools can this line of research provide for the facilitation of learning? What gaps exist in the research on this topic? What future directions can be envisaged based on these limitations?*

We hope that the contribution of this paper will be to highlight the importance of future research examining students' comprehension of the discourse they process during lectures, during their social participation in everyday life, and dealing with issues of current social relevance.

Table 1.
Story Example.

- | |
|--|
| 1. One day, Paula was surfing the Internet (setting). |
| 2. when she saw an iPhone advertisement published, (start-up event) |
| 3. and she liked the model very much (internal reaction). |
| 4. She decided that she wanted to get it (goal). |
| 5. She contacted the vendors to ask them how much it would cost (attempt). |
| 6. She realized that she did not have enough money (result). |
| 7. She decided to get a job as a delivery woman (goal). |
| 8. For a few months, she woke up early. (attempt) |
| 9. to have her afternoons free, (result) |
| 10. to be able to work. (attempt) |
| 11. She had soon saved the money she needed (result). |
| 12. She contacted the vendors of the website, (attempt) |
| 13. and bought the iPhone she so badly wanted (result). |
| 14. She was so happy that she organized a celebration with her friends. |

What events do narratives comprise?

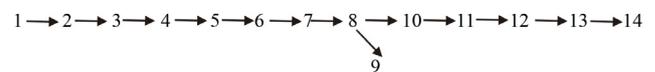
Story grammars have proposed that there are rules about how events are combined in narratives (Beker et al., 2017; Fichman et al., 2021; Mandler & Johnson, 1977; Stein & Glenn, 1979; van den Broek, 1990, 1994). Among these, narratives are organized into *episodes*, which revolve around *goals*, *attempts* to achieve them, and *outcomes* of these attempts (*success* or *failure*). Table 1 presents a sample story.

The comprehender must establish causal connections between the events that make up the narratives.

Narrative Comprehension as the Construction of a Causal Chain

According to the causal chain model, the construction of narrative coherence involves constructing a *causal chain* of events (Black & Bower, 1980; Omanson, 1982). Events that have a cause or consequence are part of this *chain*. Those that do not, represent *dead ends*. Figure 1 presents the causal chain representation of the story in Table 1.

Figure 1.
Causal Chain Representation of Story in Table 1.



Previous studies suggest that events that are part of the *causal chain* tend to be more often recalled (Beker et al., 2017; Black & Bower, 1980; Fichman et al., 2021; Goldman & Varnhagen, 1986; Omanson, 1982; Stein & Glenn, 1979; Trabasso et al., 1984; Trabasso & van den Broek, 1985), more included in summaries of the story (Trabasso & van den Broek, 1985), and judged to be more important (Trabasso & Sperry, 1985; Trabasso & van den Broek, 1985) than dead ends.

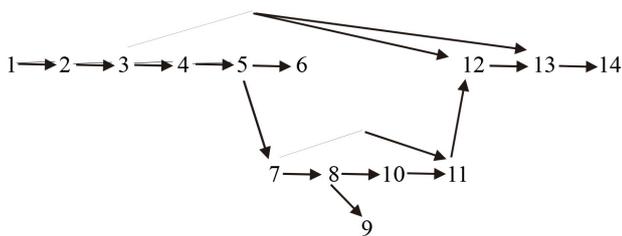
A limitation of this model is that it does not provide explicit criteria to identify the existence of a causal connection, and it contemplates the establishment of a single causal connection for each statement. In order to overcome these limitations, the causal network model has been proposed.

Comprehension of Narratives as the Construction of a Causal Network

Narrative comprehension has also been conceptualized as the construction of a *causal network* (Paviás et al., 2016; Trabasso & Sperry, 1985). The causal network model provides explicit criteria to establish the existence of a causal connection between two statements: it proposes that the cause must be prior to the consequence (*temporal priority*), it must be *operative* when the consequence occurs (e.g., a *goal* when the protagonist *tries* to obtain it), and it must be *necessary* for the consequence to occur (it must be possible for it to be proposed that, if the event that is considered a cause had not occurred, then the one considered a consequence would not have occurred either). Another contribution of this model is that it proposes that statements can have multiple causes or consequences, and distinguishes between

types of causal connections: *motivation* (linking a goal and an attempt to achieve it) - *psychological causality* (linking an event and a cognitive or emotional reaction) - *physical causality* (linking an event and changes it generates in the physical world), and *possibility* (linking events *that are necessary*, but not sufficient for others to occur). Once the causal connections between the statements are identified, they are brought together in a *causal network* representation. Figure 2 presents the one corresponding to the story in Table 1.

Figure 2.
Causal Network Representation of Story in Table 1.



Studies on the Role of Causal Connectivity in Narrative Comprehension

Trabasso, van den Broek, and Suh (1989) asked a group of students to judge the strength of the causal connection between pairs of sentences that were part of a set of narratives. They found that the judged strength was greater when all three criteria were met, and that failure to meet the *temporal priority* criterion had a greater negative effect on the estimated strength than failure to meet the *necessity* criterion. This study helped to highlight that the criteria proposed by the model match the notions of comprehenders. However, it did not examine the role of the number of causal connections of the statements. Trabasso and Sperry (1985) examined this issue and observed that college students assigned higher importance scores to events that had a high number of causal connections. Similar results were found by Trabasso and van den Broek (1985) and Pavias et al. (2016).

In turn, van den Broek and Trabasso (1986) generated alternative versions of narratives, changing the hierarchical level of the goal events (in one version they represented a *superordinate goal* and in another a *subgoal*) and their number of causal connections. The results indicated that the change in hierarchy decreased the probability of the event being included in narrative summaries, only if it was accompanied by a reduction in its number of causal connections. Similar results were found by Fichman et al. (2021).

Whereas previous studies had tended to focus on adults, a series of investigations examined the development of the ability to make causal connections. Their results indicated that children establish them from an early age (van den Broek & Helder, 2017; van den Broek, 1989), and that older children are able to establish a greater number of these connections (Beker et al., 2017; Carlson et al., 2022; Pavias et al., 2016). In turn, establishing these connections facilitates the comprehension of students with learning difficulties (Espin et al., 2007).

Applications of the Model to Facilitate Learning

Given that prior studies suggest that statements with high causal connectivity facilitate comprehension, interventions have been developed that involve presenting causal questions to elementary students that are answered based on the highly connected statements, with the goal of having them incorporate them into their representation of the material (Beker et al., 2017; Carlson et al., 2022; McMaster et al. 2012). For example, in relation to the story in Table 1, a *causal question* might be “Why did Paula decide to look for a job?”.

Other interventions involve revising texts in order to increase the number of causal connections between statements (through *text revision procedures*). These include the *Argument Overlap* (Barreyro et al., 2012; Britton & Gulgoz, 1991), and the *Increasing Coherence Relations Procedures* (Cevasco et al., 2017; Vidal-Abarca et al., 2002). These methods involve identifying types of statements (e.g., *goal, state, event*), connections that exist among them in the original text (e.g., *start, reason, result, cause*) and including new sentences with which the original statements can establish new connections. These revisions make it possible to increase the average number of causal connections per sentence, to integrate distant sentences, and to make the text more coherent. Following the proposals of the *Increasing Coherence Relations Procedure*, Barreyro et al. (2012) revised the following fragment of an original Biology text:

- 1) Unlike conifers, which produce their seeds in open cones,
- 2) angiosperms enclose theirs in a receptacle or fruit. 3) The interaction between insects and flowering plants determined the evolution of both, a process to which which is called coevolution.

and developed a new version:

- 1) Unlike conifers, which produce their seeds in open cones,
- 2) angiosperms enclose theirs in a receptacle or fruit. 2b) What allowed flowering plants to dominate the world so rapidly. 3) was their interaction with insects, which determined the evolution of both, a process that is called coevolution, 3b) thanks to which the number of angiosperms on Earth increased significantly.

Prior studies suggest that these revisions promote the answering of questions and text recall by high school and college students (Barreyro et al., 2012; Beker et al., 2017; Linderholm et al., 2004).

Research Gaps Regarding this Model and Future Directions

One gap in the studies on causal connectivity is that they have not tended to examine the role of the modality of presentation of the material. That is, they have tended to focus on written discourse materials, which have tended to be designed by researchers, but not on the comprehension of spontaneous oral discourse. This gap is significant, given that comprehension of discourse presented in the oral modality is central to students’ academic performance and social participation (Fraundorf & Watson, 2014; Muijselaar et al., 2017). In turn, there are differences between oral and written discourse, which could lead to differences in their processing. Among them, oral discourse requires processing at the speed it is produced by the speaker, it does not allow the reprocessing of statements, and it includes the transmission of nonverbal information. On the other hand, written discourse can be processed at the speed

chosen by the reader, and it allows the reprocessing of statements (Cossavella & Cevalco, 2021; Ferreira & Anes, 1994; Fox Tree & Clark, 2013). Considering these differences, the presentation of spontaneous discourse materials is important, given that previous studies have suggested that it reflects to a greater extent the construction of coherence that students perform during their social participation in everyday settings (Bhide et al., 2020; Golding et al., 1995). Related to this, preliminary studies suggest that statements that have high causal connectivity facilitate recall and response to questions and recall of emotional statements from radio interviews on topics of general interest (Cevalco & van den Broek, 2008, 2019; Cevalco et al., 2020; Cossavella & Cevalco, 2021; de Simone & Cevalco, 2020). These investigations highlight the importance of further studies continuing to examine comprehension of other types of spontaneous spoken discourse materials (such as *recorded lectures*) and other modalities (*combined spoken-written, spoken-spoken*). It is also worth noting that the materials presented by these studies have not tended to deal with current social issues (Pispira & Cevalco, 2022). In relation to this, in our laboratory we are examining the role of promoting the establishment of causal connections among statements, through the performance of *note-taking tasks*, in the comprehension of materials about the implementation of comprehensive sexual education in schools by Argentine university students. Another of our research studies focuses on the role of the presentation of *elaboration questions* that promote the identification of main ideas or statements with high causal connectivity in the comprehension of materials about the prevention of gender violence by Ecuadorian university students.

Another limitation of the research based on this model is that it focuses on the construction of the product of comprehension, but not on the cognitive processes during its processing. The proposals made by the causal inference maker model on this topic will be presented below.

Narrative Comprehension and Generation of Causal Inferences

The *causal inference maker model* contributes to overcome the limitations of previous research, since it examines the processes that occur moment by moment during comprehension. It proposes that comprehenders generate causal inferences, which have, as their starting point, the event being read. *Backward inferences* connect it to previous events. If the immediately preceding event provides causal explanation, a *connective inference* is generated. For example (van den Broek, 1994):

The man accidentally dropped the crystal glass.

The cup broke.

Inference: *The cup broke because the man dropped it.*

If it does not, a search is performed, and there are two potential sources. The first is the *reinstatement* of a previous event. A second source involves activating non-explicit information, through the generation of an *elaborative inference*. For example (van den Broek, 1994):

Pedro's little brother hit him.

Pedro told his parents.

The next day, Pedro's body was covered with bruises.

Inference: *Pedro's body was covered with bruises, because his brother had hit him.*

On the other hand, *forward inferences* generate expectations about what may happen. The model proposes the generation of *predictive inferences*, which involve anticipating events based on the reader's prior knowledge. For example (McKoon & Ratcliff, 1989):

While filming a movie, the actress accidentally fell from the 14th floor.

Inference: *The actress died.*

Studies Examining Causal Inference Generation in Comprehension

In relation to the generation of *connective* and *restatement inferences*, van den Broek and Lorch (1993) observed that the recognition of previously read events was accelerated when they were preceded by an event to which they were causally connected. This occurred both when the presented statement was the immediately preceding one and when it involved previous events. Consistent with these results, Suh (1989) found that previously read *goals* were recognized faster when they were presented immediately after their reinstatement was required. Further evidence converging to suggest that these inferences are generated was found by Hayden et al. (2018), and van den Broek and Helder (2017).

More evidence suggesting that elaborative inferences are made was found in studies in which it was observed that, when college students were presented with prior knowledge questions, they responded more quickly when they followed pairs of sentences in which that information was necessary to causally connect two statements, than when they were unrelated (Singer et al., 1992). For example:

Dorothy poured water on the fire.

The fire went out.

Question: *Did the water extinguish the fire?*

Subsequent studies have found evidence that suggests that comprehenders generate these inferences (Morishima, 2016). Other studies have found similar results regarding the generation of *emotional elaborative inferences* (Mensink, 2021; Mumper & Gerrig, 2021; Pekrun, 2021). These inferences involve establishing a causal connection between a statement and the emotional reaction it is expected to generate in the character. For example (Molinari et al., 2011):

A woman longed for the radishes she saw in a garden through the window,

During the night, her husband quickly jumped the fence, took a handful of radishes,

and took them to her.

Inference: *the woman experienced happiness.*

Regarding the generation of *predictive inferences*, prior studies suggest that the level of causal sufficiency of the event plays a role in the probability that they are generated. For example (McKoon & Ratcliff, 1989):

While filming a movie, the actress accidentally fell from the first floor.

While filming a movie, the actress accidentally fell from the 14th floor.

Inference: *The actress died.*

reading (2) results in shorter naming times than (1), suggesting that inference is more active (Murray et al., 1993). Subsequent studies

have found similar results and have suggested that individual differences and prior context play a role in the likelihood that these inferences are generated (Hayden et al., 2018; Linderholm, 2002).

Developmental studies converge with this research, suggesting that older children are able to generate inferences that connect broad parts of text (paragraphs or episodes), and to infer abstract causal connections (between events and characters' emotions; Hayden et al., 2018; Mouw et al., 2019).

Applications of the Model to Facilitate Learning

Consideration of the model's propositions has led to the identification of reader profiles (McMaster et al., 2012; Seipel et al., 2017). These include *paraphrasers* (readers who tend to paraphrase information from the text, but not to generate causal inferences), and *elaborators* (readers who tend to generate causal inferences, but which are incorrect or invalid). In other words, the model allows us to examine the performance of readers in terms of generating causal inferences. Considering that it proposes that the generation of these inferences facilitates comprehension, the interventions developed involve asking *causal questions* (which require the comprehender to causally connect the event he or she is reading about to specific previous events. For example, 'Why did Paula decide to look for a job?' in Table 1) and *general ones* (which promote the reader to make different connections, such as 'How does this event relate to what you read earlier in the text?' Karlsson et al., 2018).

Research Gaps Regarding this Model and Future Directions

Among the possible gaps, it is worth noting that the studies conducted have not tended to examine the generation of causal inferences during the comprehension of spontaneous spoken discourse. This represents a limitation, given that the cognitive processes involved in comprehending spoken discourse include, for example, processing conversational discourse markers and speech errors (such as *repairs*, or *marked pauses*, Carney, 2022), which do not need to be processed during the comprehension of written discourse. In relation to this, preliminary studies suggest that the presence of discourse markers ('but') facilitates the generation of *reinstatement inferences* (Cevasco, 2009). In turn, these initial studies indicate that the presence of pauses marked by 'eh' impairs the recognition of previously heard words, but not the generation of these inferences (Cevasco & van den Broek, 2016). These studies help us to begin to investigate the role of the interplay between causal inference generation and the characteristics of spontaneous oral discourse, and highlight the importance of further studies on this topic. It will also be interesting for new studies to examine the role of the presentation of questions that promote the generation of emotional elaborative inferences (such as "Do you consider that the speaker experienced an emotion?", "Why?"), since previous studies suggest that they play a role in comprehension. In relation to this, in our lab we are investigating the role of *emotional* and *causal* questioning during the presentation of *bullying* prevention materials by Colombian elementary school students.

Another limitation of research based on the model is that it focuses on the processes during comprehension, but not on the

interplay between the processing of causal connections and the construction of a coherent discourse representation.

The proposals made by the landscape model regarding this interplay will be presented below.

Comprehending Narratives as the Construction of a Landscape of Activations

The landscape model (Linderholm et al., 2004; Yeari & van den Broek, 2016) is a computational model that examines the interplay between cognitive processes and the product of comprehension, considering comprehension as the construction of a landscape of activations. It allows the generation of simulations, in other words, the comparison of responses generated by the program when simulating a cognitive process, under one or another theoretical alternative, with responses generated by human subjects.

The model proposes that the activation of units varies as the reading progresses, and connections (*connection strength*) are established between them. At the end of the reading, each of these units has a certain *node strength*. That is, self-connection strength. Thus, a statement with a high node strength at a given time is more likely to remain activated for a longer time than one with a low node strength. Statements or propositions enter the model in processing cycles, which include new information in working memory, and four sources of activation: 1) the sentence being processed, 2) the immediately preceding reading cycle, 3) the reinstatement of one or more previous statements, 4) information from the reader's prior knowledge.

The model contemplates, following the causal inference maker model, the generation of *connective*, *restatement*, and *elaborative inferences*. Due to the activation of each proposition throughout the processing cycles, a "landscape" of activations is obtained. That is, the activation of the aforementioned sources determines that the activation of the propositions fluctuates constantly. Thus, in each cycle new propositions are activated, others maintain or recover activation, and yet others are displaced from the focus of attention. Considering simultaneously the "peaks" and "valleys" of activation of each proposition throughout the reading cycles, a "landscape" of activations is obtained, from which the model gets its name.

Another proposal concerns *cohort* activation. That is, when one statement is activated, others connected with it also receive some activation. The amount of activation of each of the secondarily activated propositions is a function of the strength of its relation to the primarily activated proposition, and of the amount of current activation of the latter. The cohort of a proposition at a given point in the text differs from its cohort at another, as does the activation transmitted to the cohort. That is to say, just as the activations of each new cycle determine the emergence of the representation, the emerging representation with its already established connections modulates the activations of each new cycle.

In turn, the model proposes a second mechanism: *coherence construction*. It proposes that comprehenders activate information in order to obtain their *standards of coherence*. These standards reflect comprehenders' knowledge and beliefs about what constitutes good comprehension, as well as their goals for comprehending that particular text (*entertainment, study*, Beker et al., 2017; Tibken et al., 2022).

The comprehension simulation includes three phases. In the *first phase*, input values are determined for each statement, based on the analysis of the textual structure. The activation values have been set between 0 and 5. These values are arbitrary, because what is important is the differential activation of the propositions in the reading cycles. The specific value may vary according to the theory of inference generation adopted. For example, a value of 5 can be assigned to the new propositions in each cycle (maximum activation), a value of 4 to the previous propositions co-referential with the new proposition (i.e., those that share some referent with each other), and the previous propositions that have a causal link of *motivation*, *psychological cause*, or *physical cause* with the content of the current cycle, and a value of 3 to the previous propositions that have a causal link of *possibility* (since this is a weaker form of causality). In the *second phase*, the model processes these values cycle by cycle, and produces activation vectors. In the *third phase*, it establishes and updates the connections of the emerging interconnected network. The output are two matrices, one of which contains the *on-line* activation values (the “*landscape*” of activations), and the other the *off-line* connections. That is, one is the *activation matrix*, which contains the activation vectors corresponding to each reading cycle, implemented by the researcher. The other is the *connections matrix*, calculated by the program, which contains the node strengths for each proposition. The values of these matrices reflect the implementation of assumptions about the generation of inferences during comprehension, since they arise from the input of values by the researcher. If one wishes to compare the fit of different models, the landscape allows alternative simulations to be carried out. That is, it is possible to run a simulation that implements the generation of a certain type of inferences (e.g., *causal* or *emotional*), and an alternative simulation that does not provide for the generation of these inferences. The comparison of the adequacy of the alternative simulations to the on-line and off-line behavioral data allows us to elucidate which model has greater psychological validity.

Studies Examining the Construction of a Landscape of Activations during Narrative Comprehension

In order to examine whether the model’s propositions matched the comprehenders’ notions, van den Broek et al. (1996) asked a group of students to read narratives, and to estimate how active they considered each concept to be after reading them. They implemented the causal and referential *coherence standards*. That is, they implemented standards that assume that the reader attempts to obtain *referential coherence* and generates *causal inferences* during comprehension. Referential coherence is obtained when the reader can identify the referent for the objects and persons that are part of the sentence he or she is reading (Kleijn et al., 2019; O’Brien, 1987). For example (van den Broek, 1994):

Raquel and Ricardo were editing a book.

She had some doubts about the editing process.

Inference: *She refers to Raquel.*

The results indicated that the concepts that had a *high node strength* tended to be considered more active and to be recalled more often. This study provides evidence in favor of the

psychological validity of the model. Similar results were found by van den Broek et al. (1999), and Yeari and van den Broek (2016).

In order to examine the role of *emotional elaborative inference* generation, Molinari et al. (2011) implemented two alternative simulations: *causal-referential* and *causal-emotional-referential*. In the causal-referential simulation they implemented the *causal-referential* coherence standards. These standards assume that the reader attempts to obtain referential coherence and generates causal inferences during reading. In the *causal-referential-emotional simulation*, the authors implemented the causal-referential-emotional referential standards. That is, this simulation implements standards that assume that readers generate *causal* and *emotional inferences* while processing the material. Results indicated that the simulation that implemented emotional inference generation was better adjusted to students’ recall protocols. These findings converge with research from the causal inference maker model, which highlights the importance of elaborative inference generation during comprehension.

Other research examined the role of reading purposes (*study-entertainment*, Linderholm et al., 2004) in comprehension. These purposes reflect the standards of coherence of the comprehender. It was observed that the implementation of a simulation that contemplated the *study* purpose resulted in better recall of statements with high causal connectivity than that of *entertainment*. This study provided evidence supporting the model’s proposal about the role of coherence standards in comprehension.

Research Gaps Regarding this Model and Future Directions

Among the possible limitations, it should be noted that the studies conducted have not tended to examine the role of prior knowledge, the reader’s emotions, or the generation of inferences such as predictive ones. In turn, they have not tended to examine the role of the modality of presentation of the material, the presentation of spontaneous discourse materials, or ones regarding current social issues. Consequently, it will be important for future directions to examine these questions.

Constructing Causal Coherence in Narratives: Other Models

Consistent with the proposals of the models presented, *constructionist theory* (Graesser et al., 1994) proposes that readers generate inferences in order to construct narrative coherence (at the local and global level). These include causal inferences to comprehend the event that is being processed, and inferences about *the characters’ goals*. A possible limitation is that this theory does not propose that comprehenders generate elaborative and predictive inferences, given that they are not central to the construction of causal coherence (van den Broek et al., 2005).

In turn, the *event indexing model* proposes that the construction of coherence involves monitoring dimensions of continuity: *time*, *space*, *protagonists*, *motivation*, and *causality* (Bohn-Gettler, 2014; Hoeben Mannaert & Dijkstra, 2021). In relation to the causal dimension, a break or discontinuity will occur when the reader does not find causal explanation for the event he or she is reading. For example, if he or she reads the following (Radvansky et al., 2014):

- (1) *When she arrived at work, Allison began to store her belongings in her locker.*
- (2) *Her colleague arrived at almost the same time.*
- (3) *She had found a dent in her car.*

The reader will identify a causal break when processing (3). Consistent with the model's proposals, prior studies suggest that when there is causal discontinuity between two events, reading times increase (Bohn-Gettler, 2014), readers indicate that they find boundaries between events (Klomberg et al., 2022; Magliano et al., 2012), and they tend to remember sentences involving causal discontinuities to a greater extent (Radvansky et al., 2014).

Other current models highlight the role of information validation in relation to the prior knowledge of the comprehender. These include the *two-stage model of validation* (Richter & Maier, 2017), and the *RI Val model* (O'Brien & Cook, 2016; Sonia & O'Brien, 2021). For more information, see Richter and Maier (2018) and Tibken et al. (2022).

Research Gaps and Future Directions for these Models

As for possible gaps in the research, it should be noted that, like those already described, these models have not tended to examine the comprehension of spontaneous spoken discourse, nor to present materials on current social issues. Consequently, it will be interesting for future studies to examine, for example, the interplay between causal discontinuities and breaks marked by *corrections or marked pauses* in the comprehension of spontaneous spoken discourse.

It would also be interesting for future studies to examine the interplay between the processing of character goals and emotions of the listener in the processing of spoken discourse.

Conclusions

The aim of this paper was to present a review of the research on the role of the establishment of causal connections in the construction of coherence during narrative comprehension, focusing on the convergences and differences among the studies, in order to highlight gaps in the current research and to point out pending questions for further studies.

This review highlighted that statements that have a high number of causal connections make an important contribution to the construction of the product of comprehension, that readers generate causal inferences during the processing of spoken and written discourse (which establish connections among statements, as well as between explicit statements and the reader's prior knowledge), and that the activation of statements fluctuates.

The proposals made by the models allow us to think, in turn, of tools that the teacher can use to facilitate student learning. Among them, he/she can consider the introduction of *causal or general* questions during the lecture and in the materials. For example, he/she can identify and present the main ideas or ideas with high connectivity to the class, and ask questions such as "*Do you think that these ideas that were presented during the class are important to understand the topic we studied? Why? What other ideas from the topics we saw are they connected with?*". In turn, the teacher can review the material that is part of the bibliography, in order to facilitate their comprehension. To do

this, he/she can establish the causal connections that exist between the central ideas of the original text and include new statements that allow new connections to be established, as well as make the implicit causal connections explicit. This can be facilitated, in turn, through the introduction of textual markers (such as *titles* and *subtitles*), which direct students' attention to the main ideas (Beker et al., 2017). On the other hand, in order to facilitate the generation of causal inferences during the reading of the material, the teacher can model and instruct students in performing *metacognitive tasks*, such as *self-explanation* (which involves explaining to themselves the meaning of the information being processed; Lachner et al., 2021), *self-questioning* (which involves the student asking themselves during reading, "*Why does this sentence I read make sense?*", Brown & Pyle, 2021), and *self-monitoring* (which involves the student being able to identify when their comprehension is failing, from asking themselves, "*Do I feel that I understood the last paragraph/sentence I read?*", Tibken et al., 2022).

Regarding the gaps in the research, it has been pointed out that the studies conducted have not tended to focus on the modality of presentation of the material, the presentation of spontaneous discourse, or of materials about current social issues, which represent interesting pending questions for future directions.

In conclusion, this work highlights the importance of continuing studies on the role of establishing cause-effect connections in comprehension, and it recommends that these studies cover the discourse that students carry out in the educational environment, their daily lives, and on topics of social impact.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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