The Role of Connectives in Text Comprehension

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ABSTRACT

Text comprehension results in a cognitive representation of meaning conveyed by the propositions that constitute a text. A variety of linguistic and cognitive factors affect a reader's ability to construct such meaning, that is, to identify appropriate and coherent relations between the propositions. This literature review examines the role of linguistic devices such as connectives in facilitating text comprehension. Theoretical frameworks on the nature of connectives will be presented followed by a review of empirical studies that examined their function in the construction of coherent relations. These studies reveal multiple perspectives to account for the means by which connectives operate to achieve their effects. A discussion of the findings support a cognitive view whereby connectives function as procedural devices by constraining the psychological context that is brought to bear upon comprehension processes.

INTRODUCTION

Text comprehension entails a process whereby the reader succeeds in constructing a cognitive representation of the content conveyed by the text (Keenan, Baillet, & Brown, 1984; Meyer, 1984; Murray, 1995; Sanders & Noordman, 2000). Kintsch and van Dijk (1978) and Murray (1995) argued that successful comprehension does not result merely from decoding strings of letters into a random series of words or processing lists of thematically disconnected propositions. Sanders and Noordman (2000) asserted that "A crucial property of this cognitive representation is that it is coherent. Readers establish coherence by relating the different information units in the text" (p. 37). Haberlandt (1982) claimed that text comprehension results when readers' expectations of unfolding content conforms to the text's local sentence level coherence as well as global discourse coherence that convey ideas throughout the text. Thus, the ability to construct such coherence constitutes an underlying and essential component of text comprehension.

Researchers have focused on several dimensions of text processing that contribute to the

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construction of coherence relations. Halliday and Hasan (1976) proposed the notion of *cohesion* whereby explicit linguistic devices relate one element in the text to another and thus create *texture* through cohesive ties between structurally unrelated propositions. Kintsch and van Dijk (1978) emphasized referential coherence in the form of argument overlap between propositions that render a text-base coherent. The absence of such overlap, therefore, generates inference processing in order to complete these gaps in coherence. Several studies (Keenan et al., 1984; Myers, Shinjo, & Duffy, 1987; Trabasso, Secco, & van den Broek, 1984; Trabasso & Sperry, 1985) pointed to the role of causal relations as a driving force of narrative coherence that leads readers to interpret a text as a search for causal connections. Other researchers (Anderson, 2000; Haberlandt, 1982; Kintsch & van Dijk, 1978; Rumelhart, 1982) have also noted the impact of schema knowledge as a significant factor that bears upon text comprehension. Specifically, readers invoke a schematic conceptual script or frame when they encounter a corresponding instance in the text. Finally, Blakemore (1992), Blass (1993), and Sperber and Wilson (1986) highlighted the significance of psychological context which leads to the construction of coherence relations as a search for relevance between propositions.

This paper presents a review of the literature on the role of connectives in text comprehension. The underlying question may be framed in terms of whether such linguistic devices enable the reader to identify appropriate relationships between propositions, thereby facilitating a coherent representation of text (Golding, Millis, Hauselt, & Sego, 1995; Millis, Golding, & Barker, 1995; Murray, 1995). To that end, this paper will begin with a brief theoretical framework and then present a review of the main empirical studies that have examined the role of connectives in text comprehension. A discussion of the findings and their implications will follow along with proposed questions for future research.

THEORETICAL FRAMEWORK OF CONNECTIVES

Reflecting a text-linguistics approach, Halliday and Hasan (1976) suggested that a text is coherent as a result of *cohesion* which they define as "a semantic relation between an element in the text and some other element that is crucial to the interpretation of it" (p. 8). Central to *cohesion* is the notion of *texture* created by linguistic features such as reference, substitution, ellipsis, and conjunctions that create thematic relations between two or more clauses or within independent elements in the text. Halliday and Hasan's use of conjunctions encompasses the general meaning of connectives as words or expressions that join two clauses together in order to express a coherent relation. Since this paper examines the role of connectives in text comprehension, a discussion of Halliday and Hassan's framework will be limited to their view of conjunctions.

The authors delineated four types of conjunctions: *additive*, *adversative*, *causal*, and *temporal* which function as "a specification of the way in which what is to follow is systematically connected to what has gone before" (p. 227). Therefore, the mere presence of grammatical structures such as clauses or sentences fails to define a text as such. Rather, the essence of a text resides within the meaning relations that emerge from cohesive ties that are created by linguistic devices such as conjunctions. Thus, *cohesion*, or *texture* accounts for how different linguistic elements operate in tandem to construct a meaningful interpretation of

discourse. Cohesion, then, allows the reader to sense a unity of purpose from structurally independent propositions.

Whereas Halliday and Hasan (1976) focused on thematic relations signaled by linguistic devices, Blakemore (1992) and Blass (1993) argued for a cognitive view that is grounded in Sperber and Wilson's (1987) *relevance principle*. Accordingly, communication is guided by an infinite variety of assumptions and beliefs that interlocutors may access and from which they may derive appropriate inferences**.** At the same time, as Sperber and Wilson maintained, humans seek to organize and maximize these assumptions by allocating cognitive resources to identify and process information that is most relevant to the discourse context. Communication between interlocutors is therefore governed by a mutual expectation of maximum contextual effects at minimal processing costs that consume time and cognitive resources. Underlying this mutual expectation, then, is a presumption of relevance whereby the hearer assumes that the information conveyed by the speaker is sufficiently relevant to the discourse in order to warrant the hearer's cognitive efforts in processing that information.

According to Sperber and Wilson (1987), the interaction between previous and new assumptions, that is, the assimilation of new information within previous assumptions generates a contextual effect that renders new information relevant to the old. First, a contextual effect may consist of a contextual implication derived from an interaction between old and new information that yields a new assumption. Second, the interaction between old and new information may support and confirm prior assumptions. Conversely, the old and new information may interact to refute previously held assumptions.

Based upon Sperber and Wilson's (1987) relevance principle, Blakemore (1992) and Blass (1993) emphasized the role of context or cognitive environment as a critical and integral component that shapes and contours discourse interpretation. Continuing Sperber and Wilson's cognitive account of information processing, Blakemore asserted that a communicative act is therefore driven by multiple and varied assumptions that may, in turn, generate an inordinate number of contextual effects. As a result, the interlocutor must expend additional processing effort to sort through and identify the contextual effect that is most relevant to the particular communicative situation.

Within the framework proposed by Blakemore (1992) and Blass (1993), discourse connectives function as procedural devices that indicate how to process the resulting contextual effects. Blakemore suggested that a relevant contextual effect results from inferential computations underlying the construction of mental representations between propositions. In other words, a contextual effect is relevant to a preceding proposition because the interlocutor derives an appropriate inference from the possible assumptions that may be generated. Blakemore further argued that such inferential computations may result from words and expressions that convey linguistic meaning that is procedural rather than representational:

> But given that these representations are intended to undergo computations –to act as premises in deductions— it is surely possible that linguistic meaning also plays a role in determining how they are to be manipulated. In other words, it is possible that some linguistic meaning is procedural rather than representational. (p. 149)

For example, connectives such as *however* or *but* instruct the interlocutor to interpret new

information as a contradiction or refutation of a previously held assumption. The possible contextual effects derived from the interaction between two propositions are thus constrained and allow the interlocutor to reap a maximum reward of interpretation at minimum processing costs. In other words, the interlocutor infers a new and appropriate, that is, relevant assumption.

Blakemore (1992) and Blass (1993) argued that Halliday and Hasan's (1976) text-linguistics model presents an incomplete account of discourse interpretation, suggesting that "we need to move from linguistic connectivity to connectivity of content" (Blakemore, 1992, p. 85). Blakemore's view of discourse interpretation shifts the emphasis from linguistic features to the contextual environment within which the communication is situated. In other words, in the absence of context, linguistic devices fail to adequately facilitate a coherent construction of meaning. Such a cognitive perspective holds that the procedural nature of connectives enables the interlocutor to achieve a level of optimal relevance. Thus, linguistic devices such as connectives not only signal thematic relations (Halliday & Hasan, 1976). More importantly, connectives serve a cognitive function to constrain the potential contextual effects that emerge by limiting and identifying relevant assumptions, and therefore lead to an appropriate interpretation of the communication at hand.

Moreover, Blass (1993) asserted that a framework that defines the potential for discourse interpretation in terms of coherence relations between two propositions precludes single clause and discourse-initial utterances. He, therefore, argued that, "Discourse comprehension is not reducible to the discovery of coherence relations among sentences" (p. 95). Thus, according to Blass, a text-based approach (Halliday & Hasan, 1976) suggests that coherence relations are present prior to cognitive awareness of their existence by means of linguistic devices such as connectives. In contrast, Blass contended that coherence relations result from the search for and identification of relevance between propositional content and context. In other words, a text is coherent and thus interpretable because its propositions are relevant to one another within a shared psychological context, unlike a text that consists of a sequence of propositions that are connected by linguistic markers that signal thematic relations, as suggested by Halliday and Hasan (1976).

The view proposed by Blass (1993) puts forth an interesting perspective on the role of relevance in discourse interpretation. Specifically, coherence relations result as a by-product of the search for relevance. As Blass stated, "Any textual connectivity perceived is only the by-product of something deeper – relevance relations between text and context which any hearer, including the discourse analyst, automatically seeks out" (p. 99). *By-product* is an operative and interesting term that suggests that coherence relations are a consequence of a cognitive process by means of a search for relevance between propositions rather than from previously existing logical relations. Hence, linguistic markers such as connectives do not function to signal the existence of coherence relations as such. Rather, connectives serve to constrain the way in which propositions are relevant and thus may be viewed as procedural signals that enable maximum rewards of interpretation at minimum processing costs (Blakemore, 1992; Blass, 1993).

EMPIRICAL FINDINGS

General Effects of Connectives

The empirical studies discussed in this paper encompass several perspectives that explore the role of connectives in the construction of a coherent text representation. First, researchers hypothesized that the presence of connectives facilitate text comprehension by decreasing reading time and improving content recall (Britton, Glynn, Meyer, & Penland, 1982; Caron, Micko, & Thuring, 1988; Haberlandt, 1982; Meyer, Brandt, & Bluth, 1980; Loman & Mayer, 1983; Spyridakis & Standal, 1987). A second perspective focused on the role of causal relations as unique and distinct in narrative comprehension (Golding et al., 1995; Keenan et al., 1984; Myers et al., 1987; Trabasso et al., 1984; Trabasso & Sperry, 1985). A third view seeks to understand how signaling devices such as connectives stimulate cognitive processing and so examined the cognitive nature of connectives and their communicative meaning as a factor that may determine their effectiveness (Millis & Just, 1994; Millis et al., 1995; Murray, 1995, 1997; Sanders & Noordman, 2000). These studies assessed the impact of connectives by comparative measures of recall performance and reading time for connective-present and connective-absent versions of experimental sentence pairs or short narrative and expository passages. Specific details regarding these assessment tools will be presented within the review of each empirical study.

Haberlandt (1982) found facilitative effects on reading time with the causal connectives *therefore, so, consequently* as well as the adversatives *but, yet, however, instead* and *nevertheless* in connective-present sentence pairs versus no-connective pairs. The findings indicated that target sentences preceded by a connective resulted in faster reading times than unconnected sentences. According to the author, text comprehension involves expectations of unfolding content in terms of local level coherence between adjacent propositions. The meaning of a connective, therefore, corresponds to the reader's expectation regarding the nature of the relations between two sentences and thus facilitates comprehension. On the other hand, a no-connective condition compels readers to construct "compensatory inferences" (p. 243) which consume extra processing time. This notion of a reader's expectation as interacting with the meaning of connectives was subsequently explored as a *postconnective expectancy* in Murray's (1995) processing model discussed in a later section of this review.

However, other studies (Britton et al., 1982; Meyer et al., 1980) found mixed results regarding the impact of connectives on content recall. In a study comprising of three groups of ninth grade pupils representing poor, underachieving, and good readers, Meyer et al. compared the effect of adversative and causal connectives on the students' ability to exploit the rhetorical structure of expository texts. Poor readers were defined as pupils who lack knowledge of top-level text structures that may be exploited to comprehend and recall an expository text. Underachieving readers, on the other hand, were designated as those who are aware of top-level text organization but exploit their knowledge only in the presence of a connective that signals a specific rhetorical structure. Good readers were expected to implement knowledge of top-level rhetorical structures in order to identify the text's hierarchical organization and distinguish between superordinate and subordinate ideas.

The authors predicted that such signaling would aid readers to identify the hierarchical

relations between groups of sentences and ideas conveyed in the text. However, as indicated by the results of recall tasks, the effect of connectives was evidenced only for underachieving readers, thus suggesting that connectives may activate passive knowledge that would otherwise remain underutilized. Good readers as well as poor readers did not benefit from the presence of connectives. It seems then that good readers are able to apply their knowledge of text structure without an active prompt that signals a particular relation. Poor readers most likely lacked the knowledge of text structure that would have allowed them to identify and exploit appropriate connectives. In addition, the findings revealed greater facilitative effects of connectives for the problem-solution passage than the comparison-contrast text used in their study.

Britton et al.'s (1982) study also produced mixed results for the facilitative effect of connectives on comprehension of expository text passages. Like Haberlandt (1982), Britton et al. hypothesized that readers engage in text processing with limited cognitive capacity, defined by the authors following Johnson and Heinz (as cited in Britton et al., 1982) as "the limited pool of energy, resources, or fuel by which some cognitive processes are mobilized and maintained" (p. 51). Britton et al. reasoned that a text's surface structure may hamper text comprehension by imposing additional processing demands upon such limited cognitive capacity. Therefore, causal, additive, and comparison-contrast connectives may alleviate some of the cognitive efforts required to construct a representation of the text content. The absence of such connectives however, compels the reader to consume limited resources in order to interpret the relations conveyed by the text.

As predicted, processing efforts decreased in signaled versions of expository passages, as evidenced by a reaction time task in which subjects released a computer key stroke in response to hearing a click while reading the experimental passage. Prolonged response time to the click indicated increased cognitive processing. In contrast, results for free-recall measures failed to demonstrate a facilitative effect on content recall due to the presence of connectives. Moreover, contrary to faster reading time found by Haberlandt (1982), connectives failed to decrease the subjects' reading time of experimental passages in Britton et al.'s (1982) study.

However, Loman and Mayer (1983) and Spyridakis and Standal (1987) argued against quantitative recall measures as evidence of the facilitative effects of connectives, suggesting instead a qualitative approach that examines the type rather than amount of information readers comprehend and retain with the help of linguistic devices such as connectives. According to Loman and Mayer, a quantitative hypothesis emphasizes the rote nature of reading whereby expository text consists of a sequential series of unrelated units of information that may be learned and memorized. Such engagement with a text limits the reader's focus to units of primacy information (i.e., ideas presented at the beginning of a text) and recency information (i.e., ideas conveyed at the end of the text). The reader therefore fails to construct interrelationships that unfold and drive the text to its conclusion. Consequently, the reader also fails to comprehend conceptual information so as to draw appropriate inferences necessary for problem solving tasks.

On the other hand, Loman and Mayer (1983) argued, a qualitative hypothesis predicts that the presence of linguistic signals such as connectives helps readers to engage in "meaningful reading strategy" (p. 404). In other words, conceptual information revealed by the text's organizational structure aids readers to interpret the relationship between superordinate and subordinate ideas. Hence, comprehension is reflected by conceptual information and the ability

to apply the text's content to problem solving tasks rather than by a quantitative measure of details recalled. According to the findings, readers of texts that signaled causal relations in expository passages recalled key conceptual content whereas non-signaled readers recalled primacy/recency ideas. In addition, signaled readers were able to apply content to problem solving questions better than non-signaled readers.

In a similar study, Spyridakis and Standal (1987) hypothesized that signaling techniques such as logical connectives, preview sentences, and headings facilitate comprehension of expository text by revealing the hierarchical structure of superordinate and subordinate content. In addition, experimental passages contained signaling techniques consisting of global structure headings; preview sentences identifying superordinate ideas; and connectives (*for example, therefore, also, additionally*) to show the relationship between subordinate ideas. Experimental passages were also constructed with various combinations of signals in order to examine the effect of signal types in isolation as well as the effect of their interaction with other signals.

Unlike Loman and Mayer's (1983) study, however, Spyridakis and Standal (1987) developed signaled and non-signaled technical expository passages that reflected four levels of graded difficulty. Each passage expressed a specific rhetorical structure beginning with the least difficult *comparison-contrast* (level 9), and progressing to a *cause-effect-solution* (level 11), a *problem-solution* (level 12) and a *classification* (level 16) passage. The findings revealed an interesting distribution of the facilitative effects of connectives when examined in isolation of other signaling techniques.

First, the results failed to demonstrate a significant effect of connectives in the *comparison-contrast* (level 9) text or *cause-effect-solution* (level 11) passage, a finding attributed to the familiar and accessible content of the material. In contrast, the most potent effect of connectives was found for the *problem-solution* (level 12) passage as evidenced by detail and superordinate recall measures as well as inference generation scores. In addition, the most difficult *classification* (level 16) passage showed a beneficial effect of connectives only insofar as they interacted with global structure headings for inference generation but not for superordinate or subordinate recall. Finally, preview sentences combined with logical connectives proved beneficial only in the *problem-solution* (level 12) passage for all measures.

Spyridakis and Standal's (1987) findings, then, are consistent with Loman and Mayer's (1983) assertion that comprehension is demonstrated by qualitative measures. However, unlike Loman and Mayer's study in which readers encountered unfamiliar expository text, Spyridakis and Standal's pool of participants consisted of pre-engineering students who had already acquired some knowledge and familiarity with the subject matter of such technical prose. Consequently, as Spyridakis and Stendal acknowledged, their experimental material contained potentially difficult content that may nonetheless have corresponded to the participants' world knowledge, thereby mitigating the level of difficulty.

In another and rather unusual study, Caron et al. (1988) examined the potential effect of connectives on inference generation as an essential process for the successful construction of coherence relations. In order to isolate and examine the nature of inference generation, experimental sentence pairs consisted of composite sentences that were intentionally unrelated so as to prevent subjects from drawing plausible inferences. An example of such a pair is as follows: "*The priest was able to build the new church. The computer had made a serious error*" (p. 311). Such an experimental design is quite interesting and unique because the content of the

sentence pair does not seem to conform to an expected pattern of adjacent propositions.

Nevertheless, Caron et al. (1988) hypothesized that connective-present sentence pairs would trigger inference activity through elaborative processing and thus sustain the sentence content in memory. Cued and free recall tasks compared recall performance of no-connective pairs with composite sentence pairs connected by *and, because*, and *but*. Their findings demonstrated better recall for *because* sentence pairs than for no-connective pairs and those connected with *and* or *but*. In addition, recall was better for sentences connected with *and* and *because* than with *but*. However, based upon an error analysis of inferences generated by the recall responses, Caron et al. concluded that *but* and *because* produced more inferential errors than *and* thus demonstrating the effect of the different meanings of the connectives on the potential to trigger inference activity. In addition, the authors attributed higher recall of *because* pairs to a greater number of inferences that were generated by the causal connective.

Causal Relations and the Role of Connectives

Several studies (Golding et al., 1995; Keenan et al., 1984; Myers et al., 1987; Trabasso et al., 1984; Trabasso & Sperry, 1985) examined the role of the reader's search for causal relations in the construction of a coherent representation of text in narrative comprehension. Although these studies did not examine the function of specific causal connectives as such, they nevertheless provided an additional dimension through which to explore the role of connectives in text comprehension.

The primacy of causal relations holds that readers expect to identify the causes and consequences of phenomena they encounter in narrative texts, a process that parallels their means of understanding and organizing the world (Trabasso et al., 1984; Trabasso & Sperry, 1985). Moreover, Trabasso et al. distinguished between short term and long term connectivity underlying the construction of coherent relations. The former, according to the authors, is derived from linguistic cohesive devices (Halliday & Hasan, 1976) which yield sentence level or local coherence. In contrast, long-term connectivity is established when readers invoke their world knowledge in order to construct causal connections that account for the events and circumstances depicted in the narrative. As Trabasso et al. (1984) observed, "structure arises from a general consideration of viewing story understanding in terms of an attempt by the comprehender to infer relations among events in terms of human goals and purposes" (p. 108). Hence, readers construct a coherent representation of text that is primarily driven by an intuitive expectation of satisfying cause-effect relations (Trabasso et al., 1984; Trabasso & Sperry, 1985).

In Trabasso et al.'s (1984) study of adults' narrative comprehension, an analysis of the participants' interpretations of story narratives revealed that readers tend to interpret narratives by identifying cause-effect chains linked together in a causal network that carry and direct the narrative forward to its resolution. Trabasso et al. speculated that readers distinguish between such causal events and those that fail to signal cause-effect relations, described by the authors as dead-end events. These dead-end events are then discarded from the causal chain and relegated to dead-end paths since they do not lead to further causal interpretation. Consequently, the authors argued, events placed on the causal chain were better remembered than those discarded as dead-end paths. Moreover, Trabasso and Sperry (1985) found that readers judged events on the causal chain as more important than those directed and placed on dead-end paths. Thus,

readers judge causal relations as more important to the interpretation of narratives than other elements such as text structure hierarchy (Trabasso & Sperry, 1985). However, narratives do not unfold by means of causal relations alone, but may also reveal parallel and adversative relations. The researchers' focus on causal relations, therefore, risks limiting their findings since reliance on such a restricted genre excludes these other types of relations that readers seek to comprehend.

Keenan et al. (1984) also explored the nature and impact of causal relations on text comprehension. Asserting that referential coherence and argument overlap between propositions (Kintsch & van Dijk, 1978) present a limited account of coherence, the authors suggested that causal relatedness between sentences plays a significant role in the construction of coherence relations. In other words, a coherent text interpretation emerges from knowledge-based relations that are constructed during the process of interclause integration. Therefore, the authors reasoned, readers construct and integrate highly related clauses faster than those that are low related in their content. Causal relatedness was established by the degree of probability that the content of the first sentence causes a result expressed in the second sentence. The experimental sentence pairs reflected a graded scale of four levels of plausible cause-effect situations ranging from a highly probable cause-effect relation (level 1) to a highly unlikely relation (level 4). In addition, each sentence pair contained an identical second sentence so that the degree of causal relatedness was modified by the content of the first clause.

The authors expected to find faster reading time of a second sentence in a cause-effect pair as the level of relatedness increased. In addition, the authors expected to find improved recall for highly related propositions as their content would be sustained in memory. Results for reading time and a cause-recognition test confirmed increased reading time of the second sentence as the level of causal relatedness decreased and thus reflected, according to the researchers, an attempt to search for and construct a cause-effect relationship. These results therefore confirmed that interclause integration entails the construction of knowledge-based relations such as cause-effect sequences (Keenan et al., 1984). On the other hand, responses to comprehension questions did not reveal a significant impact of relatedness.

A surprising finding, however, contradicted the underlying premise of the study that predicted better recall performance for highly related cause-effect sentence pairs. Contrary to the authors' expectations, the intermediate level of relatedness yielded better recall and recognition task results than highly or low related propositions. As suggested by the researchers, cognitive processing demands may have accounted for these unexpected results. That is, on the one hand, highly related sentences require less processing efforts and so are less likely to be encoded and sustained in memory. In contrast, highly implausible sentence pairs require greater processing effort yet fail to generate an adequately plausible relation to be likewise sustained in memory. Moderately related propositions, then, are most likely to be integrated and recalled (Keenan et al., 1984).

Similar results were also obtained by Myers et al. (1987), but the researchers proposed an elaboration hypothesis to account for the findings. According to Myers et al., readers generate bridging inferences triggered by the sentence content as they attempt to integrate causal relations between sentences. Therefore, the content of low related sentence pairs may perhaps fall below an adequate threshold to elicit such elaboration whereas the highly related pairs do not require elaboration in order to construct a coherent causal relation. Hence, moderately related sentence pairs provide sufficient content to generate bridging inferences that allow for an appropriate

interpretation of causal relations.

In an effort to extend these findings, Golding et al. (1995) examined the effect of *therefore* and *but* on elaborative processing as they interact with causal relatedness. Golding et al. expected to find increased recall of highly related sentence pairs due to the elaborative processing triggered by the causal connective. However, comparative results for connective-present and no-connective sentence pairs did not show a significant effect of the connective *therefore*. Rather, connective-present findings were consistent with the previous patterns indicating decreased reading time as causal relatedness increased as well as optimal recall for moderately related sentences (Keenan et al., 1984; Myers et al., 1987).

On the other hand, results for the adversative *but* revealed interesting differences according to connective-present versus no-connective conditions. First, reading time in connective-present pairs was decreased across all levels of relatedness when compared to a no-connective sentence pair, thus confirming a signaling function of disconfirmation (Golding et al., 1995). However, recall results failed to show a significant impact of the adversative on connective-present versus no-connective pairs. Second, a comparison between all levels of connective-present pairs replicated the results reported by Keenan et al. (1984) and Myers et al. (1987), which indicated improved recall in moderately related sentences. However, the no-connective condition revealed improved recall in highly related sentences. Golding et al. concluded that a lack of signaling in the no-connective condition compelled readers to engage in elaborative processing and therefore increased the likelihood of recall, as had been suggested by Myers et al.

Cognitive Processing and Communicative Function of Connectives

Several comprehensive studies (Millis & Just, 1994; Millis et al., 1995; Murray, 1995, 1997; Sanders & Noordman, 2000) illustrated an attempt to understand the cognitive processes which connectives stimulate to achieve their effects. Millis and Just (1994) argued that "the connective explicitly signals the reader to integrate the two clauses together and form a representation which encompasses the representation of each individual clause" (p. 128). The researchers therefore analyzed the sequence of cognitive steps with which the causal *because* and adversative *although* lead to interclause integration.

The study by Millis and Just (1994) was grounded in a connective integration model whereby readers engage in a sequence of cognitive steps that result in interclause integration of two clauses joined by a connective. According to Millis and Just, when readers encounter a connected sentence pair, they read the first clause and store a mental representation of its content in working memory. When readers continue to read the second sentence, they integrate the stored representation of the first clause with the contents of the second clause. The meaning of the connective informs the readers' construction of a coherent relation between the clauses. In the absence of a connective, the reader may or may not construct the intended representation of the relation. Consequently, the authors concluded, such absence may compel readers to consume extra processing efforts in order to arrive at the intended interpretation of the two clauses.

Based upon the connective integration model, a reactivation hypothesis postulated that the presence of a connective in a connected sentence pair increases the activation level of the content of the preceding clause, thus facilitating interclause integration. Millis and Just (1994)

noted, however, that the absence of a connective does not necessarily prevent reactivation of the content or interclause integration. Reactivation may occur but to a lesser degree, and interclause integration may be achieved by means of inferences drawn from the content of the sentence pair. A greater degree of reactivation was nevertheless predicted in a connective-present pair compared to no-connective sentence pairs, thereby yielding an integrated representation of the text as evidenced by improved recall. The researchers also reasoned that integrative processing generally consumes time and occurs during sentence wrap-up, thus resulting in increased reading time at the end of the second clause. Paradoxically, then, the presence of connectives may increase reading time of the second sentence. Yet, its signaling function was expected to decrease reading time, thereby indicating its facilitative effect on interclause integration.

Results confirmed the reactivation hypothesis, as evidenced by faster response time to a probe word verification task as well as shorter reading time for the second clause in connective-present sentence pairs compared with no-connective pairs. In addition, responses to comprehension questions were more accurate in connective-present sentences than in no-connective pairs. The authors concluded that the causal connective *because* facilitates interclause integration by reactivation of the first clause as well as by signaling to the reader how to interpret its relation to the second clause.

The findings of Millis and Just's (1994) study also revealed other dimensions of the reactivation function of connectives in interclause integration. First, additional results indicated that readers construct a representation of the first clause which is then stored in working memory until its retrieval by means of reactivation after the interpretation of the second clause. Second, the findings pointed to a tentative support for causal relatedness (Keenan et al., 1984) and elaborative processing (Myers et al., 1987) as factors that interact with the connective *because* in sentence reactivation. That is, the results did not show direct evidence of an increase in the number of elaborations as such. However, according to the authors, the causal connective increased elaborative processing and thus reactivated the first clause in a moderately related sentence pair to a greater degree than in a low related pair. Third, the study showed that reactivation of the first clause also occurred when it was presented as a negated proposition. As a result, although negation initially decreased reactivation, the presence of a connective compensated for this effect by prompting the reader's search for the relation signaled by the connective.

Finally, the authors also confirmed the reactivation hypothesis for the presence of the adversative *although.* Interestingly, however, some differences emerged between the effect of the causal and the adversative connectives. Whereas the presence of a causal connective reactivated only the first clause, the presence of *although* reactivated both the first and second clause of a sentence pair connected by the adversative. Millis and Just (1994) speculated that the complex nature of adversative relations compelled readers to exert extra processing effort that sustained the content in working memory and thus led to its reactivation. In addition, the findings showed increased reading time of the second sentence in *although* pairs, in contrast to decreased reading time for sentences connected with *because*. Responses to comprehension questions for *although* pairs were also less accurate than those for *because* sentences. The overall results for *although* sentence pairs, according to the authors, suggest that adversative relations are more difficult to interpret and integrate into a coherent representation.

The comprehensive results of the study led Millis and Just (1994) to conclude that

connectives facilitate interclause integration and, thus, a common representation of text by "modulating the activation of constituent structures needed to arrive at a coherent model of the discourse" (p. 145). Specifically, connectives aid integrative processing, hence comprehension, by facilitating the reactivation of the first clause and the integration of its content with the second clause into a unified and coherent representation.

The notion of connectives as modulating devices (Millis & Just, 1994) prompted Millis et al. (1995) to compare the causal *because*, additive *and*, and temporal *after* in order to examine whether interclause integration also incorporates knowledge-based inferences triggered by the connective's meaning. The authors first hypothesized and confirmed that sentences connected with *because* generate causal inferences to a greater degree than no-connective pairs. The authors also found increased reading time and greater response accuracy on comprehension questions because, as they concluded, inference generation consumes processing time and therefore sustains the content in memory.

A second research question examined alternative explanations to account for the findings regarding causal inferences. Millis et al. (1995) reasoned that, on the one hand, causal inferences were generated due to the specific meaning of the causal connective. An additive or adversative connective, therefore, was not expected to generate causal-effect relations between adjacent sentences. Alternatively, causal inferences may have resulted from a reader's tendency to seek and construct causal relations among adjacent sentences, as argued by Trabasso et al. (1984) and Trabasso & Sperry (1985). Millis et al. therefore proposed a *specific-inference hypothesis* that predicted increased causal inferences generated by the explicit meaning of the connective *because*. Sentences joined by the additive connective *and* were not expected to yield causal inferences because the scope of the connective's communicative meaning allows for the interpretation of a wider range of relations.

In contrast, a *general-inference hypothesis* expected to find causal inferences resulting from both additive and causal connectives based upon Trabasso et al.'s (1984) and Trabasso and Sperry's (1985) conclusions that readers invoke knowledge-based causal inferences during narrative text processing. The results supported the *specific-inference* hypothesis as evidenced by a greater frequency of cause-effect inferences for sentences with the causal *because* connective than those with the additive *and*. Moreover, no-connective pairs failed to generate causal inferences. Hence, according to Millis et al. (1995), the connective *because* most likely generates causal inferences by signaling specific causal relations while the additive *and* may serve that function to a lesser extent. Sentences that are not joined by a connective are least likely to facilitate inferencing.

A third research question explored whether greater inference generation for *because* sentence pairs may be attributed to the subjects' perceived temporal relation signaled by *because*. Millis et al. (1995) therefore tested a *temporal-cuing hypothesis* by comparing the effect of *after* with *because* as well as with a no-connective sentence pair. The connective *after* failed to trigger causal inferences and so did not lend support for a temporal-cuing hypothesis. Hence, Millis et al.'s (1995) specific-inference hypothesis confirmed and expanded upon the conclusions drawn from Millis and Just's (1994) findings for the reactivation hypothesis. Specifically, the meaning of a causal connective may constrain its function in two ways. First, the meaning of a connective exerts a greater modulating effect on reactivation of the first clause. In addition, it facilitates interclause integration by triggering knowledge-based inferences associated with causal relations.

Murray (1995) further explored the role of the communicative meaning of connectives in a study that proposed a processing model whereby the connectives function to constrain the way a reader integrates two adjacent sentences into a coherent representation of text. Murray argued that the connective's meaning triggers a cognitive search that limits the range of possible relations to be construed between two clauses. Reading time and recall performance were compared between no-connective pairs and sentences linked by additives such as *moreover*, adversatives such as *however*, and causals such as *therefore*.

Results indicated that connectives decreased reading time only in connected sentence pairs that signaled adversative relations. In fact, causal connectives led to a minor increase in reading time, a finding Murray (1995) attributed to a search for causal relations triggered by the meaning of the connective which may require additional processing time. With respect to recall results, connective-present sentences failed to demonstrate a facilitative advantage over no-connective sentence pairs. However, when the findings are limited to a comparison between connective types within a connective-present condition, adversatives led to improved recall when compared to causals or additives. Thus, Murray asserted, although connective-present and no-connective pairs did not indicate significant differences in the overall impact of connectives, the meaning of the adversative facilitated interclause integration at least in comparison to additives and causals.

Yet another interesting finding was that the communicative meaning of connectives also affected the participants' own perception of logical relations conveyed by sentences joined by connectives. In other words, the participants judged connected sentences to be clear and comprehensible in comparison to no-connective pairs across all types of connectives. In particular, participants identified causal relations in both connective-present and no-connective pairs as easiest to interpret. These findings along with increased reading time for sentences joined with a causal connective led Murray (1995) to align his findings with Trabasso et al.'s (1984) and Trabasso and Sperry's (1985) conclusions emphasizing the central role of causal relations in narrative comprehension. On the other hand, adversative relations were perceived as more comprehensible in connective-present sentences than in no-connective pairs. Therefore, Murray concluded, the adversative connective enabled readers to construct a logical relation between two clauses that would otherwise remain incoherent in the absence of such a marker of disconfirmation. Although Murray's (1995) study differed in that the participants read isolated sentence pairs rather than narrative stories (Trabasso et al., 1984; Trabasso & Sperry, 1985), the relative simplicity of these sentence pairs paralleled the lack of complexity of narrative stories. Interestingly, Murray acknowledged and recognized that such simplicity may have contributed to the comprehensibility of the sentence pairs.

Based upon these findings, Murray (1995) suggested that connectives operate under a set of communicative meaning and procedural constraints that lead the reader to generate certain expectations that inform interclause integration. In other words, the presence of a particular connective in the text signals and invokes the appropriate knowledge base corresponding to the connective, thereby generating an "expectancy of the content of the post-connective sentence" (p. 120). First, adversatives are highly constrained and so limit the relationship between two sentences to contrasting propositions. Second, causal connectives are described as moderately constrained, indicating a cause-effect relationship between two sentences. Finally, additive connectives are characterized as highly unconstrained as they signal that a sentence preceded by

an additive merely elaborates upon the information conveyed in the previous sentence (Murray, 1995). This processing model seems to draw upon Blakemore's (1992) notion of connectives as expressing a *procedural* meaning that enables the interlocutor to infer a relevant contextual effect when processing propositions. In fact, Murray's notion of a post-connective expectancy of a particular relation echoes Blakemore's view of connectives as "expressions … that simply encode instructions for processing propositional representations" (Blakemore, 1992, p. 151). Interestingly, however, that reference to Blakemore (1992) is quite absent from Murray's research study.

Continuing the exploration of the effect of connectives on cognitive processing and interclause integration, Murray (1997) examined the reader's perception of narrative continuity as a salient factor that contributes to narrative interpretation. Murray proposed a psychological mechanism model grounded in Bruder, Duchan, Rapaport, Segal, Shapiro, and Zubin's (1986) and Segal, Duchan, and Scott's (1991) view of connectives as signals of deictic continuity in narrative text processing. Specifically, readers interpret successive clauses as conveying information that evolves and assimilates within their construction of the text representation as a continuous unfolding of content. Moreover, readers engage in narrative processing of the events and discourse that are depicted in the story as internal participants rather than as external third party observers. Readers thus identify with and embody the point of view of the character or narrator of the text. As they become "one" with the story's characters, readers expect to experience a continuous exposition of the narrative while they process and construct their interpretation of the story's events. From the readers' point of reference, such construction of meaning takes place within a deictic center in the narrative (Bruder et al., 1986; Segal et al., 1991).

Extending Bruder et al.'s (1986) framework, Segal et al. (1991) observed that narrative continuity may be disrupted by a change in time or place, theme, or character. Such changes result in a new deictic center in the narrative as new information is assimilated with the old. Bruder et al. specifically characterized this change as a deictic shift within the narrative as well as the readers' perspective. A deictic shift, then, represents a discontinuity between previously processed and subsequent content. Hence, this notion of deictic continuity underlies readers' engagement with a narrative story. As Segal et al. asserted:

> A new sentence in the text is interpreted in terms of an ongoing construction of an integrated component of the narrative's meaning. Unless specifically marked, the new meaning is incorporated into and regarded as continuous with the current ongoing construction. (p. 32)

Continuity thus constitutes the unmarked condition in narrative texts so that connectives serve as signals of discontinuity. Moreover, connectives function to sustain a continuous flow of content, thereby alerting readers to a deictic shift or discontinuity in the narrative and facilitating the construction of a coherent text representation (Segal et al., 1991).

Based upon this notion of deictic shift, Murray (1997) tested a *continuity hypothesis*, whereby adversatives that signal discontinuity were expected to demonstrate a greater facilitative effect than additives and causals signaling continuity. The author expected to find a facilitative advantage for adversatives because readers have less of a need for explicit signaling of continuity

since they expect a linear unfolding of text. Moreover, according to Murray, adversatives were expected to enhance readers' ability to process and integrate interclausal representations to a greater degree than connectives that signal continuity.

Each experimental sentence pair consisted of an identical target sentence preceded by a different first sentence intended to result in a target relation type that conveys an additive, causal and adversative relation. Each pair was also joined by a choice of two connectives that did not correspond to the relation conveyed by the pair, as well as a no connective option. A sample item is as follows (Murray, 1997):

> Additive: Manny informed his staff about the garage sale. (Consequently, However, no connective) He arranged for flyers to be made.
> Causal: Manny needed to publicize the garage sale. (Moreover, However, no connective) He arranged for flyers to be made.
> Adversative: Manny forgot to publicize the garage sale in the paper. (Moreover, Consequently, no connective) He arranged for flyers to be made. (p.231)

In other words, sentences were joined by incorrect connectives in order to assess whether incorrectly placed adversatives impede processing efforts to a greater degree than incorrectly placed continuous connectives such as additives and causals. Participants were presented with sentence pair connected by each possible connector as well as with no connective. Processing constraints were measured according to increased reading time of the second sentence and poor recall of the pair when compared to a no-connective set. Continuous additive connectives included *moreover, furthermore, also, and*, as well as causals which reflected a cause-effect sequence such as *therefore, so, thus, consequently*. As in Murray's (1995) study that explored the constraints of connectives, causals did not include the connective *because* signals a discontinuous effect-cause sequence. Connectives such as *yet, nevertheless, however,* and *but* comprised discontinuous signals.

Several findings emerged from the study. First, results of a general sentence continuation task indicated that readers distinguish between different types of connectives according to the predicted continuous-discontinuous dimensions. In fact, sentence pairs that were not linked by a connective were interpreted as continuous, a finding that supported the expectation of a linear unfolding of text. Second, as expected, adversatives that signal discontinuity showed greater facilitative effect than additive and causal connectives that denote continuity. In addition, inappropriate placement of connectives led to processing constraints for all types of connectives. Finally, a comparison between incorrect placement of additives, causals, and adversatives suggested greater processing constraints for incorrectly placed adversatives. Moreover, adversative relations were also judged to be less coherent than those incorrectly linked by additives and causals.

Thus, Murray (1997) concluded, adversatives that signal discontinuity are more likely to affect cognitive processing during interclause integration than additives or causals. It is important to note, however, that Bruder et al. (1986) and Segal et al. (1991) examined text processing within a genre limited to narrative stories. Since goals and expectations vary according to the discourse genre a reader encounters, the notion of deictic shift and continuity that underlies Murray's conclusions may not apply to other genres such as expository writing.

Finally, Sanders and Noordman (2000) suggested another cognitive approach to interclause integration which views coherence relations in conceptual terms such as a *problem-solution*, *cause-consequence*, or *list*, because they "establish coherence in the cognitive representation language users have or make of a discourse" (p. 38). The authors referred to coherence relations as cognitive entities that enable readers to construct a coherent text representation that encompasses both clauses. Moreover, the authors argued, such conceptual relations may be inferred or construed with or without the presence of explicit linguistic devices such as connectives. In addition, the conceptual complexity of different types of coherence relations may affect the construction of a coherent representation of two clauses.

Sanders and Noordman (2000) expected the participants to integrate and interpret problem-solution relations faster and more accurately than list relations because the reader anticipates a solution to the problem presented in the preceding sentence. In addition, the authors maintained that both implicit (no-connective) and explicit signaling (connective-present) of coherence relations ultimately yield a similar cognitive representation of the coherence relation. Consequently, an online representation may be constructed faster with the aid of connectives, but may not necessary lead to enhanced off-line recall performance. The authors, therefore, did not expect to find improved recall for connective-present versus no-connective pairs.

Experimental material consisted of sentences that conveyed a *problem-solution* relation signaled by a causal connectives *therefore* and *because*, and a *list* relation expressed by the additive connectives *also* and *furthermore*. The findings supported the hypothesis that different relation types affect text processing, as evidenced by faster processing of a *problem-solution* relation than an additive relation. Recall findings, however, were mixed. As predicted by the researchers, a delayed recall task confirmed a lack of effect of connectives. However, an immediate statement verification task revealed better recall of content from problem-solution relations in a connective-present condition, suggesting that a direct facilitative effect of connectives is limited to online processing.

The main findings then, according to the researchers, emphasize the nature of the relation as a primary factor that contributes to the reader's interpretation of coherence relations. Sanders and Noordman (2000) concluded that "coherence relations are an indissoluble part of the cognitive representation itself, whereas linguistic markers like connectives and signaling phrases are merely expressions of these relations that guide the reader in selecting the right coherence relation" (p. 56). Faster processing results may thus be attributed to the cognitive representation of a *problem-solution* versus a *list* relation. The presence of a linguistic marker such as a connective may prove less significant than the conceptual nature of the relation signaled by the marker.

DISCUSSION

The Case for a Cognitive Framework

Consideration of the studies presented in this review raise a number of issues regarding the meaning of connectives and their cognitive role in text comprehension. Evidence of the role of connectives in cognitive processing was reported by Britton et al. (1982). Although their

findings for causal, additive, and comparison-contrast connectives failed to demonstrate a positive impact on recall of content in expository text passages, a comparison of results for a reaction time task showed a decrease in cognitive processing efforts in texts that contained connectives. These findings, then, suggested a relationship between connectives and cognitive resources that are expended in order to achieve text comprehension. Britton et al.'s study may have thus provided at least partial albeit indirect support for the subsequent assertion by Blakemore (1992), Blass (1993), and Sperber and Wilson (1987) that connectives minimize processing costs in discourse interpretation. The underlying cognitive processes that may account for the nature of this relationship were subsequently explored by Millis et al. (1995), Millis and Just (1994), Murray (1995, 1997), and Sanders and Noordman (2000), whose findings contribute to a salient illustration of the cognitive dimensions of connectives and their role in a coherent interpretation of text. Their studies, however, did not specifically attempt to link cognitive processing with the relevance framework (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987). The discussion that follows, therefore, explores a potential intersection between the empirical findings of cognitive studies and aspects of relevance, an intersection that remains a question mark for future research.

Millis et al. (1995) and Millis and Just (1994) confirmed that connectives reactivate the first clause to be integrated with an adjacent clause and thus enable readers to construct a coherent and unified text representation guided by the connective's meaning. As the researchers reported, the connective *because* triggered knowledge-based inferences that modulated reactivation to a greater degree than the adversative *although* (Millis & Just, 1994) and the additive *and* or the temporal *after* (Millis et al., 1995). Moreover, a surprising result showed that the adversative *although* reactivated the second clause of a pair, a finding Millis and Just attributed to the complex processing entailed by adversative relations. Other effects of connectives included increased elaborative processing in moderately related sentences compared to low related pairs, as well as reactivation of a negated first clause.

Millis and Just (1994) therefore concluded that "the decline in activation of the first clause and its ensuring reactivation demonstrate that linguistic devices such as connectives alter the activation levels of linguistic representations" (p. 144). Reactivation of the first clause by means of a connective contributes to text comprehension by facilitating inter-clause integration. Thus, the findings for the reactivation hypothesis (Millis et al., 1995; Millis & Just, 1994) may suggest that relevant contextual effects (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987) may be generated when one clause is reactivated and integrated with another to form a coherent relation. In other words, the connective's meaning constrains these effects and aids the reader to identify relevance between propositions because they indicate how to integrate two adjacent clauses upon reactivation of the first clause.

Murray's (1995) delineation of low-constrained, moderately constrained and highly constrained connectives seems to evoke Blakemore's (1992) notion of connectives' procedural nature derived from meaning constraints and which serves to identify relevant contextual effects. As reported previously in this review, Murray concluded that the meaning of a low constrained or highly constrained connective generates a postconnective expectancy of confirmation or disconfirmation of the preceding content. In other words, a low constrained additive connective is designated as such because it allows a wider scope of interpretation and signals that the postconnective sentence merely elaborates on the preceding content. An adversative, on the other

hand, limits a relation between sentences to disconfirmation.

Furthermore, Murray's (1997) distinction between continuous additive and causal connectives versus discontinuous adversatives adds yet another dimension to the underlying processes by which connectives operate. As suggested by the author, interclause integration of adversative relations shifts cognitive processing in reverse in order to interpret a relation that emerges from content in the first clause which is disconfirmed in the subsequent clause. Based upon Murray's findings highly constrained and discontinuous adversatives, for example, may be viewed as serving to limit emerging contextual effects to a disconfirmation of a preceding contextual assumption.

Similarly, Sanders and Noordman (2000) suggested a procedural and cognitive aspect of connectives, and concluded that connectives serve as surface cues that guide the construction of text representation. Such cues or linguistic codes generate an *encoding effect* (Sanders & Noordman, 2000) that enables the reader to identify the type of relation conveyed by the content, as evidenced by their findings that causal connectives led to greater facilitation of interclause integration than additives. Thus, according to the researchers, although the absence of such a linguistic code does not necessarily prevent the reader's construction of a text representation, an appropriate interpretation may simply entail more time and effort to achieve.

Taken together, these findings (Millis et al., 1995; Millis & Just, 1994; Murray, 1995, 1997; Sanders & Noordman, 2000) may account for the cognitive processes that enable readers to identify relevance between propositions, thereby achieving relevance during discourse interpretation (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987), whether such interpretation occurs between interlocutors engaged in verbal communication or between a reader and the author of a text. Consistent with the relevance framework (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987), connectives may serve as procedural devices that constrain multiple contextual effects by instructing the reader as to how to identify relevance between relations and thus construct a coherent interpretation of text at minimal processing costs.

The case for a cognitive framework, however, must take into account a significant limitation of the studies which were based upon experimental sentence pairs. These studies attempted to categorize the function of connectives and their facilitative effects according to the type of relation that they signal such as additive, causal and adversative. However, with the exception of Caron et al. (1987), the researchers did not clearly indicate whether the experimental sentences were controlled for content transparency that would allow the participant to comprehend a relation between propositions regardless of the presence or absence of a connective.

For example, the following sentence pair may be successfully interpreted without the presence of a connective: *There was coffee all over the floor. He had dropped his glass.* A correct interpretation of a causal relation between these propositions may be relatively easy to construct by invoking the reader's world knowledge that a coffee glass can drop to the floor thus spilling the coffee. An adversative relation may also be clearly interpreted without a connective: *Death Valley is one of the hottest places on earth. Alaska is one of the coldest*. A reader's world knowledge regarding the contrasting temperatures of these geographical locales may lead to a correct interpretation of the relation without the need for an explicit adversative connective. As a result, the presence of a connective in both of these examples may actually consume extra cognitive efforts and increase reading time in order to process the connective and its meaning (H.

Williams, personal communication, November 2004).

Other examples may also suggest that connectives do not always lend themselves to strict classification. For example, an adversative relation may also be expressed by a sentence pair joined by an apparently continuous connective such as *and*: *Death Valley is one of the hottest places on earth and Alaska is one of the coldest*. According to Murray (1997), the additive *and* signals continuity yet as illustrated by this example, an adversative relation may be interpreted with relative ease. At the same time, the additive *and* may also express a causal relation, as in the following sentence: *I stepped onto the icy sidewalk and I fell flat on my face.* Here again, world knowledge allows the reader to conclude that an icy sidewalk usually causes a pedestrian to slip and fall. Finally, the continuous causal relations may also be signaled by a discontinuous connective such as *because*.

Hence, categorization of connective types according to low constrained versus high constrained and continuous versus discontinuous presents a deceptively neat correspondence to the nature of procedural constraints suggested by the relevance framework (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987). Although Blakemore attributes a procedural role to connectives, the distinction between low and high constrained connectives does not figure as an intrinsic feature of the function of connectives. In other words, the procedural nature of connectives is not quantified and distributed along a graded scale so that one type of connective such as an additive may constrain a contextual effect to a lesser degree than an adversative, as suggested by Murray (1995). Rather, Blakemore's relevance framework emphasizes the importance of context within which interlocutors interpret propositions. Connectives, then, function to select the most relevant contextual effect among a number that may arise from adjacent propositions. For example, a proposition may therefore be identified as contextually relevant because it is joined by a connective that encodes an instruction to interpret the content as a confirmation or refutation of the preceding segment. In addition, as previously noted, the text genre may also influence the characterization of a *low-constrained* versus *high-constrained* connective in the sense that a simple narrative genre mitigates the necessity for explicit connectives because the relations may be relatively transparent and thus comprehensible. Therefore, the distinction between low- and high-constrained may not be stable across all text genres (H. Williams, personal communication, November 2004).

Dialogue between cognitive studies and linguistic theory is therefore necessary in order to elucidate a variety of issues such as semantic distinctions, the role of text genre, communicative context, and reader characteristics. Such factors as sentence content and world knowledge were not specifically examined by Millis et al. (1995) and Millis and Just (1994). On the other hand, Murray (1995, 1997) acknowledged the relative simplicity of the experimental sentence pairs, suggesting further investigation of the effect of connectives on complex expository texts. The impact of reader characteristics such as ability to invoke world knowledge and awareness of text organization schema was also noted by Sanders and Noordman (2000) as issues for future research.

Effects of Communicative Meaning

In light of the findings that attribute a procedural and communicative function to connectives (Millis et al., 1995; Millis & Just, 1994; Murray, 1995, 1997; Sanders & Noordman,

2000), along with a relevance model (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987), it may be tempting to expect highly constrained adversatives (Murray, 1995, 1997) to prove most beneficial to interclause integration and text comprehension because they signal a disconfirmation in the subsequent text, thereby facilitating the goal of maximum rewards of interpretation at minimum processing costs (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987). Conversely, highly unconstrained additives (Murray, 1995, 1997) may prove to be less facilitative since readers can expect a wide range of elaborations, thus requiring greater processing efforts to construct a coherent interpretation. A comparison of these differences may contribute to the understanding of the cognitive nature of connectives in text comprehension. The findings reported in this review suggest that low constrained additive connectives as described by Murray, indeed appear to be less facilitative than causal connectives (Caron et al., 1988; Millis et al., 1995; Murray, 1997; Sanders & Noordman, 2000) or adversative connectives (Caron et al., 1988; Murray, 1995, 1997).

Upon closer consideration, however, comparative findings for causal and adversative connectives suggest a rather tentative conclusion in favor of adversative connectives. First, although Meyer et al. (1980) did not set out to compare different types of connectives per se, their findings indicated greater facilitative effect for causal connectives in problem-solution texts than in comparison-contrast passages. Likewise, Spyridakis and Standal (1987) found that connectives enhanced readers' comprehension and inference ability in problem-solution expository texts but not in less difficult comparison-contrast passages. In addition, Caron et al.'s (1988) findings demonstrated greater inference activity and recall performance in causal sentence pairs than in those connected by the adversative *but*.

Other findings (Golding et al., 1995; Haberlandt, 1982; Murray, 1995, 1997), however, pointed to a greater facilitative effect for adversative connectives than causals. Furthermore, Millis and Just's (1994) findings also revealed an inconsistent effect of differentiation between the different meanings conveyed by a connective. That is, whereas the causal connective *because* reactivated only the first clause, the adversative *although* also reactivated the contents of the second clause. Yet, in the same study (Millis & Just, 1994), reading time for both *because* and *although* sentence pairs was generally faster than for no-connective pairs while connective-present pairs led to faster reading time with *because* than with *although*. In addition, responses to comprehension sentences showed greater accuracy in *because* sentence pairs than in those linked with *although*, despite the extra processing efforts that may have retained the sentence content in working memory (Millis & Just, 1994).

A paradox seems to emerge from the findings regarding causal and adversative connectives. Although Murray (1995, 1997) characterized adversatives as highly constrained connectives, the findings do not provide consistent support for their greater facilitative effect compared with moderately constrained causals (Caron et al., 1988; Meyer et al., 1980; Millis & Just, 1994; Spyridakis & Stendal, 1987). Several factors may account for these results. First, one explanation may be rooted in the complex nature of the relations signaled by adversatives. As noted by Murray (1997) and Millis and Just (1994), the complexity of disconfirmation may entail greater processing efforts since it compels the reader to negate the content of a postadversative clause as well as engage in reverse processing that is compelled by its discontinuous nature (Murray, 1997).

Another factor is associated with findings that illustrate a significant impact of causal

relations on text comprehension (Keenan et al., 1984; Myers et al., 1987; Trabasso et al., 1984; Trabasso & Sperry, 1985). As Trabasso et al. (1984) and Trabasso and Sperry (1985) concluded, readers intuitively seek to establish causal connections in narrative reading because they seek to understand and organize their world. They therefore attempt to comprehend and interpret narrative texts as a search for causal relations. Findings in studies of causal relatedness also demonstrated the significance of knowledge-based causal relations, suggesting that moderately related sentences facilitate interclause integration to a greater extent than low or highly related sentences (Keenan et al., 1984; Millis & Just, 1994; Myers et al., 1987). Thus, the apparent central role of causal connections may have informed readers' interpretation processes in the studies that led to positive findings for causal connectives (Caron et al., 1988; Meyer et al., 1980; Millis & Just, 1994; Spyridakis & Standal, 1987).

Furthermore, the expectation of identifying explanations for events and phenomena (Trabasso et al., 1984; Trabasso & Sperry, 1985) may also represent an example of schema knowledge (Anderson, 2000; Rumelhart, 1982) that the reader brings to bear upon text interpretation. Anderson and Rumerlhart define schema as a script or frame which organizes and categorizes knowledge structures according to their characteristic features and interrelationships associated with a particular concept. The resulting conceptual knowledge is thus embedded within a frame or a script and stored in memory. Schema knowledge, then, consists of such scripts or frames that are invoked when a reader encounters a corresponding instance of that concept in a text (Anderson, 2000; Rumelhart, 1982). As Rumelhart asserted, "the process of understanding discourse is the process of finding a configuration of schemata that offers an adequate account of the passage in question" (p. 42). For example, readers may invoke a story schema that leads them to interpret a narrative in terms of causal connections, or an expository text in terms of a problem-solution or comparison-contrast script.

In line with this view, Sanders and Noordman (2000) suggested that causal relations, as expressed by the problem-solution sentence pairs in their study, invoked the schematic knowledge that led readers to anticipate a problem to a solution. Therefore, readers engaged in an active search for a solution, and thus constructed a text representation that corresponded to a problem-solution relation. Causal connectives, the authors asserted, triggered the readers' schematic knowledge, and thus may have accounted for their findings of faster text processing and accurate retrieval of problem-solution relations than additive list relations.

Finally, in their study of connectives and expository text structure, Meyer et al. (1980) speculated that the difference between the effect of causal and adversative signals may have been attributed to a developmental aspect that was not considered by the researchers. That is, schema knowledge that enables the conceptualization of problem-solution or cause-effect relations may be acquired prior to a comparison-contrast organization of discourse. Therefore, the authors suggested, the presence of the causal connectives triggered a search for meaning between relations that may have already been conceptually familiar to the readers. Thus, the findings in favor of causal connectives over adversatives (Caron et al., 1988; Haberlandt, 1982; Meyer et al., 1980; Millis & Just, 1994; Sanders & Noordman, 2000; Spyridakis & Stendal, 1987) may be attributed to the readers' predisposition towards causal connections. At the same time, schema knowledge may also have elicited causal frames or scripts, thereby inducing readers to construct a cause-effect relation in a clause preceded by a causal connective or conveyed by a global problem-solution and cause-effect discourse structure in expository text. In particular, Caron et

al.'s (1988) unique experimental design may have led participants to rely on a cause-effect interpretation as the only strategy with which to construct a representation of thematically unrelated clauses. Thus, better recall performance for *because* found by Caron et al. may have resulted due to processing demands that were facilitated by the intuitive search for explanations as readers invoked familiar world knowledge.

However, Murray's (1997) continuity hypothesis provides another perspective on causal connectives that may account for those findings that indicate greater facilitative effects of adversatives than causals (Golding et al., 1995; Haberlandt, 1982; Murray, 1995, 1997). As Murray concluded, a reader's expectation of narrative continuity may affect the communicative meaning constraints imposed by similar connectives such as *therefore* and *because*, both of which signal a causal relation. In other words, the continuous connective *therefore* signals a *cause-leads-to-effect* sequence that conforms to a linear and expected exposition of events since the effect is expressed in the second sentence. As Segal et al. (1991) observed, a continuous unfolding of narrative may be considered unmarked because it conforms to readers' expectations.

In contrast, Murray (1997) concluded that the discontinuous connective *because* triggers a postconnective expectancy that the second clause contains *the cause* for the *effect* that is presented in the first clause. Thus, *because* alerts the reader to an effect-cause sequence, which counters the expectation of linear continuity from one clause to another. Consequently, the findings for *but* versus *therefore* may suggest that the adversative is more effective because it signals discontinuity and thus overrides the signaling function of *therefore*, a continuous connective. As a result, according to the author, the facilitative effect of a continuous connective such as *therefore* is diminished when compared with the effect of a discontinuous adversative.

The results that suggest minor or lack of facilitative effect for the connective *therefore* compared with the adversative (Golding et al., 1995; Haberlandt, 1982; Murray, 1995, 1997) seem to contradict the evidence of enhanced processing and comprehension of causal relations (Meyer et al., 1980; Caron et al., 1988; Millis & Just, 1994; Spyridakis & Standal, 1987). Interestingly, however, those studies which resulted in faster reading times for causal relations compared the discontinuous connective *because* with *but*. On the other hand, the studies that indicated shorter reading time for adversative relations (Golding et al., 1995; Haberlandt, 1982; Murray, 1995, 1997) compared continuous causals such as *therefore* with adversatives**.** In light of Murray's (1997) findings, the facilitative effects of adversatives compared to *therefore* may reflect the distinction between discontinuous and continuous connectives.

In sum, a definitive assessment of the effectiveness of connectives in terms of communicative meaning distinctions remains tentative. Nevertheless, the findings contribute to a cognitive framework for the role of connectives and demonstrate that connectives do not merely signal the existence of thematic relations (Halliday & Hasan, 1976). Rather, connectives and their modulating effect reactivate a preceding clause that leads to the construction of a coherent relevant relation. Hence, consistent with the notion of the search for optimal relevance underlying discourse communication (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987), connectives serve as linguistic devices that provide procedural knowledge (Murray, 1995, 1997; Sanders & Noordman, 2000) that constrains the multiple contextual effects generated in the process of interpretation.

Directions for Future Research

The studies discussed in this review suggest a variety of avenues for future research on the role of connectives in text comprehension. One area to address concerns issues of methodology that may shed further light on the cognitive and communicative function of connectives and its implications for relevance (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987). In general, the individual studies presented in this review did not examine connectives in a systematic manner that compared their function across causal, additive, adversative, and temporal relations within the same study. For example, Loman and Mayer (1983) focused only on the causal connective *because* while other researchers examined causals with adversatives (Britton et al., 1982; Golding et al., 1995; Haberlandt, 1982; Meyer et al., 1980; Millis & Just, 1994; Spyridakis & Standal, 1987). Caron et al. (1988) and Murray (1995, 1997) compared the effect of causal, additive and adversative connectives whereas Sanders and Noordman (2000) compared causal and additive relations. Temporal connectives appear to escape scrutiny altogether, except in the study by Millis et al. (1995) in which *after* served to examine a temporal cuing hypothesis in order to determine whether the effect of *because* is due to knowledge-based causal inferences or to a temporal meaning.

Future research, therefore, may consider a systematic comparison of connective types, especially in terms of the impact of their meaning constraints and modulating effects on Millis and Just's (1995) reactivation hypothesis and Sanders and Noordman's (2000) notion of an encoding effect in the interpretation of conceptual relations. In addition, Bruder et al.'s (1986) and Segal et al.'s (1991) concept of deictic continuity in text processing presents another factor that may interact with communicative meaning constraints so as to enhance or impede comprehension. As suggested by the findings reviewed in this paper, the causal *because* was more facilitative than an adversative connective (Caron et al., 1988; Meyer et al., 1980; Millis & Just, 1994) whereas the causal *therefore* was less facilitative than an adversative (Golding et al., 1995; Haberlandt, 1982; Murray, 1995, 1997). Future research may elucidate these contradictory results by considering the role of deictic shift (Bruder et al., 1986; Segal et al., 1991) in a comparison of the discontinuous connective *because* and continuous connective *therefore*. Such a study may hone our understanding of the role of connectives in the search for relevance.

Another issue of methodology concerns the studies' experimental material which comprised of narrative stories (Trabasso et al., 1984; Trabasso & Sperry, 1985), expository texts (Britton et al., 1980; Loman & Mayer, 1983; Meyer et al., 1980; Sanders & Noordman, 2000; Spyridakis & Standal, 1987), and sentence pairs (Caron et al., 1988; Golding et al., 1995; Haberlandt, 1982; Keenan et al., 1984; Millis et al., 1995; Millis & Just, 1994; Myers et al., 1987; Murray, 1995, 1997). These diverse types of textual sources revealed advantages and disadvantages for exploring the function of connectives.

First, narrative stories represent a type of "stereotypical" (Sanders & Noordman, 2000) genre that contains conceptually familiar content. Narratives, therefore, allow readers to invoke story schema (Anderson, 2000; Rumelhart, 1982) that they have already acquired and to draw upon their prior background knowledge to facilitate a coherent interpretation of the text (Loman & Mayer, 1983; Meyer et al., 1980; Sanders & Noordman, 2000; Spyridakis & Stendal, 1987). Consequently, if narrative passages are relatively easy to comprehend, they may not directly or adequately reveal the facilitative effect of connectives in text comprehension. The findings that point to the primacy of causal relations in narrative comprehension (Trabasso et al., 1984;

Trabasso & Sperry, 1985) should therefore take into account that these narratives reflected a measured level of simplicity.

Expository text, on the other hand, is inherently more complex and presents new and unfamiliar information to the reader (Loman & Mayer, 1983; Meyer et al., 1980; Sanders & Noordman, 2000; Spyridakis & Stendal, 1987). Moreover, such experimental passages also represent a genre for which readers may not necessarily have acquired schema knowledge (Anderson, 2000; Rumelhart, 1982) that facilitates comprehension, as suggested by Loman and Mayer (1983). The impact of content complexity was also illustrated by Spyridakis and Standal's (1987) findings in which expository text passages were constructed to reflect a scale of graded levels of difficulty. Interestingly, the results did not reveal significant effects on passages of low difficulty, a finding attributed to the familiar and accessible content of those passages. In contrast, the results for increasingly difficult passages demonstrated the benefits of logical connectives on comprehension of superordinate and subordinate content. Such experimental material may therefore provide a more precise or accurate assessment of the effect of connectives to facilitate comprehension compared to narrative stories.

On the other hand, a comparison of extended texts may be more difficult to control for variables such as content difficulty, length of passage, and the number of connectives within each passage. For example, Spyridakis and Standal (1987) compared texts with different levels of difficulty as well as varying lengths. Hence, the results may have been affected by the length of passage rather than its difficulty or vice versa. Similarly, Meyer et al. (1980) found greater facilitative effects for a problem-solution passage which contained one third more signaling devices than the comparison-contrast text.

The choice of sentence pairs versus extended passages may also reflect the objective of the study. Murray (1995) cautioned that such pairs may present relations that are inherently easy to integrate and comprehend. Like narrative stories, sentence pairs may not accurately reflect the effect of connectives. Moreover, such pairs examine the effect of connectives within a condition that is devoid of a global macro-level context provided in an extended passage. However, experimental sentence pairs may reveal the cognitive processing entailed in interclause integration (Caron et al., 1988; Haberlandt, 1982; Keenan et al., 1984; Millis et al., 1995; Millis & Just, 1994; Murray, 1995, 1997; Myers et al., 1987). As Meyer et al. (1980) noted, extended passages highlight macro-level relationships between chunks of sentences that signal top-level discourse structure. Consequently, such macro-level findings may not isolate the function of connectives from the impact of a global context so as to examine the facilitative effect of connectives on micro-level interclause relations.

On the other hand, Kintsch and van Dijk (1978) noted the importance of the interaction between global macrostructures and microstructures that convey referential coherence and argument overlap in the construction of coherence relations. Similarly, Rumelhart (1982) and Anderson (2000) emphasized the significance of readers' schema knowledge of text structure that readers may invoke during comprehension. As a result, the impact of a global context which may elicit broader conceptual knowledge, either in terms of content or text genre, may not be revealed by isolated sentence pairs. For example, Meyer et al. (1980) speculated that greater facilitative effects for causal connectives in the problem-solution passage may have resulted because their subjects had not yet acquired a comparison-contrast text structure schema.

Finally, the study by Caron et al. (1988) is particularly worthy of mention because the

experimental material consisted of unrelated sentence pairs that did not seem to conform to a natural pairing. The authors developed these sentence pairs in order to assess the impact of connectives on inference generation and recall of content. Given the unrelated content of such pairs, the findings may not yield a substantive conclusion. The need for minimal plausibility was confirmed by Keenan et al. (1984) in their study on causal relatedness in which even the most highly implausible sentence pairs conveyed a minimal confluence of circumstances that expressed a cause-effect relation so as to conform to "the pragmatics of discourse" (p. 126). The subjects in Caron et al.'s study, therefore, searched for relationships that were not sustained by the content of the sentences. As Golding et al. (1995) concurred, such thematically unrelated propositions were unlikely to result in successful inter-clause integration.

Implications for ESL Learners

Although the scope of this review is limited to the general function of connectives in text comprehension rather than their specific impact on ESL learners, another area of research concerns the role of metalinguistic ability such as language knowledge and "cognitive control" (Bialystok & Ryan, 1985) that learners may exploit to facilitate text comprehension. Similarly, Baker and Brown (1984) argued that readers' metacognitive knowledge and monitoring skills facilitate text comprehension. Such knowledge entails awareness of a comprehension problem and the ability to resolve the problem by implementing a linguistic solution. A learner's metacognitive knowledge may include linguistic knowledge as well as the ability to identify a decoding problem and apply an appropriate strategy to resolve such a problem (Baker & Brown, 1984). Explicit instruction on connectives and their procedural function may improve ESL learners' metacognitive awareness and provide them with linguistic tools to facilitate their comprehension.

Geva's (1992) study provided findings that are worthy of brief mention to illustrate the potential for further research on metacognitive knowledge and its pedagogical implications. The researcher proposed a *developmental pyramid* that reflects the relationship between L2 proficiency and learners' ability to understand and utilize conjunctions in comprehension of expository text. The base of the pyramid comprises of learners with basic intrasentential knowledge of conjunctions and progresses upwards to include intersentential knowledge of conjunctions as signals of coherence relations. As the pyramid narrows towards its apex, learners are able to establish coherence relations at all levels of discourse, from intrasentential to global text structure, and thus can comprehend logical relations throughout the text. Geva concluded that, "the adult L2 learner gains more proficiency and automaticity in processing various components of L2, the ability to deal with larger chunks of text and with the logical meaning of conjunctions connecting such chunks develops" (p. 744). Thus, explicit instruction of connectives and their various functions may aid ESL learners to improve their metacognitive skills in order to exploit this knowledge to resolve comprehension problems.

CONCLUSION

This paper reviewed empirical studies that researched the role of connectives in the

interpretation of coherence relations so as to facilitate the construction of a text representation. The findings were examined in light of a cognitive model (Blakemore, 1992; Blass, 1993; Sperber & Wilson, 1987) that views discourse interpretation as governed by the search for optimal relevance between propositions. Such a framework expands upon Halliday and Hasan's (1976) notion of textual cohesion by proposing that connectives function as procedural devices that yield optimal relevance by constraining the psychological context that is brought to bear upon the task of interpretation. The findings reviewed in this paper also provide fertile ground for further research on the cognitive and communicative dimensions of connectives as facilitators of the search for relevance.

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