

Contrastive Information Processing in Discourse Comprehension*

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Abstract A brief survey of linguistic studies on the nature of contrastive information in discourse was presented first, and an attempt was also made to incorporate the linguistic theories and concepts about contrast in discourse into a psychological framework. A tentative model of processing of contrastive information in discourse was proposed, and eight experimental studies on the effects of contrastive information on comprehension and memory of short and long discourses were reviewed. Experimental results showed that contrastive sentences took more time to process at encoding, and yet were recognized faster and cued-recalled in greater amount than noncontrastive sentences. It was also found that levels of contrast in the discourse structure have some effects on encoding time. It was further found that the sentence immediately following the contrastive sentence was processed slowly regardless of whether it does or does not resolve the contrast. The implications of the results of empirical studies were discussed in relation to developing a research framework that integrate coherence studies and contrast studies across the two disciplines of linguistics and cognitive psychology.

Key words Contrast in discourse, Contrastive information, Coherence of discourse, Discourse comprehension

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The Psycholinguistic research on discourse comprehension has gone through several shifts in emphasis. In the earliest period, research was centered on the representation of explicit discourses (Kintsch, 1974). Then in 1980's, researchers in this field realized (ex.: van Dijk & Kintsch, 1983) that what is important in discourse comprehension is not the representation of a discourse as given explicitly, but rather the representation of what the given discourse is about (van Dijk & Kintsch, 1983). This realization led to studies on the role of mental models or situation models in discourse comprehension.

In a third period of development, starting from the late Eighties, cognitive scientists

shifted their attention more to the roles and effects of the knowledge comprehenders bring to processing of discourses. That is, the emphasis shifted to the comprehender's prior or background knowledge and to the interaction between this and a discourse (Lorch & O'Brien, 1995). All through these phases, the issue of 'coherence' in discourse representation has always been at the center of debate, and various theoretical ideas and empirical data on coherence in discourse representation have been proposed (Sanford & Garrod, 1994; van den Broek, 1994). Indeed, the concept of what precisely is involved by the notion of coherence has not been resolved.

Past Research on Coherence: its Limitations

There have been a series of studies, by linguists, cognitive psychologists, and other cognitive scientists, which investigated various aspects of coherence in discourse comprehension. Halliday and Hasan (1976) proposed a view of coherence mainly in terms of linguistic cohesion. Carrell (1982), on the other hand, stated a contrary view arguing that coherence is not cohesion. Hobbs (1979, 1985, 1990) characterized coherence as reference relations, and suggested a classification scheme of coherence, using a limited set of organizing principles. van Dijk and Kintsch (1983) contrasted two types of coherence, – referential coherence and global coherence, and emphasized the importance of situation models in the formation of a coherent representation of discourse. Sanders, Spooren, and Noordman (1992) postulated coherence relations as cognitive entities and proposed a taxonomy of coherence, based on a set of cognitive primitives. Garnham (1991), on the other hand, argued that it is not necessary to postulate a separate set of coherence relations to explain coherence among the parts of a discourse, and that what does matter is the relations between the linguistic information in discourse and the world that it is about. Givon (1993, 1995) asserted a cognitive view, rather than a linguistic view, of coherence such that coherence is fundamentally not a property of the text but rather of the mind. He viewed coherence as a mental entity and as grounding, classified coherence into knowledge-driven vs. grammar-cued coherence and local vs. global coherence, and came up with a provisional model of processes of coherence processing. This cognitive view resonates in Gernsbacher and Givon (1995), Graesser, Mills, and Zwann (1997), Noordman and Vonk (1998), Sanders and Noordman (2000), and Sanders (2001). Sanders and Spooren (2001) states that “coherence is considered a mental phenomenon; it is not an inherent property of a text under consideration” (p. 7).

There are some other theoretical expositions on coherence, postulated by linguists,

cognitive psychologists, and researchers in other fields. Gernsbacher and Givon (1995)'s edited book presents a comprehensive summary of the states of affairs. Some of the authors in the book emphasized the nature of coherence building as a collaborative and pragmatic work in conversational discourse. There are other positions, too. Giora (1997) and Wilson (1998) launched a pro-con debate on the implications of relevance theory for coherence. Thagard (2000) proposed a frame that could link linguistic and philosophical theories of coherence.

In reviewing this continuous development in research on coherence, we notice that there are two aspects lacking. One is a comprehensive theoretical framework for coherence in discourse that integrates linguistic studies and psychological studies. The other is that the research on coherence in discourse comprehension has been centered mostly on the aspects of assimilation of new information into the representation formed already, based on the information which appeared earlier in the same discourse. Even though there have been flurries of serious theoretical discussions by linguists on syntactic, semantic, and pragmatic aspects of contrastiveness in discourse structure, no serious attempt, at least on the part of cognitive psychologists, has been made to unravel the exact cognitive processes of how comprehenders recognize and resolve the information that is contrastive to, conflicts with, or mismatches with the prior information in the discourse (namely how they conduct the accommodation processes), and how this entails a positive effect on deeper comprehension and memory of a discourse. Nor has there been any systematic experimental study on the part of cognitive psychologists to incorporate contrastive information processing into a new theoretical or experimental framework of coherence processing in discourse comprehension. The present study is a modest attempt to review the state of the affairs and to propose a small remedy for this situation of imbalance between two disciplines.

Most researchers agree that coherence is a matter of mind rather than a purely linguistic phenomenon (Givon, 1995; Sanders, Spooren, & Noordman, 1992), and that the process of comprehending a discourse is essentially a process of constructing a coherent representation of the discourse (Lee, 1981; Lorch & O'Brien, 1995; Sanford & Garrod, 1994; van Dijk & Kintsch, 1983). In constructing a coherent representation, the compatibility between the current information (New) and the representation formed beforehand based on the preceding sentences (Given) is an important factor. Since Bransford and his colleagues' early research (Bransford, Barclay, & Franks, 1972), it has been repeatedly reported that a match between the given and the new information has some positive effects on formation of a coherent representation of a discourse, while a mismatch has negative effects. The situation that could contradict this accepted view has not been explored by cognitive psychologists.

Contrastiveness in Discourse

The central thesis of the present paper is that a mismatch in discourse representation can sometimes engender a positive effect on discourse comprehension. The possibility of such a positive effect of some contrastive or mismatch information in discourse has been raised in rhetorical texts, literatures, and the arts. Indeed, the positive aspect of recognizing and resolving some mismatching (contrastive) information is a strong motif in literature, drama, movies, and cartoons. We could even extend this analysis by suggesting that a mismatch is the possible cognitive basis of the dynamics of Zen enlightenment. In the following Zen dialogue, the enlightenment of the pupil presupposes a recognition and resolution of a contrast or mismatch present in the representation of the discourse.

Pupil : 'What is the one word?'

Master : 'What do you say?'

Pupil : 'What is the one word?'

Master : 'You make it two.' (Humphreys, 1961)

It seems that the presence of contrastive information in literary works, movies, or in Zen dialogues would somehow bring about a complete reorganization of the representation of the discourse and a deeper understanding. We could say that studies on contrast might turn out to be the best possible meeting ground between Cognitive Science, and Literature.

Before we start to explore this possibility of positive effect of contrastiveness on discourse comprehension, it seems that we need, first, to analyze and redefine the nature of contrastiveness in discourse, and then explore possible models of the cognitive mechanisms that bring about the positive effects of contrast information in comprehension and memory of discourses. The former issue has been discussed mostly by linguists. The latter issue is mainly of psychologists' concern.

Conception of Contrastiveness in Linguistics

In their description of types of cohesive connectives, Halliday and Hasan (1976) listed the adversative type of sentence connectives as connecting contrastive information to the previous information. Since their research, there have been a series of linguistic studies on the nature of contrast or contrastiveness in discourse (Couper-Kuhlen & Kortmann, 2000).

Most of the linguistic discussions on contrastiveness in discourse – We are not discussing here about the concept of contrast at lexical–semantic level (Clark, 1992, Grandy, 1992) nor at phonological level. We are discussing contrast at discourse pragmatic level. – have been centered on the issues of relationship of contrastiveness with sentential focus and topicality.

There have been continuing discussions on the issues of the nature of contrast, types of contrast, the role of contrastive linguistic markings, and conversational implicature. On types of contrast, the following researchers suggested different conceptions: In classifying the types of coherence relation, Mann and Thompson (1987) distinguished ‘contrast’ from ‘antithesis’ and ‘concession’, arguing that the former is a sort of neutral contrast that reflects the balance of nuclearity, unlike concession or antithesis. In listing conjunctive relation, Bateman and Rondhuis (1997) suggest, without clear definition of contrast, three different types of contrast: exception, replacement, and difference–opposition. In discussing about the pragmatic nature of contrastive connectives, Oversteegen (1997) proposes three different interpretations of contrastive connectives: semantic opposition, denial of expectation, and concession. He further elaborates about the difference between strong contrast (causative– contrast) and weak contrast (non–causative contrast).

Since a critical review of the vast linguistic literatures on contrast or contrastiveness is beyond the scope of the present paper, we will not go into the details of the on–going serious discussions in linguistics on this subject. (An example of the discussions can be found in the topics of the ‘PIONIER Workshop “Contrast in Discourse”, 2003’.) We will just present a limited short survey of linguistic research on contrastiveness.

Researchers have different views on the definition and nature of contrastiveness, depending on what they think about what makes a discourse contrastive. Lakoff (1971), in his discussion of ‘but’, views contrast as involving two phases: expectation and denial. Halliday and Hasan (1976) states a similar conception in their classification of cohesive connections: they view contrastiveness as some information ‘somewhat contrary to expectations.’ For van Dijk (1977) it is something ‘contrary to the content of the information given in other sentence.’ This view of denial–of– expectation is supported by other researchers, such as Lang (1984), and Ford (2000). Brausse (1998) also postulates that contrastiveness is present in a discourse when “the assertion rendered by the second clause is” in opposition “to an assumption that either may be read off, or must be inferred from, previous information.” Umbach (2004, 2005), on the other hand, proposes a position that is not based on the denial of an expectation but on the exclusion of alternatives.

The early conception of contrastiveness has gradually evolved into a more refined conception in which additional features were added. It has been argued that contrastiveness

in discourse must not only satisfy the condition of 'denial of expectation', but also the condition of providing a limited number of alternatives (Chafe, 1976; Monlar, 2002; Umbach, 2001). On the other hand, some other researchers (Monlar, 2002; Oversteegen, 1997) do not want to limit the meaning of contrastiveness to the concept of 'denial-of- expectation' with 'limited number of alternatives', and suggest a need for a more finely differentiated concept of contrastiveness. Monlar (2002) argues that contrastiveness should satisfy the following five criteria: highlighting, dominant contrast, membership in a set, limited set of candidates, and explicit mentioning of alternatives. The linguistic expositions on the nature of contrastiveness in discourse are still evolving. Nevertheless, we can say that most of researchers agree on that contrastiveness must involve, at least, some sort of 'denial-of- expectation' aspect.

Among the other aspects of contrastiveness, the aspect that has produced the most vigorous discussions are the issues of the relationship of contrastiveness with focussing and topicality (e.g., Lee, 1999, 2003), and whether contrastiveness is of syntactic, semantic, or pragmatic nature have been in the center of the discussions on contrast. Chafe (1976) separated the notion of contrastiveness from the status of focus, and Kiss (1998) distinguishes a contrastive focus from an ordinary focus, whereas Bolinger (1961) and Lambrecht (1995) view focussing is always contrastive. Lambrecht (1995) asserts that contrastiveness, unlike focus, is not a category of grammar but the result of general cognitive processes referred as 'conversational implicature'. Monlar (2002) also proposes that contrastiveness is not simply a feature of topicality and focussing, but it could be regarded as an autonomous phenomenon of information structure, and must be included into the pragmatic categories. It seems that some researchers favour the syntactic view, while others favour the cognitive-pragmatic view.

On types of contrastiveness, Lakoff (1971) proposed two types of contrastiveness; namely, 'Semantic Opposition' and 'Denial-of-Expectation'. This view, however, came under attack from other linguists; his conception was criticized because those two types can be superimposed; the former implies the latter. Mann and Thompson (1988) and Asher (1993) maintained Lakoff's concept of "Denial-of-Expectation", and classified contrastiveness in two types: Structurally-Similar and Semantically-Dissimilar. Oversteegen (1997) proposed three types of contrastive connectives (semantic opposition, denial of expectation, and concession), and elaborated on the pragmatic nature of contrastiveness. Monlar (2002) discusses two types of contrastiveness; semantic and pragmatic. Umbach (2001, 2004, 2005), lists two types of contrastiveness: Contrast in Information Structure (in a sentence), and Contrast in Discourse Structure (across clauses & sentences). She discusses three more aspects of contrastiveness - namely, semantic opposition, denial of expectation, and topic change -, and puts more

emphasis on the role of linguistic aspects rather than world knowledge. It seems there is no clear agreement among linguists on how we should classify the types of contrastiveness in discourse. Since the purpose of the present paper is to highlight the positive effects of contrast information processing in discourse, our emphasis will be on contrastiveness of 'Denial of Expectation' and 'Contrast in Discourse Structure' rather than 'Semantic Opposition' at lexical level or 'Contrast in Information Structure' at sentence level.

The theoretical discussions by linguists on the nature of contrast (contrastiveness), the conditions for contrast, types of contrast, and relation of contrast with focussing and topicality are still going on. When we examine the on-going discussions by linguists, from the psychological point of view, we find that there is not much explication, except the suggestions given by researchers such as Ford (2000), Monlar (2002), or Umbach (2005), on what the actual cognitive processes of contrast information processing might be,

Contrastive Information and Cognitive Processes

One of the main interests of cognitive psychologists in the field of language processing is to find the nature of cognitive processes involved in comprehension of discourses. If we analyze the suggestions linguistic discussions have offered us (though most of the above linguistic studies did not explicitly discuss the cognitive processes of contrastive information processing), and then integrate it with what cognitive psychologists have found empirically and formulated theoretically, we could come up with a tentative model of cognitive processes or phases of contrastive information processing in discourse comprehension.

When we examine and reinterpret the details of the above discussions by linguists, we could find that linguists have suggested some possible processes involved in contrastive information processing. From Lakoff (1971) up to Umbach (2004), the concept of 'Denial-of-Expectation' and two different types of contrastiveness - one lower (referential, semantic) level and the other higher (relational, pragmatic) level - appear repeatedly. The concepts of a sequential cognitive processes of 'expectation formation', 'denial of expectation', and 'resolution of the mismatch' are implicit in their discussions. The concepts of 'confirm + deny condition' and 'exclusion of additional elements' by Umbach (2004, 2005) suggest some additional cognitive processes involved in resolution of contrastive mismatch. Ford (2000) also focuses on the relationship between a contrast and the discourse that follows (pp. 285-306), and discusses explicitly about the later phases in contrast information processing. She argues that contrast is basically associated with explanation or solution, and that people would go into - after recognizing the presence of contrast in conversation - a series of

additional processing, such as elaboration and explanation.

When we look into the works cognitive psychologists have done on discourse comprehension and memory, we find research that has some implications for the issue of contrastive information processing. In the psychological studies on processing of atypical information in script understanding and memory, which have been conducted mainly by researchers such as Graesser and Nakamura (1982) and Mandler (1984), we can find cognitive processes including 'denial-of- expectation' are operating in processing of atypical information.

These psychological studies, however, did not show any serious concern for the possibility that the mismatch or atypical information could have some central importance in comprehension of discourse, and results in some positive effects on formation of coherent representation and memory of a discourse. They just report and discuss the negative effects of atypical information upon recognition and recall. Another limitation of these studies is that they have employed atypical information at the peripheral or micro level only. They were not concerned about the possibility of some positive effects of contrastive information - such as some deeper processing (Lee, 1979, 1981) -, or some extensive reconstruction of the overall representation of a discourse owing to the presence of some atypical or contrastive information at the higher, global, macro, or pragmatic level of discourse (Lee, 1979; Lee, Lee, Cho, & Choi, 1991)

The present study is an attempt to explore the cognitive mechanism of how processing of contrastive information in discourses entails positive effects on representation formation and subsequent memory of a discourse.

A tentative Model of Contrastive Information Processing

The linguists' concept of 'denial-of-expectation' of linguists could possibly be elaborated into a process model, by way of a mental model (Johnson-Laird, 1983) or a situation model (van Dijk & Kintsch, 1983). In this study, we propose that contrastive relation in discourses occurs when the given information and the new information mismatch on the level of situation models (van Dijk & Kintsch, 1983) or mental models (Johnson-Laird, 1983). And we further assume that such mismatch entails effort on the part of the reader to analyze and resolve it. This would result in a series of elaborative processing and lead to the updating and integrating of that information into a new more coherent representation at the level of such models. Naturally, this process will require some additional processing phases. The possibility of these additional and elaborative processes has been considered by some

researchers (Lee, 1979, 1981; Vonk & Noordman, 1990).

Lee (1979) proposed that in processing discourse materials subjects usually build up expectations about the development of the events or theme of the discourse, and then test the relevance of the expectations in the course of processing the succeeding sentences. When the meaning of the sentences in a given discourse evolves in the way subjects expect, subjects would merely confirm their expectations, and they would not add any extra information (from their semantic memory) to the information already activated through their expectation build-up. On the other hand, if the contents of the discourse deviate from expectations, “the unexpected or contrastive information would force the subjects to do some deeper and more elaborative processing to bridge the gap between their built-up expectations and the contrastive information” (Lee, 1979, p. 125). Subjects would have to activate an additional set of schema that can provide a resolution to this contradiction of their expectations. This would involve a series of new activations of inferential information, and consequently the resulting encoding (representation) will have fuller and more distinct descriptions.

In their discussion of linguistic marker ‘but’, Vonk and Noordman (1990) also suggests that there could be two stages of processing contrastive sentences: The first stage of identifying the complex concepts that have to be contrasted, and the second stage of checking the contrastive relation and adding it to the representation of the discourse. Vonk and Noordman (1990) have not tested this proposed mechanism with empirical evidence.

Based on the above review, we propose a six-phase model of contrastive information processing. The processing of contrastive information in discourses would appear to involve the following phases: 1) the process of forming a mental model or situation model (‘formation of expectation’ as postulated by the linguists, such as Lakoff, 1971) – based on the antecedent information given in the first part of a discourse. 2) The process of recognizing the presence of mismatches (‘denial of expectation’ as postulated by the linguists) between the current input information and the representation already formed. 3) The process of finding the nature or levels of mismatch between the current input information and the previous information (ascertaining the ‘limited number of alternatives’ or inferring ‘the exclusion of alternatives’ in linguists’ term). 4) The process of recognizing the presence of a contrast-resolution information. 5) The process of resolving the mismatch, based on the presence or absence of contrast-resolution information, through activating new additional relevant knowledge structures and generating a series of inferences (‘explanation’ or ‘solution’ in linguists’ term, such as Ford, 2000). 6) The process of integrating all the relevant information into a new coherent and higher abstraction level representation of the

discourse (e.g. Lee, 1979, 1981).

The additional processing stages from 2) to 6) will cause longer processing time at the time of encoding (Noordman, 2001). It could also be assumed that in the final representation, the contrastiveness itself will be stored as a higher abstraction level proposition (Lee, 1979, 1981; van Dijk & Kintsch, 1983) or as a memory code that will serve as an effective higher level retrieval cue (Lee, 1981), and shorten the retrieval time for the contrastive information. This is because higher abstraction level information is more 'distinctive' (Craik & Jacoby, 1979; Lee, 1979) or 'salient' than lower level information since there is less similar or interfering information at the higher abstraction level (Lee, 1981).

If we would go one step further and recall that linguists have discussed contrast at various levels (referential, syntactic, semantic, pragmatic, and cognitive), then we could assume that contrast can be found at more than one level and that we could extend and rephrase these multiple levels in terms of levels of discourse structure (van Dijk, 1977; van Dijk & Kintsch, 1983). Based on this assumption, it could be further proposed that the ease of processing contrastive information will be dependent upon the contrast levels in the representational structure of the discourse. If the mismatch occurs at the global level (the macro-propositional level in the propositional structure of discourses (van Dijk & Kintsch, 1983), it will bring about an overall and higher level reorganization of the previously formed representation. This will entail more extensive and deeper processing (longer encoding time), and in turn lead to a more elaborate and higher abstraction level representation that will be easier to access at retrieval (Lee, 1979, 1981). On the other hand, if the contrast were brought about by a mismatch at the local structural level (the micro-propositional level in Kintsch's term), this information would require only minimal processing (reorganizing) and thus it would be encoded faster and yet would be slower to access at retrieval, since it is not so distinctive as the much-processed upper level contrast information (Lee, 1981). To test these assumptions, a series of empirical studies has been conducted by Lee and his colleagues (Cho & Lee, 1992; Lee & Choi, 1986; Lee & Lee, 1989). The following is a brief summary of the eight experiments that we have conducted.

Experimental Studies

[Materials and Procedures]

Experiment 1, 2, and 3 were conducted to investigate the processing characteristics of contrast information present in short discourses. Two sets of thirty-two short discourses

were used in these experiments. To construct the contrastive and non-contrastive sets in Korean, thirty-two theme words were chosen, and for each theme word two different discourses of four sentences (five to seven words each) were constructed; one was a CONTRASTIVE discourse, and the other was a NONCONTRASTIVE discourse. A CONTRASTIVE discourse consists of four sentences, the last of which states information that is 'somewhat contrary to expectations' (Halliday & Hasan, 1976), 'contrary to the content of the information given in other sentences' (van Dijk, 1977), or 'denial-of-expectation' (Lakoff, 1971). In most cases a subject reading the sentences could connect them in his or her thought by using an adversative conjunction, such as 'yet', 'but', 'though', 'however', 'rather', etc. These conjunctions were not explicitly given in the discourses (see Table 1. for an example). The reason why we used sentences without sentential connectives was to avoid the possible effects of the presence of explicit contrastive (adversative) linguistic markers (The role of the contrastive or adversative linguistic markers is one of the topics of hot debate in linguistics). Each NONCONTRASTIVE discourse has the same form as the CONTRASTIVE one, except that the fourth sentence has a simple match (causative or additive) relation (Halliday & Hasan, 1976) to the other sentences. The designation of CONTRASTIVE and NONCONTRASTIVE sentences was made with full agreement among the four experimenters. Sentences were presented one by one on a computer monitor and the presentation rate was self-paced by the subject by pressing the spacebar on the keyboard.

In Experiment 1 (Lee & Choi, 1986), the processing (self-paced reading) time of the fourth sentence (which was in contrastive or noncontrastive relation to other preceding sentences) of each discourse was measured. In Experiment 2 (Lee & Choi, 1986), subjects were given a cued recall test after reading all the discourses. They were not told beforehand that there

Table 1. An Example of Materials employed in Experiment 1, 2, & 3
(All sentences were in Korean. The following is a translated version)

NONCONTRASTIVE discourse
A stiff harness was fastened to a horse.
The horse didn't like the harness.
The horse bit the harness into pieces.
The rancher put a new harness on the horse
CONTRASTIVE discourse
* The last sentence in the above example was changed to;
The rancher put a stiffer harness on the horse.

will be a recall test. Each subject was given thirty-two cue sentences (the third sentence of each discourse), and was asked to recall the fourth (target) sentences. In Experiment 3 (Lee & Choi, 1986), subjects were given thirty-two theme words and were asked to recall all the four sentences for each discourse.

In the next series of three experiments, the effects of contrast levels in discourse structure upon reading time and primed recognition time were measured using longer discourses as reading materials.

Experiment 4 (Cho & Lee, 1992) investigated the effects of levels of contrastiveness in simple story discourses. Four story discourses were presented to each subject. Each discourse consisted of fifteen sentences, and the sentence next to the last one was designated as the *target* sentence. The target sentence was constructed as having NONCONTRASTIVE or CONTRASTIVE relation to other preceding sentences. To vary the contrast level (micro & macro), the propositional structure of each discourse was analyzed following the procedures given by van Dijk and Kintsch (1983). Target sentences were constructed as either a macrostructure level sentence or a microstructure level sentence in Kintsch's term.

Experiment 5 (Lee & Lee, 1989) was conducted to test the effect of levels of contrastiveness in script discourses. The experiment was different from Experiment 4 in two aspects: one was that script discourses (twenty sentences long) were used instead of simple stories, and the other was that micro- and macro- level target sentence designation was based on script structure. Scene (in script) sentences were designated as macrostructure sentences and action (in script) sentences as microstructure sentences. The classification of scene and action followed the frame postulated by Schank and Abelson (1977).

Experiment 6 (Lee & Lee, 1989) was conducted to test the effects of presence of the information that resolves the unexpectedness of contrast. The resolution of the mismatch (conflict) brought about by the CONTRASTIVE sentence was varied as follows. The sentence immediately following the target (CONTRAST) sentence did (RESOLUTION) or did not (NONRESOLUTION) carry the information that explained, elaborated, or resolved the mismatch (contrast).

In Experiment 7 (Cho & Lee, 1992), the possibility that the above effect was due to some uncontrolled confounding effect of materials was investigated. The target NONCONTRASTIVE and CONTRASTIVE sentences were presented randomly to subjects, devoid of the discourse contexts (script or story).

Experiment 8 (Cho & Lee, 1992) was conducted to see whether the result of the above seven experiments could change depending on the types of story structures (linear or

hierarchical structure).

The general features of the procedures and the main results of eight experiments are summarized in Table 2.

Results

As shown in Table 2, the processing time for the CONTRASTIVE sentence in all of the experiments took significantly longer than that for the NONCONTRASTIVE ones.

Table 2. The Main Features and Comparison of Means across Conditions in each Experiment¹⁾

[I]: Experiment 1, 2, & 3: Thirty-two short discourses of four sentences were presented. (*D: Difference of Means)		
Experiment 1: Processing (Reading) Time for target (contrastive/ noncontrastive) sentence:		
CONTRAST: 1280.78 msec. > NONCONTRAST: 1166.93 msec. (D=113.75 msec.)		[1]
Experiment 2: Amount of Recalled target sentence cued by the immediately preceding sentence. (max.=16)		
CONTRAST: 11.71 > NONCONTRAST: 8.59 sentences (D=3.42 (19.5 %))		[2]
Experiment 3: Amount of Recall cued by the theme word of each discourse.		
1. Amount of Recalled discourses (max.=16) :		
CONTRAST: 9.50 > NONCONTRAST: 7.80 (D= .70 (4.37 %))		[3]
2. Amount of Recalled sentences per discourse (max.=4) :		
CONTRAST: 3.37 > NONCONTRAST: 2.92 (D= .45 (11.25 %))		[4]
[II]: Experiment 4, 5, 6, 7, & 8: Long discourses were presented.		
Experiment 4: Contrast levels (Macro-Micro) in <i>story</i> discourses were varied.		
1: Reading Time for the target sentence :		
CONTRAST: 4441 msec.> NONCONTRAST: 3005 msec. (D = 1436 msec.)		[5]
CONTRAST: Macro: 5030 msec. > Micro: 3977 msec. (D = 1053 msec.)		[6]
NONCONTRAST Macro: 2916 msec. ≐ Micro: 3904 msec.		
2: Recognition Latency for the target sentence primed by the sentence presented immediately prior to the target sentence;		
CONTRAST: 2258 msec. < NONCONTRAST: 3505 msec. (D = 1247 msec.)		[7]
CONTRAST: Macro: 2082 msec. ≐ Micro: 2434 msec.		
NONCONTRAST: Macro: 3264 msec. < Micro: 3748 msec. (D = 484 msec.)		[8]
Experiment 5: Contrast levels (Macro-Micro) in <i>script</i> discourses were varied.		
1: Reading Time for the target sentence:		
CONTRAST: 3018 msec.> NONCONTRAST: 2405 msec. (D = 613 msec.)		[9]
CONTRAST: Macro 3203 msec. > Micro: 2782 msec. (D = 421 msec.)		[10]
NONCONTRAST: Macro: 2265 msec. ≐ Micro: 2285 msec.		
Experiment 6: Mismatch <i>resolution</i> (Resolved-Nonresolved) was varied.		
1: Reading Time for the last sentence : RESOLUTION ≐ NONRESOLUTION		
2: Amount of Recalled sentence:		
RESOLUTION: 83 % > NONRESOLUTION: 33 % (D = 50 %)		[11]
3: Primed Recognition Latency for the last sentence:		
RESOLUTION: 1972 msec. < NONRESOLUTION: 2750 msec. (D = 778 msec.)		[12]

RESOLUTION: Macro 1978 msec. \approx Micro 1966 msec.	
NONRESOLUTION: Macro 2907 msec. > Micro 2513 msec. (D = 394 msec.)	[13]
Experiment 7: (Control Condition Experiment): The target sentences used in Experiment 4, 5, & 6 were randomly, devoid of its discourse context (script or story).	
<i>Reading Time and Primed-Recognition Time:</i> CONTRAST \approx NONCONTRAST	
Experiment 8: Two different story structures: linear or hierarchical.	
1: <i>Reading Time:</i> (The same trends for both of structures.)	
CONTRAST: 4635 msec. > NONCONTRAST: 2848 msec. (D = 1787 msec.)	[14]
2: <i>Primed Recognition Latency:</i> (The same trends for both of structures.)	
CONTRAST: 2464 msec. < NONCONTRAST: 3481 msec. (D = 1017 msec.)	[15]

1) The value of the *F* and the statistical significance level of each comparison are given in the Appendix I.

However, in terms of recall amount, CONTRASTIVE sentences were superior to NONCONTRASTIVE sentences in all measures.

The results of Experiments 4 and 5 showed a statistically significant interaction effect between contrastiveness and contrast levels. With NONCONTRASTIVE sentences, macro- and micro- sentences were processed in almost the same amount of time, while with CONTRASTIVE sentences macro-sentences took longer to process (1053 msec longer in Experiment 4, and 421 msec longer in Experiment 5) than for micro-sentences. The same trend was observed for the last sentences (the sentence immediately following the target sentence). And in the retrieval test (primed recognition test), CONTRASTIVE sentences were recognized faster (1247 msec) than NONCONTRASTIVE ones, and contrast levels had effects for NONCONTRASTIVE sentences only. Macro-sentences took less time to be recognized than micro-sentences in NONCONTRASTIVE condition only. In CONTRASTIVE condition, recognition of macro- and micro- sentences took almost the same amount of time.

The results of Experiment 6 showed that the reading time of the last sentence for the RESOLUTION condition and NONRESOLUTION conditions was not significantly different (a contrast level effect only showed up). It seems that the processing of the sentence following the CONTRASTIVE sentence takes longer, regardless of whether it does or does not resolve the mismatch; presumably this reflects time taken to integrate it with the previously formed representation. It appears then that certain attempts to resolve the contrast or mismatch are made before the onset of the next (resolving) sentence. The positive effect of processing a RESOLUTION sentence appeared at retrieval only; RESOLUTION sentences were retrieved in greater amount (more than twice) and faster (770 msec) than NONRESOLUTION sentences. The contrast levels effect showed up only in the retrieval test. Macro-sentences

were retrieved faster than micro-sentences in the NONRESOLUTION condition only. The retrieval time for macro- and micro- sentences were not different in the RESOLUTION condition.

The results of Experiment 7 (a Control Condition experiment) showed that the target sentences, without its discourse contexts, were read and primed-recognized almost in equal time regardless of whether they were used as CONTRASTIVE or NONCONTRASTIVE sentences in the previous experiments.

Experiment 8, with two different types of story structure, reconfirmed the general trends of the other experiments: longer encoding time but shorter recognition latency for contrastive information (regardless of the types of story structure). This effect was stronger with the macro-level contrast.

Discussion

The main thesis of the eight experiments was to show that processing contrastive information in discourse entails some positive effects on comprehension and memory of a discourse. We began this experimental study by hypothesizing that it would take more time to encode contrast information and yet this information would be retrieved faster and better. Further we proposed that the effect of contrastive information would be stronger when contrastiveness is present at the macro- than at the micro- structure level of a discourse.

A review of a body of our experimental data on contrastive information processing has consistently showed that CONTRASTIVE information in discourses took longer to process at encoding, and yet was retrieved faster and better, and moreover that this effect was more pronounced at macro-structure level. It was also observed that within the CONTRASTIVE condition macro-level contrast sentences took longer to process at encoding than micro-level contrast sentences did, while the retrieval time for both were not reliably different. It was further found that the time taken to process the sentence immediately following the contrast sentence was relatively long, regardless of whether it did or did not resolve the mismatch (conflict) in meaning produced by the contrastive sentence.

The general results of the eight experiments can be interpreted as supporting our main thesis and research hypotheses. The possible mechanism of how contrastive information, esp. at macrostructure level, took longer to process and yet was retrieved faster was discussed earlier. It was postulated that a contrastiveness in a discourse representation is brought forth mostly by a mismatch at the global level of representation, which is a mismatch or a conflict at the level of situational or mental models. This mismatch requires works on the

part of the comprehender to resolve and then reformulate the representation. This would trigger another series of processing phases. This involves deeper processing with 'spreading elaboration and integrative elaboration' (Lee, 1979) or with elaborative inference and coherence inference (Sanford, 1990). This deeper processing or higher level inference leads to the representation of the contrast information as a macro- or global level proposition (Lee, 1979, 1981; Lee et al., 1990), which is a more distinct representation since there is less similar or interfering information at the higher level of abstraction, and thereby results in faster and better retrieval.

The finding that it took longer to process the sentence immediately following the contrast sentence irrespective of whether it is a contrast-resolution or contrast-nonresolution sentence can be accounted for along the line of reasoning as follows: The input of a contrast sentence initiates a series of processing steps as described above. These processing steps might not have been finished when the following sentence was presented. The residual processing load of the contrast sentence might spill over on to the processing time for the next phase. This could have caused the longer processing time of the last sentence, regardless of whether the new information is micro- or macro- level information and whether it does or does not resolve the mismatch brought about by the preceding contrast sentence.

General Discussion

The starting point of this study was two fold; one was about investigating the nature of contrastive (in the sense of semantic and pragmatic, but not in the sense of phonological or syntactic) information processing in discourse comprehension, and the other was about finding a point of a possible theoretical linkage between linguistics and cognitive psychology in the studies of contrast in discourse. Having these two goals in mind, we reviewed the theoretical studies by linguists on coherence and contrast in discourse, and introduced, rephrased, and extended their theoretical concepts and views into a psychological research framework on contrast information processing in discourse comprehension. This led to a new experimental research paradigm of studying cognitive processes of contrastive information processing, with particular emphasis on response latency.

We have discussed about the necessity of developing a process model for contrastive information processing. Based on the results of the experiments we have reviewed and the previous discussions, we could summarize the cognitive phases that might be involved in the

processing of contrastive information in discourse and propose a tentative model (see Table 3). We are proposing the model to delineate what aspects of contrastive information processing should be studied in the future research.

With regard to the nature and effects of processes involved in processing contrastive information, we have also postulated that the processing of contrastive information in discourse is an important part of our common discourse practices, and that contrastive information processing entails a more cohesive or coherent representation of the discourse at a higher level of abstraction than a normal non-contrastive discourse does. It was assumed that the presence of contrast in a discourse calls for a reevaluation of the mental models or situation models already formed based on the discourse contents appeared before. This leads to a massive activation of relevant higher-level knowledge and inferences beyond simple 'coherence inferences' (Sanford, 1990). In other words, a 'deeper processing of spreading and integrative elaboration' (Lee, 1979) ensues from the presence of a contrast.

The end result of these processing activities is that the contrast information is represented as a higher abstraction level proposition in the representation structure of the discourse. This makes the representation more coherent at a higher level (Lee et al., 1990; Lee, Choi, Lee, & Cho, 2000). This type of coherence goes beyond the lower level of 'coreferential coherence' or simple 'thematic coherence' discussed by the traditional studies on coherence, which have studied coherence mainly in terms of match-with or assimilation-into the already formed representation. The study of contrast requires a comprehensive and reconceptualized theoretical framework of 'coherence in discourse comprehension' that incorporates the positive effects of processing contrastive information in discourse. To develop this sort of framework, cognitive psychologists must be willing to incorporate into their theoretical endeavors what linguists have achieved in their theoretical works on the issues of contrast, focus, topicality, role of linguistic markers, concession and so on.

We can notice, immediately, a positive implication of formulating this sort of integrative framework: we could extend the results of psychological research on contrast to the linguistic and psychological studies on irony, and develop a more comprehensive view on cognitive processes of human understanding of adversative information in discourse. We can view that understanding irony is a kind of contrastive information processing. Several discussions on irony have been put forward by cognitive scientists (e.g.,: Gibbs, 1986; Gibbs & Colston, in press; Giora, 2004). Our finding that it takes longer to process contrastive information is supported by their research on irony. Gibbs (1986) found that story sentences with non-conventional sarcasm take longer to read. Giora, Fein, and Schwartz (1998), and Giora (2003) presented some empirical results that show slower processing time for the

unfamiliar, un-echoic, implicit irony. They discuss the possibility of irony comprehension involving a process of suppressing the representation of previously built-up expectation. We could postulate the possibility of similar processes for contrast information processing. Further theoretical refinement and empirical inquiries on this issue are in need.

Another direction to which we could extend the current research on contrast could be the study of emotion in discourse comprehension. It is widely accepted that an irony, sarcasm, or contrast information in a discourse often brings about an affective state, mostly a surprise, in the comprehender. Chafe (1994) argued that contrastiveness is often accompanied by affect. Teigen and Keren (2003), discussing contrast interpretation of surprise in social situation, suggested that a greater contrast is accompanied by higher ratings of surprise, and that the contrastiveness provides a trade-off relation between cognition and emotion (pp. 55-58). It seems that we need a broader framework of contrastive information processing that encompasses cognitive aspects and affective aspects. This could lead to a theoretical formulation that can narrow the current gaps between Cognitive Science research and Literary studies.

Table 3. A Tentative Model of Contrastive Information Processing Phases

Phases	INPUT	Processing & Results
Discourse	Input Begins	
Phase 1:	Input of the 1st part of the discourse (D1) (foregrounding)	-Build a Mental Model (Semantic Space) 1 (MM1) for D1 -Generate some possible expectations(Forward Inference: FI) -Maintain it (MM1+FI) in Working Memory
Phase 2:	Input the 2nd part of the discourse (D2)	-Recognizing the presence of a contrast
Phase 3: Computing the nature of Contrast		
	3.1. if Situation1: Adversative Connective present (O)	-Build a Temporary Empty Slot for a possible Mismatch Frame -Spreading Activation -Search for a Possible New negative Mental Model (MM2) -Finding a New Mismatching MM2 -Relevance Testing of MM2 with respect to MM1 -Shallow Generation of possible Inferences -Generate a Working Integrative Frame (IF3) -Expect an Input of Resolution/Elaboration Discourse Piece (D3)
	3.2. if Situation2: Adversative Connective absent (X)	-Spreading Activation -Build a possible new Mental Model(MM2) -Detection of Mismatching Aspects (Nature, Level) -Relevance Testing of MM2 with respect to MM1 -Generation of possible Inferences

	-Generate a Working Integrative Frame (IF3) -Expect a following Resolution/Elaboration Part
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Phase 4: Input of the Resolution/Explanation Part of the Discourse (D3)
 (*If no Resolution text follows the prior text, goto Phase 5.)

3.1. if Situation 1: Resolution Text: present (O)

- Build a Mental Model(MM3) for D3
- Compare MM3 to IF3
- IF matched THEN goto Phase 6
- If mismatched THEN goto Phase 5

3.2. if Situation 2: Resolution Text : not present (X)

- Generate further possible Explanation and Resolution Frame
- Goto Phase 6

Phase 5: Elaborate Inferencing

- 2nd Spreading Activation with guidance
- Generate alternative interpretation Models
- Conduct a series of relevance tests of the activated alternative frames, with the MM1, MM2, MM3
- If resolved, THEN goto phase 6
- If not, THEN repeat the Generation-of-Inferences-and-Test Cycles

Phase 6: Integration without any further Input

- Integrate the whole Discourse
- Store the Final Representation at a Higher Abstraction (Macroproposition) Level

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Appendix I. The F values, Standard Errors of Means, and Statistical Significance Levels of Comparisons Listed in Table 2.

[1]: $F(1,18) = 37.09$, $MSe = 1747.347$, $p < .01$; [2]: $F(1,18) = 35.84$, $MSe = 2.31$, $p < .01$;
[3]: $F(1,18) = 12.282$, $MSe = 2.372$, $p < .01$; [4]: $F(1,18) = 18.559$, $MSe = 9.347$, $p < .01$;
[5]: $F(1,28) = 66.61$, $MSe = 990184.89$, $p < .001$; [6]: $F(1,28) = 11.89$, $MSe = 115444.55$, $p < .01$;
[7]: $F(1,28) = 78.0$, $MSe = 638541.22$, $p < .001$; [8]: $F(1,28) = 66.61$, $MSe = 990184.89$,
 $p < .001$; [9]: $F(1,40) = 36.39$, $MSe = 495162.44$, $p < .01$; [10]: $F(1,40) = 7.12$, $MSe = 599188.20$,
 $p < .01$; [11]: $F(1,16) = 72.00$, $MSe = 599188.20$, $p < .01$; [12]: $F(1,60) = 60.14$,
 $MSe = 160952.45$, $p < .01$; [13]: $F(1,60) = 11.19$, $MSe = 160952.45$, $p < .01$; [14]: $F(1,28) = 50.39$,
 $MSe = 2029011.43$, $p < .001$; [15]: $F(1,28) = 6.83$, $MSe = 580338.39$, $p < .001$.
