Effects of Coherence Marking on the Comprehension and Appraisal of Discourse

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Abstract

In the research on the role of coherence marking in discourse, several factors have been ignored so far. In this paper, we will adopt a new approach, where we will not only investigate effects on comprehension, but also on appraisal and feeling of knowing. Moreover, the current theory will be extended by testing whether we can generalize results over different groups of subjects (with and without prior knowledge) and over genres (informative and persuasive). The results from two experiments show that it *is* indeed possible to generalize over genres and over subjects. Coherence markers have a positive influence on both comprehension and on appraisal.

Keywords: coherence marking, text comprehension, discourse

Introduction

It has regularly been shown that marking of relational coherence influences the mental representation that a reader constructs from a text. In general, readers benefit from the presence of connectives (*because, therefore*) and lexical cues (*the consequence is*) that explicitly mark the coherence in a text. The markers make relations explicit that would otherwise have to be inferred by the reader himself. There is empirical evidence for the facilitation that markers of coherence cause during the reading-process (Gaddy, van den Broek, & Sung, 2001). They shorten the processing time of following segments (Britton, Glynn, Meyer, & Penland, 1982; Sanders & Noordman, 2000).

In this paper, a new approach to the effect of coherence markers will be presented. The first new aspect of our approach concerns different types of effects. Although empirical research on coherence marking has provided us with ample knowledge on the effects on text comprehension, other effects have received less attention. In this paper, we will not only discuss the comprehension effects that coherence markers can have, but also the effects on appraisal (what is the reader's opinion on text quality?). A second new aspect of our approach is that we use different text types or genres. Most of the previous research on coherence marking is based on informative texts. In this paper, we will also investigate effects of coherence markers in persuasive texts, since very little is known about the effect that markers of coherence have in genres other than the informative. The third aspect of our approach concerns prior knowledge. Recent insights in text processing (for instance McNamara and Kintsch, 1996) have shown that reader characteristics such as prior knowledge have to be taken into account. The text-reader interaction is crucial to develop the knowledge we may have on the basis of earlier research on marking of coherence.

Off-line effects of Coherence Marking

In general, research into the role of coherence marking on the mental representation *after* reading a text does not provide clear-cut answers. In some cases, linguistic marking leads to a better structure in a free reproduction task (Meyer, Brandt, & Bluth, 1980), to a faster and better answer on text comprehension questions immediately after having read the text (Millis & Just, 1994) and to a faster answer on a verification task (Sanders & Noordman, 2000). Still, markers of coherence do not seem to influence the quantity of remembered information (Britton et al., 1982; Sanders & Noordman, 2000), except for signals of importance (Lorch & Lorch, 1986), such as *the situation can be summarized as follows*. On the one hand, there is research that shows that markers of coherence cause better answers on text comprehension questions (Degand, Lefevre, & Bestgen, 1999; Degand & Sanders, 2002). On the other, some researchers do not find any effect of coherence marking on text comprehension questions (Spyridakis & Standal, 1987). Not all of these studies are equally reliable (see Degand & Sanders, 2002). The studies vary among other things in quality of the manipulations, naturalness and length of the experimental texts and, last but not least, the characteristics of the reader are mostly not included in the research.

Prior knowledge

The influence of prior knowledge about the text topic on text comprehension has often been described. In their research on 'learning from text', McNamara and Kintsch (1996) find an interaction between prior knowledge and marking of coherence: readers with prior knowledge benefit optimally from a non-marked text, readers who lack this knowledge perform better on text comprehension questions after a

marked version. As much as we believe in this interaction effect of coherence marking with reader's knowledge, there is a difficulty with the McNamara and Kintsch experimental texts. It is sometimes impossible to understand certain passages of the non-marked version without the appropriate prior knowledge[1]. In this paper, the same interaction-effect is the focus of our experiment, but this time with text versions that are also understandable without the prior knowledge. It only takes more cognitive energy to integrate the segments in the right way and construct a coherent representation, but it is not impossible. Moreover, McNamara and Kintsch manipulated many different aspects of coherence, some of which differ quite a lot form pure linguistic marking. In the explicit version they provided the reader with more examples, they changed the order in which the information was presented, etc. Therefore, it is important to investigate the same interaction as McNamara and Kintsch did, but only with purely linguistic markers of coherence.

Feeling of Knowing

Up to this point, only one aspect of information processing has been discussed: the mental representation. Another aspect, usually not included in previous research, is the meta-cognitive judgment of a reader on his or her own understanding of a text, also known as Feeling of Knowing (FOK). Sometimes, the term Illusion of Knowing is used, relating to the wrong sense of understanding readers may have after reading a text. Glenberg, Wilkinson and Epstein define this phenomenon as follows: "The belief that comprehension has been attained when, in fact, comprehension has failed" (1982: 597). Rawson and Dunlosky (2002) investigated to what extent readers base their estimated performance on the difficulty they experience in text processing. In these experiments, subjects predicted a better score on comprehension questions when they had read a text with coherence markers. This indicates that the when a text is easier to process, people think they understood it better. Based on these studies, we expect that markers of coherence do not only influence the mental representation, but also the extent to which a reader thinks he or she has understood the text.

Appraisal

A third aspect of coherence marking in discourse that has so far been ignored is appraisal. How do people evaluate the use of coherence marking in texts? Do they appreciate explicit texts more than implicit ones?

Coherence markers are supposed to help the reader and make it easier to construct a coherent representation. If markers are absent, more cognitive effort is needed in order to understand a text. This is supposed to have an effect on the judgment of quality. Garbarino and Edell (1997) found that the quality of advertisements was judged to be poorer when subjects had to invest more energy in the process of

understanding. This could very well be the case for coherence markers as well.

Genre

In existing research on marking of coherence and prior knowledge, mostly short informative texts are used. In this paper, we will discuss experiments where longer texts were used, from two different text genres: informative and persuasive, in order to check whether the effects of coherence marking differ between both genres.

How exactly do we distinguish between informative and persuasive texts? The most commonly used definition bases the distinction on the author's intention (for instance O'Keefe, 1990). This definition may suffice in theory, but in the empirical context of an experiment, a more detailed operationalization is needed. Many persuasive texts try to convince the reader by providing information, which makes the difference between these genres smaller and smaller. In persuasive texts, providing accurate information plays an important role. Schellens and de Jong (2004) analyze twenty brochures and conclude that argumentation is often presented as information. One characteristic is always present: pragmatic argumentation. Advantages to the desired behavior or disadvantaged to the non-desired behavior are stressed. In this experiment, the distinction between informative and persuasive texts is based on the absence or presence of pragmatic argumentation.

Experiment 1

In the following paragraph, we will discuss a first experiment to develop the current theory on coherence marking.

Hypotheses

Readers make representations of texts at three different levels (Kintsch, 1998; Schmalhofer & Glavanov, 1986). The level of the exact formulation, where grammar and vocabulary play a part, is referred to as the surface code. The second level of meaning is called text base: readers construct the semantic meaning of sentences. The third level is the situation model, where readers integrate textual information and prior knowledge. In text comprehension research the latter two are the most important levels.

In this experiment, we measured only the situation model representation, where the interaction between prior knowledge and marking of coherence occurs. We expected to replicate the interaction effect of McNamara and Kintsch (1996): Readers with prior knowledge will perform better after an implicit version. Readers without prior knowledge will perform better after an explicit version (hypothesis 1).

The expectation on Feeling of Knowing is that the coherence markers will provide the (perhaps wrongful) feeling of having understood the text. (Glenberg et al., 1982; Rawson & Dunlosky, 2002). The explicit versions cause a greater Feeling of Knowing than the implicit versions (hypothesis 2).

The third hypothesis concerns appraisal: The implicit version receives a less positive evaluation. A text that leaves its coherence implicit demands more cognitive energy from a reader and this annoys the readers.

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[1] In the explicit version, abbreviations are being used which are explained for in the marked versions (for instance ARVN for South Vietnamese Army). In the unmarked version, much geographical knowledge is assumed to be familiar to the reader (e.g., Hanoi is North-Vietnam).

Finally, we had no concrete hypotheses concerning the two different genres. This part of the experiment is therefore explorative.

Method

Materials Two text topics were selected in order to make natural informative and persuasive texts: genetic manipulation and organ donation. Persuasive texts on these topics often try to persuade by incorporating information and facts in the text. This enables us to actually investigate comprehension and appraisal for both genres.

For every topic, we constructed an informative and a persuasive version, based on existing materials. Pragmatic argumentation was a central characteristic for the persuasive versions. The persuasive versions underline the advantages to the desired behavior, or the disadvantages to the un-desired behavior ('by giving up your organs after death, you are helping other people'). The informative texts did not contain pragmatic argumentation.

The four texts (informative and persuasive for both topics) were subsequently manipulated to create an implicit and an explicit version. Marking of coherence is taken in a very broad sense in this study. This implies that the following aspects have been manipulated in the texts: global coherence (headings and organizers), relational local coherence (connectives and lexical cue phrases), and referential local coherence (repeating the antecedent). The following paragraph is a text passage from the persuasive organ donation text, the markers are underlined.

Tim is only 16, but his heart seems worn out. This is caused by the fact that he had leukemia and the chemotherapy seriously damaged his heart. Tim has been on the waiting list since 1996. (....) These are only examples. At this moment, there's a long waiting list for donor organs. You can do something about the long waiting list by giving permission for your organs to be donated after death. If you find this a difficult decision to make, the information in this brochure can help you.

In the implicit version, there were some coherence markers present to make the text natural enough. In the explicit version, 25 more coherence markers were used than in the implicit version.

Comprehension was measured by means of 4 open-ended situation model questions, such as 'Why is it no longer necessary to carry a codicil with you?' The correct answer would be that the decision to be an organ donor is nationally registered.

FOK was measured by asking subjects to rate their understanding of the text on a 10-point Likert scale and on a 4-point scale.

Appraisal was measured with 15 items, all semantic differentials like 'very easy- very difficult' on 7 point Likert scales. The items could be categorized in 4 different categories, see Table x, based on Ortony, Clore and Collins (2001). All these items and questions were presented in a booklet, following the text. The appraisal questions were presented before the comprehension questions, to avoid an influence of 'not-knowing-the-answer' on appraisal questions about the comprehensibility of the text.

Table 1: Dimensions and items

Dimension	Example of operationalization	
1. Appealingness	Clear	Vague
2. Acceptance	Credible	Not credible
3. Accessibility	Difficult	Easy
4. Structure	Coherent	Not coherent

Subjects Eighty students of Utrecht University participated in this experiment: 26 History students, 54 Biology students. We expected the Biology students to know significantly more about genetic manipulation and organ donation. This assumption was controlled for by asking 4 prior knowledge control questions, prior to the experiment. A t-test showed that both groups differ significantly on prior knowledge (t(79) = -10.59, p < 0.001). Biologists score higher than History students.

Design The experimental factor prior knowledge is a between-subjects factor with values high and low. The experimental factor text version is a within-subjects factor with the values no marking and with marking. Furthermore, there are two conditions: informative and persuasive, and two text topics: genetic manipulation and organ donation. In total, we used 8 different texts in this experiment: 2 topics * 2 versions * 2 genres. These factors were integrated in a Latin Square Design: every subject read 2 texts, one of which implicit and the other explicit, one of which persuasive and the other informative, one of which on genetic manipulation and the other on organ donation. The experiment took about 40 minutes. Subjects were instructed not to turn back the pages they had already read.

Results

Every hypothesis is analyzed for the informative and persuasive genre separately. All analyses were first conducted per text, but hardly appeared to differ between the two topics. Therefore, the two topics are integrated in the presentation of the results. Two-way ANOVAs are calculated to test the effects of marking of coherence and prior knowledge on the dependent variables.

Effect on comprehension The answers to the open-ended questions on the open-ended questions were scored as follows: 1=incorrect, 2=doubtful, 3=correct. This did not cause any problems, since most of the answers clearly fell in category 1 or 3. The doubtful answers were scored with the help of an expert in biology, and they were mostly assigned category 2. Table 2 shows the effects of marking of coherence and prior knowledge on comprehension questions for the informative texts. Internal reliability between the questions was measured with Cronbach's alpha: for the genetic manipulation text, $\alpha = 0.33$, for organ donation, $\alpha = 0.45$).

An interaction-effect of marking of coherence and prior knowledge occurred in the informative genre, just as predicted (see hypothesis 1, $F(1,77) = 3.722$, $p < 0.05$, $\eta^2 = 0.05$). Readers without prior knowledge perform better after the explicitly marked text than after the implicit version (t(50) = -2.576, p < 0.05). Readers with prior knowledge perform

equally well on both versions (t(106) = 0.057, p > 0.9). There is also a significant main effect of prior knowledge (F(1,77) = 15.493, p < 0.01, η^2 = 0.17): subjects with prior knowledge perform better then subjects who lack this knowledge.

Table 2: Comprehension scores (means, standard deviations and number of observations) for informative texts

	No marking	With marking
Less prior knowledge	1.38 (0.77) (n = 13)	1.93 (0.76) (n = 13)
More prior knowledge	2.44 (0.75) (n = 27)	2.29 (0.76) (n = 27)

For persuasive texts, the situation differs, as is represented in Table 3. There is no interaction-effect of marking of coherence and prior knowledge, but there is a main effect of marking of coherence (F (1,75) = 2.7, p = 0.05, η^2 = 0.04) and of prior knowledge (F (1,75) = 10.4, p < 0.01, η^2 = 0.12). Readers with prior knowledge perform on average better than readers without, just as for the informative genre. For both groups, however, the benefits are greater after having read the explicit version than after the implicit version.

Table 3: Comprehension scores (means, standard deviations and number of observations) for persuasive texts

	No marking	With marking
Less prior knowledge	1.46 (0.78) (n = 13)	1.92 (0.76) (n = 13)
More prior knowledge	2.22 (0.75) (n = 28)	2.39 (0.85) (n = 26)

Effect on feeling of knowing We expected the explicit versions to cause a higher FOK than the implicit ones. We only found significant effects for the informative genre: a main effect of marking of coherence (F (1,76) = 2.882, p < 0.05): the version with marking causes more FOK than the version without marking, conforming hypothesis 2. Apparently, the explicit version gives a reader the impression of having understood.

It is also important to check whether this impression is correct or not. We used a linear regression analysis to calculate whether FOK could be a predictor for the actual comprehension scores. FOK does appear to be an adequate predictor of the actual comprehension scores for the informative texts (r = 0.31, p < 0.02), and for the persuasive texts (r =.26, p < 0.03). Coherence marking does not cause an *illusion* of having understood the text when this is not actually the case. Marking of coherence actually causes better comprehension, and readers seem capable of assessing their own comprehension. In the informative texts, coherence markers lead to a higher FOK.

Effect on appraisal Reliability of all 15 appraisal items was high (α = 0.85), and therefore we analyze all 15 items together. The expectation was that the text with marking would be more positively evaluated than the one without marking. This expectation was confirmed for informative texts over all items (F1,80) = 5.3, p < 0.05). More precisely, the informative explicit text was judged to be significantly

less vague, clearer, simpler, less demanding and more coherent.

In the persuasive texts, these effects are less distinct. The overall effect is not significant, but several items show an significant effect of coherence marking on appraisal. The persuasive explicit text is judged to be significantly clearer, more coherent and more credible than the implicit text.

Conclusion and discussion from experiment 1

For comprehension, the results of McNamara and Kintsch (1996) have been replicated with texts that were varied systematically in the linguistic marking of coherence relations and text structure. We found an interaction effect of prior knowledge and marking of coherence in the informative texts. In the persuasive texts, the explicit version was beneficiary for both groups. The coherence markers do not give readers the illusion of having understood the text: the effect of marking on FOK reflects an accurate prediction of comprehension.

The effects on appraisal for both the informative and persuasive texts were as predicted: the implicit versions were judged more negatively on the four dimensions involved than the explicit version.

A very important point of concern is that the open ended comprehension questions were not reliable. Therefore, we decided to replicate the experiment with a different method: the sorting task (McNamara and Kintsch, 1996).

Experiment 2

The second experiment is a replication of experiment 1, with a few adaptations. The method to assess comprehension has been changed to a sorting task[2]. Also, only relational coherence marking was manipulated, not referential coherence marking. The same materials and the same design were used, only the subjects differed.

Method

Sorting tasks Text comprehension at the situation model level was tested by means of a sorting task. In a sorting task, a subject has to categorize key concepts from a text according to the text (McNamara & Kintsch, 1996), therefore tapping the situation model representation. Example 1 is an example of a sorting task for the genetic manipulation text.

(1) "Here's a list of key words taken from the text. Make groups of words that you think should go together on the basis of the text. You can make as many groups as you want, and they can be of any size. Draw a circle for each group you want to make and put the right numbers in the circle."
1. solving the world hunger problem
2. crossing existing crops
3. moratoria
4. making new proteins, etc.

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[2] We have validated several methods to assess comprehension and the sorting task seems to be the most valid (Kamalski, Sanders, Lentz, & Bergh, submitted). The sorting task scores better than other methods of text comprehension on criteria such as reliability, known group validity, divergent and convergent validity.

In this example, key concept 1 would have to be categorized with other arguments in favour of genetic manipulation, 2 and 4 with other originally intended goals in the past and 3 with solutions. When scoring these sorting tasks, only wrong categorizations lowered the score attributed to the subject with one point. An example would be a subject putting one argument against with all the other arguments in favour. This is definitely wrong, and would lower the score. Incomplete groups (for instance, instead of categorizing all arguments in favour, a subject makes 2 groups of these arguments) only lowered the score for this group with 0.5 points.

Subjects 67 medical students participated in the high knowledge group, 64 law or history students participated in the low knowledge group. We expected the medical students to have more prior knowledge about organ donation and genetic manipulation than law students. This expectation was confirmed: $t(129) = -20.3$, $p < 0.0001$. Students without prior knowledge received an average score of 0.29 on the comprehension score, students with prior knowledge received on average 3.55 (on a scale from 0 to 5).

Results

Effect on comprehension Comprehension was measured with a sorting task. The proportion of correctly categorized items is calculated, and then multiplied by 10 to make the sorting task score resemble normal test scores on comprehension, usually on a scale from 1 to 10. Reliability was acceptable (genetic manipulation task: $\alpha = 0.56$, organ donation $\alpha = 0.64$). When we analyzed both genres separately, we found no differences, so the analysis we report here combines both genres in a repeated measure ANOVA. There is a main effect of marking of coherence ($F(1,126) = 3.80$, $p = 0.05$), see Table 3. There is no interaction with prior knowledge.

Table 3: Comprehension scores
(means and number of observations)

Text version	Comprehension score	
	informative	persuasive
Without marking	6.04* (64)	6.03*(64)
With marking	6.49*(63)	6.70*(67)

* p < 0.05

Effect on feeling of knowing Subjects were asked to rate their own level of comprehension by means of two questions: one on a 4 point scale, and one on a 10-point scale. On both scales, the effect is visible: we will report on both scales combined ($\alpha = 0.67$).

There is a main effect of coherence in the persuasive texts, ($F1,127) = 3.30$, $p = 0.03$, $\eta2 = 0.03$). In the informative texts, the same effect is visible, but less strong: $F(1,122) = 2.40$, $p = 0.06$, $\eta2 = 0.02$). In all cases, the texts with marking cause a higher feeling of knowing than the texts without marking.

We checked whether FOK is accurate: are the participants able to correctly assess their understanding? A linear regression analysis revealed a predictive relation in the informative genre ($r = 0.86$, $p = 0.03$), and in the persuasive genre ($r = 0.49$, $p < 0.001$).

Effect on appraisal Combining all observations, a two way ANOVA with marking of coherence and prior knowledge revealed a main effect of marking of coherence ($F(1,247) = 7.850$, $p = 0.05$, $\eta2 = 0.03$) and a main effect of prior knowledge ($F(1,247) = 4.756$, $p = 0.03$, $\eta2 = 0.02$). The implicit versions were, as expected, evaluated more negatively as the explicit versions. The readers without prior knowledge were more lenient in their judgments.

Although we did not differentiate between genres in our hypotheses, we still checked whether this assumption was correct. These same effects were tested for the different genres. When we performed the same two- way ANOVA on the informative texts, the effect was not significant, but the data still showed a strong tendency. For the persuasive texts, the effect pertained: $F(1,127) = 19.026$, $P < 0.001$, $\eta2 = 0.14$).

Conclusion from experiment 2

In experiment 2, we have seen that coherence marking leads to better comprehension for both genres. In the persuasive genre, marking leads to a more positive evaluation. In the informative genre, there is a similar tendency, but the results are not significant. The coherence markers do not give readers the false illusion of having understood the text: the markers actually improve comprehension, and readers seem to be aware of this in both genres.

The results from experiment 2 show not much difference between genres or knowledge groups, if any. The only difference is that the effects on appraisal are not significant in the informative genre.

Comparison: conclusion and discussion

In summary, the effects of coherence marking seem stable over genres and over knowledge groups. The overall conclusion seems to be that marking of coherence causes better comprehension, improves the impression of having understood the text, and results in more positive evaluations.

However, there are a few results that are more problematic to interpret. How about the interaction effect on comprehension that we saw in experiment 1? In experiment 2, only a main effect of coherence was found, and prior knowledge did not play a role anymore. Two possible explanations exist for this difference. The first one is a methodological one. In the first experiment, we used comprehension questions that revealed to be unreliable (internal reliability, measured with Cronbach's alpha was very low). In the second experiment, sorting tasks were used to assess comprehension. This method has proven to be more reliable in an elaborate experiment on the validity of several comprehension methods (see Kamalski et. al, submitted). This means that there is a valid reason to consider the interaction-effect in experiment 1 as less reliable then the main effect in experiment 2. However, it is not unequivocally sure that this difference in methodology causes the different result. A second possible explanation lies in the exact nature of the prior knowledge that the subjects had: in experiment 1, the subjects were Biology students, in experiment 2 they were Medicine students. It is possible that the nature of the prior knowledge matters so much, that even within a group of

experts (both Biology and Medicine) only one subgroup had the exact knowledge structure to their disposition that they needed in the experiment. A solution to this problem would be to provide exactly the knowledge that readers need before the actual experiment. This would give us control over the specific knowledge participants have. This control was absent in the two experiments in this paper.

Another result that is not completely stable is the effect of markers on appraisal. The results all point in the same direction, but at one occasion, they were not significant (informative texts in experiment 2). We have shown that marking of coherence has a positive effect on text appraisal on the three other occasions, and this seems to indicate a pretty stable effect.

The same reasoning applies to FOK: on three out of four occasions, we found strong significant effects that show that markers of coherence lead to a high feeling of knowing, but in one case (persuasive texts, exp 1), this effect was not significant.

Despite these differences, the overall conclusion seems to be that we *can* generalize effects of coherence marking over genres and groups of subjects. In general, differences between the two genres are small. Also, the difference between high and low prior knowledge is minor. We have shown in two experiments that coherence markers can have a positive effect on both comprehension and appraisal, and that they are therefore useful in informative and persuasive texts. Only two texts have been used in these experiments: the results need to be replicated with more texts. However, another theoretically important question remains: do these markers also influence the persuasive power of a text? A persuasive text does not only aim at conveying information, but also at convincing the reader. This aspect of coherence markers should not be neglected and merits more attention in future research.

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