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Recalling Oral and Written Discourse

Gert Rickheit, Hans Strohner, Jochen Müsseler,
and Dieter Nattkemper
University of Bielefeld, Bielefeld, Federal Republic of Germany

We prescribed an expository text in two versions that varied in difficulty. The text was presented either orally or under one of two reading conditions, a normal reading or a moving window condition. The subjects were business trainees whose main communication experience was in either written or spoken communication. Immediately after presentation of the text, we asked the subjects to answer questions about it. The answers given after reading in the moving-window mode were in every respect the same as those given after self-controlled reading. There were differences between the listening condition and the two reading conditions, depending on the nature of the subjects' main communication experience and the difficulty of the text. We concluded from these results that the differences between the processing of oral and written discourse are caused neither by the difference of processing control nor by structural factors but by factors related to the communication experience of the subjects.

Recall performance after reading and listening to the same discourse has been shown to be different in terms of the number of text statements recalled accurately (e.g., Green, 1981; Hildyard & Olson, 1982; Hron, Kurbjuhn, Mandl, & Schnotz, 1985; Rickheit & Strohner, 1983). In these studies, reading resulted in more accurate free recall than did listening. Reading seems to be particularly advantageous in recalling difficult texts (e.g., Hildyard & Olson, 1978; Müsseler, Rickheit, & Strohner, 1985).

But there are also results that show a better free recall after listening than after reading (Sannomiya, 1982, 1984; Thorndyke, 1976). This may be due to the ways the tasks were presented in these studies. For example, Thorndyke presented his visual text in lines. This procedure may have disrupted some units of meaning and thus prevented the text from being encoded as semantic units. The studies of Sannomiya (1982, 1984) show that omitting data at the level of micropropositions and recruiting as subjects pupils with insufficient reading ability could lead to a misinterpretation of the results.

In the present study we attempted to clarify the modality effect and to establish the kind of mechanisms involved. There seem to be two plausible explanations for the modality effect: a structural advantage and a processing advantage of the visual modality.

Proponents of the structural explanation claim, for example, that some inherent qualities of the visual modality, such as its neurological basis, result in more persistent traces than do the corresponding qualities of the auditory modality. So far, this claim has not been tested experimentally in the context of discourse processing.

If such an explanation is valid, there should be no modality differences between different groups of subjects. This should be the case because structural features have uniform characteristics for all subjects. If, on the other hand, an interaction could be shown between the input modality and different groups of subjects whose main communication experience is in either oral or written communication, then this would contradict such an interpretation.

The processing explanation presupposes that reading and listening to a text require different strategies for acquiring information (cf. Nickerson, 1981). Textual information offers the reader a greater degree of freedom than it offers the listener. The reader is able to control the parameters of time (the duration of fixation) and of space (point of fixation) in acquiring information. Furthermore, the reader has the opportunity to review sections of the text needed to construct semantic units. The listener does not have this opportunity. The subject has little control over the speed of oral presentation. The listener is also unable to focus repeatedly on a particular point in the message. As opposed to the case in reading, in listening this is possible within the limits of working memory.

The processing explanation can be tested if the conditions of presentation of a text are made comparable for reading and listening. This outcome can be achieved by use of a word-for-word presentation for reading. The parameters of space and time should be limited to controlling the degree of freedom that exists in normal reading. Other relevant facets of the reading process should be maintained in order to approximate the conditions of everyday reading. Thus, each word should appear in the same spatial position in which it would appear in the normally written text, so that eye movements are not hindered. The time of presentation should, however, be variable within certain limits. It is known from studies on eye movements that in reading, the eyes are fixed longer on words at the beginning and at the end of a sentence than on those

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Correspondence concerning this article should be addressed to Gert Rickheit, Universität Bielefeld, Fakultät für Linguistik und Literaturwissenschaft, D-4800 Bielefeld, Federal Republic of Germany.

in the middle. This variability in the fixation time should be accounted for by a corresponding extension of the presentation time and of the interval of time between the words.

Should the reproductions after a word-for-word visual presentation be more like those that result after hearing a text, the hypothesis that modality effects are based on the different degrees of control in acquiring information from reading and listening would be supported. Should the word-for-word presentation be more like that of normal reading, other causative factors must be sought.

An alternative hypothesis is that the influence of processing control would be discernible only when the text message is sufficiently difficult. As when in difficult texts the regressive eye movements increase, the text recall following word-for-word presentation should be like that following auditory presentation. Understanding after the reading of a difficult text should be negatively affected by the word-for-word presentation. In the case of easy texts, this may be less apparent.

Method

Subjects

The 210 subjects were German-speaking business trainees of both sexes. The business trainees were all in the 2nd or 3rd year of training. Their mean age was 19.1 years, and the standard deviation was 1.8 years. The main communication experience of the subjects was based on the following two criteria:

(a) The profession of the subjects—the subjects were business trainees for professions that require a considerable amount of written communication (e.g., sales managers) or trainees for professions that require a relatively small amount of written communication (e.g., mechanics). (b) The responses of the subjects to a questionnaire—the subjects were asked to state how much time they spent using a particular communication medium (e.g., newspapers, books, radio, television, and cinema). The subjects were assigned to experimental groups according to both of these criteria. Subjects in the written communication group had professions in which writing was the main means of communication. These subjects spent most of the time devoted to communication reading and writing. Subjects in the spoken communication group had professions in which speech was the main means of communication. These subjects spent most of the time devoted to communication listening and speaking.

The two subject groups differed with respect to their educational level. The group whose main communication was written had a higher level of education than the group whose main communication was spoken, $\chi^2(2, N = 210) = 39.37, p < .001$.

Materials

The text that was presented was about 430 words long. We took it from an area in which subjects had everyday knowledge to ascertain the possible interaction of subjects' world knowledge with knowledge gained from the text during the reading or hearing of the text. A theme from popular science, various aspects of drug consumption (e.g., different drugs, drug dependence, the drug trade, the drug scene, withdrawal symptoms, and treatment), was discussed.

We drew up two versions of text with different degrees of difficulty. We transposed separate sections of the text version at a macrostructural level and used various embedded structures at the syntactic level. The advantage of this procedure was that we could draw up both an easy and a difficult version of the text without having to resort to different text bases. Comparability of the texts at the propositional level was thus ensured.

In a control experiment, the easier version of the text was shown to be higher than the difficult text in fluency, comprehensibility, consecutiveness, and ease to recall. In another control experiment, the easier version of the text also gave different internal representations of its macrostructure. Subjects evaluated the text after reading each sentence and indicated whether a new aspect of the subject matter was discussed and how important the separate statements appeared to the subject. According to the evaluation of the subjects, the importance of each statement was considerably different in the text versions. We thus assumed a different construction of the macrostructure in each text.

The text as a whole was presented visually, orally, or visually word for word. If the whole text was presented visually, the subjects were given the text, which was typewritten on two pages. The subjects to whom the text was orally presented heard a tape recording of the text read by a male speaker. The text was presented visually word for word on the display screen of a microcomputer. Each word appeared in the same spatial position on a line as it did in the written text (moving window technique). The line was always situated in the middle of the screen. The presentation time for a word was 280 msec. This period was followed by an interval of darkness on the screen of 50 msec. In order to enable subjects to do a return sweep of the material with their eyes, the presentation time for a word at the beginning of the line was 400 msec. It is known from studies of eye movements in reading that the fixation time is considerably longer at the beginning and at the end of sentences or clauses than within the sentence itself. For this reason, the period of screen darkness was lengthened to 1 after a period and to 280 msec after a comma.

Design

The experimental design of the study included three factors: main communication experience (written or spoken), presentation modality (listening, normal reading, or word-for-word reading), and text difficulty (easy or difficult). In each of the 12 cells of the $2 \times 3 \times 2$ design, there were 15 subjects, that is, a total of 180 experimental subjects.

In addition, there were two control groups, each consisting of 15 subjects. The subjects in one control group were business trainees whose main form of communication experience was written communication. The subjects in the other control group had spoken communication as their main form of communication experience. The control subjects answered the 20 test questions without having read or listened to the experimental test. The function of the control groups was to reveal possible differences in how questions were answered or in the world knowledge between the two experimental subject groups.

Procedure

The subjects were tested in groups of 4 or 5. They were instructed to carefully listen to or read the text in order to take a test following the presentation. They were told that when the whole text was presented visually, they would be allowed to read it only once. In the case of the word-for-word presentation, subjects were given training with a neutral text before the experimental text was presented, in order for the subjects to accustom themselves to the way in which the words were to be presented.

Immediately following presentation of the text, the subjects were asked 20 questions on the content of the text, for example, "Which drugs are allowed?" and "What are the causes of drug abuse?" The questions were arranged in random order. Each question was written

in the upper part of an otherwise blank sheet, so that the subjects could write their answers below the question.

Evaluation

The answers of the subjects were transposed into lists of propositions according to the procedure described by Turner and Greene (1977). Each proposition thus transposed was finally classified by one of five trained raters into one of four evaluation categories, as shown in Table 1.

A proposition was classified as a *complete reproduction* if the predicate–argument structure of the responded proposition was in agreement or was synonymous with a proposition of the original text.

A proposition was classified as a *partial reproduction* if it contained only part of the predicate–argument structure (or its synonym) of an original proposition.

A proposition that contained at least a part of one original proposition of the text base was classified as a *text inference.*

A proposition was classified as a *world knowledge inference* if it was based exclusively on world knowledge of the subject.

The correlation coefficients of interrater reliability for the five evaluation categories were between .75 and .94.

Results

A multivariate comparison between the two control groups resulted in a significant difference, $T^2 = 15.85$, $F(4, 25) = 3.54$, $p < .05$.

Subjects whose main communication experience was in written communication tended to recall more complete reproductions than did those whose main communication experience was in spoken communication, but this effect did not reach a high level of significance, $M = 4.7$ versus 3.8, $t(28) = -.76$, $p > .10$. More text inferences were produced in the first group, $M = 38.1$ versus 23.7, $t(28) = -2.31$, $p < .05$. This also applied to text and world inferences, $M = 43.4$ versus 32.3, $t(28) = -1.74$, $p < .10$. A reverse effect was seen in the case of partial reproductions, $M = 7.5$ versus 10.8, $t(28) = 2.88$, $p < .01$.

This effect may have resulted from the fact that different strategies were used by the two groups in answering questions or that there were differences in their knowledge. In any case, these underlying differences must also be taken into account in the comparison of the experimental groups. We thus subtracted the mean score of the appropriate control group from the score of each experimental subject.

The subtraction of a constant value from the experimental groups is an unusual but effective way to control the communication experience variable. This is because the subtraction of a constant value from the experimental raw score changes only the sum of squares in the main variable, communication experience, but does not influence the respective error. Likewise, the remaining main effects and the interaction effects are not affected. The resulting difference scores served, in addition to the raw scores, as dependent variables in the statistical analyses in the main variable, communication experience.

The difference scores of the four evaluation categories for each subject were entered as dependent variables in a multivariate analysis of variance (MANOVA). The variables in this MANOVA were main communication experience (written or spoken), presentation modality (listening, normal reading, or word-for-word reading), and text difficulty (easy or difficult). There was a significant effect for the main communication experience, $F(4, 165) = 7.52$, $p < .001$, and for the text difficulty, $F(4, 165) = 2.48$, $p < .05$. In addition, there was a significant interaction between the presentation modality and the text difficulty, $F(8, 330) = 3.08$, $p < .01$ and a trend toward a significant interaction between the presentation modality and the main communication experience, $F(8, 330) = 1.93$, $p = .055$.

Subsequently, univariate analyses of variance (ANOVAS) for the difference scores were carried out for each of the four evaluation categories. The variables in these analyses were the same as in the MANOVA.

For complete reproductions (see Figure 1), there was a significant effect of the main communication experience, $F(1,$

Table 1
Evaluation Categories and Examples From the Original German Version and Their Translations

Evaluation category	Example	Translation
Original propositions		
Proposition 1	*Kommen zu, es, Entzugserscheinung*	Come to, it, withdrawal symptom
Proposition 2	*Ist ein, Schmerz, Entzugserscheinung*	Is a, pain, withdrawal symptom
Complete reproduction of Proposition 1		
Complete version	*Kommen zu, es, Entzugserscheinung*	Come to, it, withdrawal symptom
Synonymous version	*Entstehen, Entzugserscheinung*	Arise, withdrawal symptom
Partial reproduction of Proposition 1	*Kommen zu, es, Erscheinung*	Come to, it, symptom
Text inferences		
Proposition 1	*Kommen zu, es, Schmerz*	Come to, it, pain
Proposition 2	*Kommen zu, es, Fieber*	Come to, it, fever
World knowledge inference	*Hoch, Fieber*	High, fever

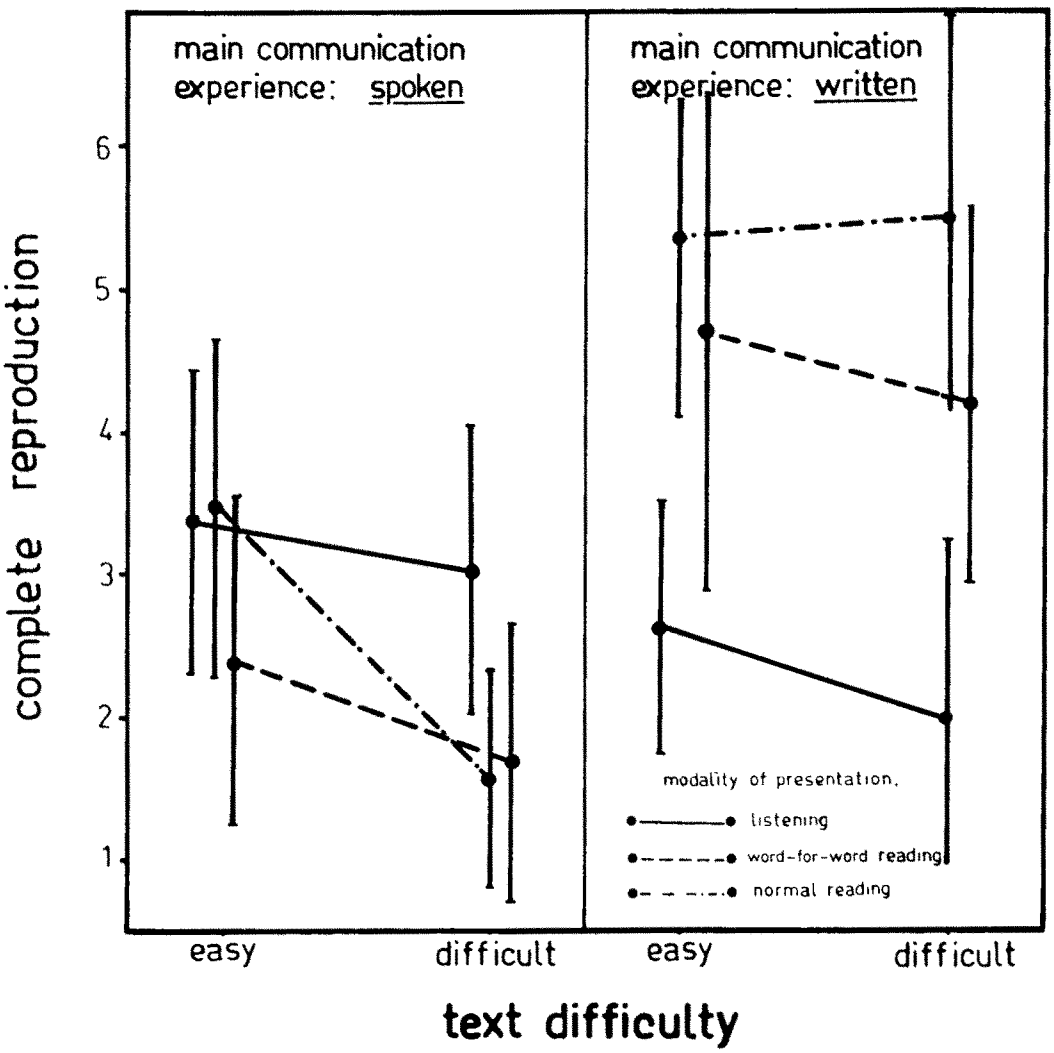

Figure 1. Means and standard errors of the difference scores for the number of complete reproductions. The difference score is the result of subtracting the mean score of the appropriate control group from the score of each experimental subject.

168) = 4.75, $p < .05$, $MS_e = 20.27$, and a trend toward an interaction between presentation modality and main communication experience, $F(2, 168) = 2.86$, $p = .059$, $MS_e = 20.27$. In both reading groups, those subjects whose main communication experience was in written communication recalled more complete reproductions than did those subjects whose main communication experience was in spoken communication. In the analysis of raw scores, this effect is even more evident, $F(1, 168) = 12.08$, $p < .001$, $MS_e = 20.27$. However, for listening, there was a trend in the opposite direction.

For partial reproductions, there was also a significant effect in the difference scores of the main communication experience, $F(1, 168) = 26.25$, $p < .001$, $MS_e = 16.42$, which resulted from the higher scores of the subjects with mainly written communication experience. Because there was no such effect in the raw scores, $F(1, 168) = .15$, $p > .10$, $MS_e = 16.44$, this effect seems to have been due mainly to the subjects' world knowledge in answering questions.

For text inferences (see Figure 2), the effect of text difficulty was significant, $F(1, 168) = 7.94$, $p < .01$, $MS_e = 261.36$, as well as for the interaction between presentation modality and text difficulty, $F(2, 168) = 10.27$, $p < .001$, $MS_e = 261.36$, in the difference scores. These effects are due to the high number of text inferences subjects made after listening to the easy text version and to the low number of text inferences they made after listening to the difficult text version. For both reading groups, there were no differences between the two text versions. The main communication experience was significant in the analysis of raw scores, $F(1, 168) = 30.25$, $p < .001$, $MS_e = 261.36$.

In the case of world knowledge inferences (see Figure 3), there was also a significant effect of text difficulty, $F(1, 168) = 5.45$, $p < .05$, $MS_e = 222.27$. There were more world knowledge inferences with the easy text version. In addition, there was an interaction between main communication experience and text difficulty, $F(2, 168) = 3.96$, $p < .05$, $MS_e = 222.27$. With the difficult text version, the subjects whose

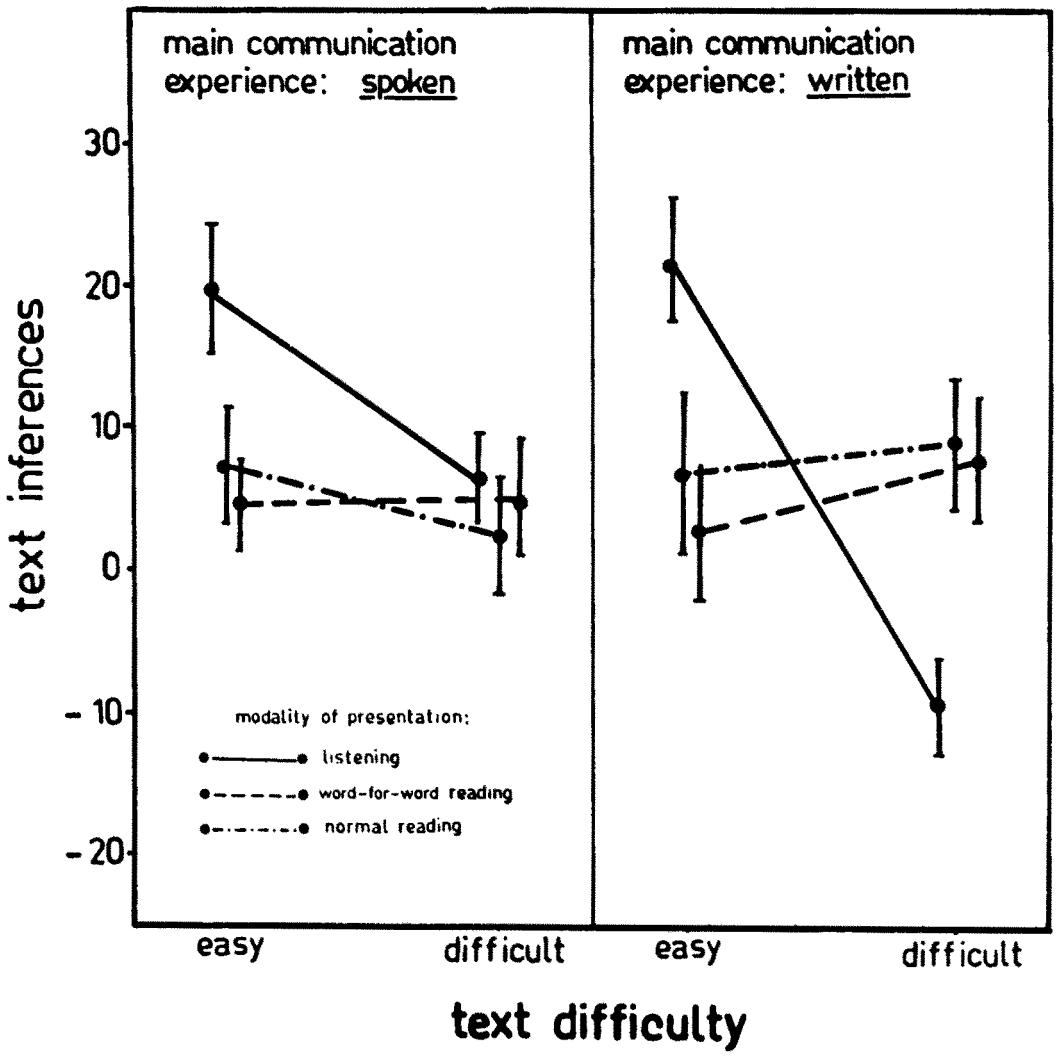

Figure 2. Means and standard errors of the difference scores for the number of text inferences. The difference score is the result of subtracting the mean score of the appropriate control group from the score of each experimental subject.

main communication experience was in spoken communication produced more world knowledge inferences than did the subjects whose main communication experience was in written communication. There was the same tendency of interaction between the presentation modality and text difficulty as there was in the text inferences. But here the interaction reached only the 10% level, $F(11, 69) = 2.39$, $p < .10$, $MS_e = 222.27$.

The main communication experience was significant in the analysis of raw scores, $F(1, 168) = 17.59$, $p < .001$, $MS_e = 222.27$. This means that world knowledge appears to be a decisive effect.

For all dependent variables, there were no differences between the two reading groups.

Discussion

The results of the present study do not support the two causal hypotheses that we referred to in the introduction of this article. Because different subject groups showed a systematically different recall performance after subjects read or listened to the same text, the explanation of the modality effect by a structural advantage of the visual modality can be refuted. On the other hand, the processing hypothesis fits in well with the observed difference between subject groups. It is conceivable that the two subject groups coped differently with the processing demands of written and oral texts. Other results of the present study, however, are not compatible with the processing explanation.

No significant differences were found either between the two reading conditions for the two reproduction categories or for the two inference categories. This was true for both subject groups. Likewise, the difficulty of the text had no influence on either reading condition. Information processing in reading a text thus appeared not to be influenced by the degree of processing control occurring in the pattern of eye movements. This result is comparable to that found in other studies, in which a predominance of the natural reading condition, as

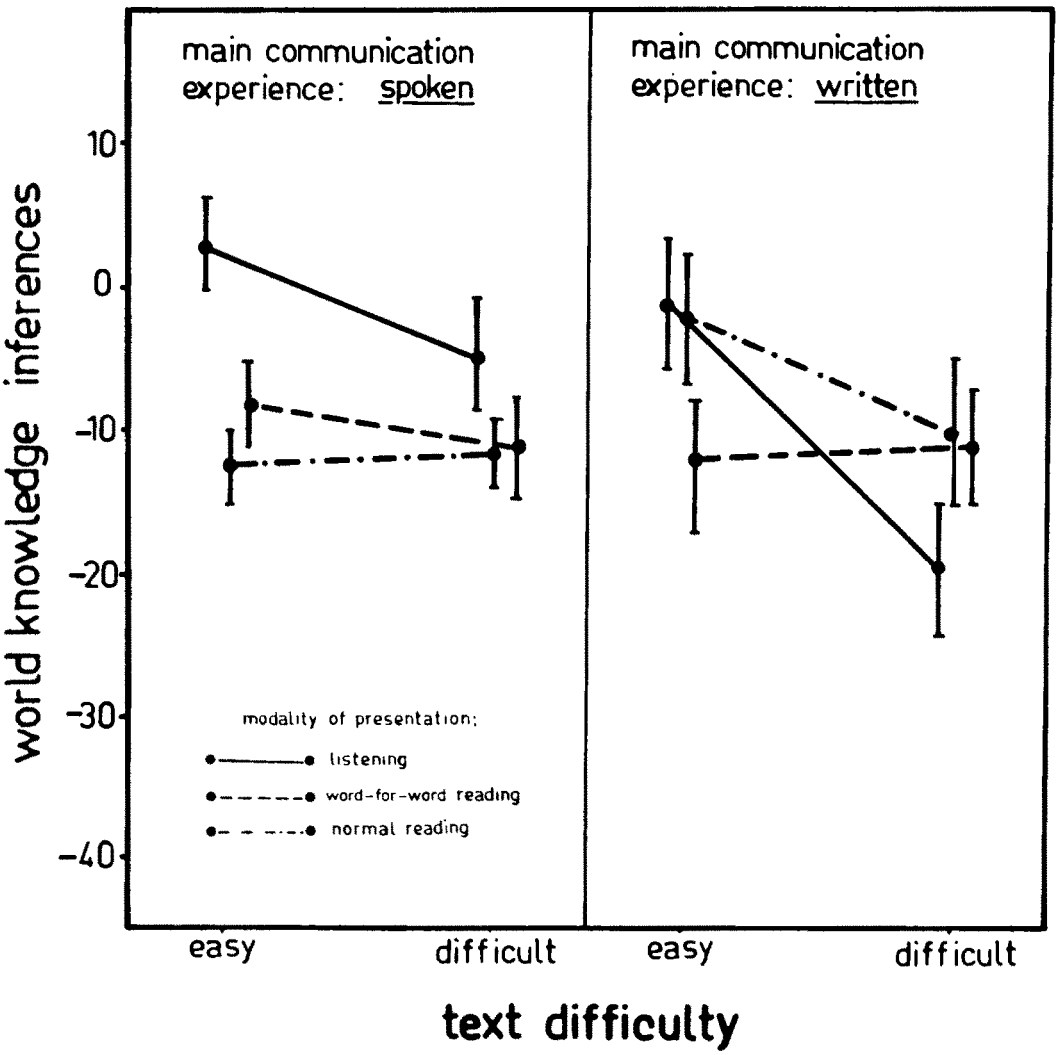

Figure 3. Means and standard errors of the difference scores for the number of world knowledge inferences. The difference score is the result of subtracting the mean score of the appropriate control group from the score of each experimental subject.

opposed to word-for-word text presentation that cannot be controlled by the subjects, could not be established (Juola, Ward, & McNamara, 1982; Just, Carpenter, & Woolley, 1982). The fact that there are no differences between the reading conditions leads one to conclude, in agreement with Ward & Juola (1982), that the corresponding processes involved in understanding a text are similar. Therefore, the processing explanation of the modality effect has to be refuted as well.

The present experiment could give rise to the criticism that communication experience may be confused with educational level and reading ability. We do not think, however, that this criticism is sufficient to explain all the effects. First, if educational level and reading ability are significant, a great disadvantage should have been observed after a word-for-word presentation to the subject group whose main communication experience was oral. In the pretest that we carried out, all the subjects with this main experience were able to read the text at a speed corresponding to the speed of presentation, so that it was not necessary to exclude any subject. Second, a possible disadvantage resulting from lower educational level would have been manifested when these subjects answered questions that tested their world knowledge. There is, however, no apparent difference in the inference categories in respect to either the mode of visual presentation or in respect to the type of communication experience that subjects had.

There was an interaction between the difficulty of the text and the presentation modality in both inference categories. The number of inferences increased after subjects heard the easy text. A similar observation has been reported in various other studies (Harris, 1981; Hildyard & Olson, 1978, 1982; Rickheit, Strohner, & Müsseler, 1987; Slowiaczek & Clifton, 1980). Hildyard and Olson (1982) attributed this effect on hearing and reading a text to different attentional strategies. They believed that when listening to a text, the listener tends to extract the essential information, whereas a reader gives equal attention to all parts of the text, including detailed information.

A similar interpretation could be applied to our results. If it is assumed that when listening to a text, the listener extracts mainly the gist of it, then mental representations, which exist prior to the experiment, must frequently be called on in order to answer the questions. With this interpretation, the influence of modality on inference forming is seen as being less during the comprehension than during the reproduction phase (Rickheit & Strohner, 1983). The increase in inference would thus be a substitution strategy for inadequate processing during listening.

The results of the experiment indicate that results of the previous studies on recall performance after subjects have read or listened to the same text should be interpreted with caution. One weakness of those studies concerns the type of subjects who participated in the experiments. They were generally college students who were very experienced in written communication. The present study also involved subjects who were more familiar with spoken than with written communication. Whereas subjects whose main communication was written recalled more complete reproductions in the visual modality than in the auditory modality, there was an opposite trend among subjects whose main communication experience was in spoken communication. Thus, we conclude that in studying the modality effect on text recall, the communication experience of the subjects must be taken into account.

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