

TOPIC INTEREST AND FREE RECALL OF EXPOSITORY TEXT

ULRICH SCHIEFELE
UNIVERSITY OF BIELEFELD

ANDREAS KRAPP
UNIVERSITY OF THE BUNDESWEHR MUNICH

ABSTRACT: This study investigated the relations between topic interest, cognitive characteristics, variables of the reading process, and free recall of expository text. Eighty male university students were presented with a text on "Psychology of Communication." Prior to reading the text, general intelligence, prior knowledge, and topic interest were assessed. The results revealed that topic interest was significantly related to recall of idea units, elaborations, and main ideas. In addition, interest was significantly related to the sequence of recalled main ideas. The relations between interest and the various indicators of recall were independent of prior knowledge and intelligence. Topic interest, but neither prior knowledge nor intelligence, was significantly related to variables of the reading process (e.g., arousal). However, no evidence was found that these variables mediate substantial parts of the effect of topic interest on recall.

TOPIC INTEREST AND FREE RECALL OF EXPOSITORY TEXT

An increasing body of research deals with the influence of interest on learning from text (for reviews see Asher 1980; Hidi 1990; Hidi & Baird 1986; Schiefele 1992; Wade 1992). Within this field, two different conceptions of interest are distinguished: (1) individual, or topic, interest and (2) situational, or text-based, interest (Krapp, Hidi, & Renninger 1992). Topic interest is conceived of as a relatively enduring evaluative orientation towards certain topics, whereas text-based interest is an

Direct all correspondence to: Ulrich Schiefele, Universität Bielefeld, Fakultät für Psychologie und Sportwissenschaft, Postfach 100131, 33501 Bielefeld, Germany.

Learning and Individual Differences, Volume 8, Number 2, 1996, pages 141-160.
All rights of reproduction in any form reserved.

Copyright © 1996 by JAI Press Inc.
ISSN: 1041-6080

emotional state aroused by specific text features. The majority of previous studies found positive relations between interest and measures of text learning. This is equally true for topic interest (e.g., Alexander, Kulikowich, & Schulze 1994; Renninger 1992; Schiefele 1990, 1992) and text-based interest (e.g., Garner & Gillingham 1991; Hidi & McLaren 1988; Shirey & Reynolds 1988). In addition, the positive impact of interest on text learning seems to be largely independent of the nature of texts (narrative vs. expository), text difficulty, type of learning test (e.g., multiple-choice vs. recall), reading ability, and age or grade level.

In spite of these positive results, studies investigating the relation between topic interest and text learning suffer from a number of shortcomings.¹ First, although earlier studies employed a wide range of measures of text learning (e.g., free recall, cued recall, sentence or word recognition, Cloze-procedure, and multiple-choice questions), most of these studies used only one indicator of learning. Only a small number of studies assessed two or more qualitatively different indicators. For example, Renninger (1992) found that students recalled more points or facts and main ideas of texts for which they had interest as opposed to texts for which they had "noninterest" (see below). In addition, students were less likely to make comprehension-related errors when recalling texts with interesting topics. Flammer, Schläfli, and Keller (1978) showed that interest is significantly related to correct sentence recognition but not to structural aspects (correct categorization of different concepts). Rickheit and Strohner (1986) differentiated between recall of propositions, proximal and distal inferences, and elaborations. However, they obtained no significant results. Both the Flammer et al. and Rickheit and Strohner studies are afflicted with several problems (e.g., inadequate measurement of interest) that limit the validity of their results (see Schiefele 1990).

Second, another problem of earlier research concerns the role of cognitive characteristics of the learner. Prior studies most often included reading ability as a cognitive variable and found consistently that the relation between topic interest and text learning is not affected by reading ability (e.g., Osako & Anders 1983; Stevens 1979; Walker, Noland, & Greenshields 1979; Weber 1980). However, research has failed to investigate systematically the influence of intelligence and prior knowledge on the interest-learning relation.

Those studies addressing the possible interaction between topic interest and prior knowledge obtained conflicting results. For example, Alexander et al. (1996), Baldwin, Peleg-Bruckner, and McClintock (1985), Entin and Klare (1985), and Weber (1980) found that interest and prior knowledge were significantly related to text learning and did not interact. Hare and Devine (1983), on the other hand, obtained a significant relation only between prior knowledge and learning. Finally, Osako and Anders (1983) found weak effects for both prior knowledge and topic interest. In an extensive review of the relations among interest, knowledge, and learning, Tobias (1994) concluded that on the average about 20% of the variance of topic interest may be accounted for by topic-related knowledge. In addition, Tobias reported evidence suggesting that interest and prior knowledge have significant effects on text learning independently of one another. However, it seems that the influence of prior knowledge exceeds that of interest.

To the best of our knowledge, only one study on topic interest and text learning has included a measure of intelligence (Groff 1962). Unfortunately, this author failed to test whether intelligence affects the relation between interest and text learning.

Third, although, after three decades of research, it is well documented that topic interest and learning from text are significantly related, no efforts were made to explain that positive relation. Therefore, our knowledge of factors and processes (e.g., attention, learning strategies) that probably mediate the effect of interest on learning is small. It was only recently that Hidi (1990, 1994) discussed the role of attention as a mediating process in the relation between situational interest and text learning.

The present study is part of a larger research program designed to overcome the deficits outlined above. In this research program we conceptualize topic interest as the relatively long-term orientation of an individual towards a certain topic, or a domain of knowledge (Krapp et al. 1992; Schiefele 1991, 1992). Two aspects or components of interest are distinguished: feeling-related and value-related valences. Feeling-related valences refer to the feelings that are associated with a topic. Feelings of involvement or stimulation are seen as most typical of interest. Value-related valences refer to the attribution of personal significance to a topic. In addition, both feeling-related and value-related valences are of intrinsic nature. This is to say that both types of valences are *directly* related to a certain topic and are not based on the relation of this topic to other topics, objects, or events. For example, if a student associates mathematics with high personal significance because mathematics helps him or her to get a prestigious job, then we would not speak of interest.

It is important to mention that topic and individual interest are not exactly the same. Rather, topic interest is a subgroup of individual interest. Individual interests may refer not only to topics, or domains of knowledge, but also to material objects and activities.

Renninger (1990, 1992) has proposed a different definition of individual interest. She distinguishes between interests (high value and high knowledge with regard to the interest object) and noninterests (low value and high knowledge). In contrast to Renninger, our conception of interest does not include topic-related knowledge as a component.

Corresponding to the above analysis of shortcomings of prior studies, the following goals were pursued in the present investigation: to give a more precise picture of the effects of interest by including multiple indicators of recall, to include measures of prior knowledge and intelligence, and to explore the role of relevant mediating variables.

Four different indicators of free recall of text were used: number of idea units (an idea unit usually corresponds to a proposition), number of main ideas (or macro-propositions; see below), number of elaborations, and coherence of recall (defined here as the correctness of the sequence of reproduced idea units or main ideas). The number of recalled idea units is supposed to be an indicator of the overall quantity of text learning. This measure does not allow conclusions about the level of comprehension a learner has achieved. However, number of main ideas, number of

elaborations, and sequence of recall indicate deeper levels of comprehension or learning.

Prior knowledge specifically related to the text ("topic knowledge," see Alexander, Schallert, & Hare 1991) was tested by means of multiple-choice items and questions without given response alternatives. In addition, the subjects were presented with an IQ test.

As relevant mediating variables we selected arousal, attention, and use of learning strategies. The crucial role of these variables in the learning process has been supported by a large number of studies (e.g., Eysenck 1982; Hidi 1990; Pintrich 1989; Pokay & Blumenfeld 1990; Thayer 1989).

The measurement of arousal in the present study followed Thayer's (1989) theory. According to Thayer, self-reports of arousal are more valid than physiological indicators (see also Eysenck 1982). Thayer distinguished between two bipolar dimensions of arousal: energetic arousal (e.g., "energetic" vs. "sleepy"), and tense arousal (e.g., "nervous" vs. "relaxed"). Only the energetic dimension is involved in motivational processes. In contrast, tense arousal is similar to a stress dimension and was not included in the present study.

Attention is an elusive concept and has been defined in a number of different ways (cf. Eysenck 1982; Kinchla 1992). We adopted the view of Humphreys and Revelle (1984; Revelle 1989) and defined attention as the amount of allocated resources during information processing (Wickens 1989). We used subjective ratings and reading times as measures of attention.

A wide array of different learning strategies has been proposed in the literature (e.g., Pintrich 1988, 1989; Weinstein 1988). For purposes of the present study, we selected three different strategies that are of considerable importance for learning from text (e.g., T. H. Anderson & Armbruster 1984; Kiewra 1989; Wade & Trathen 1989): elaboration, note-taking, and underlining. Underlining is mainly used to highlight important information. Note-taking may serve different purposes (e.g., elaboration, organisation, monitoring).

The main hypotheses of the present study were: (1) Topic interest is significantly related to all indicators of text recall. (2) Interest is more strongly related to indicators of deeper levels of learning (main ideas, elaborations, sequence of recall) than to the quantity of learning (number of idea units). (3) The relations between interest and recall are independent of prior knowledge and intelligence. (4) Interest is significantly related to arousal, attention, and use of learning strategies. (5) The latter variables mediate significant parts of the presumed influence of interest on text recall.

METHOD

SUBJECTS

A total of 80 male first-semester students at the University of the Bundeswehr Munich took part in the study. The participants were majoring either in computer science or social science. They were between 20 and 27 years old ($M = 22.2$).

EXPERIMENTAL TEXT

Because it was our primary goal to investigate relations between interest and learning, we used a text for which the present sample presumably had low levels of prior knowledge. A second criterion in selecting an appropriate text was that interest in the topic of the text should display large variance. This was tested in a pilot study. The topic finally selected was "Psychology of Communication." The text was based on two articles from German psychology textbooks. It consisted of 1115 words (about five pages) and had four parts: "The Concept of Communication," "Models of Communication," "Verbal and Nonverbal Communication," and "Practical Applications."

INSTRUMENTS

COGNITIVE VARIABLES

Two weeks before reading the text, prior knowledge and intelligence were assessed. The test of prior knowledge was composed of 13 multiple-choice items and three questions without given response alternatives (free-response questions). The multiple-choice test was related to information contained in the text ("topic knowledge"), whereas the free-response questions asked for "domain knowledge," i.e. knowledge of the domain of psychology of communication not directly addressed in the text (Alexander et al. 1991). The multiple-choice items contained four or five response alternatives. In each case there was only one correct answer.

The homogeneity of the multiple-choice test of prior knowledge was examined by means of Rasch-analysis. Traditional reliability tests (e.g., Cronbach's Alpha) were not applied because the multiple-choice items differed widely in difficulty and were not highly correlated. The Rasch-analysis was performed by using the statistical software "BIGSTEPS" (Wright & Lincacre 1991). BIGSTEPS provides the fit statistic t for individual items, which indicates how far an item deviates from the assumption that "solving" difficult items implies solving less difficult items. t values between -2 and $+2$ indicate acceptable deviations (Wright & Masters 1982). For the present scale, t values between -1.44 and $+0.81$ were obtained. Therefore, it can be concluded that the multiple-choice test of prior knowledge forms a homogeneous scale. In addition, a reliability coefficient of .94 was obtained. This coefficient expresses the amount of observed item variance that is not due to estimation error.

Answers to free-response questions (basic conditions of human communication, differences between natural and technical communication, social influence on language) were analyzed by two independent student raters. The rating procedure involved the evaluation of all statements in each response as correct or incorrect

(range of correct answers for question one: 0 - 5, for question two: 0 - 8, for question three: 0 - 5). The two raters agreed on 86% of all evaluated answers. Values on free-response questions were z-standardized and then combined into a single score. The two measures of prior knowledge were not significantly correlated ($r = .20, n = 80, ns$).

Intelligence was measured by using five subtests of the WILDE-Intelligence-Test (Jäger & Althoff 1983). Two subtests served to assess verbal thinking, whereas the other tests were designed to measure reasoning, word fluency, and memory. The sum of all subtests was used as an estimate of general intelligence.

TOPIC INTEREST

The interest questionnaire was comprised of two parts. In the first part the subjects should indicate how they expected to feel while reading the text (feeling-related valences). They were asked to use the following adjectives in estimating their expected feelings: ("While reading the text on 'Communication,' I expect to feel ...") "bored," "stimulated," "interested," "indifferent," "involved," and "engaged." When estimating value-related valences, subjects were asked to use the terms "meaningful," "unimportant," "useful," and "worthless" to describe the value of the text's topic to them personally. All items had to be rated on four-point rating scales (ranging from "completely true" to "not at all true"). For each subject a score of topic interest was computed by adding feeling-related and value-related scales. Prior studies (e.g., Schiefele 1990, 1991) have shown that this measure of interest is unidimensional and highly reliable. In the present study, a reliability coefficient (*Alpha*) of .91 was obtained.

In addition, earlier studies (e.g., Schiefele 1990) confirmed the intrinsic character of the present assessment of feeling-related and value-related valences. Specifically, it was shown that high levels of feeling-related and value-related valences were strongly associated with a situation-specific intrinsic motivational orientation (cf. Deci & Ryan 1985), i.e., highly interested readers felt self-determined, they did not wish to be doing something else, and after reading they agreed to read another text on the same topic.

PROCESS VARIABLES

We measured the following process variables: arousal, attention (intensity, persistence), elaboration, note-taking, and underlining. Arousal, intensity of attention, and elaboration were assessed by means of four-point rating scales (ranging from "completely true" to "not at all true").

Arousal. Level of arousal was estimated by using the energetic arousal subscale of Thayer's (1985, 1986, 1989) "Activation-Deactivation Adjective Check List" (AD-ACL). This subscale is available in short and long versions. We chose the short version consisting of 10 adjectives that have to be rated individually. One half of these adjectives are descriptors of low arousal (e.g., "tired") and the other half are descriptors of high arousal (e.g., "active"). Thayer (1989) has presented consider-

able evidence for the reliability and validity of the energetic arousal scale. In the present study, coefficient *Alpha* was .93.

Attention. In text learning situations, two dimensions of attention are to be distinguished: intensity and persistence (cf. Reynolds 1992). The intensity dimension of attention was assessed by means of two rating scales ("I was completely caught up in what I was reading"; "When reading the text, I was concentrated"; $r = .64$, $p < .001$). The persistence dimension of attention was measured by means of recording the subjects' reading times. The two measures of attention were not significantly correlated ($r = .13$, *ns*). This is in line with results of prior studies (R. C. Anderson 1982; Shirey & Reynolds 1988).

Elaborations. In order to assess use of elaborative learning strategies, a six-item questionnaire was administered. Students were asked (1) to what extent they have associated the text content with personal events or (2) prior knowledge, (3) whether they created mental images, (4) produced their own thoughts or ideas, (5) tried to paraphrase the text in their own words, and (6) thought about the essence and purpose of the text. For this scale a coefficient *Alpha* of .68 was obtained.

Underlinings and Margin Notes. Subjects were explicitly allowed to underline passages in the text and to make notes in the margins. Individual measures for the use of these methods were derived by counting the number of underlined and noted words. Because these measures exhibited large amounts of variance (numbers ranged from 0 to 389 for underlined words and from 0 to 62 for noted words), they were combined in categories. For underlined words 16 categories and for noted words 8 categories were formed.

RECALL TEST

After reading the text, the subjects were asked to write down the text content as completely as possible. It was not necessary to reproduce the original wording. The recall protocols were analyzed independently by two student raters. The first step was to divide the text into idea units. Each idea unit represents a meaningful information complex that corresponds to a proposition (cf. van Dijk & Kintsch 1983). In contrast to a complete propositional analysis, the identification of idea units does not include determining the nature of relations between text units (Mandler & Johnson 1977; Mayer 1985). The parsing of the text into idea units was done by four experts. Disagreements were resolved by discussion. The final list included 99 idea units.

Secondly, all idea units identified in the recall protocols were rated as being complete (1 point), incomplete (0.5 points), or wrong (0 points). In addition, idea units containing correct information not stated explicitly in the text were categorized as "new." Thus, new idea units are equivalent to elaborations. Intercoder correspondence was determined by the ratio between the number of unanimously evaluated idea units and the total number of evaluated idea units. For the present

sample, this coefficient was .89. All disagreements were discussed by the two raters and resolved.

The third step in analyzing the recall data consisted in identifying the main ideas of the text. Main ideas contain the most important information in the text. They are similar to van Dijk and Kintsch's (1983) "macropropositions." The task of parsing the text into main ideas was performed by the four experts mentioned above. Then, the two student raters identified complete and incomplete main ideas in each recall protocol. No wrong main ideas could be identified. The raters agreed in 93% of all cases. Disagreements were resolved by discussion.

Idea units or main ideas that appeared more than one time in the same recall protocol were counted only once.

In addition to the analysis of idea units and main ideas, the sequence of recall was determined. We assumed that a coherent recall protocol should follow the sequence of idea units, or main ideas, in the original text. The omission of parts of the text was not seen as an indicator of incoherence. Therefore, a sequence of idea units (or main ideas) such as 2 - 5 - 17 - 42 - 68 was evaluated as coherent, whereas a sequence such as 42 - 2 - 5 - 68 - 17 was evaluated as incoherent. More precisely, the latter sequence contains two incoherent (42 - 2, 68 - 17) and two coherent transitions (2 - 5, 5 - 68).

Two different indicators of coherence were computed. One was based on the sequence of idea units, the other on the sequence of main ideas. In order to determine individual scores of coherence, the number of coherent transitions in each recall protocol was weighted by the overall number of idea units or main ideas, respectively.

PROCEDURE

All tests and questionnaires were completed by the subjects in several introductory seminars. The average group size was 18. The seminars' regular teachers served as the experimenters. Two weeks after testing for intelligence and prior knowledge, the main part of the study was conducted. At the beginning of the session, the subjects were told that the study had to do with the quality of textbooks and that they should evaluate a text. No mention was made of a recall test in order to avoid a strong extrinsic motivational orientation. The subjects were then presented with a short summary of the text to read. Following this, they had to indicate their degree of interest in the topic and were given 20 minutes to read. The students were explicitly allowed to underline and to make notes in the page margins. After completing the reading phase, the students filled out the questionnaires designed to assess the process variables (arousal, intensity of attention, and elaboration). Subsequently, the recall test was administered. All students were able to finish the text within the given time. Individual reading times were recorded by the subjects.

RESULTS

In this section, we first present descriptive statistics for all variables included in the study. Next, we examine the relations between the predictor variables (interest, prior knowledge, intelligence) and the criterion variables (recall of idea units and main ideas, coherence of recall). Finally, relations among predictors, variables of the reading process, and criteria are analyzed.

DESCRIPTIVE STATISTICS

Table 1 depicts ranges, means, and standard deviations for all variables. The means reported in Table 1 were not different for social science and computer science students. It is noteworthy that correlations between topic interest and prior knowledge (multiple-choice: $r = .02$, *ns*; free-response questions: $r = .26$, $p < .05$), topic interest and intelligence ($-.01$, *ns*, $n = 80$), and between prior knowledge and intelligence (multiple-choice: $r = .15$, *ns*; free-response questions: $r = -.02$, *ns*) were either low or nonsignificant. The low correlations between interest and prior knowledge were not unexpected because the topic of the experimental text was unfamiliar to most students (cf. Tobias 1994). The low correlations between intelligence on the one side and interest and prior knowledge on the other side are in line with other studies which found evidence for the independence of expertise in a particular domain and overall aptitude (e.g., Schneider & Körkel 1989).

The multiple-choice measure of prior knowledge was not significantly correlated with any of the variables included in the present study. Therefore, we decided to report only those results related to prior knowledge that were measured by free-response questions.

TOPIC INTEREST AND RECALL

We analyzed the contributions of topic interest, prior knowledge, and intelligence as predictors of recall by means of multiple regression analyses. The predictor variables were entered simultaneously into the regression equations.

The results showed that topic interest was significantly related to the total amount of recalled idea units and the number of new idea units (see Table 2). In addition, a significant relation between prior knowledge and new idea units was observed, whereas intelligence did not contribute significantly to any indicator of recall of idea units. Although the relation between prior knowledge and total number of idea units was only marginally significant, it is obvious that topic interest and prior knowledge predicted recall of idea units equally well.

TABLE 1
Descriptive Statistics

Variable	Range ^a	M	SD
Topic Interest	1 - 4	2.45	0.62
Intelligence ^b	94 - 120	107.49	6.55
Prior Knowledge			
Multiple-Choice	0 - 13	4.63	1.75
Free-Response ^c	0 - 16	6.71	3.65
Idea Units			
Complete ^c	2 - 43	17.03	9.16
Incomplete ^c	1 - 22	7.25	4.12
Wrong ^c	0 - 2	0.34	0.59
New ^c	0 - 7	1.75	1.68
Sequence ^d	0 - 1	0.78	0.09
Main Ideas			
Complete ^c	0 - 11	4.28	2.78
Incomplete ^c	0 - 8	3.05	2.10
Sequence ^d	0 - 1	0.67	0.17
Arousal	1 - 4	2.68	0.66
Attention			
Intensity	1 - 4	2.62	0.60
Persistence ^c	6 - 20	14.71	3.86
Elaboration	1 - 4	2.49	0.56
Underlining ^{ce}	1 - 16	7.44	4.96
Note-Taking ^{ce}	1 - 8	3.03	2.51

Notes: $n = 80$.

^aIf not otherwise indicated, the scales' endpoints are reported.

^bStandardized IQ scores (with $M = 100$ and $SD = 10$).

^cThe range of values was determined empirically.

^d $n = 78$ (One subject did not produce any main idea, another subject produced just one).

Therefore, no indicator of coherence could be computed).

^eValues represent categories (see text).

As is shown in Table 3, the results revealed that topic interest was significantly related to the total number of main ideas. Specifically, it was found that interest did predict the number of complete main ideas, but not the number of incomplete main ideas. No significant relations between intelligence and prior knowledge and recall of main ideas were obtained.

Sequence of recall of idea units was not significantly related to any predictor variable. However, topic interest contributed to the prediction of sequence of main ideas (see Table 4).

ANALYSIS OF PROCESS VARIABLES

We hypothesized that interest affects variables that play a key role in the processing of text. Therefore, we examined the relations between interest and arousal, attention, elaborative strategies, note-taking, and underlining (see Table 5 for inter-correlations). The results revealed that interest was significantly related to arousal, intensity of attention, elaboration, and note-taking, but not to persistence of atten-

TABLE 2
Interest, Prior Knowledge, and Intelligence as Predictors
of Recall of Idea Units

Criterion/Predictor	R^2	r^a	beta	$F(1,76)$	p
Total IUs ^b	.14				
TI		.28*	.23	4.34	< .05
PK		.26*	.20	3.48	= .066
IQ		.17	.17	2.67	ns
Complete IUs	.14				
TI		.26*	.21	3.72	= .058
PK		.25*	.20	3.27	= .075
IQ		.03	.18	2.83	ns
Incomplete IUs	.04				
TI		.17	.15	1.63	ns
PK		.13	.09	.66	ns
IQ		.03	.03	.09	ns
Wrong IUs	.03				
TI		-.04	-.05	.19	ns
PK		.01	.02	.04	ns
IQ		-.17	-.17	2.34	ns
New IUs	.23				
TI		.37***	.30	8.25	< .01
PK		.36**	.28	7.37	< .01
IQ		.13	.14	1.85	ns

Notes: $n = 80$. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests); IU = Idea unit; TI = Topic interest; PK = Prior knowledge (free response questions); IQ = Intelligence.

^aZero-order correlations.

^bThe total number of idea units includes complete (1 point) and incomplete idea units (0.5 points).

TABLE 3
Interest, Prior Knowledge, and Intelligence as Predictors
of Recall of Main Ideas

Criterion/Predictor	R^2	r^a	beta	$F(1,76)$	p
Total MIs ^b	.15				
TI		.35*	.32	8.47	< .01
PK		.21	.13	1.48	ns
IQ		.11	.12	1.25	ns
Complete MIs	.14				
TI		.36*	.34	9.46	< .005
PK		.16	.08	.51	ns
IQ		.10	.11	1.00	ns
Incomplete MIs	.23				
TI		.17	.12	1.10	ns
PK		.24**	.21	3.50	= .065
IQ		.09	.09	.73	ns

Notes: $n = 80$. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests); MI = Main idea; TI = Topic interest; PK = Prior knowledge (free response questions); IQ = Intelligence.

^aZero-order correlations.

^bThe total number of idea units includes complete (1 point) and incomplete idea units (0.5 points).

TABLE 4
Interest, Prior Knowledge, and Intelligence as Predictors
of Sequence of Recall

Criterion/Predictor	R^2	r^a	beta	$F(1,76)$	p
Sequence of IUs	.04				
TI		.20	.20	2.78	ns
PK		.05	-.00	.00	ns
IQ		.01	.01	.01	ns
Sequence of MIs ^b	.16				
TI		.39***	.41	13.51	< .001
PK		.06	-.06	.30	ns
IQ		-.08	-.07	.41	ns

Notes: * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests); IU = Idea unit; MI = Main idea; TI = Topic interest; PK = Prior knowledge (free response questions); IQ = Intelligence.

^aZero-order correlations.

^b $n = 78$ (two subjects recalled less than three main ideas. In these cases it made no sense to determine the amount of coherence.)

tion (reading time) and underlining (see Table 6). In addition, significant relations between prior knowledge and arousal and intensity of attention and between intelligence and note-taking were obtained. The next step in the analysis was to investigate the role of process variables as mediators of the relation between topic interest and text recall. Total numbers of idea units and main ideas were used as measures of text recall in this analysis. In order to demonstrate the mediating effect of a variable, four conditions have to be met (cf. Baron & Kenny 1986): (1) The correlations between predictor and mediator, (2) between predictor and criterion, and (3) between mediator and criterion must be significant. (4) Using a regression model, the inclusion of the mediator as an additional predictor must lead to a significant decrease in the predictor-criterion relation. The results in Tables 6 and 7 reveal that the first three conditions were met by arousal, intensity of attention, and note-taking. Therefore, only these variables were tested as mediators of the effects of interest on recall.

The mediating effects of arousal, attention, and note-taking were tested separately. Because of the substantial correlations among these variables it was not reasonable to perform a path analysis including all three mediators.

Arousal was tested first as mediator of the effect of interest on recall. The results (cf. Figure 1) showed that inclusion of arousal as an additional predictor lead to nonsignificant regression coefficients for topic interest. However, arousal could

TABLE 5
Zero-Order Correlations among Process Variables

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) Arousal	—	.56***	.26*	.38***	.49***	.11
(2) Attention-Intensity		—	.08	.48***	.29**	-.10
(3) Attention-Persistence			—	.02	.27*	.20
(4) Elaboration				—	.17	-.05
(5) Note-Taking					—	.37***
(6) Underlining						—

Notes: $n = 80$. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests).

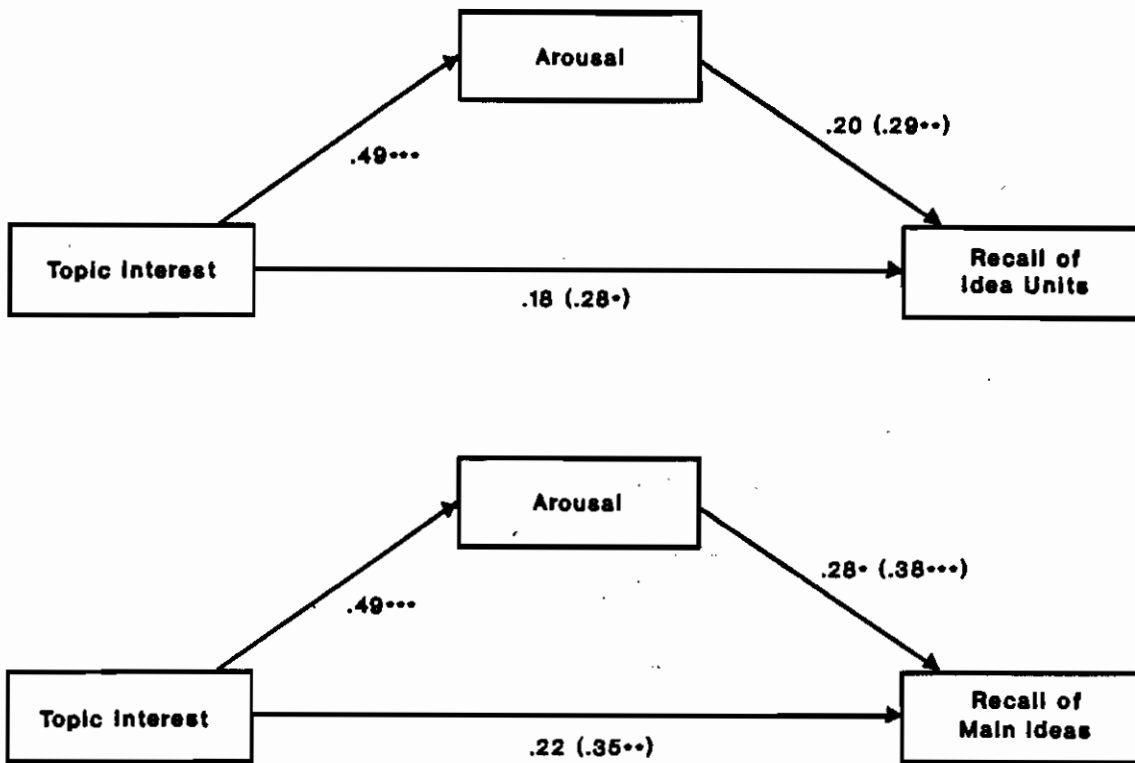


FIGURE 1
 The role of arousal as a mediator of the effects of topic interest on recall. (Reported values represent standardized regression coefficients. Zero-order correlations are indicated in brackets.) (* $p < .05$, ** $p < .01$, *** $p < .001$).

predict recall significantly over and above the predictive contribution of topic interest only in the case of main ideas. Even there, only a weak indirect effect of interest on recall via arousal was found (.14).

The same analysis was repeated for attention and note-taking. In both cases, the regression coefficients for topic interest remained significant and were not substantially reduced when attention or note-taking were entered in the regression model. Therefore, intensity of attention and note-taking cannot be regarded as mediators of the effects of interest on recall.

DISCUSSION

The results of the study suggest that topic interest is significantly related to different indicators of free recall of expository text. Interestingly, the highest correlations were obtained between topic interest and recall of elaborative propositions and main ideas. This result lends credit to the assumption that interest increases not only the overall quantity of recall but also the depth of learning. In accordance with

TABLE 6
Relations between Interest, Prior Knowledge, Intelligence,
and Variables of the Reading Process

Criterion/Predictor	R ²	r ^a	beta	F(1,76)	p
Arousal	.29				
TI		.49***	.55	29.74	< .001
PK		-.07	-.21	4.46	< .05
IQ		.04	.04	.19	ns
Attention-Intensity	.17				
TI		.32**	.39	12.67	< .001
PK		-.16	-.26	5.71	< .05
IQ		.08	.08	.53	ns
Attention-Persistence	.05				
TI		.21	.22	3.60	= .062
PK		.03	-.03	.06	ns
IQ		-.05	-.04	.15	ns
Elaborative Strategies	.15				
TI		.38***	.38	11.80	< .001
PK		.09	-.01	.01	ns
IQ		-.07	-.07	.39	ns
Note-Taking	.17				
TI		.31**	.27	6.22	< .05
PK		.22	.15	1.93	ns
IQ		.23*	.23	4.84	< .05
Underlining	.03				
TI		.07	.03	.07	ns
PK		.16	.15	1.61	ns
IQ		.03	.03	.07	ns

Notes: $n = 80$. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests); IU = Idea unit; MI = Main idea; TI = Topic interest; PK = Prior knowledge (free response questions); IQ = Intelligence.

^aZero-order correlations.

that assumption, the evidence shows that highly interested readers produced more coherent sequences of main ideas. These results are in line with studies by Benware and Deci (1984) and Grolnick and Ryan (1987) who have shown that intrinsic motivation leads to more conceptual learning as opposed to rote learning. Moreover, the present study suggests that the relations between interest and learning are independent of levels of prior knowledge and intelligence.

TABLE 7
Zero-Order Correlations between Process Variables
and Recall of Idea Units and Main Ideas

	Idea Units	Main Ideas
Arousal	.29**	.38***
Attention- Intensity	.26*	.32**
Attention-Persistence	.21	.31**
Elaboration	.07	.11
Note-Taking	.23*	.28*
Underlining	-.09	-.11

Notes: $n = 80$. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests).

The present findings are also in line with Renninger's (1992) study. Her sample included fifth and sixth grade students, and by means of intraindividual comparisons she found that learners recalled both more idea units and more main ideas when they read texts with interesting topics. However, there was no evidence for stronger effects of interest vs. noninterest on recall of main ideas than on recall of idea units. In addition, interest vs. noninterest did not differ with regard to the sequence of recall. The difference between the present results and Renninger's study are probably due to age differences between the samples. The fifth and sixth grade students in Renninger's study may not yet have developed the necessary metacognitive skills to differentiate aptly between important and unimportant information (e.g., Brown & Smiley 1977). Furthermore, we conceptualized and measured interest in a different way than Renninger.

In contrast to topic interest, only weak and mostly nonsignificant relations between prior knowledge and intelligence and text recall were found. Prior knowledge was significantly correlated with recall of idea units and new idea units but not with recall of main ideas or the sequence of recall. It can be concluded that prior knowledge increases the quantity of recalled idea units regardless of their importance. This result contrasts with a study by Stahl, Hare, Sinatra, and Gregory (1991) in which prior knowledge was positively related to recall of "gist units." However, these authors have not controlled for interest in the topic ("Baseball"). Therefore, it is likely that prior knowledge and interest were confounded in their study.

At least two reasons for the low relations between prior knowledge and recall should be considered (cf. Tobias 1994). First, the present study was designed to allow for a maximum effect of interest by using a topic about which most students had low levels of prior knowledge. As a consequence, it is not surprising that prior knowledge was lowly (but significantly) correlated with interest and text recall. Second, the text was not very difficult to understand.² Thus, it was possible to understand the text even without much prior knowledge.

Intelligence was not at all related to any indicator of text recall. As is true for prior knowledge, this result should not be generalized to other contexts. Two features of our study possibly contributed to that finding. First, as already mentioned, one feature concerns the low difficulty of the experimental text. Because the text was not hard to understand, intelligence did not affect text recall significantly. Second, the sample of the present study was comprised of university students with relatively homogeneous levels of intelligence (cf. Table 1). Therefore, the variance of IQ scores was somewhat restricted.

To summarize, the present study was able to show that topic interest is significantly related to text recall independently of prior knowledge and intelligence. However, because of the specific experimental context of our study, it is not clear whether these positive findings also apply to groups of learners with high prior knowledge and heterogeneous intelligence. Probably, topic interest affects learning mainly in the early phases of learning processes and when the learning material is of low or moderate perceived difficulty.

It should not be concluded that prior knowledge and intelligence are irrelevant for text learning. These factors will be more powerful predictors of text recall when students are presented with difficult learning materials and when students

vary strongly with regard to prior knowledge and intelligence (e.g., Alexander & Kulikowich 1991; Körkel & Schneider 1991; Tobias 1994).

An important aspect of the study was the inclusion of potentially mediating variables, namely arousal, attention, elaborative strategies, note-taking, and underlining. First of all, the findings revealed that interested readers displayed higher levels of arousal, intensity of attention, elaboration, and number of margin notes. With the exception of elaboration, all of these variables were positively correlated with text recall. However, no evidence was found for substantial mediating effects. Therefore, it seems as if the included process variables are just epiphenomena of interest and do not have a causal role in learning from text. From a theoretical point of view, this is not unexpected. Presumably, interest leads directly to the activation of information-processing capacity. This process of activation is probably accompanied by enhanced levels of arousal and attention. The high correlation between arousal and attention supports the assumption that both states are related to the same underlying process, namely the activation of resources of information processing. Consequently, it may be more promising to try to assess those cognitive processes that are facilitated by increased use of cognitive capacity. According to Kintsch (1986, 1988), the relevant processes are those related to forming verbatim, propositional, and situational representations of text (Schiefele in press). For example, it may be useful to examine the extent to which interested and uninterested readers are forming inferences or relate new material to their prior knowledge.

Based on the present study, a number of tasks for future research can be formulated. First, future studies should use samples with varying prior knowledge and intelligence and text materials with different difficulty levels (e.g., Renninger 1992). Thus, it should be possible to get a better account of the independence of the effects of interest, knowledge, and cognitive ability. Second, for measuring process variables other methods than retrospective self-report should be used (e.g., eye fixations; see Imai, R. C. Anderson, Wilkinson, & Yi 1992; Just & Carpenter 1984). In addition, the search for relevant mediators should focus on cognitive variables or processes. Third, the present study involved only short-term learning results. Data concerning long-term effects of interest are needed. Finally, one should keep in mind that the validity of the present results is confined to a specific learning situation in which the learner had only limited time to study a certain text. Different, perhaps stronger, results are to be expected when using a more flexible learning situation where the student is allowed to study the text over an extended period of time (e.g., Benware & Deci 1984). Under these circumstances it seems more likely, for example, that learning strategies have significant effects on text learning.

ACKNOWLEDGMENTS: This work was supported by a grant from the Deutsche Forschungsgemeinschaft (Kr 716/4-1). The authors wish to thank Johanna Sauter and Inge Schreyer for their valuable help in analyzing the data. In addition, the authors also extend thanks to K. Ann Renninger and Steven H. Adams, who carefully reviewed an earlier version of the article and provided helpful comments.

NOTES

1. The same is true for text-based interest (see Schiefele, 1988). This is not discussed here because the focus of the present study is on topic interest.
2. Subjective ratings of text difficulty were assessed by three rating scales (asking for difficulty, complexity, and readability). The mean value was 1.64 ($SD = 0.47$), on a scale ranging from 1 (low difficulty) to 4 (high difficulty).

REFERENCES

- Alexander, P. A. & J. M. Kulikowich. (1991). "Domain knowledge and analogic reasoning ability as predictors of expository text comprehension." *Journal of Reading Behavior*, 23, 165-190.
- Alexander, P. A., J. M. Kulikowich, & S. K. Schulze. (1994). "The influence of topic knowledge, domain knowledge, and interest on the comprehension of scientific exposition." *Learning and Individual Differences*, 6, 379-397.
- Alexander, P. A., D. L. Schallert, & V. C. Hare. (1991). "Coming to terms: How researchers in learning and literacy talk about knowledge." *Review of Educational Research*, 61, 315-343.
- Anderson, R. C. (1982). "Allocation of attention during reading." Pp. 292-313 in *Discourse processing*, edited by A. Flammer & W. Kintsch. Amsterdam: North-Holland.
- Anderson, T. H. & B. B. Armbruster. (1984). "Studying." Pp. 657-679 in *Handbook of reading research*, edited by P. D. Pearson. New York: Longman.
- Asher, S. R. (1980). "Topic interest and children's reading comprehension." Pp. 525-534 in *Theoretical issues in reading comprehension*, edited by R. J. Spiro, B. C. Bruce, & W. F. Brewer. Hillsdale, NJ: Erlbaum.
- Baldwin, R. S., Z. Peleg-Bruckner, & A. H. McClintock. (1985). "Effects of topic interest and prior knowledge on reading comprehension." *Reading Research Quarterly*, 20, 497-504.
- Baron, R. M. & D. A. Kenny. (1986). "The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations." *Journal of Personality and Social Psychology*, 51, 1173-1182.
- Benware, C. A. & E. L. Deci. (1984). "Quality of learning with an active versus passive motivational set." *American Educational Research Journal*, 21, 755-765.
- Brown, A. L. & S. S. Smiley. (1977). "Rating the importance of structural units of prose passages: A problem of metacognitive development." *Child Development*, 48, 1-8.
- Deci, E. L. & R. M. Ryan. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.
- Entin, E. B. & G. R. Klare. (1985). "Relationships of measures of interest, prior knowledge, and readability to comprehension of expository passages." *Advances in Reading/Language Research*, 3, 9-38.
- Eysenck, M. W. (1982). *Attention and arousal*. Berlin: Springer.
- Flammer, A., A. Schläfli, & B. Keller. (1978). "Meeting the readers' interest—who should care?" Pp. 679-686 in *Practical aspects of memory*, edited by M. M. Gruneberg, P. E. Morris, & R. N. Sykes. London: Academic Press.
- Garner, R. & M. G. Gillingham. (1991). "Topic knowledge, cognitive interest, and text recall: A microanalysis." *Journal of Experimental Education*, 59, 310-319.

- Groff, P. J. (1962). "Children's attitudes toward reading and their critical reading abilities in four content-type materials." *Journal of Educational Research*, 55, 313-317.
- Grolnick, W. S. & R. M. Ryan. (1987). "Autonomy in children's learning: An experimental and individual difference investigation." *Journal of Personality and Social Psychology*, 52, 890-898.
- Hare, V. C. & D. A. Devine. (1983). "Topical knowledge and topical interest predictors of listening comprehension." *Journal of Educational Research*, 76, 157-160.
- Hidi, S. (1990). "Interest and its contribution as a mental resource for learning." *Review of Educational Research*, 60, 549-571.
- _____. (1994). Attention and learning: A reexamination of the selective attention hypothesis of the prose learning literature. Manuscript submitted for publication.
- Hidi, S. & W. Baird. (1986). "Interestingness—A neglected variable in discourse processing." *Cognitive Science*, 10, 179-194.
- Hidi, S. & J. McLaren. (1988, April). The effect of topic and theme interestingness on children's school performance. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.
- Humphreys, M. S. & W. Revelle. (1984). "Personality, motivation, and performance: A theory of the relationship between individual differences and information processes." *Psychological Review*, 91, 153-184.
- Imai, M. R. Anderson, I. A. G. Wilkinson, & H. Yi. (1992). "Properties of attention during reading lessons." *Journal of Educational Psychology*, 84, 160-173.
- Jäger, A. O. & K. Althoff. (1983). *Der Wilde-Intelligenz-Test (WIT)* (The WILDE intelligence test). Göttingen: Hogrefe.
- Just, M. A. & P. A. Carpenter. (1984). "Using eye fixations to study reading comprehension." Pp. 151-182 in *New methods in reading comprehension research*, edited by D. E. Kieras & M. A. Just. Hillsdale, NJ: Erlbaum.
- Kiewra, K. A. (1989). "A review of note-taking: The encoding-storage paradigm and beyond." *Educational Psychology Review*, 1, 147-172.
- Kinchla, R. A. (1992). "Attention." *Annual Review of Psychology*, 43, 711-742.
- Kintsch, W. (1986). "Learning from text." *Cognition and Instruction*, 3, 87-108.
- _____. (1988). "The role of knowledge in discourse comprehension: A construction-integration model." *Psychological Review*, 95, 163-182.
- Körkel, J. & W. Schneider. (1991). "Domain-specific versus metacognitive knowledge effects on text recall and comprehension." In *Learning and instruction: European research in an international context* (Vol. 3), edited by M. Carretéro, M. Pope, P. R. J. Simons, & J. I. Pozo. Oxford: Pergamon.
- Krapp, A., S. Hidi, & K. A. Renninger. (1992). "Interest, learning, and development." Pp. 3-25 in *The role of interest in learning and development*, edited by K. A. Renninger, S. Hidi, & A. Krapp. Hillsdale, NJ: Erlbaum.
- Mandler, J. M. & N. S. Johnson. (1977). "Remembrance of things parsed: Story structure and recall." *Cognitive Psychology*, 9, 111-151.
- Mayer, R. E. (1985). "Structural Analysis of science prose: Can we increase problem-solving performance?" Pp. 65-87 in *Understanding expository text*, edited by B. K. Britton & J. B. Black. Hillsdale, NJ: Erlbaum.
- Osako, G. N. & P. L. Anders. (1983). "The effect of reading interest on comprehension of expository materials with controls for prior knowledge." Pp. 56-60 in *Searches for meaning in reading/language arts processing instruction*, edited by J. A. Niles & L. A. Harris. Rochester, NY: National Reading Conference.
- Pintrich, P. R. (1988). "A process-oriented view of student motivation and cognition." Pp. 65-79 in *Improving teaching and learning through research. New directions for institutional*

- research (Vol. 57), edited by J. Stark & L. Mets. San Francisco: Jossey-Bass.
- _____. (1989). "The dynamic interplay of student motivation and cognition in the college classroom." *Advances in Motivation and Achievement*, 6, 117-160.
- Pokay, P. & P. C. Blumenfeld. (1990). "Predicting achievement early and late in the semester: The role of motivation and use of learning strategies." *Journal of Educational Psychology*, 82, 41-50.
- Renninger, K. A. (1990). "Children's play interests, representation, and activity." Pp. 127-165 in *Knowing and remembering in young children*, edited by R. Fivush & J. Hudson. Cambridge, MA: Cambridge University Press.
- _____. (1992). "Individual interest and development: Implications for theory and practice." Pp. 361-395 in *The role of interest in learning and development*, edited by K. A. Renninger, S. Hidi, & A. Krapp. Hillsdale, NJ: Erlbaum.
- Revelle, W. (1989). "Personality, motivation, and cognitive performance." Pp. 297-341 in *Abilities, motivation, and methodology*, edited by R. Kanfer, P. L. Ackerman, & R. Cuddeback. Hillsdale, NJ: Erlbaum.
- Reynolds, R. E. (1992). "Selective attention and prose learning: Theoretical and empirical research." *Educational Psychology Review*, 4, 1-48.
- Rickheit, G. & H. Strohner. (1986). "Auswirkungen thematischer Interessen auf die Textproduktion (Effects of topic interest on text production)." *Unterrichtswissenschaft*, 4, 430-432.
- Schiefele, U. (1988). "Motivationale Bedingungen des Textverstehens (Motivational conditions of text learning)." *Zeitschrift für Pädagogik*, 34, 687-708.
- _____. (1990). "The influence of topic interest, prior knowledge and cognitive capabilities on text comprehension." Pp. 323-338 in *Learning environments*, edited by J. M. Pieters, K. Breuer, & P. R. J. Simons. Berlin: Springer.
- _____. (1991). "Interest, learning, and motivation." *Educational Psychologist*.
- _____. (1992). "Topic interest and levels of text comprehension." Pp. 151-182 in *The role of interest in learning and development*, edited by K. A. Renninger, S. Hidi, & A. Krapp. Hillsdale, NJ: Erlbaum.
- _____. (in press). "Topic interest, text representation, and quality of experience." *Contemporary Educational Psychology*.
- Schneider, W. & J. Körkel. (1989). "The knowledge base and text recall: Evidence from a short-term longitudinal study." *Contemporary Educational Psychology*, 14, 382-393.
- Shirey, L. L. & R. E. Reynolds. (1988). "Effect of interest on attention and learning." *Journal of Educational Psychology*, 80, 159-166.
- Stahl, S. A., V. C. Hare, R. Sinatra, & J. F. Gregory. (1991). "Defining the role of prior knowledge and vocabulary in reading comprehension: The retiring of number 41." *Journal of Reading Behavior*, 23, 487-508.
- Stevens, K. (1979). "The effect of topic interest on the reading comprehension of higher ability students." *Journal of Educational Research*, 73, 365-368.
- Thayer, R. E. (1985). "Activation (arousal): The shift from a single to a multidimensional perspective." *Biological Bases of Personality and Behavior*, 1, 115-127.
- _____. (1986). "Activation-Deactivation adjective check list: Current overview and structural analysis." *Psychological Reports*, 58, 606-614.
- _____. (1989). *The biopsychology of mood and arousal*. New York/Oxford: Oxford University Press.
- Tobias, S. (1994). "Interest, prior knowledge, and learning." *Review of Educational Research*, 64, 37-54.
- van Dijk, T. A. & W. Kintsch. (1983). *Strategies of discourse comprehension*. Orlando: Academic Press.

- Wade, S. E. (1992). "How interest affects learning from text." Pp. 255-277 in *The role of interest in learning and development*, edited by A. Renninger, S. Hidi, & A. Krapp. Hillsdale, NJ: Erlbaum.
- Wade, S. E. & W. Trathen. (1989). "Effect of self-selected study methods on learning." *Journal of Educational Psychology*, 81, 40-47.
- Walker, S. M., R. G. Noland, & C. M. Greenshields. (1979). "The effect of high and low interest content on instructional levels in informal reading inventories." *Reading Improvement*, 16, 297-300.
- Weber, C. K. (1980). "Cognitive and affective influences on text comprehension." *Dissertation Abstracts International*, 40, 5802-A.
- Weinstein, C. E. (1988). "Assessment and training of student learning strategies." Pp. 291-316 in *Learning strategies and learning styles*, edited by R. R. Schmeck. New York: Plenum Press.
- Wickens, C. D. (1989). "Attention and skilled performance." Pp. 71-105 in *Human skills*, edited by D. H. Holding. Chichester: Wiley.
- Wright, B. D. & J. M. Linacre. (1991). *A user's guide to BIGSTEPS*. Chicago: Mesa Press.
- Wright, B. D. & G. N. Masters. (1982). *Rating scale analysis*. Chicago: Mesa Press.