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Text recall in adulthood: The roles of text imagery and orienting tasks

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Summary. Three experiments were conducted to investigate dual-code theory and the levels-of-processing approach in discourse processing. Three concrete and three abstract tests were constructed to be equivalent in the degree to which they were perceived as concrete vs. abstract. All experiments presented concrete and abstract texts under three orienting tasks. Results of the first experiment showed main effects for both text concreteness and orienting tasks and an interaction that can be described by the lack of a difference between the recall rates for the concrete and the abstract texts under the intentional-learning condition. In the second experiment, longer texts were used and a second trial was introduced. The interaction was not replicated. There were main effects for concreteness, orienting tasks, and trials. The third experiment replicated Experiment 2 with subjects in their late 40s and over 70. Main effects were obtained as before. Age interacted with both orienting task and concreteness, indicating that older adults gain less than middle-aged adults from intentional-learning instructions and benefit less from highly concrete texts. The discussion focuses on the relation of Materials and Subjects as factors to dual-code theory and levels of processing approach.

As an area of research in cognitive psychology, the study of discourse processing and comprehension has received considerable attention in recent years (e.g., Flammer & Kintsch, 1982; Frederiksen, 1975; van Dijk & Kintsch, 1983). The investigation of memory (as a specific category of information processing) for text materials (as a subset of discourse) has both benefited from, and influenced, research in discourse processing (e.g., Kintsch, 1974; Kintsch & van Dijk, 1978; Meyer, 1975). Most theorists view the text as being composed of smaller units (such as ideas, sentences, or semantic propositons), which are coded by the reader and evaluated semantically on the basis of a larger context of discourse or knowledge schemata. Thus one important set of factors influencing text-recall performance includes such characteristics of the subject as verbal ability and prior knowledge of the content of the story (e.g., Hultsch & Dixon, 1983; Jenkins, 1979).

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There are, however, at least three other sets of factors influencing individual differences in text-recall performance (Jenkins, 1979): (a) Criterial Tasks, such as free recall or recognition; (b) Materials, such as organization or text imagery; and (c) Orienting Tasks, such as activities or instructions. In the present study, we address explicitly variations in two of these factors – namely, Materials and Orienting Tasks – and control pertinent variations in the other two – namely, Subjects and Criterial Tasks. More specifically, in a series of three experiments, we vary the imagery quality (concrete vs. abstract) of the texts and the instructions followed by subjects when reading the texts. At the same time, we introduce the factor of adult age, and we control for the subject factor of verbal ability via the intelligence test IST70 and attempt to randomize interest and prior knowledge by using more than one text per imagery condition. In order to maximize comparability to much previous work in text processing in adulthood, a free-recall criterial task is employed.

A survey of several recent reviews of text recall in adulthood (e.g., Hultsch & Dixon, 1984; Meyer, 1988; Meyer & Rice, 1983; Spilich, 1983) reveals that individual- and age-related differences in performance are related to these four factors (Jenkins, 1979). For example, such subject variables as verbal and other cognitive abilities (e.g., Dixon, Hultsch, Simon, & von Eye, 1984; Hultsch, Hertzog, & Dixon, 1984; Meyer & Rice, 1983) and prior knowledge or metamemory (e.g., Dixon & Hultsch, 1984; Hultsch & Dixon, 1983; Zelinski, Gilewski, & Thompson, 1980) have been investigated. Perhaps the most typical criterial task is immediate free recall, with only moderate interest in recognition tasks (e.g., Spilich, 1983) and longer delay intervals (e.g., Dixon, Simon, Nowak, & Hultsch, 1982; Hultsch et al., 1984). With regard to the factors of interest in this study, most adult developmental research on materials as variables has addressed issues of text structure (e.g., Cohen, 1979; Dixon et al., 1984; Meyer & Rice, 1981; Spilich, 1983; Zelinski, Light, & Gilewski, 1984), with only moderate interest in imagery as a stimulus characteristic of the problem or text (e.g., Fullerton, 1983; Whitbourne, Manzi, & Cody, 1983; Whitbourne & Slevin, 1978; Winograd & Simon, 1980; Marschark, 1985). Finally, most adult developmental research pertaining to the orienting-task factor in text processing has been cast in a levels of processing framework (see Craik & Lockhart, 1972; e.g., Simon et al., 1982; Berger-Zenk, von Eye, Dixon, & Lortz, 1983; Dixon & von Eye, 1984). Overall,

although differential predictive patterns have been observed for young and old adults, the relatively clear cohesiveness of the patterns associated with, for example, word-list recall has been observed for texts (Hultsch & Dixon, 1984).

Regarding the two factors of major interest in the present study – Materials (specifically concreteness of the text) and Orienting Tasks – there is some precedent upon which to base predictions. High imagery, i.e., high imageability of the meaning of verbal material, has consistently been shown to be a powerful predictor of the effectiveness in learning processes (Paivio, 1971; Paivio, Clark, & Lambert, 1988; Cornoldi & Paivio, 1982). Both the learning material and the instructions have been manipulated. For example, pictorial material (Madigan, 1983), word lists (von Eye & Krampen, 1981, 1983), sentences (Begg & Paivio, 1969; Belmore, 1982), and prose passages (Marschark, 1985) have been used as learning materials. The instructions under which the subjects examined the learning material varied from standard learning instructions or instructions to learn by visualizing the learning material (Treat & Reese, 1976) to incidental learning conditions (Paivio & Lambert, 1981). The learning process itself has also been varied from paired-associate learning and recall to list learning and free recall and to discrimination learning (for an overview, see Pressley, 1977; Yuille, 1983).

One common basis for these investigations is the dual-coding theory (Paivio, 1971, 1983, 1986), the main assumption of which is that cognition is constituted by the activity of two symbolic systems that are partly interconnected, but functionally independent. The one system is imaginal, the other verbal. According to this model, verbal material that describes concrete objects should be more easily accessible in recall because two codes are available instead of only one, as when abstract objects are described. These assumptions led to investigations in which the degree of imagery of verbal materials was determined. The dual-coding model is especially robust for list learning, e.g., single words such as standardized nouns, adjectives, and verbs (e.g., Paivio, Yuille, Madigan, 1968; Wippich & Bredenkamp, 1977). When sentences are considered (e.g., Begg & Paivio, 1969; Belmore, 1982; Cornoldi & de Negri, 1977), the adequacy of the model is somewhat more ambiguous (Marschark, 1985). Thus, the context-availability model has been developed to supplement the dual-coding account of mental representation (Kieras, 1978; Schwanenflugel & Shoben, 1983). Briefly, in the case of meaningful sentences and multisentence prose, the content of concrete passages is more likely to overlap with prior knowledge, thus facilitating acquisition and retrieval (Kieras, 1978). A number of studies have indicated that observed differences in recall between concrete and abstract passages are not completely accounted for by the dual-coding model (e.g., Marschark, 1985; Schwanenflugel & Shoben, 1983). As Marschark (1985) points out, the context-availability model would predict that imagery effects would be most pronounced for list materials (words or sentences) and attenuated for connected prose. In a series of experiments, Marschark (1985) indeed found that connected concrete and abstract sentences were remembered equally well, whereas for randomly presented lists of sentences concrete materials were recalled significantly better than abstract materials. Although the present study is not designed to compare the two models directly, it may offer results that reflect on their range of applicability. It employs (a) different texts, including abstract texts in which (unlike those of Schwanenflugel and Shoben, 1983) the story and the context itself are abstract; (b) three orienting tasks; and, unlike most research on text imagery and recall, (c) both young and old adults.

Until recently, relatively little research was conducted applying the dual-coding model to connected prose (one early exception was that of Yuille and Paivio, 1969). Furthermore, most studies that exist have focused on young adults to the exclusion of old adults. Clearly, the manifold confounds of other variables with imagery in text recall have contributed to the complications alluded to above and the lack of developmental extensions. Examples of confounding variables are the degree to which a text is understandable or familiar. When single words are used as learning materials, these variables can be controlled. Control of such variables for texts is more difficult to accomplish and, if accomplished, may severely restrict the range of generalizability. For example, one approach to controlling confounding variables is to hold the text itself constant. Wippich and Bredenkamp (1979, Experiment 7), for instance, constructed a text and varied only its title. Imagery ratings of the text provided by independent groups of subjects varied significantly, depending on the titles. Recall rates, however, measured in the number of words correctly recalled, did not vary significantly. Other researchers have used similar text contents, and substituted high- for low-imagery words (e.g., Marschark, 1985).

A second problem of engaging in imagery research with texts has to do with the measurement of memory performance. In the few experiments in which sentence and text materials have been used, several methods of measuring memory performance have been applied. One consists of presenting subjects with multiple-choice items (Anderson & Kulhavy, 1972; Denis, 1979; Belmore, 1982; Chaguiboff & Denis, 1981), in which the subjects have to identify the words – mostly the nouns – that they recognized as present in the text. A second method of measuring memory performance was free verbatim recall with number of correctly recalled words as the unit of measurement (Wippich & Bredenkamp, 1979; Kulhavy & Swenson, 1975; Yuille & Paivio, 1969). A third method involves decomposing paragraphs into idea units. Scorers check whether idea units are present in a recall protocol (Marschark, 1985). A fourth method decomposes texts into propositional units. Again, coders check whether recall protocols contain the gist of a proposition (Thiel & von Eye, 1986). For reasons of comparability with previous research on the levels of processing, the present research adopted the last approach.

Another reason for the decision to use propositional decomposition is that it has been shown that the degree to which a text is high in imagery depends not only on single words. Rather, it is determined by what one could call the imagery "Gestalt" of a text, i.e., by characteristics that become apparent only when the entire text is looked at. Von Eye and Krampen (1982) and Thiel and von Eye (1986) showed that the imagery of a concrete text is rated higher than the imagery of its parts, i.e., sentences, nouns, adjectives, and verbs. For the abstract texts used in these studies, the inverse relation was observed. The imagery of an entire abstract text was rated lower than the imagery of its parts.

From these results it follows that recall techniques that focus on elements of texts can lead to an underestimation of the imagery effect. In particular, this conclusion might be true if various "levels" of processing are taken into account. When, for example, a text is processed at a "shallow" level, e.g., by a search for spelling errors, the gist of the text might be picked up by the subjects, whereas single components such as particular words cannot be remembered. The same applies to processing at "deep" levels. "Deep" semantic processing does not necessarily focus on single elements of texts. It might result in a focus on relationships, a process in which single elements are evaluated on the basis of their contribution to the Gestalt rather than on their isolated, individual features. Although there are many levels-of-processing studies and commentaries in the literature (e.g., Baddeley, 1978; Cermak & Craik, 1979; Craik & Lockhart, 1972), there are, as alluded to above, relatively few dealing with text materials (e.g., Burton, Niles, & Wildman, 1981; Marslen-Wilson & Tyler, 1976; Schallert, 1976) and relatively few dealing with adult development (e.g., Craik & Simon, 1980; Mason, 1979; Zelinski, Walsh, & Thompson, 1978). In a study investigating orienting-task effects on text recall in adulthood, Simon, Dixon, Nowak, and Hultsch (1982) found that young adults benefited from two "deep processing" conditions, performing at the level of intentional recall. In this study, middle-aged and old adults performed at the same low level in the two "deep" conditions as they did in the "shallow" condition. Only under intentional instructions were these two age groups able to perform as well as the young adults. In two replications of that study with German adults, some improvement was observed for the two "deep" conditions, as compared to the "shallow" condition, but for all age groups recall was better under intentional instructions (Berger-Zenk, von Eye, Dixon, & Lortz, 1985; Dixon & von Eye, 1984). In all of these experiments, personal narratives were used as text materials.

In the present set of experiments, the texts are varied along the dimension of concreteness-abstractness, and three orienting tasks (adopted from Simon et al., 1982) are employed. It differs from one earlier study addressed to orienting tasks and imagery (viz., Groninger & Groninger, 1982) both in terms of the stimulus materials (words vs. texts) and the orienting tasks (the present ones are unrelated to imagery). Each successive experiment is designed to replicate part, and to extend part, of the previous experiment.

The first experiment analyzes the confluence of dual-code theory and levels of processing approach. It investigates the question if, in addition to concreteness and depth-of-processing main effects, an interaction exists that indicates that concreteness effects vary with depth of processing.

The second experiment replicates the crossing of imagery with depth of processing. Differences from the first one include the increased length of texts, the number of texts representing each level of concreteness, and an additional trial. For both the high- and the low-concreteness level, two texts were constructed to overcome the possible confound between concreteness level and content of text in Experiment 1. All four texts are identical as to the number of propositions. In a pilot study, the concreteness levels of the two concrete and the two abstract texts were perceived as equivalent. The second trial was introduced to determine if the common incidental-learning paradigm leads to recall patterns that are similar to those obtained when subjects expect the request for recall. In addition, a variation in the "shallow" depth of processing condition was introduced. Subjects followed an instruction under which more distinctive encoding was expected. Subjects worked under time pressure.

The third experiment replicated the first two in crossing dual-code theory with the levels-of-processing approach. However, to obtain some indicators as to what extent the results of the first two experiments can be generalized across the life span, middle-aged and old adults were recruited as subjects.

Experiment 1

In this experiment, fundamental procedures and effects are investigated. Text Imagery is crossed with Orienting Task in young adults. Main effects for text recall are expected, with concrete texts (as opposed to abstract texts) and intentional instructions (as opposed to other orienting tasks) producing superior recall. An interaction is not expected.

Method

Subjects. Sixty undergraduate students from Trier University in West Germany participated. Students at this university are required to participate in a certain number of experiments, but none is required to participate in any given experiment. The average age of the students was 19.6 years (range = 18–27).

Text materials. The texts were selected so as to differ significantly in their degree of concreteness. This manipulation was accomplished on the basis of an earlier experiment in which students rated the degree of concreteness of a series of texts. The concrete text selected was a short paragraph in which a classroom situation before a mathematics examination is described. An independent sample of undergraduate university students ($N = 20$) rated the text on a scale of 1 (abstract) to 7 (concrete) as $\bar{X} = 6.53$. The abstract text selected was a short paragraph on the person of Einstein. It was rated as $\bar{X} = 1.47$ on the concreteness scale (von Eye & Krampen, 1982). The concrete test contained 44 words, the abstract text 42. Each text contained 5 clauses and a total of 9 nouns, 7 verbs, and 6 adjectives.

The meaning of both texts was represented by a structured set of propositions known as a text base. This text base was constructed according to Kintsch's (1974) system as applied to German text materials (Ballstaedt, Schnotz, & Mandl, 1981). In this system a proposition consists of a predicate and one or more arguments. Arguments are word concepts or other propositions themselves. The propositional analysis of the present texts, implemented according to the criteria of Kintsch (1974) and specified by Turner and Greene (1978), indicated that each text contained 36 propositions.

Design. Six experimental conditions were formed by crossing concreteness of texts (concrete vs. abstract) with orienting task (shallow, deep, intentional). Thus, the design may be viewed as a 2×3 ANOVA, with two between-subjects factors.

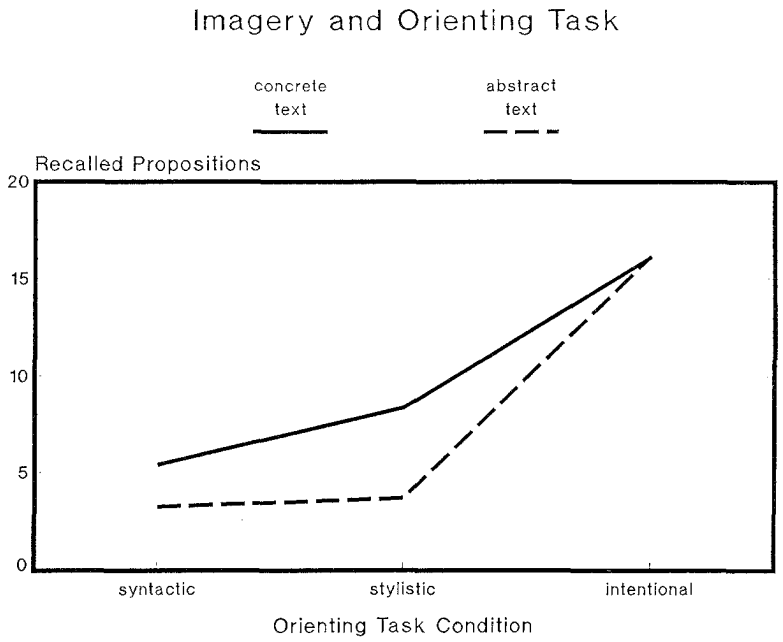

Fig. 1. Effects of imagery and orienting task on text recall (Experiment 1)

Procedure. Subjects were assigned randomly to one of the six cells. In the "shallow" orienting task, subjects were asked to mark minor spelling errors present in the text. In the "deep" orienting task, subjects were asked to read the texts and to evaluate stylistic characteristics. In the intentional condition, subjects were asked to read the text in order to remember the gist of its meaning. These conditions were adopted from previous studies with text materials and adults (Dixon & von Eye, 1984; Simon, Dixon, Nowak, & Hultsch, 1982). Testing was self-paced.

All subjects were first given the subtest of verbal intelligence of the *I*ntelligence-*S*tructure-*T*est (IST70; Amthauer, 1973) to account for effects of possible group differences in verbal abilities. After this test, subjects were presented with the texts and written instructions. Following the completion of the orienting task, all subjects were asked for their written recall of the gist of the text. For the two incidental learning conditions, the recall task was assumed to be unexpected. All experiments were done in group sessions, in which individuals were allowed to proceed at their own pace. Only the intelligence task was given under the usual time restrictions.

Scoring. Each recall protocol was checked against the propositions in the text base. A proposition was scored as correctly recalled if it was present in the protocol and reflected the gist of the proposition's meaning. Only one scorer compiled the protocols. However, a reliability check was conducted among this scorer and two others familiar with this scoring system. Counting only scoring decisions that included recalled propositions, there were 360 scoring decisions made by each scorer. There was always an agreement higher than 90% between each two scorers on the assignment of a given proposition to the group of correctly recalled propositions.

Results

A two-factor ANOVA and a two-factor ANCOVA were conducted on the total number of correctly recalled propositions. In the ANCOVA, there were no significant differences among the experimental groups as regards the verbal ability and years of education covariates, and negligible differences to the ANOVA results. Therefore, only the ANOVA results are given in this report.

Significant main effects were found for Orienting Task, $F(2,57) = 95.68$, $P < .001$, and Concreteness, $F(1,57) = 12.44$, $P < .001$. The interaction between these two factors was also significant, $F(2,57) = 4.53$, $P < .05$. As shown in Fig. 1, inspection of the interaction revealed that the concrete text was recalled better than the abstract text in both the "shallow" ($\bar{X} = 5.40$ vs. $\bar{X} = 3.25$ propositions) and the "deep" ($\bar{X} = 8.35$ vs. $\bar{X} = 3.70$ propositions) conditions, but this difference did not appear under the intentional condition ($\bar{X} = 16.10$ vs. $\bar{X} = 16.15$ propositions).

Discussion

This first attempt to investigate the confluence of the depth-of-processing model and dual-coding theory in the realm of text recall in adulthood provided one surprise finding. Specifically, whereas the orienting task and text-imagery effects were significant and in the direction predicted, the observed interaction pattern showed that in the intentional condition there were no differences in the subjects' recall performance for concrete and abstract texts. Thus for this condition, the expected extension of results with word lists and sentences was not found. The expected imagery effect was found, however, for the two incidental conditions. Although the two stories were designed so as to differ only in concreteness, it is possible that some unknown text structure or text-content variables may account for this unexpected finding. For example, an abstract story about Einstein may have been unexpectedly familiar, or of interest, to German university students and one of these variables may have contributed to the higher-than-expected recall performance. On this assumption, the results presented replicate Marschark's (1985) findings. This author found no recall differences between concrete and abstract texts under intentional-learning conditions. However, under a comprehension instruction – an incidental learn-

ing condition – recall rates were slightly higher than under the learning instruction. Thus the context-availability model seems to account for only part of the present results. However, so does dual-code theory. In the following two experiments we shall attempt to come to conclusions on the replicability of these findings.

These results elucidate the earlier findings from the application of the depth-of-processing model to text recall in adulthood (Dixon & von Eye, 1984; Simon et al., 1982). In both of these studies the intentional condition was associated with superior recall as compared with the "shallow" orienting task for young adults. The "deep" orienting task, however, resulted in a more ambiguous pattern. In one experiment (Simon et al., 1982) it was associated with recall equivalent to the intentional condition for young adults, whereas in the other experiment (Dixon & von Eye, 1984) it was associated with recall only slightly above that in the "shallow" condition. As can be seen in Fig. 1, the concreteness of the text moderates this relationship. For concrete texts, a "deep" orienting task is associated with recall midway between that of the "shallow" and intentional tasks and significantly different from both, whereas the "deep" task for abstract text is associated with recall rates virtually identical to those in the "shallow" task.

Four variations on Experiment 1 were instituted in Experiment 2. First, new longer texts were used to determine the degree to which the results obtained in the first experiment are content dependent. The predictions for this variation are that overall recall rates decrease, but the concreteness effects still prevail. Second, with the same aim, each subject processed two texts, both from the same concreteness level. Here we expect a learning-to-learn effect. Subjects will show higher recall rates in the second trial. However, there should be no interaction with text concreteness (cf. von Eye & Krampen, 1981). In addition, we expect the intentional condition to yield the highest recall rates in both trials. However, we expect some effect of the switch from the incidental-learning condition to the condition in which the subjects expect to be asked for recall. In particular, we expect the difference between the two orienting talks to be reduced, because "shallow" processing should be unlikely if a reader expects to be asked for recall.

Third, the "shallow" orienting task was modified so as to promote more distinctive encoding. Specifically, subjects were asked, as before, to identify misspelled words, but in addition to list them in a space provided in the margin of the text. This orienting task will be called syntactical. Fourth, time restrictions were placed on the processing of the text materials. Subjects were informed that the total time available was limited to 20 minutes, and therefore to proceed with their task as carefully, but quickly, as possible. Thus it would not be possible for subjects to perform their orienting task and then to review the Trial 2 text or to learn the text intentionally while performing the orienting task.

Experiment 2

Method

Subjects. One hundred different undergraduate students from Trier University in West Germany participated under the same voluntary conditions as in Experiment 1. The average age of the subjects was 21.8 years (range = 19–31).

Text materials. Four texts were constructed so as to differ (in pairs) in their degree of concreteness. All texts were short, well-organized narratives ($\bar{X}$ number of words = 172) containing 100 propositions each (again using the Kintsch 1974 system). One concrete text was about the popular German activity of strolling through a forest. It was rated on a concreteness scale of 1 (abstract) to 7 (concrete) as $\bar{X} = 6.30$. The second concrete text was about the contents and functions of a personal office (concreteness rating of $\bar{X} = 6.15$). One of the abstract texts was about the principles of the German banking system (concreteness rating $\bar{X} = 2.05$). The second abstract text was about the philosophy of Nicolaus von Cues (concreteness $\bar{X} = 1.95$). The texts contained the same number of clauses, nouns, verbs, and adjectives.

Design. In this repeated measures design, subjects read in each trial one of the two concrete or the two abstract texts under one of three orienting task conditions. Thus, the ANOVA design was a Orienting Task (3) × Story (4) × Trial (2), with trial as a within-subjects factor.

Procedure. Subjects were assigned randomly to the 12 experimental groups. The stylistic and intentional tasks were the same as in Experiment 1. The syntactical task required subjects to identify and to list misspelled words. Recall occurred after the reading of each story, and the instructions were again to recall in a gist fashion. Within the given time frame, testing was self-paced. All subjects were given the IST70 verbal intelligence test before beginning the experiment. The texts were presented in counterbalanced order.

Scoring. The scoring procedures were identical to those used in Experiment 1. An inter-rater reliability check was conducted. Twenty-five protocols were randomly selected and independently scored by three raters. About 400 scoring decisions were made by each scorer. The level of agreement among each two raters was at least 92%.

Results

A three-factor ANOVA and an ANCOVA with IQ as a covariate were conducted on the number of correctly recalled propositions. As in the first experiment, the covariate had no effect. Therefore, we report only the ANOVA results. Significant main effects were found for Orienting Task, $F(2,88) = 24.05$, $P < .001$, Story, $F(3,88) = 31.87$, $P < .001$, and Trial $F(1,88) = 39.01$, $P < .001$. The orienting-task effect resulted from the expected stepwise superiority of intentional ($\bar{X} = 19.95$), "deep" ($\bar{X} = 15.21$), and "shallow" ($\bar{X} = 10.71$) conditions. the story effect resulted from the two concrete texts ($\bar{X} = 20.59$, $\bar{X} = 20.40$) being recalled better than the two abstract texts ($\bar{X} = 9.72$, $\bar{X} = 10.52$). The significant trial effect resulted from the unsurprising fact that on the second occasion subjects recalled more than on the first occasion.

Of the interactions, only that between orienting task and trial was significant, $F(2,88 = 4.35$, $P < .05$. As Figs. 2 and 3 indicate, this interaction resulted from a closing of the gap between the recall performances in Trials 2 and 1 from the "shallow" ($\bar{X} = 7.38$ vs. $\bar{X} = 14.04$), to the "deep" ($\bar{X} = 12.95$ vs. $\bar{X} = 17.47$) to the intentional ($\bar{X} = 19.11$ vs. $\bar{X} = 20.78$) condition. Figure 2 gives the recall rates for the first, Fig. 3 for the second trial.

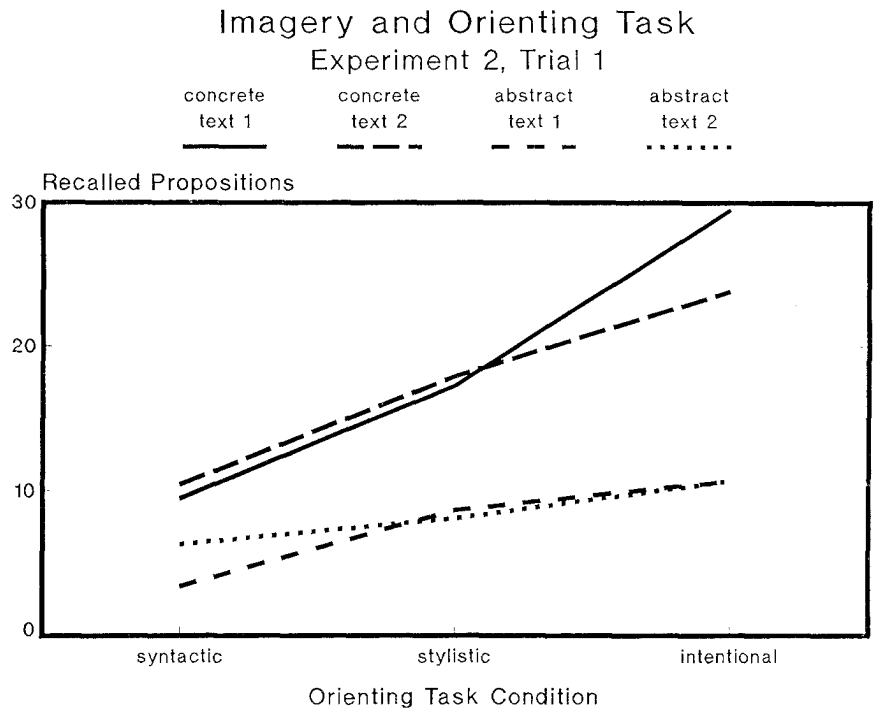

Fig. 2. Effects of imagery and orienting task on text recall (Experiment 1, Trial 1)

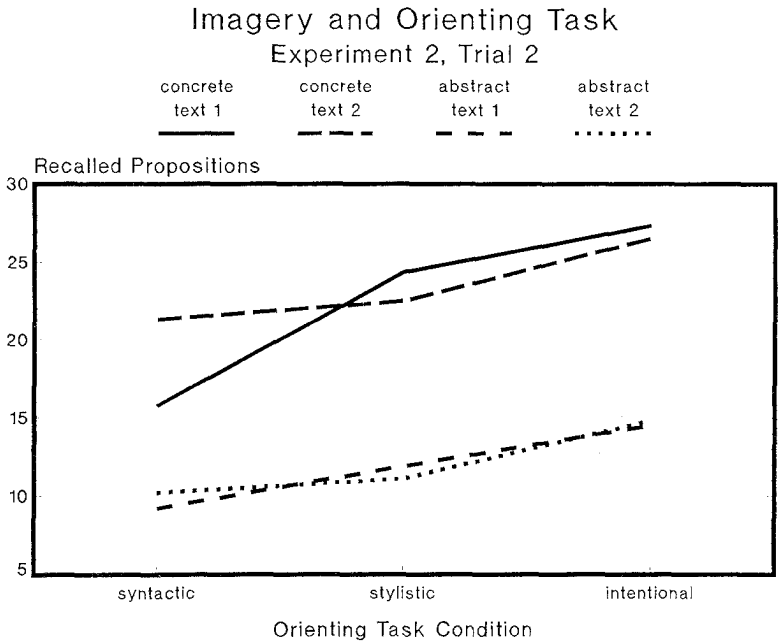

Fig. 3. Same as Fig. 2, but from Trial 2

Discussion

In this experiment, the main effects of both the imagery and the orienting tasks were significant, thus replicating the main results of Experiment 1. In this experiment, however, the Imagery × Orienting Task interaction, which was significant in Experiment 1, did not reach significance. Thus concrete texts were recalled better than abstract texts under all conditions, and intentional instructions produced better recall than did the orienting tasks. These two effects appear to be robust and consistent with the results of studies that used lists as stimulus materials (cf. Thiel & von Eye, 1986).

In addition, the trial factor produced, as expected, a significant main effect, with second trial learning superior to first trial learning. This factor also interacted significantly with orienting task, such that in Trial 2 subjects in the "shallow" and "deep" conditions remembered almost as well as subjects in the intentional condition. This suggests, of course, that the recall task in the second trial was not unexpected. However, there was no significant three-way interaction and no other significant two-way interactions. Thus, the concreteness effects were maintained across trials and orienting tasks.

Overall, recall rates for the first trial in Experiment 2 were not below those in Experiment 1. In both experi-

Table 1. Mean age, years of education, and verbal-ability score for each age group in two experiments

Age group	Variable		
	Age	Years of education	Verbal ability[a]
Experiment 2			
Young	$M = 21.80$	$M = 13.6$	$M = 8.0$
$N = 101$	range = 19–31	range = 13–15	$SD = 2.29$
Other characteristics: university students, required participation, time pressure			
Experiment 3			
Middle aged	$M = 46.4$	$M = 10.3$	$M = 8.9$
$N = 53$	range = 35–59	range = 8–13	$SD = 2.61$
Old	$M = 70.4$	$M = 8.96$	$M = 6.45$
$N = 60$	range = 60–82	range = 8–13	$SD = 2.92$
Other characteristics: voluntary participation, no time pressure			

[a] The verbal subtest of the Intelligence Structure Test (IST70; Amthauer, 1973)

ments, subjects recalled about 10% of the propositions. Thus, considering the time constraints of Experiment 2, we may conclude that the difficulty (e.g., comprehensibility) of the texts in Experiment 2 is lower. Still, clear concreteness effects prevail.

As indicated in the general introduction, there are often clear adult age-related differences in level of text recall and in patterns of influences on performance (e.g., Simon et al., 1982; Berger-Zenk et al., 1985). Given the relative robustness of the present pattern of effects in young adult subjects, the subsequent research question was whether these effects could apply also throughout the adult life span. Thus in Experiment 3 adults ranging in age from 35 to 82 were tested by means of the procedures and materials honed in the previous two experiments.

Experiment 3

Method

Subjects. Middle-aged ($N = 53$, $\bar{X}$ age = 46.6 years, range = 35–59) and old ($N = 60$, $\bar{X} = 70.4$ years, range = 60–82) working and retired adults were volunteer participants. They all lived in West Berlin. They were located through recruitment advertisements, community organizations, and personal contacts. Background information on the present subjects, as well as comparable information on the young adult subjects in Experiment 2, is presented in Table 1.

Text materials. The same four texts as in Experiment 2 were used. As before, there were two concrete and two abstract texts.

Design. Each subject processed only one text. However, because the two concrete and the two abstract texts were recalled equivalently in Experiment 2, the two concrete texts were treated as belonging to the same level of the concreteness factor. Accordingly, the two abstract texts were treated as belonging to the other level of the concreteness factor. Thus, the resulting ANOVA design was Orienting Task (3) × Text Imagery (2) × Age (2).

Procedure. Subjects were assigned randomly to the Orienting Task and Text Imagery groups. The syntactic (distinctive encoding), stylistic, and intentional instructions were the same as in Experiment 2. Unlike those in Experiment 2, however, subjects were not under any time pressure, i.e., the testing was self-paced. As a covariate, before the experimental texts, the verbal subtest of the IST70 was administered.

Scoring. The scoring procedures were identical to those used in the earlier experiments. An inter-rater reliability check was again conducted. Twenty protocols were randomly selected and independently scored by three raters. There were about 300 scoring decisions made by each scorer. The level of agreement between each two raters was above 92.3%.

Results

A three-factor ANOVA was conducted on the number of correctly recalled propositions. Significant main effects were found for Orienting Task, $F(2,101) = 23.16$, $P < .001$, Text Imagery, $F(1,101) = 40.85$, $P < .001$, and Age, $F(1,101) = 26.71$, $P < .001$. The direction of the orienting task and imagery effects were as predicted on the basis of the results of young adults (Experiments 1 and 2). That is, more propositions were recalled after intentional-learning instructions ($\bar{X} = 28.70$) than after "deep" instructions ($\bar{X} = 19.16$) and, lowest of all, "shallow" instructions ($\bar{X} = 12.78$). Like the young adults, these middle-aged and older subjects recalled propositions from concrete texts ($\bar{X} = 26.35$) better than from abstract texts ($\bar{X} = 14.07$). An ANCOVA with the IST70 scores as a covariate did not reveal any significant changes in the results. The covariate had no effect.

The Orienting Task × Age interaction was significant, $F(2,101) = 3.10$, $P < .05$, and the Text Imagery × Age interaction approached significance, $F(1,101) = 3.56$, $P < .07$. The former interaction resulted from a widening gap in the recall performance between middle-aged and the old adults from "shallow" through "deep" to intentional instructions. That is, for the distinctive encoding instructions ("shallow"), older adults were able to perform almost as well as middle-aged adults ($\bar{X} = 9.82$ vs. 15.74), but were not able to gain as much from intentional instructions ($\bar{X} = 20.36$ vs. 37.05). The marginal Text Imagery × Age interaction resulted from the gap in performance between middle-aged and old adults for concrete texts (gap = 12.81 propositions) being greater than the difference for abstract texts (gap = 7.16 propositions). Thus, the trend is for older adults to perform at a level closer to the performance of middle-aged adults for abstract texts, but not to benefit as much as the latter when reading concrete texts. Figure 4 depicts the pattern of mean differences.

Discussion

For several reasons, direct comparison between the young adults of Experiment 2 and the middle-aged and old adults of the present experiment is hazardous. Prominent among these reasons are the following: (a) the young subjects were university students ($\bar{X}$ years of education = 13.6), whereas the middle-aged ($\bar{X}$ years of education = 10.3) and old adults ($\bar{X}$ years of education = 8.96) were not; (b) the participation of the young subjects was not entirely

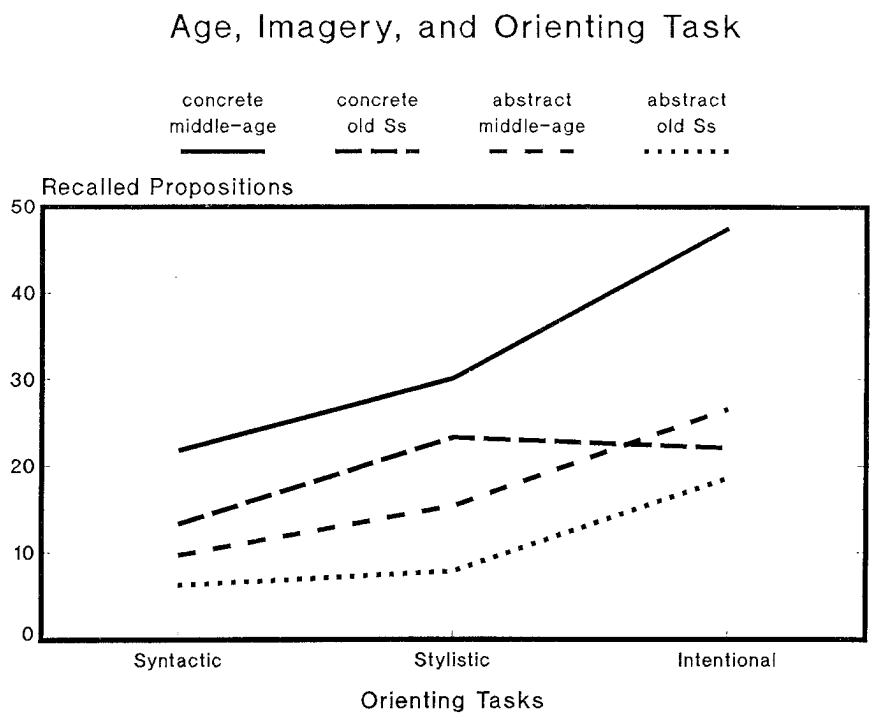

Fig. 4. Effects of age, imagery, and orienting task on text recall (Experiment 3)

voluntary, whereas both older groups volunteered to participate; and (c) the young subjects in Experiment 2 performed under time pressure, whereas the older subjects did not. Nevertheless, it may be helpful to interpret the present results in the context of Experiment 2.

Like the young adults, within age groups and across conditions, subjects recalled the concrete text better than the abstract text. Within imagery condition, for middle-aged adults, as for young adults, recall rate was improved from "shallow" to "deep" to intentional instructions. For old adults in the present experiment, this trend was not so clear. Specifically, (a) old adults recalled the concrete texts equivalently in the "deep" and intentional conditions and (b) they recalled the abstract texts statistically equivalently in the "shallow" and "deep" conditions. Furthermore, the difference in recall between concrete and abstract texts under the intentional conditions for old adults was not as great as it was for the two younger age groups.

The significant interaction, however, was between orienting task and age. Collapsing across abstract and concrete texts, old adults were able to perform closer to the level of middle-aged adults for the "shallow (difference = 5.65 propositions)," and even the "deep (difference = 7.18 propositions)," orienting tasks, but the intentional-learning instructions led to by far superior performance by the middle-aged subjects (difference = 20.36 propositions). This general pattern of stepwise improvement from "shallow" to "deep" to intentional instructions in adulthood replicates and extends the results of Dixon and von Eye (1984) to very different texts. The wide gap between the performance of the middle-aged and the old adults under intentional instructions could be due, in part, to the unusually low verbal ability of the older adults (see Table 1). This effect, however, did not statistically realize. On the other hand, it may be that the middle-aged adults performed extremely well under intentional instructions, especially on the concrete stories (see Figure 4).

The Orienting Task × Text Imaging Interaction appeared only in the first, but not in the second and third experiments. Since in earlier experiments (Thiel & von Eye, 1986) this interaction did not appear either, we may conclude that this interaction is either text-content specific or results for these texts only. The present data do not allow us to make a decision as to which alternative is the major reason.

Overall, the replication of the patterns obtained in Experiment 2, with both different procedures and very different adult age groups, testifies to the robustness of the effects. Some general conclusions are offered in the following section.

General discussion

A series of three experiments was conducted to investigate the confluence of dual-code theory and levels-of-processing approach in the discourse-processing domain. The results of these experiments suggest that:

1. The superiority in recall of concrete material – a well-established result for lists of items – applies also for contextually meaningful material, i.e. short narratives. The texts constructed for the experiments were equivalent in concreteness as perceived by independent samples of subjects.

2. Two levels of processing and an intentional-learning condition led to different recall rates. The differences showed the expected signs: shallow processing resulted in poorest, deep processing in intermediate, and intentional learning in the highest, recall rates. Differential encoding instructions led to recall rates that lie between recall rates from the shallow and the deep conditions. A second trial led to overall higher recall rates. The overall pattern of recall rates was maintained.

3. There is no interaction between orienting tasks and concreteness levels. The interaction obtained in Experiment 1 could not be replicated and is, therefore, attributed

to text content or structure rather than to the text characteristics under study. Overall, the effect strength seems to be greater for imagery than for orienting tasks.

4. In none of the experiments did verbal intelligence as measured by the verbal subscale of Amthauer's (1970) IST70 have statistically significant effects on recall rates.

5. The overall pattern of results is robust across adult ages, ranging from about 18 to 85 years. However, there are some indicators suggesting that older adults do not benefit as much as middle-aged and younger adults from intentional learning, and the concreteness effect is somewhat weaker for older adults under the intentional-learning condition.

The overall pattern of results provides further empirical support for dual-code theory (cf. Paivio, 1983). Similar results were obtained by Thiel and von Eye (1986), who conducted an experiment parallel to the present Experiment 2, but without subjecting subjects to time pressure and without a second trial. As compared to Thiel and von Eye's (1986) subjects, the present sample in Experiment 2 displayed clearly lower recall rates under all experimental conditions. For instance, the present sample recalled on average only 4.85 propositions of the abstract texts under the "shallow" orienting task, whereas in Thiel and von Eye's experiment the respective recall rate was 7.80. However, the overall pattern of results was the same in both experiments. Thus it can be concluded that under time pressure the typical rank order of mean differences is preserved.

One concern of the present experiments was the interplay between the levels of processing and dual-code perspectives. Predictions from dual-code theory lead one to expect an interaction between the concreteness and the orienting task variables. More specifically, dual coding predicts that recall of concrete verbal material uniformly increases with increasing depth. The reason for this prediction is that semantic-processing tasks are more likely to stimulate both imagery and verbal-associate learning. Abstract verbal material, however, should benefit only from the shift from shallow to semantic-orienting tasks. Dual-code theory predicts uniform recall for different semantic orienting tasks, because these tasks do not increase the probability of dual coding.

If these assumptions hold true, the increase in recall rates from the syntactic to the stylistic orienting task should be approximately the same for concrete and abstract texts. The present results confirm this assumption. In all experiments and trials, concrete and abstract texts benefit about equally from the stylistic condition (see Figures 1–4). The small numerical differences are not statistically significant.

These results confirm the first part of the assumptions on the interaction between the dual code and the levels of processing perspectives for text recall. The second part was confirmed in an experiment conducted by D'Agostino, O'Neill, and Paivio (1977). These authors compared recall rates for concrete and abstract words under one shallow, and several deep, orienting tasks. Results showed that recall for concrete words uniformly increases with the depth of processing. Recall for abstract words was the same across all semantic orienting tasks, but lower under the shallow condition.

The second part of the assumptions cannot be tested with the present data. It would have required a differentiation of levels of deep processing. However, the results of Simon et al.'s (1972) experiment suggest that text recall does not respond as sensitively as list recall to manipulations of the depth of processing. Future research needs to develop experimental conditions that depict finer differences in levels of processing in memory for texts.

Although the present experiments were not designed to provide a test of the context-availability model (Marschark, 1985; Kieras, 1978), results suggest that, at least for the materials used here, strong imagery effects can be found even for texts, and for adults from different age groups. The texts used in the present experiments are comparable in their propositional length and grammatical structure. In the present experiments, only texts were used. Therefore, it cannot be decided if results obtained with unconnected sentences would have led to even stronger imagery effects. However, the measures of effect strength for the concreteness effects obtained in the present experiments are relatively high, that is, about $\omega^2 = 0.20$, and therefore, it cannot be expected that they are much higher for contextually unrelated materials (in Thiel and von Eye's 1986 experiment, effect strength for concreteness was $\omega^2 = 0.24$).

Whereas Materials as a factor had strong effects on recall rates, differences between subjects had no effect. In none of the three experiments did the covariate verbal intelligence lead to any modification in the description of effects of experimental factors. However, these results are not necessarily contradictory to the findings, e.g., of Dixon et al. (1984; cf. Hultsch et al., 1984). These authors were able to provide a meaningful classification of subjects into low and high verbal-ability groups. This grouping led to a statistically significant main effect. However, the effect strength was relatively small ($\omega^2 = 0.043$). In the present experiments, subjects were more homogenous in their verbal ability. Therefore, possible effects may be attenuated. A variation in verbal IQ scores was obtained only in Experiment 3. However, there is a confound with age (see Table 1).

With respect to the age differences obtained in Experiment 3, the results from the studies carried out by Dixon and von Eye (1984) and Berger-Zenk et al. (1985) have been replicated. It can be concluded that both concreteness and orienting-task effects can be observed without interaction across the entire adult age range. However, both effects seem to be attenuated for the older age group. Text construction for future experiments will have to be made with special attention to the possibility that older subjects may perceive text characteristics in a manner different from younger adults, and respond to orienting tasks differently. Such considerations can be based, for instance, on results of a study that took into account preexperimental knowledge of subjects from different age groups in the construction of the texts (Hultsch & Dixon, 1983). This manipulation led to smaller age differences in text recall.

From an experimental perspective, most problematic for the research of discourse processing is the control of possible confounding variables. Concreteness is to a certain extent always confounded with the content of a text, because certain abstract contents cannot be equivalently expressed by the use of concrete words. But even if this is possible, and the resulting text is perceived as equally abstract to the parallel text that uses abstract words, it cannot be excluded that the discrepancy between concrete words

and abstract content would not have effects on recall rates. Another way of controlling this confound was used by Wippich and Bredenkamp (1977). These authors kept the text's content constant and by varying the title induced their subjects to interpret it either in an abstract or in a concrete fashion. However, although the texts were perceived as differing in concreteness, the differences in recall rates did not reach significance. Marschark (1985) used tests with the same number of words and sentences. However, he exchanged words to obtain a concrete vs. abstract content. His experiments also showed no concreteness effects on recall.

A third way of dealing with this problem was realized in the present experiments. The contents at each level of concreteness were varied, while the concreteness level was kept constant.

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