A partial replication study was conducted comparing children’s recall of news stories presented via television and via print. Unlike the procedure in previous experiments, television news stories were compared not only with literal transcripts of the television narratives, but also with two different “real” newspaper versions written by journalists. In addition, the study investigated whether the relative effectiveness of television and print in conveying news information was dependent on children’s reading proficiency. A sample of 144 fourth and sixth graders was presented with a sequence of five children’s news stories, either in their original television form or in one of the three print versions. The results of a cued-recall test indicated that children who watched the news on television remembered the stories better than children who read one of the three print versions, regardless of their level of reading proficiency.

A study of the relative effectiveness of television and print to transmit news information to children was undertaken by comparing children’s recall of news stories presented either via television or in three different print versions. Television is used far more frequently by children than print. Timmer, Eccles, and O’Brien (1985) found, for example, that elementary school children spent about 2.3 hours per day watching television, whereas they devoted only 8 minutes per day to leisure-time reading. Because television occupies a predominant position in their media use, children get most of their news information from television, rather than from newspapers, radio, or discussions with others (Comstock & Paik, 1991). Children’s use of television as their main source of news information has raised concerns among educators as well as publishers of newspapers, because studies conducted with adults suggest that people learn less from television news than from newspapers (e.g., Gunter, 1987; Robinson & Levy, 1986).

To our knowledge, however, children’s learning from television and print news has been examined in only one experimental media comparison study (Walma van der Molen & van der Voort, 1997), which found that, unlike adults, children remembered most from news presented via television. Because a single study conducted with children does not provide a large enough basis for drawing conclusions, the relative effectiveness of television and print to transmit news information to children was again investigated in the present study. This study partly replicates Walma van der Molen and van der Voort’s (1997) previous news media comparison. In addition, it was extended to include
two new conditions in order to control for a possible methodological artifact.

The assumption that printed news is remembered better than television news is based mainly on experiments conducted with highly educated adults (college or university students) in which recall of television news stories was compared with recall of print versions containing exactly the same verbal information. With one exception (Stauffer, Frost, & Rybolt, 1981), all studies showed that the printed news was remembered best (DeFleur, Davenport, Cronin, & DeFleur, 1992; Facorro & DeFleur, 1993; Furnham & Gunter, 1985; Gunter & Furnham, 1986; Gunter, Furnham, & Gietsion, 1984; Gunter, Furnham, & Leese, 1986; Wicks & Drew, 1991; Wilson, 1974). The superior recall of printed news found for adults is usually attributed to the fact that readers can exercise more control over their information processing than viewers (Kozma, 1991). Unlike viewers, readers can digest the news at their own pace, reread passages, and check details, all of which can facilitate the storage of information (e.g., Furnham & Gunter, 1985; Gunter, 1987).

However, it is questionable whether the findings of the media comparison studies conducted with adults also apply to children. First, reading ability is less well-developed in children than in adults, so that children may be less able to benefit from the opportunities print offers for efficient information processing. Second, as the media comparison studies have been conducted with adults with advanced reading skills, the observed superiority of print news may apply to the more proficient readers only, whereas less proficient readers might profit more from news broadcast on television.

In the one experimental news media comparison conducted with children (Walma van der Molen & van der Voort, 1997), recall of five television stories from a children's news program was compared with recall of printed literal transcripts of the television narratives. In addition, it was examined whether the relative effectiveness of television and print was dependent on children's reading proficiency, and their expectation of a memory test. A sample of 152 children was randomly assigned to either the television or print condition. In each condition, half of the children were led to expect a memory test. The results of a cued-recall test indicated that children who had watched the news on television remembered more than those who had received the same news in print, regardless of their reading proficiency or expectation of a memory test.

There are three alternative explanations for the superior recall of television news found with children. The first assumes that children benefit from the addition of television pictures to the verbal message as suggested by Paivio's (1969, 1971) dual-coding hypothesis. According to Paivio, audiovisual information is stored in memory in two separate but associated codes—one verbal and one visual—whereas text-only information is stored in one verbal code only. During recall, the visual memory code serves as an extra retrieval cue, which could account for the superior recall of television stories compared with stories without pictures. However, dual-coding may enhance recall only when the verbal information is supplemented with redundant pictures, that is, pictures that convey the same basic propositional meaning as that conveyed by the text (e.g., Drew & Grimes, 1987; Graber, 1990; Levin & Lesgold, 1978; Levin & Mayer, 1993; Nugent, 1982; Reese, 1984). When verbal and visual information do not correspond, limited-attentional-capacity theories predict that the viewer's attentional capacity may be exceeded and that the viewer may be distracted from the verbal message (e.g., Drew & Grimes, 1987; Grimes, 1990, 1991).

To examine the plausibility of the dual-coding explanation, Walma van der Molen and van der Voort (1997) classified the questions in their cued-recall test into two types: (a) questions about verbal information that was supplemented with redundant pictures in the television stories and (b) questions about verbal information that was presented only verbally or with nonredundant pictures. Because the superior recall of television compared with print news was found only in the case of verbal information supplemented with redundant pictures, the authors concluded that the additional memory code offered by redundant audiovisual information may indeed have been responsible for the observed superior recall of television news.
An alternative explanation, however, is that children have not yet developed sufficient reading proficiency to profit fully from the opportunities print offers for efficient information processing. Walma van der Molen and van der Voort (1997) argued that if the observed superior recall of television news is attributable to children’s imperfect reading proficiency, the recall advantage of television compared with print news should be smaller among more proficient readers than among less proficient readers. Although the results of their study indeed showed that the recall difference between television and print was largest among less proficient readers, the interaction between medium and reading proficiency was statistically significant only at the .10 level. The authors therefore concluded that their study did not provide conclusive evidence that imperfect reading proficiency may explain children’s superior recall of television news.

A third possible explanation is that the potential advantages of text were underutilized in the study in question, because the printed stories were not originally written as newspaper stories. As was the case in the studies conducted with adults, the printed texts were identical to the television narratives to ensure comparability between the two experimental media conditions. Although according to Walma van der Molen and van der Voort (1997) the printed stories were perfectly understandable as texts without the accompanying visuals, recall of the print versions may nevertheless have been disadvantaged to some degree, because the stories were not written as newspaper stories.

The present partial replication study was conducted for three reasons. First, replication was needed because children’s recall of television and print news had been examined in only one experiment. Although replication research is often underrated and therefore rather scarce in the social science literature (Neuliep & Cranford, 1990; Rosenthal, 1990), philosophers of science generally agree that any claim for the existence of a relationship should be subjected to a test of replicability at some stage, before it can serve as a basis for scientific theory (Lytton, 1994). A second reason was inspired by the previous finding of an almost significant interaction between medium and children’s reading proficiency, an effect that could easily turn out differently in a replication study. Third, the study was designed to examine whether superior recall of television news results from an artificial underutilization of the print medium.

In the present study, recall of television and print news as well as the influence of reading proficiency on the relative effectiveness of the two media was examined employing the same stimulus materials and age range as in the original study. Furthermore, the experiment was supplemented with two print conditions which presented children with real newspaper coverage of the same topics written by two journalists from a children’s newspaper.

In the present study we again expected that children would remember more from television news than from the same news presented in print. A recall advantage of television was observed not only in the study being replicated (Walma van der Molen & van der Voort, 1997) in which news stories were used as stimulus material, but also in television-print comparisons conducted with children in which fictional stories were used (Beentjes & van der Voort, 1991a, 1991b, 1993). In addition, experiments comparing fictional television stories with stories that were read aloud to children showed that children in the television condition remembered more central information (Greenfield & Beagles-Roos, 1988), more detailed story information (Beagles-Roos & Gat, 1983; Greenfield & Beagles-Roos, 1988), and more actions (Gibbons, Anderson, Smith, Field, & Fischer, 1986; Hayes, Kelly, & Mandel, 1986; Meringoff, 1980).

However, our claim is not that television per se is a more effective informational medium for children than print. As Clark (1983, 1994a, 1994b) has argued, it is not the medium that causes gains in learning, but the instructional strategy embedded in the media presentation. Unlike Clark, however, we feel that television may offer special opportunities for increasing learning. We believe that Kozma (1994a, 1994b) is correct in arguing that the use of dynamic pictures distinguishes television from most other media. Especially when used as a news medium, the ability to provide dynamic pictures is a unique attribute of television that the other available news media (newspapers and radio)
do not possess. However, television’s use of dynamic pictures does not automatically enhance children’s learning. As discussed earlier, a prerequisite of enhanced learning is that the television pictures convey the same basic propositional meaning as that conveyed by the verbal commentary.

In the television stories used in the present study, only part of the verbally conveyed information was supplemented with redundant television pictures. Based on the dual-coding hypothesis, it was theorized that children remember more from those verbal information elements that are supported by redundant pictures. Based on limited-attentional-capacity theories, however, it was hypothesized that better recall for television compared with print news does not occur for verbal information elements that are not supported by redundant pictures.

In addition, we expected to find that the predicted recall advantage of television compared with print news would be smaller among more proficient readers than among less proficient readers. Although Walma van der Molen and van der Voort’s (1997) interaction between medium and reading proficiency was significant only at the .10 level, Beentjes and van der Voort (1993) did find that the recall difference between television and print was smallest among more proficient readers in their comparison study in which fictional stories were used as stimulus material. However, the latter authors’ classification of children as more proficient or less proficient readers was based on teachers’ judgements, rather than on objective test scores.

Finally, it was hypothesized that the television news stories would be recalled better than the print versions written as newspaper stories. It may well be that stories originally written as newspaper stories are recalled better than the literal transcripts used in previous research. However, the recall advantage of television found by Walma van der Molen and van der Voort (1997) was considerable: Children in the television condition correctly answered almost 20% more recall questions than children in the print condition. Therefore, we considered it unlikely that the recall advantage of television would disappear completely in a comparison of television news stories with real newspaper stories.

**METHOD**

**Participants**

The study was conducted with a sample of 70 girls and 74 boys from grades 4 (n = 72; M age = 9 years 8 months) and 6 (n = 72; M age = 11 years 6 months) from five primary schools in the urban district of Leiden, The Netherlands. The children came from both lower- and middle-class families and did not have any learning, visual, speech, or hearing disorders. The five primary schools that participated in the present experiment were comparable in socio-economic make-up to the five schools that participated in Walma van der Molen and van der Voort’s (1997) earlier study. Participation in the study was part of the children’s normal school routine. Children whose score on a standardized test of reading comprehension (National Institute for Education and Measurement, 1981, 1991) was more than two standard deviations below the group mean were not included in the sample. The assumption was that participation of this subgroup of very poor readers would obstruct procedures in the print condition and could lead to a disproportionate reduction of performance in the print conditions.

**Design**

Children were assigned to one of four experimental medium conditions: (a) a television condition in which children watched children’s television news stories, (b) a print condition in which children read literal transcripts of the television narratives (“transcript”), (c) a print condition in which children read newspaper stories about the same topics written by a journalist from a children’s newspaper (“newspaper version 1”), and (d) a print condition in which children read newspaper stories about the same topics written by a second journalist from a children’s newspaper (“newspaper version 2”).

A 2 (Grade 4 vs. Grade 6) × 2 (Less vs. More Proficient Readers) × 4 (Television vs. Transcript vs. Newspaper Versions 1 and 2) design was used. To reduce error variance, a randomized block factorial design (Kirk, 1968) was chosen.
Reading proficiency was used as a matching variable to form blocks. Within each grade, children were matched into blocks of four children with identical or almost equal scores on the reading comprehension test. Subsequently, within each block children were randomly assigned to one of the four experimental medium conditions. Because the children were placed in blocks of four participants with a comparable level of reading proficiency, the factor medium was used in the analyses as a within-subjects, or rather, “within-blocks” factor; the two other factors were between-subjects factors. The distinction between less proficient and more proficient readers was made within each grade, using the median of scores on the reading comprehension test as the cutoff score. Hence, half of the children in the experiment belonged to the category of less proficient readers; the other children were regarded as more proficient readers. To control for possible experimenter effects, the participation of four experimenters was systematically varied across grades and across the four experimental medium conditions.

Stimulus Materials

In each of the four experimental conditions children were presented with five news stories. The news stories were identical to those used by Walma van der Molen and van der Voort (1997). The five news stories had been taken from the Jeugdjournaal (Children’s News), a daily news program in The Netherlands designed specifically to make the news comprehensible to children of about 10 to 12 years of age. The news stories had been broadcast at least one and a half years prior to the experiment and involved isolated news events that had not attracted repeated media attention. The chance that children would have advance knowledge of the news stories was therefore minimal. In selecting the five television news stories, care was taken that the spoken commentary in the news stories was perfectly comprehensible without the accompanying pictures. Hence, a literal transcript of the television narrative was used in the transcript condition, without additions or deletions.

The five news stories were representative of the issues typically covered by the Dutch Children’s News program, including topics of special interest to children as well as “adult” topics. The stories selected covered the following events: “Bear set free in sanctuary after years of captivity,” “Bullied Japanese pupils play hooky,” “Queen Beatrix opens new railway tunnel,” “Rhinoceros wrongfully sold to circus,” and “New U.S. law restricts purchase of firearms.” Each television news story began with a short summary delivered by an anchorperson and continued with film footage accompanied by spoken commentary.

Only part of the verbally conveyed information in the television items was supplemented with redundant pictures because it is difficult to illustrate abstract information with pictures. The verbal information elements that were most frequently visualized with redundant film footage involved people (e.g., Queen Beatrix; American cowboys carrying firearms), animals (e.g., a bear and a rhinoceros), objects (e.g., a train and a railway tunnel). Other verbal information elements that were frequently pictured involved the actions of both people (e.g., Queen Beatrix opening the new railway tunnel) and animals (e.g., a bear doing tricks while in captivity) as well as objects in motion (e.g., a train running through the new tunnel). Finally, the television stories frequently provided redundant verbal and visual information about places. In some cases the places mentioned in the spoken commentary were pictured with real-life film footage (e.g., a circus and a school), whereas in other cases schematic visualizations were used (e.g., a city plan or a map of Europe showing the country were the bear was set free).

For the television condition, the five news items were combined into the format of a regular children’s newscast, including the Children’s News leader and credit titles. The total duration of the newscast was 11 minutes, about the same as that of a regular Children’s News broadcast.

The literal transcripts of the five news stories were presented in a newspaper format. The television titles that served to announce each television news story were used as headlines for the printed stories. The introductory commentary, delivered by an anchorperson in the early part of each of the television stories, was transformed.
into a bold printed lead in the print versions. The remaining text of the television stories was printed in two columns. Thus, an attempt was made to approximate the natural format of newspapers as closely as possible, while keeping the information conveyed by the printed transcripts identical to the verbal information conveyed by the television stories.

For the newspaper versions two journalists from a Dutch weekly children's newspaper were each asked to write, independently of each other, a newspaper story about each of the five news topics. Two newspaper versions were used to enable investigation of whether memory for the news information was influenced by differences in the writing style of the two journalists. The journalists were instructed to thoroughly take note of the content of the television items and then to write a newspaper story about each topic, in their own words and with a structure of their own choice. We examined the newspaper stories so as to determine whether they covered all the information later probed by the memory test, which proved to be the case. In addition, each newspaper story contained approximately the same number of words as the literal transcript of the television narrative. The texts for the two newspaper conditions were given the same format as the texts in the transcript condition.

**Procedure**

To reduce the possibility of classroom effects, children from each classroom were assigned to each of the four experimental medium conditions. In each class, the experiment was conducted simultaneously in two vacant rooms in the school building. This way, two conditions were administered per test session. To prevent children from telling each other what was expected of them in the experiment, the other two conditions were completed the same morning or afternoon in a second session immediately following the first. To reduce the possibility of session-order effects, the four medium conditions were systematically varied over the first and second test sessions. Each session lasted about 50 minutes.

A maximum of 16 children from any given class participated in the experiment. Children were called from their classroom in groups of six or eight. Half of these children were taken to one of the rooms by one experimenter; the other children were taken to the other room by a second experimenter. To enhance ecological validity, the children did not participate in the experiment individually, but were tested in small groups of three or four, as was done in Walma van der Molen and van der Voort (1997). At home, children generally learn about the news in the presence of others. Moreover, the children were expected to be more relaxed in the presence of peers, rather than alone with a strange experimenter.

In each of the four experimental medium conditions, the children were seated at tables separated by a distance of about four feet. In the television condition, the children sat at a distance of about seven feet from a 16-inch color television placed at eye level.

In the experiment conducted by Walma van der Molen and van der Voort (1997), a distinction was made between children who did and children who did not expect to be tested. Knowledge of an impending memory test, however, did not affect the relative effectiveness of television and print news. In the present experiment, all children were subjected to experimental treatments which led them not to expect a memory test. The assumption was that an instruction aimed at preventing expectation of a memory test would increase the ecological validity of the experiment, because children do not expect to be questioned about the news in the home situation either. An attempt was made to prevent children from expecting a test by suggesting that their watching or reading of the news was only intended as a way to pass the time the experimenter needed to prepare the actual experiment. In each condition the children were told: "We are going to do something special and different today. However, I still have some preparations to complete for you, which I can only do now, because I have just learned all your names." In the television condition the experimenter then proceeded to say: "In the meantime, you can watch some television. I have here a videotape of an episode of the Children's News. You can
CHILDREN'S RECALL OF TV AND PRINT NEWS STORIES

watch that while I'm busy working." In the three print conditions the experimenter proceeded to say: "In the meantime, you can read something. I have here some stories from a children's newspaper. You can read that while I'm busy working." Casually, the children were asked not to talk to each other. They were told that talking would make it difficult for the experimenter to concentrate.

The children in the television condition were exposed to the news for 11 minutes. The children in the three print conditions, however, were allowed to read the news stories at their own tempo. The decision was made not to hold exposure time constant across the television and print conditions, because Walma van der Molen and van der Voort's (1997) study had shown that most children needed more than 11 minutes to read the five news stories. Constant exposure times would therefore put children in the print conditions at a disadvantage and prevent a meaningful media comparison. The average reading time in the three print conditions was 12 minutes and 26 seconds. There was no statistically significant difference in reading time between the three print conditions.

Immediately after presentation of the five news items, the children in the television condition were presented with the first dependent measure. The children in the three print conditions had been asked to raise their hands when they finished reading, at which time they were presented with the first dependent measure. The first measure concerned the children's evaluations of the stimulus material. Subsequently, a cued-recall test was presented to measure the children's recall of the stories. Both measures were preceded by written instructions. The children's reading proficiency had been established three weeks prior to the experiment.

Measures

Reading proficiency. Reading proficiency was assessed by means of standardized reading comprehension tests developed by the National Institute for Education and Measurement (1981, 1991). Two different test versions were used to measure reading comprehension in the fourth graders and sixth graders. Each test contained five texts with a total of 25 corresponding multiple-choice questions. The questions asked the children to identify the central theme of a text, to link different parts of a text, and to draw inferences from the information provided in the texts. Cronbach's alpha (K-R 20) was .85 (Grade 4) and .80 (Grade 6).

Evaluation of stimulus materials. To establish whether the children rated the three print versions equally, children were asked to evaluate each news story by means of a semantic differential scale. The scale consisted of three contrast pairs intended to measure the extent to which children had understood each news story, and three contrast pairs concerning the extent to which children had found each story interesting to watch or read. The children responded to the statements on a six-point scale. Contrary to our expectation, a factor analysis did not show separate factors for understanding and being interesting. The analysis showed one common factor with high factor loadings for all contrast pairs, that explained 49% of the variance in scores on the rating scale. Cronbach's alpha for the complete rating scale based on all six statements was .85.

Recall. Memory for the five news stories was measured by means of a paper-and-pencil test developed by Walma van der Molen and van der Voort (1997). The memory test contained 56 open-ended questions (the number of questions varied between 10 and 12 questions per news story). For each of the five news stories, questions were generated about each of the five components most news stories are composed of: event, place, principal(s), cause, and consequence (Findahl & Höijer, 1985). In addition, questions about story details were generated. Examples of questions are: "One of the news stories was about a bear that was set free. In which country was the bear set free?" "What was the first thing that the bear did when it was set free?" "Write down the name of another country where more bears are going to be set free in the near future." The memory test contained only questions about information that was present in the text of the printed news stories—and in the television narrative. Hence, the test did not include questions on visual information that
was not conveyed verbally. Cronbach's alpha (K-R 20) was .92 in the present experiment; in their previous study, Walma van der Molen and van der Voort found an alpha of .93.

As discussed before, in the television news stories some of the information conveyed verbally was supplemented with pictures conveying more or less the same information. To enable the analysis of the contribution of redundant pictorial information to children's story recall, Walma van der Molen and van der Voort (1997) had two independent judges classify the questions in the memory test into two types: (a) questions about information that was conveyed only verbally, in print and in the television narrative ("verbal only" information), and (b) questions about verbal information that, either partly or completely, was also presented visually on television ("visual" information). Interrater agreement as measured by Cohen's kappa was .96. Thirty-five questions from the memory test were categorized as verbal only (Cronbach's alpha = .89), and 21 questions as visual (Cronbach's alpha = .84).

RESULTS

Initial data checks showed that the distributions of rating and recall scores satisfied the assumptions underlying analysis of variance. Main effects of gender and interactions involving gender were not significant for any measure. Therefore, gender was not included in the analyses. There were no statistically significant differences in rating or recall scores between children who participated in the first test sessions and children who participated in the second sessions.

In the analyses of variance, the children included in each block of four, who had been matched on reading proficiency, were treated as if they were one person who had been treated with repeated measures (Kirk, 1968; Tabachnick & Fidell, 1989). All effects were assessed at the .05 level.

Evaluation of Stimulus Materials

A 2 (Grade 4 vs. Grade 6) x 2 (Less vs. More Proficient Readers) x 4 (Television vs. Transcript vs. Newspaper Versions 1 and 2) x 5 (News Items 1 Through 5) analysis of variance was performed on the rating scores, with medium condition and news item as within-subjects factors and grade and level of reading proficiency as between-subjects factors. Table 1 presents the mean rating scores for the television condition and the three print conditions as a function of grade. The main effect of medium condition was not statistically significant, which indicates that there was no significant difference in children's evaluation of the three print versions and the television version. The interaction effect of medium condition and news item was not statistically significant either, which means that no significant differences in children's ratings of the four medium conditions were found for any of the five news items. There was, however, a statistically significant main effect for news item, \(F(4, 128) = 13.34, \text{MSE} = 0.338, p < .001\). Not every news item was similarly evaluated: The topic concerning the purchase of firearms in the United States was

<table>
<thead>
<tr>
<th>Grade</th>
<th>TV M</th>
<th>SD</th>
<th>Transcript M</th>
<th>SD</th>
<th>Newspaper 1 M</th>
<th>SD</th>
<th>Newspaper 2 M</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>4.87</td>
<td>0.51</td>
<td>4.87</td>
<td>0.77</td>
<td>4.63</td>
<td>0.59</td>
<td>4.68</td>
<td>0.43</td>
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<tr>
<td>6</td>
<td>4.91</td>
<td>0.29</td>
<td>4.56</td>
<td>0.48</td>
<td>4.84</td>
<td>0.47</td>
<td>4.79</td>
<td>0.43</td>
</tr>
<tr>
<td>M</td>
<td>4.90</td>
<td>0.41</td>
<td>4.71</td>
<td>0.65</td>
<td>4.73</td>
<td>0.54</td>
<td>4.73</td>
<td>0.43</td>
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</tbody>
</table>

Note: Minimum score is 1 (low evaluation) and maximum score is 6 (high evaluation).
rated highest ($M = 4.96, SD = 0.71$), whereas the topic concerning the opening of a new railway tunnel was rated lowest ($M = 4.52, SD = 0.75$). None of the other main or interaction effects was statistically significant.

Recall

A $2 \times 2 \times 2 \times 2$ (Grade 4 vs. Grade 6) $\times$ (Less vs. More Proficient Readers) $\times$ (Television vs. Transcript vs. Newspaper Versions 1 and 2) $\times$ (Verbal Only vs. Visual Information) analysis of variance was performed on children’s total scores on the memory test, with medium condition and type of information as within-subjects factors and grade and level of reading proficiency as between-subjects factors. The upper part of Table 2 presents the mean proportions of correct answers for the four medium conditions as a function of grade. There was a statistically significant main effect for medium condition, $F(3, 96) = 11.48, MSE = 0.036, p < .001$. The proportion of variance accounted for was $\eta^2 = .26$, using $\eta^2 = SS_{\text{effect}} / (SS_{\text{effect}} + SS_{\text{error}})$ (Cohen, 1973, 1988; Tabachnick & Fidell, 1989). To determine which medium conditions differed significantly, six paired $t$-tests were performed, using an alpha-level of .008 based on a Bonferroni correction (Pedhazur & Pedhazur Schmelkin, 1991). As predicted, the television news stories were not only recalled better than the literal transcripts of the television narratives, $t(35) = 5.32, p < .001$, but were also recalled better than both newspaper version 1, $t(35) = 3.64, p < .002$, and newspaper version 2, $t(35) = 5.26, p < .001$. There were no statistically significant differences in recall between the three print versions (for all these comparisons $p$ was > .10).

There was a statistically significant interaction between the four medium conditions and the verbal only and visual information categories, $F(3, 96) = 17.43, MSE = 0.005, p < .001, \eta^2 = .36$. This interaction is depicted in Figure 1. The superior recall of television compared with the three print versions was especially pronounced when the news information had been effectively visualized on television. For questions about information that was conveyed both verbally and visually on television, mean recall scores (with standard deviations in parentheses) were .68 (.19), .45 (.18), .49 (.19), and .46 (.18) for the television, transcript, and newspaper versions 1 and 2, respectively, whereas mean recall scores for verbal-only information were .56 (.19), .45 (.20), .47 (.22), and .50 (.17), respectively. Follow-up tests showed that children in the television condition scored significantly higher on the visual measure than children who received (a) the literal transcripts of the television narratives, $t(35) = 7.06, p < .001$, (b) newspaper version 1, $t(35) = 5.32, p < .001$, and (c) newspaper version 2, $t(35) = 7.31, p < .001$. There were no significant differences between the three print versions on the visual measure (all $p$‘s were > .20). Although

Table 2

<table>
<thead>
<tr>
<th>Medium</th>
<th>TV M</th>
<th>TV SD</th>
<th>Transcript M</th>
<th>Transcript SD</th>
<th>Newspaper 1 M</th>
<th>Newspaper 1 SD</th>
<th>Newspaper 2 M</th>
<th>Newspaper 2 SD</th>
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<td>Grade</td>
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<td>4</td>
<td>.54</td>
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<td>Reading Proficiency</td>
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<tr>
<td>More proficient readers</td>
<td>.69</td>
<td>.13</td>
<td>.55</td>
<td>.17</td>
<td>.56</td>
<td>.20</td>
<td>.58</td>
<td>.12</td>
</tr>
<tr>
<td>Less proficient readers</td>
<td>.51</td>
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<td>.35</td>
<td>.15</td>
<td>.40</td>
<td>.18</td>
<td>.39</td>
<td>.17</td>
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<tr>
<td>Total M</td>
<td>.60</td>
<td>.18</td>
<td>.45</td>
<td>.19</td>
<td>.48</td>
<td>.20</td>
<td>.49</td>
<td>.17</td>
</tr>
</tbody>
</table>

Note: Scores represent mean proportions of correct answers.
the recall advantage of television compared with the three print versions was most pronounced for information that was conveyed both verbally and visually on television, there was also a difference in retention between verbal-only information presented on television and the same information presented in print. Follow-up tests showed that children remembered more from verbal-only information presented on television than from the same information presented in (a) the literal transcripts of the television narratives, $t(35) = 3.54, p < .001$, (b) newspaper version 1, $t(35) = 2.34, p < .026$, and (c) newspaper version 2, $t(35) = 2.61, p < .014$. However, the latter two $p$-values are not significant if a Bonferroni correction is applied, which leads to a corrected alpha-level of .008. There were no significant differences between the three print versions on the verbal only measure (all $p$'s were $>.05$).

Sixth graders ($M = .57, SD = .18$) remembered significantly more of the news stories than fourth graders ($M = .44, SD = .18$), $F(1, 32) = 18.69, MSE = 0.069, p < .001, \eta^2 = .37$. There was no statistically significant interaction between grade and medium condition: Both fourth and sixth graders remembered more from the television news stories than from the three print versions and this medium effect was about the same size in both grades.

The lower part of Table 2 presents the mean proportions of correct answers for the four medium conditions as a function of reading proficiency. Overall, more proficient readers ($M = .59, SD = .17$) remembered the news stories better than less proficient readers ($M = .41, SD = .18$), $F(1, 32) = 33.13, MSE = 0.069, p < .001, \eta^2 = .51$. Contrary to our expectations, however, the interaction between medium condition and reading proficiency was not statistically significant, interaction $F < 1$, which indicates that the

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**Figure 1**  Mean recall scores for television and the three print versions as a function of verbal only and visual information.
recall advantage in the television condition as compared with the three print conditions was about equally large for both less proficient and more proficient readers. The analysis of variance of recall scores showed no other statistically significant main or interaction effects.

DISCUSSION

This study replicates the finding that children recall television news better than printed news. As was found by Walma van der Molen and van der Voort (1997), children remembered televised news stories better than identical print versions. And again, the recall advantage of television as compared with print news was found to be particularly pronounced in the case of verbal information supplemented by redundant television pictures. Our findings therefore support the hypothesis that children's superior recall of television information is due, in part, to the extra mnemonic support offered by redundant pictorial information.

As discussed previously, a possible alternative explanation for the superior recall of television information found by Walma van der Molen and van der Voort (1997) is that the potential advantages of text were underutilized because the print condition in that study involved only literal transcripts of the television narratives. The present study showed that the television news stories were not only remembered better than the literal transcripts, but also better than texts originally written as newspaper stories, indicating that the observed recall advantage of television is not attributable to an artificial underutilization of the print medium. The printed news was less well remembered despite the fact that the print conditions were given preferential treatment in two respects. The readers were exposed to the stimulus materials for an average of one and a half minutes longer than the viewers. In addition, the very poorest readers were excluded from the experiment, because it was expected that these children would reduce recall scores in the print conditions for reasons that were of no theoretical interest to us.

Another alternative explanation for the recall advantage of television observed in both Walma van der Molen and van der Voort's (1997) study and the present study, is that children have not yet developed sufficient reading proficiency to profit fully from the opportunities print offers for efficient information processing. As discussed previously, if the observed superior recall of television news is attributable to children's imperfect reading proficiency, television's recall advantage over print should be smaller among more proficient readers than among less proficient readers. Whereas Walma van der Molen and van der Voort in their previous study found that the recall advantage of television as compared with print news was somewhat, but not significantly, smaller among more proficient readers than among less proficient readers, the present study provided no indication at all that the superior recall of television was related to differences in children's levels of reading proficiency. Contrary to our expectations, the recall advantage of television applied almost evenly to both more and less proficient readers. Apparently, a child's level of reading proficiency does not affect recall of the stimulus materials used in the experiment. In the study being replicated, the failure to find a significant interaction effect was attributed to the low level of difficulty of the stimulus materials employed. It was argued that the television transcript was perfectly understandable to children between 10 and 12 years of age, which, in our view, also applies to the newspaper stories used in the present study. As has been argued before, children's reading proficiency might affect the relative effectiveness of television and print news only if the verbal information is less easy to understand.

A third alternative explanation for the recall advantage of television observed in the present study is that children paid more attention to the televised newscasts than to the print stories. It might be argued that children's familiarity with and attraction to television may have resulted in the children paying fairly close attention to the television stories, even though they were not told they would be tested. In contrast, given that they did not expect to be tested, the children may not have paid as much attention to the printed stories. However, there are two reasons
why we doubt that the recall advantage of television over print is attributable to differential attention. First, Walma van der Molen and van der Voort (1997) investigated the amount of mental effort children invested in watching and reading the news stories. For children who did not expect to be tested, there were no significant differences between the amount of mental effort invested in watching or reading the news. Second, according to Salomon (1984), there is little reason to expect that children pay more attention to television than to print. On the contrary, Salomon argues that children tend to invest more mental effort in reading print than in watching television, because children experience print as a "tough" medium and television as an "easy" medium.

Whereas in Walma van der Molen and van der Voort's (1997) study the recall advantage of television was confined to verbal information that was supplemented with redundant television pictures, the present study also found, although to a lesser extent, that verbal-only television information was remembered better than the same information presented in print. The latter finding cannot be explained in terms of the dual-coding hypothesis. The recall advantage of verbal-only television information might reflect a "radiation effect": A greater knowledge of the information elements that were presented both verbally and visually may help viewers to absorb the verbal-only information elements as well.

The present study again showed that the finding that adults remember print news better than television news does not apply to children. One possible reason for the opposite results obtained for adults and children is that different types of television news stories were used in the studies conducted with the two age groups. In the children's news stories used in the two studies conducted with children, television's capacity to supplement verbal information with pictures was effectively utilized. In the regular adult television news stories used in the studies conducted with adults, on the other hand, the news is frequently illustrated with pictures that are unrelated to the television commentary (e.g., Robinson & Levy, 1986). It may very well be that the recall advantage of print news found with adults does not apply when print is compared with television stories containing pictures more closely related to the verbal message. Conversely, the recall advantage of television observed for children may not hold for television news stories that do not provide redundant pictures. How different types of stimulus materials affect the relative effectiveness of television and print news is being investigated in an experiment in progress in which both children and adults are subjected to television and print stories in both children's and adult news formats.

Finally, what are the implications of the present study for theory and practice regarding instructional media? The study lends further support to the hypothesis that information conveyed both verbally and visually is recalled better than text-only information, provided that there is considerable semantic overlap between the content of the verbal and visual channels. Therefore, it is important that producers of children's television news, as well as designers of instructional television programs, ensure that verbal and visual content are closely related. If this condition is met, television newscasts can be an effective aid to the teacher of media studies and social studies. In addition, television news stories may help teachers of many other subjects to update and illustrate their subject matter. The use of television news in instructional settings may encourage children's interest in current affairs. However, it is equally important that schools attempt to increase children's interest in reading newspapers, because print news usually provides more information about news events than do television news programs.

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REFERENCES


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