Children's and Adults' Recall of Television and Print News in Children's and Adult News Formats

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Experiments comparing television and print news have shown that children learn most from television, whereas adults learn most from print. An experiment was conducted in which both 96 children (5th and 6th graders) and 96 adults (university students) were presented with a sequence of five news stories, either in their original televised form or in a printed version. Half of the participants were presented with stories taken from a children’s news program (high audiovisual redundancy), whereas the other participants were exposed to corresponding stories adopted from an adult news program (low audiovisual redundancy). Results indicated that both children and adults learned most from television stories when presented in a children’s news format, whereas the recall advantage of television disappeared when adult news stories were involved. The results suggest that the correspondence between verbal and visual content of television stories is decisive for the relative effectiveness of television and print.

Both children and adults rely on television as their main source of news information. Since the beginning of the 1960s, public opinion surveys have consistently shown that a growing number of adults claim to learn most about the news via television, rather than through newspapers or other news media (Roper Reports, 1995). Children depend almost exclusively on television for their knowledge about news events (Comstock & Paik, 1991).

Experimental Media Comparisons of Television and Print News

A number of researchers have argued that it is undesirable to have people informed about the news primarily through television instead of news-
papers, because there are reasons to believe that print is a much more effective medium to convey news information (e.g., Gunter, 1987; Robinson & Davis, 1990; Robinson & Levy, 1986). The assumption that television is a less effective news medium than print is based in part on findings from media comparison experiments that established how much consumers remember from television news stories compared with print versions of the same stories, which consisted of literal transcripts of the television narratives.

Initially, these experimental television-print news comparisons were conducted almost exclusively among highly educated young adults (college or university students). With the exception of one study in which no media difference was found (Stauffer, Frost, & Rybolt, 1981), adults were found to remember more from print news than from a comparable television news presentation (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). It is only recently that four experimental television-print news comparisons were conducted among children (Beentjes, Vooijs, & van der Voort, 1993; Walma van der Molen & van der Voort, 1997, 1998, 2000). The children involved in these studies were in the highest grades of elementary school (10 to 12 years of age). The results of the experiments conducted with children were diametrically opposed to those obtained with adults. Unlike adults, children were found to remember more from television news stories rather than from the same news presented in print.

To our knowledge, no research has yet addressed the question of how the opposite results obtained for adults and children may be explained. The goal of the present study was to investigate two rival explanations.

The Reading Proficiency Explanation

The superior recall of print news observed with adults is usually attributed to the fact that print offers more opportunity to exercise control over the processing of information than television does (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). Therefore, one explanation for the finding that printed news is remembered best by adults, but not by children, may be that children are less able to benefit from the opportunities that print offers for efficient information processing because their reading skills are less well developed than those of adults. We will refer to this explanation as the reading proficiency explanation.
The Semantic Overlap Explanation

The television-print news comparisons conducted with adults or children not only used participants who differed in age and reading proficiency, they also used different types of stimulus materials that differed in the degree to which the verbal and visual content of the television stories showed semantic overlap. The television news stories used in the studies with children were derived from the *Jeugdjournaal* (Children's News), a program in which an effort is made to use pictures that are redundant with the verbal message, that is, pictures that convey the same basic propositional meaning as that conveyed by the verbal commentary. The studies involving adults, on the other hand, used regular adult television news stories. Although none of the studies conducted with adults provided information about the correspondence between the verbal and pictorial content of the television stories they used, it may be readily supposed that the degree of semantic overlap between the verbal and visual information was relatively low. News programs intended for an adult audience usually contain a large proportion of so-called standard news pictures (e.g., politicians arriving in limousines) that convey little meaning and are often at best only partially related to the spoken commentary (e.g., Brosius, Donsbach, & Birk, 1996; Robinson & Levy, 1986; Wember, 1976).

An alternative explanation for the opposite outcomes of the media comparison studies conducted with adults or children may therefore be that the semantic overlap between the verbal and visual content of the television stories was considerably greater in the studies involving children than in the studies with adults. We will refer to this explanation as the semantic overlap explanation. According to Walma van der Molen and van der Voort (1997, 1998, 2000), the superiority of television news observed in their studies with children was the result of the close correspondence between the verbal and visual content of the television stories employed. Based on Paivio’s (1969, 1971) dual-coding hypothesis, they argued that television can facilitate information transfer by adding relevant visual information to the verbal message. The dual-coding hypothesis posits that audiovisual information is stored in memory in two separate but associated codes—one verbal and one visual—whereas text-only information is stored in a verbal code only. During recall, the visual memory code serves as an extra retrieval cue that could enhance recall. However, dual coding may enhance recall only if the verbal information is supplemented with redundant pictures. When verbal and visual information do not correspond, limited—attentional capacity theories suggest that the viewer's attentional capacity is exceeded, with the result that the viewer
is distracted from the verbal message (e.g., Brosius et al., 1996; Drew & Grimes, 1987; Grimes, 1990, 1991; Lang, 1995).

Inspired by limited–attentional capacity theories, the semantic overlap explanation attributes the inferiority of television news observed in the studies with adults to the relatively low degree of semantic overlap between the verbal and visual content of the adult television stories that were used, which prevented the participants from benefiting from the extra mnemonic support offered by redundant pictorial information. However, inspired by the dual-coding hypothesis, the semantic overlap explanation attributes the superiority of television observed in the studies with children to the relatively high degree of semantic overlap in the children’s news stories, which enabled the participants to profit from television’s potential to facilitate recall by offering redundant pictorial information.

Causal Mechanisms

The researchers involved in the television-print news comparisons conducted with adults did not directly investigate the causal mechanisms that underlay the observed superior recall of print news. The assumption was that the superior recall of print news followed from the opportunities that print offers to exercise control over the processing of information. However, none of the available studies established whether the participating readers used techniques that may facilitate the processing of information (such as rereading passages or checking details). The question of whether the use of such techniques really was responsible for the observed superior recall of print news was also not examined.

The television-print news comparisons conducted with children, however, did examine various mechanisms that could underlie the superior recall of television observed in these studies. Three studies provided evidence to suggest that the dual-coding hypothesis offered the most plausible explanation for the observed superiority of television news. In each of these three studies, the recall advantage of television compared with print news was found to apply mainly to verbal information elements that were effectively visualized on television, whereas no recall difference (Walma van der Molen & van der Voort, 1997) or a considerably smaller recall advantage of television (Walma van der Molen & van der Voort, 1998, 2000), was found for information elements that were presented only verbally, without the use of redundant pictures.

Three of the studies conducted with children examined the validity of two rival theoretical explanations for the observed superiority of television news. First, no support was found for the rival hypothesis that the observed recall
advantage of television was attributable to the fact that children in the television condition only had to listen to the verbally presented information, whereas children in the print condition had to read all the information themselves. A study that included not only a print version but also an audio version of the television stories (Walma van der Molen & van der Voort, 2000) showed that the television news stories were remembered better than both the print and the audio versions, and no recall differences were found between the print and audio stories. Second, no support was found for the hypothesis that the superior recall of television news was attributable to children’s level of reading proficiency. Both more and less proficient readers proved to remember most from the television stories, and the recall advantage of television compared with print was about equally large for both groups of readers (Walma van der Molen & van der Voort, 1997, 1998, 2000).

The printed news stories employed in the studies conducted with children consisted of literal transcripts of the television narratives (as opposed to stories originally written as newspaper stories) and were not accompanied by a newspaper photo. Two studies therefore examined whether the inferior recall of the printed news might be due to an artificial underutilization of the print medium. These studies included not only literal transcripts of the television narratives but also additional print conditions consisting of stories originally written as newspaper stories (Walma van der Molen & van der Voort, 1998) or literal transcripts supplemented with a photo (Walma van der Molen & van der Voort, 2000). There were no indications that the inferior recall of printed news was due to underutilization: The television news stories were remembered better than any of the printed news stories, and no recall differences were found between the various print conditions.

The Present Study

In the study presented here, the validity of the reading proficiency and the semantic overlap explanation was established by subjecting children and adults to television and print stories in both children’s and adult news formats. The present study thus encompassed 2 (age group) × 2 (type of news program) comparisons between television and print news. Two television-print comparisons replicated previous studies that examined either (a) children’s memory for television and print news in a children’s news format, or (b) adults’ memory for television and print news in an adult news format. The other two television-print comparisons examined (c) adults’ memory for television and print news in a children’s news format, and (d) children’s memory for television and print news in an adult news format. To our knowledge, the latter two television-print comparisons have not been carried out before.
Table 1
Expected Direction of Recall Differences Between Television and Print as a Function of Age Group and Type of News Program for the Reading Proficiency and Semantic Overlap Explanation

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Type of News Program</th>
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<td>Children’s News</td>
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<td>Children</td>
<td>TV &gt; Print (Hypothesis 1)</td>
<td>TV ≥ Print (Hypothesis 4)</td>
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<tr>
<td>Adults</td>
<td>TV &lt; Print (Hypothesis 3)</td>
<td>TV &lt; Print (Hypothesis 2)</td>
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<td>Semantic overlap</td>
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</tr>
<tr>
<td>Children</td>
<td>TV &gt; Print (Hypothesis 1)</td>
<td>TV ≤ Print (Hypothesis 6)</td>
<td></td>
</tr>
<tr>
<td>Adults</td>
<td>TV &gt; Print (Hypothesis 5)</td>
<td>TV &lt; Print (Hypothesis 2)</td>
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</table>

Note. The greater-than or less-than signs mean that there is a statistically significant recall advantage or disadvantage, respectively, of television compared with print.

As will be discussed in more detail below, the assumption was that if the opposite results obtained for adults and children are caused by differential reading capacities, adults should remember most from print, whereas children should benefit most from television, regardless of whether stories are presented in an adult or a children’s news format. On the other hand, if the opposite results obtained for adults and children are attributable to differences in semantic overlap, both children and adults should remember most from television stories in a children’s news format, whereas both groups should remember most from print when the news is presented in an adult format.

Hypotheses

Table 1 summarizes the expected outcomes of each of the four television-print comparisons in the case that either the reading proficiency or semantic overlap explanation is true. In either case, we expected to find that children remember more from television news presented in a children’s format than from the same news presented in print (Hypothesis 1), and that adults remember less from television news in an adult format than from a comparable print version (Hypothesis 2). The decision about the plausibility of the two rival explanations therefore depends on the outcomes obtained for the other two television-print comparisons that examined adults’ memory for news presented in a children’s format (Hypotheses 3 and 5) and children’s memory for news presented in an adult format (Hypotheses 4 and 6). Note,
however, that an unequivocal decision about the validity of the reading proficiency or the semantic overlap explanation is possible only if the complete pattern of outcomes of the four television-print comparisons is in accordance with one or the other explanation. The rationale for each of the six hypotheses included in Table 1 is explained below.

**Hypotheses Based on Previous Research**

Previous television-print news comparisons conducted with children consistently showed that children remember children’s television news stories better than print versions of the same news. This finding is consistent with both the reading proficiency and the semantic overlap explanation, because the observed superiority of television may be due both to children’s relatively low level of reading proficiency and to the relatively high audiovisual redundancy in the children’s television news stories. Irrespective of which explanation holds true, we therefore expected to find that

*Hypothesis 1:* Children remember more from television stories in a children’s news format than from the same stories presented in print.

Conversely, previous studies conducted with adults showed that adults remember more from printed news stories than from television stories presented in an adult news format. This finding is also consistent with both the reading proficiency and the semantic overlap explanation, because the observed superiority of print may be due both to adults’ relatively high level of reading proficiency and to the relatively low audiovisual redundancy in the adult television news presentations. Irrespective of which explanation holds true, we therefore expected to find that

*Hypothesis 2:* Adults remember less from television stories in an adult news format than from the same stories presented in print.

**Hypotheses Based on the Reading Proficiency Explanation**

If adults’ relatively high level of reading proficiency is the underlying cause of their superior recall of print news, adults must remember most from print news, not only relative to adult television news but also in comparison with television news presented in a children’s news format. If the opposite results obtained with adults and children are best explained by the reading proficiency explanation, we therefore expected to find that
Hypothesis 3: Adults remember less from television stories in a children’s news format than from the same stories presented in print.

The decision about the expected outcome of the comparison of children’s memory for adult television and print news is complicated by the fact that children are confronted with news information that might be too difficult for them, because the news stories are meant for an adult audience. The reading proficiency explanation generally gives reason to expect that children, because of their relatively low level of reading proficiency, remember most from television, regardless of whether the news is presented in a children’s or an adult format. However, it may very well be that for children, adult news is so difficult to comprehend that they learn little of both the televised and the printed stories, with the result that the recall advantage of television is no longer observable. If the opposite results obtained with adults and children are best explained by the reading proficiency explanation, we therefore expected to find that

Hypothesis 4: Children remember television stories in an adult news format better than or equally well as the same stories presented in print.

Hypotheses Based on the Semantic Overlap Explanation

If the relative effectiveness of television and print news is determined by the degree of semantic overlap between the verbal and visual content of the television stories, then adults, just as children, must remember children’s television news stories that show a close correspondence between verbal and visual information better than news stories presented in print. If the semantic overlap explanation holds true, we therefore expected to find that

Hypothesis 5: Adults remember more from television stories in a children’s news format than from the same stories presented in print.

However, the semantic overlap explanation predicts that children, just as adults, remember less from an adult television news presentation characterized by a relatively low level of audiovisual redundancy than from the same news presented in print. However, if the adult news proves to be too difficult for children, it is again conceivable that children will learn little of both the televised and the printed stories, with the result being that the inferiority of television is no longer observable. If the opposite results obtained with adults and children are best explained by the semantic overlap explanation, we therefore expected to find that
Hypothesis 6: Children remember television stories in an adult news format less well than or equally well as the same stories presented in print.

Method

Participants

The study was conducted with a sample of 96 children (M age = 11 years, 0 months) and a sample of 96 young adults (M age = 21 years, 9 months). The children came from Grades 5 and 6 of three lower- and middle-class primary schools in the urban district of Leiden, the Netherlands. As in previous television-print comparisons conducted with children, children with a score on a standardized test of reading comprehension (National Institute for Education and Measurement, 1981, 1991) more than two standard deviations below the group mean were not included in the sample. The assumption was that participation of this small subgroup of very poor readers would obstruct procedures in the print condition and could lead to a disproportionate reduction of performance in the print condition. The adults were first- and second-year undergraduates in the Department of Education at Leiden University, the Netherlands. None of the participants had any learning, visual, speech, or hearing disorders.

Design

Adults and children were randomly assigned to one of four experimental conditions: (a) a television condition in which participants watched five children’s television news stories; (b) a print condition in which participants read literal transcripts of the television narratives of the children’s news stories; (c) a television condition in which participants watched five adult television news stories about the same topics; and (d) a print condition in which participants read literal transcripts of the television narratives of the adult news stories. In each of the four conditions, 24 children and 24 adults participated.

A 2 (adults vs. children) × 2 (television vs. print) × 2 (children’s vs. adult news) factorial design was used. To reduce error variance, a randomized block factorial design (Kirk, 1968) was chosen. Within each grade, children were matched into blocks of four children with identical or almost equal scores on a reading comprehension test, according to the procedure used in the previous studies conducted with children (Walma van der Molen & van der Voort, 1997, 1998, 2000). No reading comprehension test was available for students at the university level. Therefore, another measure of reading
ability was used as the matching variable: Adults were matched into blocks of four participants with identical or almost equal scores on a vocabulary test designed for university students. Within each block, children and adults were randomly assigned to one of the 2 (television vs. print) × 2 (children’s vs. adult news) experimental conditions. Because the participants were placed in blocks of four with either a comparable level of reading proficiency or a comparable vocabulary level, the factors of medium and type of stimulus material were treated in the analyses as within-subjects, or rather, “within-blocks” factors. Age group was a between-subjects factor.

Within each grade, children were grouped into less proficient and more proficient readers, using the median of scores on the reading comprehension test as the cutoff score. For adults, a distinction was made between participants with relatively small and large vocabularies, using the median of scores on the vocabulary 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 more proficient readers. Similar to this, half of the adults were categorized as having large vocabularies whereas the others were regarded as having small vocabularies. Six experimenters conducted the experiment. To control for possible experimenter effects, the participation of the experimenters was systematically varied across age groups and across the four experimental conditions.

*Stimulus Materials*

In each of the four experimental conditions, participants were presented with five news stories. The five children’s news stories had been chosen from the 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 five adult news stories dealt with the same five topics and had been taken from the *NOS 8-uur Journaal* (8 o’clock News) broadcast every evening by the Dutch Broadcasting Corporation. When selecting the stories, five criteria were used. First, to minimize the likelihood that participants had previous knowledge of the news stories, only stories that had been broadcast at least 2 years prior to the experiment were selected. Second, for the same reason, the selected stories all involved isolated news events that had not attracted repeated media attention. A third criterion was that the television narratives had to be comprehensible without the accompanying pictures, so that literal transcripts of the television narratives could be used in the print conditions, without additions or deletions. In addition, corresponding stories from the children’s and adult news had to be approximately equal in length. Finally, corresponding children’s and adult stories were selected.
only if they contained a considerable information overlap, so that the same memory test could be used for both the children's and adult news stories.

All news stories broadcast between December 1993 and March 1994 by the Children's News and 8 o'clock News were videotaped. About half of the news stories included in the Children's News were also covered by the 8 o'clock News. However, most of the stories shared by the two news programs did not comply with one or more of our selection criteria. The most important criteria that were not met were the absence of foreknowledge and equality in length. Reviewing of the videotapes was continued until five stories were found that complied with all five criteria. The stories selected covered the following events: “Police clears five buildings occupied by illegal tenants in Amsterdam,” “Queen Beatrix opens new railway tunnel,” “Violent forest fires ruin parts of Australia,” “Navy finally finds Dutch submarine that disappeared in 1940,” and “Government declares nature reserve to be new National Park.” After having selected these stories, it was checked whether the children's television news stories indeed showed more semantic overlap than the adult versions of the stories. As will be explained in more detail in the paragraph describing the memory test used, audiovisual redundancy proved to be about four times higher in the children’s news stories than in the adult versions.

For the television conditions, the news items were combined into the format of a regular children's or adult newscast, including each program's news leader and credit titles. Each television news story began with a short summary delivered by an anchorperson and continued with film footage accompanied by spoken commentary. The total duration of the children's newscast was 10.3 minutes; the adult newscast took 10.4 minutes.

The literal transcripts of the 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 each television story 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.

Procedure

Both children and adults participated in the experiment in small groups of four. The decision was made to expose participants to experimental
conditions in small groups, rather than individually, for two reasons: (a) to increase the ecological validity of the study, because at home, people usually watch television in the presence of others as well (Bower, 1985); and (b) to improve the comparability between the present study and previous television-print news comparison studies conducted with adults or children, most of which also tested participants in small groups.

Adults were tested at the Department of Education at Leiden University. The experiment with adults was carried out in six successive test sessions spread over 5 days. In each session, the 2 (television vs. print) × 2 (children’s vs. adult news) experimental conditions were executed simultaneously in four vacant rooms in the university building. Each undergraduate student who participated in the experiment had indicated previously that he or she was willing to participate in an experiment conducted by the department and had received an advance notice informing the participant where and when to apply. As an incentive, the students were promised $10 for their participation in the experiment.

Children were tested in vacant rooms in their school buildings. Because the participating primary schools did not have four rooms vacant in their building, the experiment was conducted simultaneously in two vacant rooms at each school. Children were called from their classroom in groups of eight. Half of these children were taken to one of the rooms by one experimenter; the other children were accompanied to the other room by a second experimenter. This way, in each classroom two conditions were administered per test session. The other two conditions were completed the same morning or afternoon in a second session immediately following the first. The four experimental conditions were systematically varied over the first and second test sessions to reduce the possibility of session-order effects. For both children and adults, each test session lasted about 40 minutes.

To reduce the possibility of classroom effects, children from each classroom were assigned to each of the four experimental conditions. For the same reason, adults from different first- or second-year courses were assigned to each of the experimental conditions. In each of the four experimental conditions, the children and adults were seated at tables separated by a distance of about 4 feet. In the television condition, participants sat at a distance of about 7 feet from a 16-inch color television placed at eye level.

All participants were informed in advance that a test would follow their exposure to the news stories. Walma van der Molen and van der Voort (1997) examined whether knowledge of an impending memory test affected the superiority of television over print news found with children; this proved not to be the case. In previous media comparison experiments investigating adults’ recall of television and print news (e.g., Facorro & DeFleur, 1993;
Furnham & Gunter, 1985), all participants knew in advance that their knowledge of the news would be tested. We therefore decided not to use an instruction that prevents participants from expecting a test, although an instruction aimed at preventing expectation of a memory test could increase the ecological validity of the experiment. Both children and adults were told, “As you know, today you are participating in an experiment.” In the television conditions, the experimenter proceeded to say, “I have here a videotape of the Children's News (8 o'clock News) that we are going to watch. Watch the tape quietly; when it is finished, I want you to answer some questions.” In the print conditions, the experimenter said, “I have here some stories from a children's newspaper (some newspaper stories) that I want you to read. Read the stories quietly at your own tempo; when you are finished reading, I want you to answer some questions.”

The participants who watched the news stories on television were exposed to the news for 10.3 minutes in the children's news condition and 10.4 minutes in the adult news condition. The participants in the two print conditions were allowed to read the news stories at their own pace. The decision was made not to maintain a constant exposure time across the television and print conditions because a pilot study had shown that about 50% of the children and about 20% of the adults needed more time to read the news stories. Constant exposure times would therefore put participants in the print conditions at a disadvantage and prevent a meaningful media comparison. The average reading times for the children's news stories were 12.1 and 8.8 minutes for children and adults, respectively; on average, reading of the adult print stories took 14.0 and 9.3 minutes for children and adults, respectively.

Immediately after the presentation of the five news items, the participants in the television conditions were presented with the memory test. The participants in the print conditions had been asked to raise their hand when they were finished reading, at which time they were presented with the memory test. We did not use a distracter task because previous television-print news comparison studies conducted with adults or children also administered recall measures immediately after news exposure. A cued recall test was used to measure the participants' memory for the news stories. The test was preceded by written instructions. Both the children's reading proficiency and the adults' vocabulary level had been established 3 weeks prior to the experiment.

Measures

Reading proficiency. The children's level of reading proficiency was assessed by means of standardized reading comprehension tests developed
by the Dutch National Institute for Education and Measurement (1981, 1991). Two different test versions were used to measure reading comprehension in fifth 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 .83 (Grade 5) and .80 (Grade 6).

**Vocabulary level.** The adults’ vocabulary level was measured by means of a multiple-choice test developed specifically for college and university students (Elshout & Veenman, 1992; Veenman & Elshout, 1995). The test contained 60 difficult words, each with four possible word meanings. Participants were given 15 minutes to circle the answers that conveyed almost the same meaning as the original words. Examples of difficult words used in the test are “blasphemy,” “apoplexy,” “panacea,” and “meander.” Cronbach’s alpha was .82.

**Recall.** Memory for the news stories was measured by means of a paper-and-pencil test containing 57 open-ended cued recall questions. In previous media comparison experiments, especially those conducted with adults, a variety of recall measures have been used. In the present experiment, the decision was made to elicit participants’ recall of the information with cued recall questions, because free recall tests without retrieval cues may underestimate participants’ actual knowledge of information to which they have been exposed (Berry, 1983; Levin & Lesgold, 1978; Woodall, Davis, & Sahin, 1983). The idea of using a multiple-choice test was abandoned because we were interested in participants’ recall of the news information rather than their recognition.

The memory test contained only questions about information that was present in the television narrative, and thus in the printed texts, of both the children’s and adult news stories. The test did not, therefore, include questions on visual information that was not conveyed verbally. For each of the five news topics, questions were generated about each of the components that most news stories are composed of: event, place, principal(s), cause, and consequence (Findahl & Höijer, 1985). In addition, questions about story details were generated. A number of questions were rephrased on the basis of insights gained from pilot studies conducted with 87 children from Grades 5 and 6 and 68 university students who did not take part in the actual experiment. Cronbach’s alpha (K-R 20) for the final test was .89 for the total sample, .88 for the children, and .75 for the adult participants. Examples of questions are, “One of the news stories was about Queen Beatrix opening a new
railway tunnel. What is the name of the new tunnel?” “When did they start building the new tunnel?”

To enable an analysis of the contribution of redundant pictorial information to story recall, two independent judges classified the questions in the memory test into two types: (a) questions about information that was conveyed only verbally, in print or in the television narrative (“verbal only” information), and (b) questions about verbal information that either partly or completely, was supported with redundant pictures on television (“visual” information). Examples of questions that referred to information that was conveyed only verbally are the previously mentioned questions about the opening of the new railway tunnel. An example of a question about information that was also presented visually on television is, “One of the news stories was about forest fires. Where exactly did they take place?” The answer, “South East Australia,” had been presented verbally as well as with redundant television pictures (a map of Australia that highlighted the disaster area).

The classification of questions was carried out separately for the children’s news stories and the adult news stories. Interrater agreement, as measured by Cohen’s kappa, was .92 for the children’s stories and .96 for the adult stories. Our experiment was based on the assumption that the children’s news stories would contain more redundant audiovisual information than the adult stories. The content analysis indeed showed that the correspondence between the verbal and visual content of the television stories was considerably stronger in the children’s news stories than in the adult news stories. For the adult stories, only 5 questions (9%) were categorized as visual, whereas 52 questions (91%) were categorized as verbal only. For the children’s news stories, 20 questions (35%) were categorized as visual, whereas 37 questions (65%) were categorized as verbal only. Although the amount of redundant audiovisual information was greatest in the children’s news stories, the correspondence between verbal and visual content was far from complete. However, audiovisual redundancy cannot possibly be complete because news stories usually contain a number of abstract ideas that cannot be illustrated with pictures.

Results

Initial data checks showed that the distribution of recall scores satisfied the assumptions underlying analysis of variance. There were no statistically significant differences in recall scores between children who participated in the first test sessions and children who participated in the second sessions. Because the participants included in each block of four had been matched on
reading proficiency or on their score on the vocabulary test, in the analysis of variance, the factors medium and type of news program were treated as within-subjects, or rather, within-blocks factors (Kirk, 1968; Tabachnick & Fidell, 1989). All effects were assessed at the .05 level.

**Main Analysis**

A 2 (adults vs. children) × 2 (television vs. print) × 2 (children’s vs. adult news) analysis of variance was performed on the total scores on the memory test, with medium and type of news program as within-subjects factors, and age group as between-subjects factor. Table 2 presents the mean proportions of correct answers for viewers and readers as a function of age group and type of news program. Three main effects were found. First, adults (M = .64, SD = .11) remembered significantly more of the news than children (M = .45, SD = .16), $F(1, 46) = 56.25$, $MSE = 0.031$, $p < .001$. The proportion of variance accounted for was $\omega^2 = .54$, using $\omega^2 = \frac{(SS_{\text{effect}} - (a-1)(MS_{\text{error}}))}{(SS_{\text{total}} + MS_{\text{error}})}$ (Keppel, 1982; Kirk, 1968). Second, the children’s news stories (M = .59, SD = .17) were recalled better than the adult stories (M = .50, SD = .16), $F(1, 46) = 37.06$, $MSE = 0.009$, $p < .001$, $\omega^2 = .43$. Third, there was a statistically significant main effect for medium: Viewers (M = .56, SD = .16) exhibited higher recall than readers (M = .52, SD = .17), $F(1, 46) = 6.05$, $MSE = 0.011$, $p < .019$, $\omega^2 = .09$. However, no simple overall interpretation can be given to the significant main effect found for medium, because there was a statistically significant interaction between medium and type of news program, $F(1, 46) = 16.44$, $MSE = 0.011$, $p < .001$, $\omega^2 = .24$. In accordance with the semantic overlap explanation, the recall advantage of television compared with print news only pertained to the children’s news stories and did not extend to the adult news (see Table 2).

To determine whether the results presented in Table 2 fitted the complete pattern of outcomes predicted by the semantic overlap explanation, four paired t tests were performed, using an alpha level of .013 based on a Bonferroni correction (Pedhazur & Pedhazur Schmelkin, 1991). These follow-up tests showed that the outcomes of all four television-print comparisons were consistent with the semantic overlap explanation. As predicted by Hypothesis 1, children remembered significantly more of the children’s television news stories than of the print versions of the same stories, $t(23) = 3.09$, $p < .006$. On the other hand, as predicted by Hypothesis 2, adults remembered significantly more of the printed versions of the adult news stories than of the adult television stories, $t(23) = 2.69$, $p < .013$. As predicted by Hypothesis 5, adults who had watched the children’s news stories on television exhibited significantly better recall than the readers of the print versions, $t(23) =$
Table 2

Mean Recall Scores for Television and Print as a Function of Age Group and Type of News Program

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Type of News Program</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Children’s News TV</td>
<td>.55 (.16)</td>
<td>.43 (.16)</td>
<td>.41 (.14)</td>
<td>.40 (.14)</td>
</tr>
<tr>
<td></td>
<td>Children’s News Print</td>
<td>.43 (.16)</td>
<td>.65 (.10)</td>
<td>.56 (.10)</td>
<td>.63 (.10)</td>
</tr>
<tr>
<td></td>
<td>Adults TV</td>
<td>.72 (.07)</td>
<td>.65 (.10)</td>
<td>.56 (.10)</td>
<td>.63 (.10)</td>
</tr>
<tr>
<td></td>
<td>Adults Print</td>
<td>.54 (.17)</td>
<td>.54 (.17)</td>
<td>.49 (.14)</td>
<td>.52 (.17)</td>
</tr>
</tbody>
</table>

Note. Scores represent mean proportions of correct answers (with standard deviations in parentheses).

2.97, p < .008. Finally, in accordance with Hypothesis 6, no statistically significant difference in recall was found between children who had watched the adult news stories and those who had read the print versions, t(23) = .54, p > .59.

In addition to the interaction between medium and type of news program, there was a statistically significant interaction effect between medium and age group, F(1, 46) = 4.79, MSE = 0.011, p < .035, \( \omega^2 = .09 \), indicating that adults remembered television news (\( M = .64, SD = .11 \)) just as well as print news (\( M = .64, SD = .10 \)), whereas children remembered television news (\( M = .48, SD = .17 \)) better than print news (\( M = .41, SD = .15 \)). However, as can be seen in Table 2, this interaction effect is inconsequential. The observation that children remembered television news better than print news applied only to news in a children’s format, and the finding that adults remembered as much from television as from print resulted from the fact that the recall advantage of television observed for the children’s news was offset by the recall advantage of print observed for the adult news. None of the other interaction effects were statistically significant, all ps > .68.

Contribution of Redundant Visual Information

As discussed above, both children and adults remembered more from television than from print when the news was presented in a children’s news format. To establish whether the redundant visual information in the children’s television news stories was responsible for the relative effectiveness of television, two additional analyses of variance were conducted, one for children and one for adults, with medium as a within-subjects factor and recall of verbal-only and visual information provided by the children’s news as an additional within-subjects factor. Figure 1 depicts the interactions between medium and type of information found for children and adults.
For children, a statistically significant interaction between medium and information type was found, $F(1, 23) = 6.83, \text{MSE} = 0.007, p < .017, \omega^2 = .20$. As shown in the left part of Figure 1, children's superior recall of the children's television stories compared with print news was especially pronounced when the verbal news information had also been depicted visually on television. Follow-up tests showed that on questions about information that was conveyed both verbally and visually in the television items, viewers ($M = .64, SD = .18$) performed considerably better than readers ($M = .46, SD = .19$), $t(23) = 3.55, p < .003$. On questions about information that was conveyed only verbally, viewers ($M = .50, SD = .16$) also performed better than readers, although to a lesser extent, ($M = .41, SD = .15$), $t(23) = 2.44, p < .024$. The latter $p$ value was still significant when a Bonferroni correction was applied, leading to a corrected alpha level of .025.

A statistically significant interaction between medium and information type was found for adults as well, $F(1, 23) = 6.98, \text{MSE} = 0.004, p < .016, \omega^2 = .19$ (see the right section of Figure 1). Follow-up tests showed that adults' superior recall of the children's television stories was largely due to their superior recall of redundant audiovisual information. On questions about information that was conveyed both verbally and visually on television,
viewers ($M = .83, SD = .10$) scored significantly higher than readers ($M = .71, SD = .13$), $t(23) = 4.39, p < .001$. When information was conveyed only verbally, viewers ($M = .66, SD = .08$) performed slightly but not statistically better than readers ($M = .61, SD = .10$), $t(23) = 1.68, p > .10$.

To establish whether the scarce redundant pictorial information elements in the adult television stories contributed to children’s and adults’ news recall, two analyses of variance were conducted, one for children and one for adults, with medium as a within-subjects factor and recall of verbal-only and visual information provided by the adult news as an additional within-subjects factor. Figure 2 depicts the interactions between medium and type of information found for children and adults.

For children, a statistically significant interaction was found between medium and information type, $F(1, 23) = 11.32, MSE = 0.018, p < .004, \omega^2 = .29$. As shown in the left part of Figure 2, a recall advantage of television occurred for redundant audiovisual information. Follow-up tests showed that when information elements were conveyed both verbally and visually in the adult television items, viewers ($M = .60, SD = .21$) remembered considerably more than readers ($M = .42, SD = .22$), $t(23) = 3.05, p < .007$. However, when information elements were conveyed only verbally, no recall difference was
found between viewers \((M = .40, SD = .15)\) and readers \((M = .40, SD = .14)\), \(t(23) = .03, p > .95\).

For adults, a somewhat different statistically significant interaction between medium and information type emerged, \(F(1, 23) = 5.54, MSE = 0.019, p < .028, \omega^2 = .16\) (see the right section of Figure 2). Follow-up tests showed that on questions about information that was conveyed both verbally and visually in the adult television items, viewers \((M = .82, SD = .17)\) performed slightly but not statistically better than readers \((M = .76, SD = .18)\), \(t(23) = 1.16, p > .25\). However, on questions about information that was conveyed only verbally, readers \((M = .62, SD = .11)\) performed better than viewers \((M = .54, SD = .11)\), \(t(23) = 2.95, p < .008\).

**Reading Proficiency and Vocabulary Level**

To examine whether children’s level of reading proficiency or adults’ vocabulary level affected the relative effectiveness of television and print news, separate analyses of variance were conducted for children and adults, with medium and type of news program as within-subjects factors and reading proficiency (children) or vocabulary level (adults) as the between-subjects factor. In both analyses, main effects were found for reading proficiency or vocabulary level, indicating that those children categorized as more proficient readers \((M = .52, SD = .13)\) remembered more than less proficient readers \((M = .38, SD = .15)\), \(F(1, 22) = 16.80, MSE = 0.028, p < .001, \omega^2 = .40\), and that adults with large vocabularies \((M = .66, SD = .10)\) remembered more than adults with small vocabularies \((M = .61, SD = .11)\), \(F(1, 22) = 5.02, MSE = 0.012, p < .036, \omega^2 = .14\). However, there were no statistically significant interactions between reading proficiency or vocabulary level and the factors medium and/or type of news program (all ps > .10), indicating that the pattern of outcomes presented in Table 2 was about the same for more and less proficient readers and for adults with large and small vocabularies.

**Discussion**

**The Semantic Overlap Explanation**

This study was designed to test two types of explanations for the opposite findings obtained with adults and children in previous television-print news comparisons. The results of our study were clearly in favor of the semantic overlap explanation, which argues that the relative effectiveness of television and print as vehicles for conveying news information is determined to a large extent by the amount of semantic overlap between the verbal and visual

151
content of the television news employed in the media comparison. The observed pattern of results of our four television-print comparisons conformed fully with the hypotheses we had formulated on the basis of the semantic overlap explanation.

The semantic overlap explanation was supported most strongly by the findings obtained with adults. On one hand, adults learned most from print when print news was compared with adult television news that was characterized by a small amount of semantic overlap between pictures and text. On the other hand, adults learned most from television when print was compared with children's television news stories that were marked by a relatively close relationship between pictures and text. Analyses of which types of information elements (verbal-only vs. visualized) were best remembered by adult viewers and readers lent further support to the idea that the correspondence between the verbal and visual content of television news stories determines the relative effectiveness of television and print. Adults' superior recall of children's television news stories was most pronounced for those verbal information elements that were supplemented with redundant pictures. Moreover, the finding that adults exposed to adult news stories profited most from print applied only to those information elements that were conveyed verbally. The scarce information elements that were adequately visualized in the adult television news stories were remembered slightly, though not statistically better by viewers than by readers.

The television-print recall differences observed in children also clearly supported the semantic overlap explanation. As was found for adults, children learned most from television when pictures and commentary were closely related (the children's news). However, the superiority of television was no longer observable when children watched adult television news stories in which the semantic overlap between pictures and commentary was decidedly restricted. Again, analyses of the contribution of verbal-only versus visualized information elements to the recall of viewers and readers lent further support to the semantic overlap explanation. As was found for adults, children's superior recall of children's television news stories was most pronounced for those verbal information elements that were supplemented with redundant pictures. Although no overall differences between children's recall of adult television and print news stories were found, a recall advantage of television did occur when information elements were presented both verbally and visually.

The children's and adult television news items that were used in the present study not only differed in their use of redundant audiovisual information but also in difficulty level. Due to the specific nature of the two types of news programs, the news items showed different levels of complexity,
comprehensibility, usage of concrete versus abstract language, and so on. In theory, the simultaneous variation of difficulty level and high- and low-redundancy formats could hinder our interpretation of the observed pattern of results because difficulty level may provide an alternative explanation for the semantic overlap hypothesis. However, the observed differences in difficulty level manifested themselves not only in the television versions of the two news programs but also in the literal transcripts of the narratives that were used as print versions. Therefore, if the lower difficulty level of the children’s items accounted for the observed superior recall of the children’s television news items, one would also expect the children’s print stories to be recalled better than their adult counterparts. As can be seen in Table 2, however, this was not the case. No significant recall differences were found between the print versions of the children’s and adult news items. We therefore maintain that the results of the present study are best explained by the relatively large amount of redundant audiovisual information available in the children’s television items.

The findings mentioned above do not only argue in favor of the semantic overlap explanation, they simultaneously support the two underlying information-processing theories. The observed recall advantage of redundant audiovisual information lent confirmation to the dual-coding hypothesis, which posits that recall is enhanced by the extra mnemonic support offered by redundant audiovisual information. Limited–attentional capacity theories were supported by the finding that adults exposed to adult news stories remembered most from print only when verbal information elements were supplemented with nonrelated television pictures. The latter finding suggests that the large quantity of nonredundant pictures found in adult television news stories may indeed have diverted the viewers’ attention away from the verbal message. In a review of 24 studies, Lang (1995) applied a limited–attentional capacity approach to studies of the influence of audiovisual redundancy on memory for television messages. Although this review showed that attentional capacity depends not only on audiovisual redundancy but also on such factors as structural complexity of the message (e.g., still pictures vs. moving pictures) and familiarity with the information presented, the results of the present study are consistent with the capacity model proposed by Lang. According to this model, cued recall (which is assumed to tap the storage of information) is better for multiple-channel redundant messages than for single-channel messages, whereas conflicting multiple-channel messages are assumed to result in lower cued recall than single-channel and multiple-channel redundant messages.

It should be noted, however, that dual-coding and limited–attentional capacity theories cannot entirely account for the superiority of television
found with children’s news stories. Although the recall advantage of children’s television news was most pronounced for verbal information supplemented with redundant pictures, information that was conveyed only verbally was also, although to a lesser extent, remembered better via television. In previous television-print comparisons of children’s memory for children’s news stories, Walma van der Molen and van der Voort (1998, in press) also found that verbal-only television information was remembered somewhat better than the same information presented in print, a finding that the authors ascribed to a “radiation effect.” They argued that because the viewers of the children’s news were better acquainted with those parts of the news story in which the verbal message was supported by redundant pictures, this redundant information could have produced a stronger foundation for the rest of the knowledge to be supported on.

The Reading Proficiency Explanation

The results of the present study did not support the reading proficiency explanation. The pattern of results of the four television-print comparisons was incompatible with the outcomes anticipated on the basis of the reading proficiency hypothesis. Moreover, neither children’s level of reading proficiency nor adults’ vocabulary level was found to interact with the relative effectiveness of television and print. Although irrespective of the medium employed, both children and adults with more proficient reading skills remembered the news better than those with less proficient reading skills, the relative effectiveness of television and print proved to be about the same for more and less proficient readers in each of the four media comparisons.

In previous television-print news studies, Walma van der Molen and van der Voort (1997, 1998, in press) also failed to find a statistically significant interaction between medium and children’s level of reading proficiency, a finding that was not anticipated. The authors attributed their failure to find an influence of reading ability to the high level of comprehensibility of the children’s news. They suspected that an influence of reading proficiency is more likely to occur when children are presented with news stories that are less easy to understand. However, the latter presumption was not corroborated by our findings obtained with adult news stories, which children found more difficult to understand. Even for adult news stories, the relative effectiveness of television and print was not affected by children’s level of reading proficiency.

The absence of an interaction between reading ability and medium may also have been the result of the nonrepresentative composition of our samples of children and adults. Following the selection procedures employed in
previous television-print news studies, our sample of children did not include a subgroup of the very poorest readers, whereas our sample of adults was restricted to well-educated university students. It is reasonable to assume that precisely those children and adults with the poorest level of reading ability will profit most from news presented via television. Note, however, that on this assumption, inclusion of the poorer readers in the experiment would have led to an even stronger recall advantage of children’s television news stories.

Limitations of the Study

Apart from the use of samples from which the poorest readers were excluded, three other limitations that might restrict the generalizability of the study’s findings deserve attention at this point. One limitation is that the study only examined the recall of short news stories that take no longer than about 2 minutes, because this type of news story is common in standard television newscasts. Further research is needed to establish the relative effectiveness of television and print for conveying news stories of longer duration (e.g., a documentary broadcast vs. a full-page newspaper article).

A second possible restriction is that the present study was confined to news stories that were derived from the Dutch Children’s News and the Dutch 8 o’clock News. The poor correspondence between pictures and commentary found in the Dutch adult news is a phenomenon that seems to be typical of newscasts broadcast in most countries in the Western world. The use of standard news pictures and a concomitant low level of audiovisual redundancy has been observed in adult news programs produced in many countries, including the United States (Robinson & Levy, 1986), the United Kingdom (Gunter, 1987), and Germany (Brosius et al., 1996). However, there is more reason to doubt whether the Dutch Children’s News is truly representative of children’s news programs broadcast elsewhere. Our impression is that the producers of the Dutch children’s news tend to place more emphasis on audiovisual redundancy than producers of children’s news programs in other countries do. Whether this impression is correct needs to be established through systematic content analysis. No matter what such an analysis would reveal, it should be noted that our findings concerning the effectiveness of children’s television news may be generalized only to children’s news programs characterized by a relatively high degree of audiovisual redundancy.

Perhaps the most important limitation of our study is that the participants were given the opportunity to read and watch the news under relatively quiet experimental conditions. In the home situation, both viewers and readers usually acquaint themselves with the news under less optimal
conditions. Whereas readers are able to shut out the outside world by withdrawing themselves behind the newspaper, viewers of television newscasts are more likely to be distracted by other ongoing activities in the living room. An observational study of British families watching television in their homes (Gunter, Furnham, & Lineton, 1995) confirmed that both children's and adults' attention may well be divided when watching television newscasts. It is quite possible, therefore, that under normal home viewing conditions, the recall advantage of children's television news observed in our experiment will be less favorable to television.

Conclusion

The findings from the present study cast doubt on the conclusion drawn from previous television-print comparisons with adults that print is a more effective medium for conveying news information than television. The observed superiority of print news seems to apply only to the specific stimulus materials that were employed in the experiments conducted with adults, that is, adult television news programs characterized by a relatively low degree of semantic overlap between verbal and pictorial information. The present study suggests that if television stories contain a greater amount of redundant audiovisual information, television can be more effective than the same news presented in print. The importance of a high level of audiovisual redundancy has also been demonstrated in a number of intramedia comparison studies conducted with adults, which compared adult television news stories marked by a low level of audiovisual redundancy with comparable television stories presented in a high-redundancy format (e.g., Drew & Grimes, 1987; Graber, 1990; Reese, 1984; Son, Reese, & Davie, 1987). These intramedia comparisons showed that high audiovisual redundancy was associated with greater news recall, whereas low audiovisual redundancy was found to impair learning. Curiously enough, however, the findings from these intramedia comparisons have not been taken into account in the interpretation of the outcomes of intermedia comparisons of television and print news conducted with adults. A final test of the semantic overlap hypothesis would be to combine the designs of previous intermedia and intramedia comparison experiments conducted with adults, that is, to vary high- and low-redundancy formats in adult television news and to compare adults' memory for these versions with their memory for the same news presented in print.

On one hand, the relatively large amount of knowledge that children seem to gain from children's television news is "good news" for children, because they rely primarily on the medium that can serve them most effectively. On
the other hand, the relatively small amount of knowledge that adults acquire from adult television news is "bad news" for adults. The results of the present study indicated that adults learned less from the adult television news stories than from the children's television news stories, and even the print versions of the adult stories were less effective than the children's television stories. On the basis of these results, it would, however, be incorrect to conclude that television news can replace printed news simply by becoming more redundant. Newspapers usually present more thorough accounts of news events than television news programs do and they may confront consumers with more abstract issues and ideas. Moreover, unlike many television news programs, newspapers usually do not restrict themselves to news that is easily supplemented with appealing pictures. However, the results of the present study do show that the benefit adults derive from the adult television news would be greatly improved if the producers of news programs were willing to take an example from the Dutch children's news, that is, to take care that the pictures selected correspond as closely as possible to the verbal commentary.

Notes

1. An earlier version of this article was presented at the 49th annual meeting of the International Communication Association, San Francisco, May 1999. The authors thank the Dutch Organization for Scientific Research and the Royal Netherlands Academy of Arts and Sciences for providing support for this study. Correspondence concerning this article should be addressed to Juliette H. Walma van der Molen, Amsterdam School of Communication Research, University of Amsterdam, Oude Hoogstraat 24, 1012 CE Amsterdam, the Netherlands; e-mail: walmavandermolen@pscw.uva.nl.

2. Although other, algebraically equivalent formulas for estimating omega squared are available, the one used here requires less computational effort when used for more complex experimental designs (Keppel, 1982).

References


Walma van der Molen, van der Voort / TV and Print News


