

Radio vs. Television: Their Cognitive Impact on Children of Different Socioeconomic and Ethnic Groups

by Patricia Greenfield and Jessica Beagles-Roos

For a sample of first- through fourth-grade children, bearing an audiotaped version of a story stimulated more imaginative responses (especially among working-class children) than watching an animated version, which for its part led to superior recall of story information.

In 1965 Marshall McLuhan proclaimed in *Understanding Media* (30) that "the medium is the message." Ten years later Olson and Bruner (36) addressed the cognitive aspect of McLuhan's thesis, asserting that each medium is associated with a unique pattern of skills for dealing with or thinking about the world. Salomon (43) demonstrated the connection between symbolic forms associated with the technology of a particular medium and the cultivation of particular mental skills. This line of argument implies that different content presented in the same medium will have some effects in common. It also implies that the

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effects of two media will differ from one another even when they are transmitting the same content.

Yet twenty years after *Understanding Media*, the empirical study of comparative media effects is mired in controversy, due to inadequately controlled studies and failure to specify the precise relationship between specific presentation attributes and specific cognitive effects (6). The work of Meringoff and colleagues (32, 33, 34) is an important exception to these problems, and our research follows in this tradition.

From both the experimental and historical points of view, the comparison of television and radio has particular interest. Because television is an audiovisual medium and radio is purely auditory, a controlled comparison of the effects of the two media provides information about the specific impact of the dynamic visual imagery of television. (Note that, although we have labeled the auditory medium "radio" and the audiovisual medium "television," we could have labeled them "audio" and "video"; indeed, our results should apply to a comparison of any audiovisual medium with dynamic visual imagery and any purely auditory medium.) Comparison of the two media's effects also provides hypotheses about possible effects of television's supplantation of radio as the dominant entertainment medium in the home.

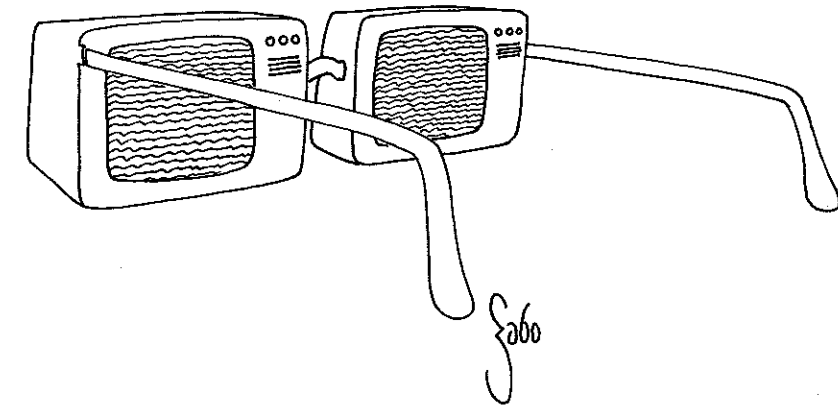
Although television and radio are mass (and almost universal) media, no study has compared their impact in different social class and ethnic groups. Various groups are known to differ in their television-viewing habits and attitudes. Black people have more positive attitudes toward and watch more television than white people; working-class people have more favorable attitudes toward and watch more television than middle-class people (9, 12). These are the groups that we chose for our subgroup comparisons.

More specifically, we wanted to look at the psychological "message" of radio and television in two cognitive areas: imagination and transmission of information. By using two different programs as stimuli we were able to look at both sides of McLuhan's thesis: that different media have different effects despite equivalent content, and that a medium's effect will be in some ways consistent even when its content varies.

In addition, our choice of stories—one based on an African folktale and involving black characters (in the TV version), the other written in the form of an Italian folktale and involving white characters (in the TV version)—enabled us to examine the effects of ethnically related content on how information is processed. In line with the findings of Newcomb and Collins (35), we wondered whether a possible tendency to identify with ethnically similar characters would enhance memory and perhaps even imagination.

Another possible effect of story content involves memory. *A Story, a Story* (23), based on an oral tradition, consisted of three repetitions of one story pattern. If, as is thought, this oral device works to enhance memory, then *A Story, a Story* would be remembered better than *Strega Nona* (10) in both radio and TV or simply in the radio (oral) version.

Finally, our inclusion of children in two age groups enabled us to study the developmental aspect of McLuhan's formulation.



Our first question was whether radio would be more stimulating than television to the imagination across social class and ethnic lines. Imagination can be roughly defined as mental representations, either verbal or visual, that go beyond the characteristics of the immediately preceding stimulus situation. Within the context of this general definition, our earlier research and that of others had indicated that radio might be more stimulating to the imagination in predominantly middle-class white populations (3, 19, 31, 33). This effect may be attributable to the fact that radio, lacking visual imagery, leaves more to the imagination: it allows the listener to construct his or her own mental images, which can then be expressed verbally or visually. However, results have not been entirely clear-cut. Runco and Pezdek (42) did not find a difference between television and radio in stimulating children's "creativity" (operationalized in a way that falls within our general definition of imagination). However, their task elicited few creative responses in either medium; this problem did not exist for our task in a similar middle-class population (19).

Differences in media habits identified in earlier research led us to believe that there might be differences between ethnic or social class groups as well. If it is true, as demonstrated in our study of white middle-class children (19), that TV actually depresses the imagination, then heavier viewing groups—working-class and black children—might exhibit less imagination overall and might possibly respond less to the stimulation of radio.

Our second question was whether television would transmit more information than radio and whether this would occur across social class and ethnic lines. The visual imagery of television might reinforce and expand the memory trace left by auditory input. Indeed, children rely heavily on visualized actions and less on auditory content when recalling narratives or drawing inferences (4, 14, 32). Preschoolers in one study made fewer errors in recalling a television story than a radio story, although there was no difference

for adults (24). A number of studies (3, 5, 39, 41) have found that older children had better memory for material presented in audiovisual form than in audio form alone. All of these studies used either middle-class white or ethnically heterogeneous groups. However, the same superiority of television has also been found for poor black fifth graders (28).

A number of studies of news recall by children, adolescents, and adults reveal greater overall recall when the material is presented in a television format than when it is in a radio format (2, 20, 21, 45, 48, 49). Although differences in recall according to medium are not always found (26, 47), any differences consistently favor television over radio.

The results in favor of television seem to depend upon the two channels of communication presenting mutually reinforcing and complementary information. Whenever most or all of the information to be retained can be found in the audio mode only, the advantage of an audiovisual presentation either disappears (22, 40) or becomes a disadvantage (3, 15, 50; but cf. 52). For example, children and adults exposed to a radio and a TV story with identical soundtracks showed better recall of figurative and expressive language (3, 24), dialogue (24), and sound effects (24) following the radio version. In the domains of figurative language and dialogue, the visual images do not provide reinforcing information and apparently distract the child from the purely auditory information. Moving images are even more distracting than still ones in this respect (32). The general conclusion is that dynamic visual imagery enhances overall verbal recall to the extent that the information being recalled is, in fact, given a visual representation in the television version (see also 13).

When material is not presented directly but must be inferred, the distinctive informational qualities of each medium have even sharper effects on cognitive processes. Thus, television's ease in presenting action is reflected in the finding that reliance on action to justify inferences made about a story is greater for television than radio (3, 17). Not surprisingly, television is also superior to still pictures in stimulating the production of action-based inferences (32). Radio's exclusively auditory nature results in greater reliance on verbal material to justify inferences following a radio story than following a television story with an identical soundtrack (4). The absence of moving visual images in radio and picture books also leads to more use of outside material (such as personal experience) to justify inferences than does television (4, 32).

Another purpose was to find out if these specific effects of television and radio on types of inference would hold in various ethnic and social-class groups. In addition, we hypothesized that heavier viewing groups (black and working-class children), having had more experience with the medium, would derive more information from it and therefore perform better on memory tasks. Unlike other studies, our research could investigate the effects of story structure and culturally relevant content and assess the interaction between content and medium with respect to both imagination and memory. Because our multigroup design yielded a much larger-scale study than oth-

ers, we were also able to detect more subtle media effects than were revealed in previous studies.

Stories were selected as the genre to be presented. They are a familiar, entertaining, and effective means of exposing children to information (32). The fictional aspect of stories also made them suitable for the investigation of imaginal processes.

In order to maximize the potential generalizability of the results, we selected two dissimilar stories, each adapted from a children's storybook. Each story was made into both a fully animated film in $\frac{3}{4}$ " videocassette for viewing on a television monitor and an audiocassette for listening to a tape recorder. The selected materials were supplied by Weston Woods Studios. *A Story, a Story* (23) is an African folktale about the origin of stories, and *Strega Nona* (10) is a sorcerer's apprentice-style tale of a young man's misadventures with a witch's magic pasta pot. Conversation with 29 children in the pilot study revealed that none of them was familiar with either story.

To ensure that narration and length of the audiovisual (television) and audio (radio) formats were comparable, we developed identical soundtracks of the storybook text for both the TV and radio versions of each story. In addition, the two stories were of similar length. The incomplete versions used to study imagination had running times of 6 minutes, 59 seconds for *Strega Nona* and 7 minutes, 52 seconds for *A Story, a Story*. The complete versions used in the memory study had running times of 7 minutes, 40 seconds and 8 minutes, 30 seconds, respectively.

Our first experiment compared the ability of radio and television to stimulate imagination. A total sample of 192 children from Los Angeles County contained three equal subsamples of middle- and working-class children, black and white children, and younger (first and second grade) and older (third and fourth grade) children. Children for whom English was not a first language and those identified as learning-disabled were eliminated. Schools were selected to draw students from homogeneous areas in terms of social class and ethnicity.

All children were exposed to both stories. Half of the children of a particular age, class, and ethnic group saw and heard an animated television version of *Strega Nona* (with white characters) and heard an audio version of *A Story, a Story*; the other half were exposed to an animated television version of *A Story, a Story* (with black characters) and an audio version of *Strega Nona*. Within each of the two treatment conditions, half of the subjects were exposed first to television and half first to radio, yielding four conditions with six children per cell. Within a group of a particular age, class, and ethnicity, equal numbers of boys and girls were randomly assigned to each of the four treatment conditions (although we did not plan to use sex as an independent variable in the data analysis).

Each child was individually tested by a female experimenter of his or her own ethnic group in an available room in the school. The child was seated

next to the experimenter at a table. Each session began with a brief informal conversation to help the child feel at ease and to make certain that he or she understood that the experiment had nothing to do with formal grades or testing.

The story was introduced as follows: "We are going to look/listen to a story. It is called *Strega Nona/A Story, a Story*. After we have heard/seen this story, we are going to talk about it." Then the story (stopped just prior to its end) was presented once to each child, who was asked to complete it.

In the audiovisual presentation condition, the story was presented on a television monitor located in front of the child at eye level. In the audio presentation condition, an audiocassette was played on a combination radio/cassette recorder that stood in front of the child. The audio presentation therefore simulated radio, just as the video presentation simulated television.

Immediately after the video or audio presentation, the experimenter asked the child: "Now, I would like you to tell me a story about what *you* think is going to happen next." If the child did not respond, the experimenter used a series of systematic prompts, all of which were restatements of the original question, for example, "What do you think is going to happen now? Can you tell me?"

Each child's response was tape recorded and later transcribed. The two testing sessions took place about a week apart.

The production of novel elements, whether characters, settings, feelings, or dialogue, constituted our basic definition of imagination. Our coding unit was the simple proposition, termed an event. It could be either imagined (not found in the stimulus story) or not. An imagined event could contain imagined characters, settings (time or place), feelings, or dialogue. The presence of one of these subcategories in an imagined event was considered a mark of imaginative quality.

Characters were either "vague" (introduced with a pronoun or a general term such as "the man," "the child," etc.) or "specific" (introduced with a specific noun, including proper names, or a modifying adjective). Dialogue was either "direct" (whatever would be placed in quotation marks in a written transcript) or "indirect" (paraphrases of a character's speech).

Two quantitative variables, number of original words and number of repeated words, were also assessed. Repeated words directly echoed the general plot, events, or other parts of the story (words or images) to which the child had been exposed. The number of original words was computed by subtracting repeated words from the total words in the child's story (excluding endings such as "That's all"). The number of original words was not correlated either positively or negatively with the number of repeated words (19). With the exception of the repeated words measure, which is conceived as being inversely related to imagination, all other measures were viewed as facets of a single underlying variable of imagination. Test coding by the second author and another rater on a subset of twelve stories resulted in an interrater reliability of .90.

Table 1: Mean scores for story completion measures by medium, class, and ethnicity

Response measures	Medium		Class		Ethnicity	
	Radio	TV	Middle	Working	Black	White
Imaginative events	11.30	9.49**	6.63	14.15**	5.97	14.81***
Specific characters	0.87	0.61*	0.34	1.14****	0.42	1.06***
Vague characters	0.49	0.26**	0.34	0.41	0.13	0.62****
Direct dialogue	0.63	0.70	0.34	0.98	0.25	1.07**
Indirect dialogue	0.43	0.47	0.32	0.58	0.28	0.63*
Emotional feelings	0.63	0.61	0.40	0.84***	0.49	0.75*
Time settings	0.98	0.87	0.59	1.26***	0.38	1.47****
Location settings	1.16	1.04	0.82	1.39****	0.51	1.70****
Imaginative words	107.87	89.20***	64.76	132.31**	53.27	143.80***
Imaginative quality	4.61	4.13	2.83	5.91***	2.18	6.56****
Repetitive words	8.17	20.16***	10.14	18.19***	19.02	9.31*

* $p \leq .05$ ** $p \leq .025$ *** $p \leq .01$ **** $p \leq .001$.

(based on F values with $df = 1, 188$)

Each dependent variable described above was subjected to two multiple-regression analyses using each subject's average score as a covariate (38). This covariate procedure provides a way of building within-subjects comparisons into a regression analysis and is therefore analogous to a repeated-measures analysis of variance.¹

Between- and within-subject variables were analyzed separately in order to obtain the correct error terms to compute F values. The variables and their interactions were entered in the equations in a fixed order. The between-subject variables were age (first and second grade vs. third and fourth grade), order of media (radio first vs. television first), class (working vs. middle), and ethnicity (black vs. white). The within-subject variables were medium (radio vs. television), story (*Strega Nona* vs. *A Story, a Story*), and interview (first session vs. second session).

Because large numbers of dependent variables were analyzed, in presenting results we focus on patterns of effects, not single effects. The mean scores for all dependent measures are displayed by medium, class, and ethnicity in Table 1. (Because age did not have a main effect on any variable, it is omitted from the table.)

Did radio stimulate the imagination more than television? As seen in Table 1, radio led to significantly greater creation of new story material for the measures of imaginative events, specific characters, vague characters, and imagi-

¹ This measure was used instead of an analysis of variance (or a multivariate analysis of variance based on an analysis of variance model) because of the need for an experimental design in which, for any individual subject, a given story was presented in only one medium. An analysis of variance model would have required omitting one independent variable (such as story or interview) from the analysis, and interactions involving the omitted variable could not have been assessed. Thus, our multiple-regression analysis provides a way of assessing the effects of all independent variables and their interactions in the context of an incomplete design.

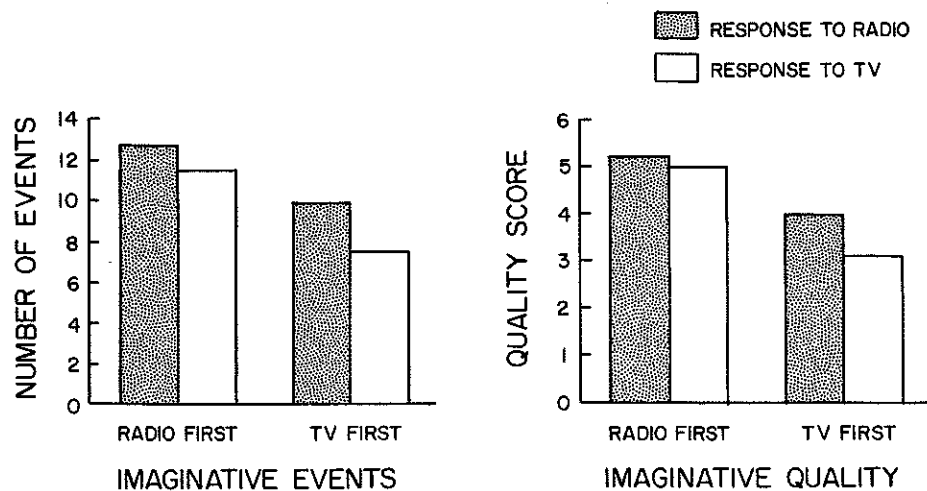


Figure 1: Performance on imagination measures under different conditions of medium and order

native words. Second, in comparison with radio, television stimulated significantly greater production of words repeating the stimulus story, which we consider to be the opposite of an imaginative response.

The impact of the medium encountered first seemed to carry over to the other medium in the second interview, significantly affecting both the number of imaginative events elicited and imaginative quality ($p < .01$). As shown in Figure 1, hearing the first story in a radio version stimulated a response to the television version of the other story in the second interview that was more imaginative (in terms of both number of events and quality) than the response to the radio presentation of the second story by those who saw a televised presentation of the first story. These interactions, consistent with the main effect of medium, suggest that radio enhances imaginative response and television depresses it.

But radio's enhancement of imagination was not completely consistent. Medium-by-ethnicity interactions occurred for the following aspects of story completion: imaginative events ($p < .025$), specific characters ($p < .01$), vague characters ($p < .01$), time settings ($p < .01$), total imaginative words ($p < .01$), and imaginative quality ($p < .01$). On these measures, radio induced significantly more original completions than television for white but not for black children, whose low level of imaginative response did not differ for the two media.

Class and ethnicity both had a major impact on imaginative response, while age had almost none. As shown in Table 1, working-class children produced significantly more imaginative responses than middle-class children on seven out of ten measures. They also produced longer stories (repetitive words plus

imaginative words). White children showed more imaginative responses than black children on every measure.

Significant interactions of class and ethnicity were obtained for the measures of imaginative quality, specific characters, time settings, and imaginative events ($p < .05$). For these measures, working-class white children were by far the most imaginative of all the groups.

There was not one main effect of age on any variable. Of the two interactions of age with other variables, only that between age and interview was interpretable: Older children were far less likely to repeat the original stimulus story in the second interview ($p < .025$). This finding suggests that, for older children, experience with the task made them more willing to be imaginative in the second session. There was only one main effect of story: *A Story, a Story* stimulated more imagined specific characters ($\bar{x} = .95$) than did *Strega Nona* ($\bar{x} = .53$, $p < .01$), clearly because *A Story, a Story* contained many more characters.

Three variables showed significant interactions between story and medium: imaginative events ($p < .025$), imaginative words ($p < .01$), and time settings ($p < .01$). In these cases, *Strega Nona* yielded medium differences (in favor of radio), whereas *A Story, a Story* did not. Thus, characteristics of the stimulus (story) as well as the individual (ethnicity and social class) influence imaginative response to different media. In accord with McLuhan's proposition, the medium has a definite effect on imaginal activity, but that effect is moderated by content and audience factors.

The second experiment compared the ability of radio and television to transmit information. The same materials and design used in our first experiment were employed here, with parallel groups of subjects. The only difference was that the stories were played all the way through rather than being stopped before the end.

Children were individually tested at their schools. As in the first study, white children were tested by white experimenters and black children by black experimenters, and all experimenters were female. For the first session, each child was given sufficient time to feel comfortable in the experimental surroundings. The two experimenters introduced themselves and briefly explained the equipment. One of these two provided the story's name and asked the child to listen carefully because the other adult (referred to by name) would later ask the child about the story. At this point, the other adult left the room and the story was presented. At the conclusion of the story, children indicating that they already knew the story were eliminated from the experiment. After the second adult returned to the room, children were asked to tell the newcomer as much of the story as they could. The child's retelling was recorded, as was the rest of the session. This retelling was the basis for the free recall measures, described below.

The adult who was not present for the story introduced the next task by saying, "Now, I am going to ask you some questions about the story. You probably won't be able to answer them all because they are very hard questions and

there are no right or wrong answers to them. I would like you to do the best you can and try to answer." The adult then asked 33 questions about the story. Of these, only six had one right answer (see 3, Appendix A, for the complete set of questions). The questions fell into four categories.

Finally, the adult who had been present for the story presented the picture sequencing task. She displayed a sample picture containing major story characters, who children were asked to name. The adult pointed to each figure in turn and named it if necessary. Then, each child was asked to arrange seven pictures in order to tell the story from beginning to end.

At the end of this task, the child was escorted back to the classroom. No indication was given that the child would return for a second session, and the child was asked to keep each session a secret so that the other children would also be surprised when they came. The second testing session, presenting the other story in the other medium, took place about a week later.

A wide variety of measures of free recall were developed. Measures paralleling those used in the first study were among those used. These included total number of words, number of specific and vague characters, amount of direct and indirect dialogue, and number of time and location settings. Literal expressions, synonyms, and phrases capturing the gist of the story were all scored, as were intrusions ("added statements"). Feeling states, scored in the imagination study, occurred too infrequently to constitute a valid variable. Repeated mention of a character, discrete time, or discrete location was counted only once; that is, the number of *different* times and locations was tallied. Interrater reliability was 87 percent.

In addition, two measures of free recall were taken from the work of Char and Meringoff (5). First, recall of each story was assessed, using Char's system for coding the twenty major propositions in *A Story, a Story* (5). A parallel system was then developed for assessing recall of the propositional content of *Strega Nona*. Second, following Meringoff (32), recall of action information was also coded.

For *cued recall* questions, as in "What happened after.," there might be no one right answer but rather a variety of good answers. Answers to 17 cued recall questions devised for each story were coded as appropriate or inappropriate, and the total number of appropriate answers became the cued recall score.

Three forced-choice questions related to *recognition of expressive or figurative language*, as in rhymes, alliteration, and repetition of words. The score on this variable was the number correct.

Three questions tapped *memory for audiovisual details*. These were presented both auditorily and visually in the television stories; they were available on the soundtrack alone in the radio stories. Number correct was the score on this variable as well.

Each child's sequential ordering of the seven pictures was compared to the correct order to yield a deviation score of *picture sequencing*. The deviation score was determined by a graphic method (25, p. 648) and reflects the num-

ber of inverted pairs and the magnitude of the discrepancy. Deviation scores were subtracted from 21, the maximum deviation score for 7 items, so that higher scores would reflect more correct sequencing.

We assessed inference as well as recall. Answers to *inference* questions did not lie within the story but had to be inferred. There were no right answers; scoring focused on the basis for the inference. Meringoff's work (32) and our preliminary results (3) indicated that reasons, rather than inferences themselves, varied according to medium of presentation. Therefore, we scored each inference response for its source of information, using seven categories. The *visual* content category applied to any action or character description, particularly facial expressions, visible on the screen and not conveyed verbally. The *audio* content category included non-illustrated narration of events and excluded dialogue.

The *audiovisual* content category applied to information presented both in the visual channel and soundtrack in the videotape version of the story. Because scorers were unaware of the medium condition (written transcripts of the audiotapes for each session were scored blind as to both medium and age), responses to radio presentations could be scored as visual and audiovisual even if no visual information had been available. We retained this distinction because content selected for animation may be qualitatively different from non-visual story content in terms of thematic importance and translatability to visual images. Furthermore, using these categories removed the ambiguity of scoring responses to the television story. When information is presented dually in the verbal and visual channels, it is impossible to assess whether the child derived the information from both channels jointly or either one alone. Our coding scheme allowed both a purely verbal comparison and an audiovisual comparison between media. This latter was, in fact, a test of the impact of dual coding (television) vs. auditory coding alone (radio). (Only a few visual responses were attributed to the radio story, and they were ignored in analyses.)

The justifications were also scored for the inclusion of *action* and *dialogue* both directly taken and inferred from the story.

The *story elaboration* category applied only to information that was directly related to but went beyond the explicit story content. It included inferences and elaborations of the story. The *outside of the story* category applied to information unrelated to the story. It included the child's personal opinion, the child's experiences, and general world knowledge.

Each justification response was tallied in every appropriate category. Interrater reliability was 80 percent, which is exceptionally satisfactory given the difficulty of working with this type of material.

The data analysis followed the same pattern as in the earlier experiment. Again, the presentation of effects will focus on significant differences and on patterns of effects rather than single variables. The mean scores for all 14 measures of recall and recognition memory are displayed by medium and age in Table 2.

Table 2: Mean scores for recall and recognition measures by medium and age

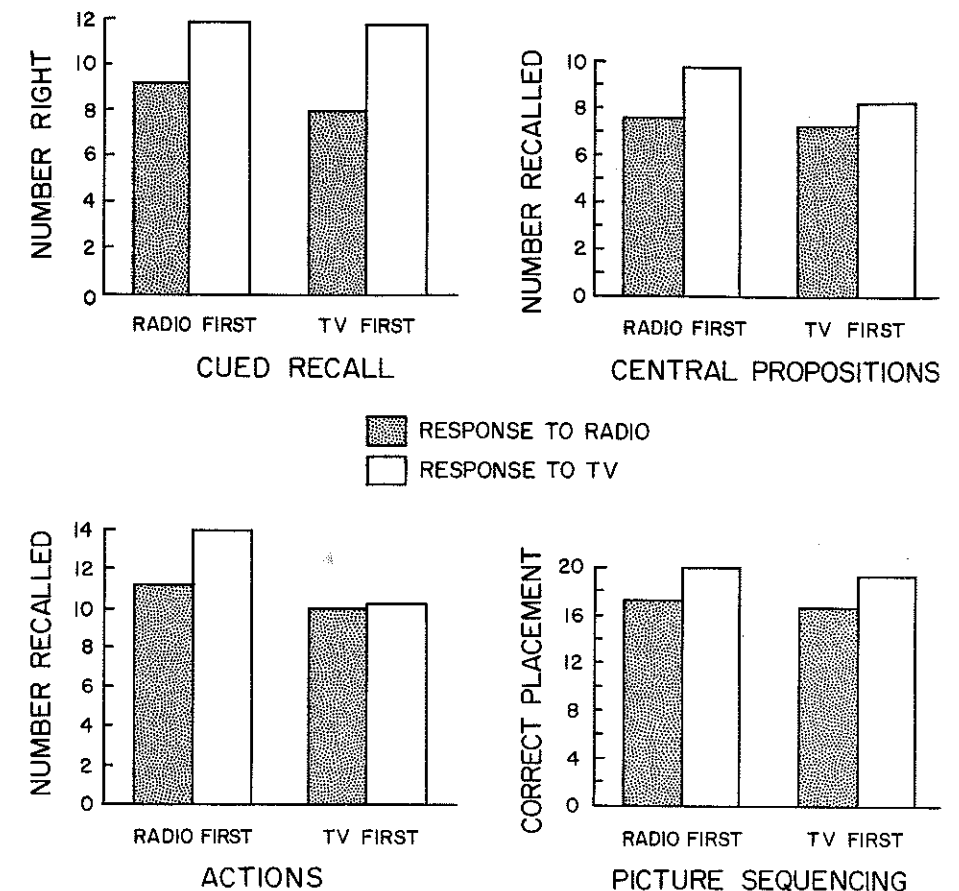
Response measures	Medium		Age	
	Radio	TV	Younger	Older
Free recall				
Central propositions	7.40	8.95****	5.66	10.69****
Total words	195.07	203.14	131.85	266.35****
Actions	10.57	12.09**	7.61	15.05****
Specific characters	2.15	2.00	1.55	2.54****
Vague characters	2.12	2.80****	2.19	2.73****
Direct dialogue	2.14	1.61*	1.09	2.65****
Indirect dialogue	2.31	2.38	1.54	3.15****
Location settings	2.87	2.91	2.10	3.67****
Time settings	0.41	0.52	0.26	0.67****
Added statements	5.66	5.69	4.05	7.31****
Cued recall	8.56	11.73****	8.71	11.59****
Picture sequencing	16.91	19.55****	17.43	18.96****
Expressive language	1.93	1.94	1.90	1.98
Audiovisual detail	1.28	1.80****	1.42	1.66****

* $p \leq .05$ ** $p \leq .025$ **** $p \leq .001$.
(based on F values with $df = 1, 188$)

In line with the hypothesis that visual images reinforce memory, television significantly enhanced overall retention of the story. Recall of central propositions, cued recall, and reconstruction of the story sequence with pictures was significantly better with television than radio (see Table 2). Note that although children in the radio condition never saw any visuals, their picture sorting performance was better than would be expected by chance.

As in the imagination study, the presentation order of the two media had a significant effect, in this case on both general indices of recall (central propositions and cued recall) and more specific indices of recall (actions, locations, picture sequencing). (Probability values ranged from .05 for cued recall and picture sequencing to .01 for central propositions, actions, and locations.) Children tend to perform better with radio when it is presented first and better with television when it is presented second. (See Figure 2 for four examples of these interactions.) The results are consistent with the hypothesis that a "low mental effort" set induced by television (44) is maintained for the subsequent radio presentation, while a "high mental effort" set induced by radio is maintained for the subsequent television presentation. The set created by a given medium thus can be as important for transmission of content as it is for imagination.

Several differences between media in transmitting content were consistent with their qualities (see Table 2). Television led to significantly better recall of story actions. Details presented audiovisually were remembered better from TV, where they were accompanied by a relevant visual image, than from radio, where they were presented only verbally. Television also led to more vague recall of characters than did radio. As predicted, radio, relative to television, significantly enhanced recall of direct dialogue. However, contrary to prediction, there was no difference between radio and TV for figurative or expressive

**Figure 2: Scores on memory measures under different conditions of medium and order**

language. Nor were there significant medium differences for number of total words, specific characters, indirect dialogue, locations, times, and added statements (see Table 2).

The pattern of group effects consisted primarily of age differences in the absence of class and ethnic differences. As expected, older children retained significantly more of the story, and this occurred for 13 of the 14 measures shown in Table 2.

Only a few significant class and ethnic differences were obtained (not shown in Table 2). Middle-class children ($\bar{x} = 10.73$) did better on cued recall than working-class children ($\bar{x} = 9.57$, $p < .05$), although the two groups did not differ on free recall of central propositions. Black children added the most ($\bar{x} = 7.77$) and white children the least new statements ($\bar{x} = 3.59$) when recalling the stories ($p < .001$). White children ($\bar{x} = 18.77$) were more accurate than black children at reconstructing the story sequence in pictures ($\bar{x} = 17.68$, $p < .05$).

.01). Contrary to the idea that ethnic relatedness of story content might enhance comprehension, black children were less successful at the cued recall of the African folktale ($\bar{x} = 8.52$) than of the Italian story ($\bar{x} = 10.56$, $p < .001$). There was no difference between the two stories for white children.

In summary, measures of explicit story memory showed the expected developmental change, but, more important, class and ethnic differences were the exception rather than the rule. This pattern contrasts with that found in the study of imagination, where class and ethnic differences were prevalent and age differences notably absent.

Main effects of story were relatively few. More specific characters were recalled from *A Story, a Story* ($\bar{x} = 2.54$) than from *Strega Nona* ($\bar{x} = 1.62$, $p < .001$), while more time settings were recalled from *Strega Nona* ($\bar{x} = .58$) than from *A Story, a Story* ($\bar{x} = .35$, $p < .001$). Whereas more direct dialogue was recalled from *A Story, a Story* ($\bar{x} = 2.36$) than from *Strega Nona* ($\bar{x} = 1.38$, $p < .001$), more indirect dialogue was recalled from *Strega Nona* ($\bar{x} = 3.09$) than from *A Story, a Story* ($\bar{x} = 1.60$, $p < .001$). For the free recall measures, differences between the stories were consistent with their varying content. Significant differences on recall of audiovisual detail were inconsistent and difficult to interpret.

How would the medium affect inference processes? Mean scores for all seven types of inference justifications are presented in Table 3 by medium, age, class, and ethnicity. Radio elicited significantly more inferences based on audio and "outside the story" information, which, like imaginative response, requires mental representation that goes beyond an immediate stimulus. Television, in contrast, elicited significantly more inferences based on story actions, confirming the potency of that medium for making action information salient. Television also stimulated significantly greater use of information presented both verbally and visually on TV, but only verbally via radio. Contrary to expectation, radio did not stimulate greater use of dialogue or story elaborations in justifying inferences.

The impact of the initial medium carried over to the other medium for just one source of inference, audio ($p < .01$). There were more audio-based inferences in response to the radio story when it was the first medium than when it followed TV, and there were more audio-based inferences in response to the TV story when it followed the radio story than when it was the first medium to be presented.

Only one of the medium effects was moderated by another variable: The advantage of radio for outside-story justifications was more pronounced for younger children than for older ones ($p < .05$).

In general, age, class, and ethnicity also affected the source of inference (see Table 3). First, older children supplied more justifications than younger children for five of the seven categories (audio, audiovisual, action, dialogue, and elaborated material). Second, white children used significantly more audio and audiovisual sources of inference than did black children, while black children used significantly more elaborations of story material in their explanations than

Table 3: Mean scores for types of inference sources by medium, age, class, and ethnicity

Source	Medium		Age		Class		Ethnicity	
	Radio	TV	Younger	Older	Middle	Working	Black	White
Audio	0.72	0.56**	0.52	0.77****	0.85	0.44****	0.40	0.88****
Visual		1.26	1.16	1.39	1.36	1.16	1.30	1.25
Audiovisual	2.00	2.30***	1.93	2.37****	2.32	1.98***	1.91	2.39****
Action	2.48	3.15****	2.49	3.13****	2.91	2.71	2.67	2.94
Dialogue	0.74	0.82	0.63	0.94***	0.82	0.74	0.71	0.86
Story elaborations	3.23	3.11	2.70	3.65****	2.93	3.41***	3.36	2.99**
Outside story	2.31	1.73****	2.14	1.90	1.95	2.10	2.16	1.88

* $p \leq .05$ ** $p \leq .025$ *** $p \leq .01$ **** $p \leq .001$.
(based on F values with $df = 1, 188$)

did white children. Third, middle-class children provided significantly more audio and audiovisual sources for inferences than did working-class children, while working-class children used significantly more elaborations in their justifications. Note that the influence of age, class, and ethnicity on children's inferential processing was most often independent of other variables, including medium.

Our results showed that, across different ages, social classes, and ethnic groups, cognitive responses to audio and audiovisual presentations differ for the same content, while there are common responses to each medium across different content. Overall, the results support McLuhan's (30) thesis that "the medium is the message."

Cross-media studies invariably require a trade-off. The need to experimentally isolate the variable of medium dictates using two presentations that are otherwise as similar as possible. Yet, as Dorr (11) has pointed out, the greater the similarity between two media presentations in content, the more likely it is that the typical characteristics of one or both media have been removed. To get a soundtrack that we could use both in the audio version of a story and in the audiovisual version, we had to use narration, which is not typical of the television medium. For this reason, any medium differences obtained may be underestimates of the true differences that are produced by ecologically typical exemplars of the two media.

Despite these caveats, the videotapes are ecologically valid in the sense that the Weston Woods tapes are widely distributed to libraries and schools and have also been played on television. The audio/radio presentations were also ecologically valid. *A Story, a Story* has, for example, been read on a number of children's radio programs (for example, *East of the Sun, West of the Moon* on National Public Radio). More children may hear stories on audiocassette than on radio these days; children in our study, nevertheless, often listened to the radio in the car. In any case, our audio stimuli should be relevant to conclusions about audio media generally.

However, our results also indicate that the medium does not constitute the only "message"; children of course remember the content of each story. Thus certain categories more prevalent in *A Story, a Story*—characters and direct dialogue—were recalled with statistically greater frequency in that story than in *Strega Nona*, while indirect dialogue, more prevalent in *Strega Nona*, was recalled more in response to that story. However, story content had no effect on overall measures of recall, such as recalled propositions or cued recall. Contrary to our hypothesis, *A Story, a Story* did not produce better verbal recall than *Strega Nona*, even though it was originally generated through an oral tradition and contained devices (such as repetition) that are supposed to enhance the learning of orally transmitted material. The general cognitive "messages" of a medium overlay the specific messages of the content being transmitted.

More specifically, there was evidence from both the imagination study and the inference results that radio or audio was more powerful as a stimulus to the imagination, while material presented in an audiovisual or television format was more memorable. The presence of dynamic visual images seemed to be a detriment to the imagination but a boon to the memory. It has been suggested that children make up more imaginative endings simply because they remember less of the story in the radio or audio condition. However, there was no difference between the two media in the amount of material children added during recall (see Table 2). Even more telling, the imaginative endings were not irrelevant to the preceding story but typically maintained continuity with it, using characters and settings from the preceding story and adding new events (see Table 1). Two story endings randomly selected from second interviews concerning *A Story, a Story* in one fourth-grade classroom illustrate the continuity of endings from the preceding story. A brief synopsis of *A Story, a Story* is as follows:

Ananse, the Spider man, went to Nyame, the Sky God, to ask for stories. The Sky God said that he could have them if Ananse brought him Osebo, the leopard of the terrible teeth, Mboro, the hornet who stings like fire, and Mmoatia, the fairy who men never see. Ananse went down to earth and caught all three creatures. He took them up to the Sky God, and the Sky God gave him the stories.

A child who heard and saw the story on videotape ended it as follows: "I think that the spiderstories that the spiderman had, he is gonna give 'm out to all the children and their parents will read them and pass them on in generations." Another child from the same class who simply heard the audio presentation provided this ending:

The town would like the stories and they would put them on display in a type of house or like the city hall or. . . and then the books would probably get worn out and ripped and torn and everything and apart and they would thank the spiderman for getting the books and the spiderman will be pretty proud that he helped the people get their books and stories and I guess that's all.

Although we used a verbal measure of imagination in our study, there is no

reason for us to believe the results would be different with a visual measure (see 34).

The overall results for memory, showing that an audiovisual presentation leads to better memory than does audio alone, indicates that visual imagery does enhance verbal memory, as has been found for both children and adults (29, 37).

The findings of better recall from television than from radio differ from our preliminary results (3, 17). However, these earlier results were based on a crude, quantitative measure—number of words recalled—without any measure of recall accuracy. With the added measures of accuracy—recall of central propositions and cued recall—we have found differences in favor of television. Based on the white, middle-class subsample, we found that audio stimulated significantly longer recalled narratives than did television. With the larger sample reported here, this was still the case (see Table 2), but the medium difference was no longer statistically significant. Unlike Hayes, Kelly, and Mandel (24), we found no tendency for audio to stimulate more intrusions into recall of material not found in the original story.

Although audiovisual presentations led to greater overall recall, each medium appeared to highlight particular types of information, which were then recalled better in that particular medium. Action was more memorable in the audiovisual format, dialogue was more memorable in the audio format. This pattern of results is consistent with the dominant trends in the literature.

More recently, however, a memory study like ours but with younger children (ages 4 and 7) and simpler, shorter stimulus stories (16) produced a somewhat different pattern of results. Like us, Gibbons et al. found superior action recall with an audiovisual presentation but only for four-year-olds. It may be that, because the stories were so easy to learn, the older children did not need the visual aid. Another possibility is that the absence of narration to reinforce action information in their audiovisual presentations removed the advantage of the television medium. In our videotaped stories, the visual action was in addition to, not a substitute for, verbalized action. Unlike our results, dialogue was recalled better under audiovisual than audio conditions. This may be because the audiovisual stories used by Gibbons et al. had no narration, only dialogue, thus making dialogue relatively more salient. Or it may be because, before the age of 7, an audio track does not add anything to children's recall of a film (27). At the younger age, the visual may be the pathway to understanding the verbal. Indeed, even in our study, the first and second graders remembered much less dialogue than did the third and fourth graders (see Table 2).

Finally, in our study the audiovisual presentation led to more vague recall of characters, i.e., the use of pronouns or general nouns to refer to characters without any antecedent noun to make the reference specific. Baggett (1) had found similar results with an adult sample. Our explanation is the following: Television is an audiovisual communication medium in which a verbal message is often specified by a visual image. Children retelling the audiovisual ver-

sion of a story act, verbally, as if the images are present even though they are retelling the story to someone who had never seen them. (This explanation may shed light on the common perception that television is causing people to become less articulate in their verbal behavior.)

Another unexpected but interesting result was that whatever the cognitive process—imagination or memory—it was enhanced when a child listened to the audio version before watching the audiovisual version and diminished when the latter preceded the former. This result involves more than an immediate effect; the first medium the children were exposed to in our experiment often had an impact that carried over to the second medium, typically encountered a week later. A possible explanation for this pattern of results lies in Solomon's (44) notion of a cultural set concerning the amount of mental effort required to process information transmitted by a given medium. In the United States, television is perceived as an "easy" medium, and relatively little effort is invested in it (44). Our hypothesis is that radio does not have this association in our experiment. Therefore, when a child's first exposure in the study was to radio, it set up an expectation of greater mental effort, an expectation carried over to the second session a week later. The cultural set causes children in the United States to learn less from television than they might, for, even though TV was more memorable overall than radio, its memorability was, ironically, greater when children were first exposed to radio. Another possible explanation, either alternative or complementary, is that audio/radio stories would be more novel than televised cartoons, and so the children gave increased effort and attention to the more novel medium (6).

Although our study was not directly concerned with long-term effects, it has implications for understanding them. One can think of the long-term impact of the medium as consisting of the accumulation of many immediate and short-term effects. For example, if television promotes a focus on action information, while radio promotes a focus on expressive language, over the long term a child receiving information almost exclusively from television may develop a great store of action knowledge but have little interest in poetry.

From a historical point of view, the growing importance of television means that children socialized by this medium may have more information but be less imaginative, less verbally precise, and less mentally active than an earlier generation for whom radio was a major medium of socialization. A part of this historical speculation is supported by the results of Williams and Harrison in Canada (53). Before the introduction of television in their town, children scored higher on one test of creative imagination than children in two other towns with television already available. Two years after the introduction of TV, their creative imagination was significantly lower and there was no difference between them and children in the other two towns.

As far as social class and ethnicity are concerned, the vast majority of media effects generalized across social class and ethnic lines. However, imagination as measured in our study was an exception; audio versions of stories stimulated

the imaginations of white but not black children (cf. 42). This result could have been an artifact of the overall low imagination scores exhibited by the black children. These scores are in themselves problematical because, in the memory study, black children in a sense used their imaginations significantly more than white children in adding more "original" material (mainly inferences, with some intrusions) to their recall and in more often justifying inferences with implicit and elaborated material. Being tested in a school setting, perhaps they interpreted the imagination study as a situation calling for a "right" answer, an interpretation that may have hampered free play of their imaginations.

Most important, there was inconsistent support for the thesis that groups known to watch more TV—black and working-class children—would be less imaginative. Although white children were more imaginative than black children on the story continuation task (as predicted), working-class children were more imaginative than middle-class children, and white working-class children were the most imaginative group of all (contrary to prediction). The finding of working-class superiority in the realm of imagination also goes against traditional stereotypes of class differences in socialization.

Measurement of explicit comprehension mainly revealed age differences in the absence of class and ethnic differences. These age differences confirm our earlier findings with the more limited white middle-class sample (3), as well as the findings of other studies concerning the advantage of age for recalling or reconstructing televised content (7, 8, 32, 46, 51).

With the exception of the added statements category, the few class and ethnic differences that were found in retention of the stories went in the traditional direction, with black or working-class children resembling younger subjects in their responses and white or middle-class children resembling older subjects. Thus, where there were class or ethnic differences in explicit comprehension (as measured by memory tasks) they went counter to our hypothesis that groups who watch more television (black and working-class) would learn more from an audiovisual presentation than groups who watch less (white and middle-class). Imagination, in contrast to explicit comprehension, was influenced more by class and ethnic differences and less by age.

Implicit story comprehension, as measured by sources of inference, was sensitive to age, social class, and ethnicity. Thus, age effects were associated with the more structured memory tasks and less with the less structured task of story completion. We can conclude that cognitive mechanisms of implicit and explicit memory are still under development in the later elementary years.

Overall, class and ethnicity made a greater difference in the two more ambiguous domains of imagination and inferential justification, where there are no "right" answers provided by the immediate stimuli, while they made a smaller difference in the more clear-cut domain of explicit story comprehension. In the former case, the child calls upon his or her own knowledge and background, as has been observed in cross-cultural research (e.g., 18). Indeed, main effects of class and ethnicity rival those of medium in their importance to processes of both imagination and inferential comprehension.

Contrary to the hypothesis suggested by the results of Newcomb and Collins (35), there was little interaction of ethnicity and story. That is to say, *A Story, a Story* was not a more potent stimulus for black children because of its African content or black characters; nor was *Strega Nona* more potent for white children because of its European cultural content or white characters. Indeed, the only two-way interaction between story and ethnicity found black children less successful at the cued recall of *A Story, a Story* than of *Strega Nona*. Both stories were set in foreign cultures and in past times, and characters performed feats that were impossible in real life. These characteristics made the characters and events of both stories unfamiliar to all children, no matter what their ethnic background.

Our results have important implications for education: The fact that each medium has its own profile of cognitive advantages and disadvantages implies that a balanced education will utilize each one to do what it does best—audio to stimulate imagination and highlight verbal information, video to transmit information in general and action information in particular.

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