EFFECT OF 3-D TELEVISION ON SPONTANEOUS RECALL AND LEARNING

Gregory Fouts and Charlotte Johnston
University of Calgary

Children's spontaneous recall and learning of 3-D and conventional television programs were assessed. Three dimensional reality interfered with spontaneous recall however no difference in learning in 3-D and conventional programs occurred.

On a jugé de l'aptitude des enfants à reconnaître spontanément et à apprendre par le moyen de programmes à triple dimension par rapport et aux programmes conventionnels. Le réalité à triple dimension nuit au rappel spontané; cependant, il ne vint aucune différence dans l'étude de programmes à triple dimension et de programmes conventionnels.

Several attributes of television programs have been found to influence children's visual attention to television; for example, physical attributes (e.g., animation, movement, repetition) and contents, e.g., the presence of puppets, animals and women (Anderson & Levin, 1976; Anderson, Alwitt, Lorch, & Levin, 1979). One physical attribute of television programs which will soon appear in homes is the presentation of binocular depth cues by three dimensional (3-D) television techniques. In the past twenty years, there have been at least ten different 3-D television viewing systems suggested and/or developed (Butterfield, 1970, 1972; Dudley,
The perception of binocular depth on television is comparable to that in 3-D movies. Each 3-D system, by various means, records and then presents two slightly different two dimensional (2-D) views of the same scene (corresponding to the two views which the two eyes normally receive), and through binocular fusion of these two views by the viewer's eyes, a three dimensional image appears. Three dimensional television makes use of physiologically based depth cues, e.g., convergence, accommodation, binocular disparity, and pictorial depth cues, e.g., linear and size perspective, interposition, shadow, texture gradient, while conventional 2-D television only uses the latter. The purpose of this study was to determine the effect of observing 3-D televised contents by comparing children's recall and learning after viewing conventional 2-D and 3-D programs.

One effect of viewing 3-D television may be to increase the learning of viewed contents, since (a) 3-D presentation should be more attention-getting and holding because of its novelty and presenting images closer to reality, (b) the third dimension adds information such as distances and physical relationships among materials and people in a program, and (c) the addition of proprioceptive or physical cues from muscular changes in the eyes is associated with images and may facilitate encoding and memory of viewed contents. On the other hand, the viewing of 3-D television may result in less learning than 2-D presentation, for the following reasons. First, one aspect of conventional television is its distinctness from reality, and perhaps child viewers would prefer not having 3-D reality in their television viewing, i.e., 3-D television may be too real and thus conflict with their desire for more fanciful forms of entertainment. Second, Gabor (1970) has argued that 3-D television may create a "puppet theatre" effect in children, i.e., the characters and objects may
appear so lifelike that children will find it difficult to accept the reduced size, and thus be confused when they see three dimensional people appearing only four inches tall on the television screen. Third, since 3-D television is novel, child viewers may focus on the sensations associated with the perception of depth and attend less to the informational content.

A second purpose of this study was to assess the effect of 3-D presentation of different contents, aggressive and prosocial. Considerable research on the effects of watching television has shown that aggressive contents (e.g., Liebert, Neale & Davidson, 1973; Liebert & Schwartzberg, 1977; Fouts, 1977) and prosocial contents (Friedrich & Stein, 1973; Stein & Friedrich, 1975; Lesser, 1977) can be learned by child viewers. One issue with which this study dealt was whether 3-D presentation of different contents would differentially influence the amounts recalled and/or learned, e.g., would there be more learning of aggressive than prosocial contents when presented three dimensionally? This issue is particularly important if 3-D presentation of violence increases attention and learning of such acts.

METHOD

**Subjects and Apparatus**

Sixteen children, 8-10 years old (8 of each), participated. Half the children (4 of each sex) watched television wearing special viewing glasses, the other half watched by viewing through a hood attached to the television screen; both modes of viewing allowed the viewing of 2-D and 3-D presentations. The recording and presentation of 3-D programs involved (a) recording the programs with a beam splitter attached to the camera (the beam splitter produces two slightly different views of the same
scene on the television screen, corresponding to left- and right-eye views); (b) a polarization filter being placed over the television screen (polarization of light insures that each eye only sees the view appropriate for it) and a child wearing special glasses with polarized prisms (prisms help a viewer fuse the two images into one) or a child viewing through a hood which contained prisms (the child's head rested on the hood and the area around his eyes was completely enclosed by the hood), and (c) the glasses and hood permitting a child to fuse the two side-by-side images on the screen into one 3-D image. Two dimensional recording and presentation involved taping a program with conventional equipment and a child viewing a single image on the screen with either glasses or the hood (which had no polarization filters or prisms). The use of glasses and hood in the viewing of 2-D programs provided no depth effect and served as a placebo condition. Regardless of the dimensionality of the presentation, the images on the screen (12" monitor) were the same size, contrast and brightness.

Two program contents were used, aggressive and prosocial (medical), which resulted in four different presentations: 2-D and 3-D aggression and 2-D and 3-D prosocial presentations. The aggressive program presented a peer male model (8 years old) engaging in a series of 16 different behaviors, each of which involved picking up one of five aggressive toys (e.g., sword, gun, as well as being able to use his foot as in an aggressive kick), and exhibiting an aggressive act toward one of seven targets (e.g., stabbing a Snoopy dog, shooting a Yogi Bear punching bag). After each act, the model replaced the toy on the pile of toys and picked up a different toy. Two of the aggressive toys and three of the targets were not used in the 16 different aggressive behaviors. In the prosocial medical program, the same model modeled 16
different behaviors; each involved picking up one of five medical toys (e.g., stethoscope, thermometer, as well as being able to use his arms to hug a target) and exhibiting a prosocial act toward one of the same targets (e.g., taking the temperature of Yogi, hugging Snoopy). Two of the medical toys and the same three targets as in the aggressive program were not used in the 16 different prosocial behaviors. The two programs, aggressive and prosocial, were the same in terms of using the same model to model 16 different behaviors (which were presented in a random order), having the same length (5 minutes), being accompanied by music, and being presented in black-and-white. Both programs were videotaped using a regular camera with one lens (2-D presentation), and the same camera using a beam splitter (3-D presentation).

Procedure

Each child was escorted to the experimental room and seated by a female experimenter. For those using glasses to view a program, the chair was approximately 2 m. from the monitor which was on a table. For those using the hood, the chair was close to the monitor and hood so that while sitting, the child's head could touch the hood (which extended 50 cm. from the monitor and was at eye level). For all children, there was a brief practice tape (viewing inanimate objects) so as to become familiar with wearing glasses or viewing through the hood. For those viewing a 3-D program first, the practice tape was in 3-D and the experimenter queried them to ensure that the two images were being fused into a three dimensional image; for those viewing a 2-D program first, the practice tape was in 2-D. After familiarization, children were instructed that they would view a program about a boy playing. Half the children (4 of each sex) viewed a 3-D program first, followed by a 2-D
program; half had the reverse order.

Following each program, the television was turned off, followed by two tests for learning, Spontaneous Recall and Learning. In the Spontaneous Recall test, the experimenter asked the child, "Tell me everything you can remember in the program." Using a checklist, the experimenter recorded correct recall of modeled behaviors and incorrect responses (e.g., using a modeled toy with a target, not using a nonmodeled toy). When the child could not recall any more behaviors, the experimenter began the Learning test which involved pointing to each of five toys one-at-a-time and instructing the child, "Tell me who the boy ___ with this ___ in the program. I'll give you two cents for each thing you remember." The experimenter put two pennies in front of the child for each correct answer and recorded correct and incorrect responses.

To summarize, a latin square design was employed—each child saw both contents (aggressive/prosocial) and the 2-D and 3-D presentation of contents. Additionally, the order of presentation of contents and dimensionality was counterbalanced, with equal number of boys and girls being represented in each cell of the latin square and orders of presentation. Thus, although this study used only sixteen children, by employing three within-subject variables (dimensionality, content, type of test), the design maximized the amount of information provided.

RESULTS

Examination of the effects of order of presentation, program contents and sex of children on correct recall of behaviors in the Spontaneous Recall and Learning tests, using t-tests, revealed no significant (p > .05) effects. Therefore, a Mode of Presentation (glasses or hood) X Dimensionality (2-D, 3-D) X Test
(Spontaneous Recall, Learning) analysis of variance was conducted (see Table 1). The means and standard deviations for this analysis are presented in Table 2. There was a main effect of Test, i.e., more correct answers occurred in the Learning (10.91) than Spontaneous Recall (6.88) test. There was a significant Dimensionality X Test interaction. This interaction is presented in Figure 1. Examination of the simple effects revealed that in the Spontaneous Recall test, children viewing 2-D presentations recalled significantly \( t[1,15] = 2.51, p < .02 \) more than when viewing 3-D presentations, with no significant difference occurring in the Learning test.

Table One
Analysis of Variance for Mode of Presentation, Dimensionality and Test

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Presentation</td>
<td>1</td>
<td>43.89</td>
<td>1.31</td>
</tr>
<tr>
<td>Dimensionality</td>
<td>1</td>
<td>31.64</td>
<td>2.49</td>
</tr>
<tr>
<td>Test</td>
<td>1</td>
<td>260.02</td>
<td>11.21**</td>
</tr>
<tr>
<td>Subjects</td>
<td>14</td>
<td>33.61</td>
<td></td>
</tr>
<tr>
<td>Mode of Presentation X</td>
<td>1</td>
<td>0.16</td>
<td>.001</td>
</tr>
<tr>
<td>Dimensionality</td>
<td>1</td>
<td>34.52</td>
<td>1.49</td>
</tr>
<tr>
<td>Mode of Presentation X</td>
<td>1</td>
<td>34.52</td>
<td>5.02*</td>
</tr>
<tr>
<td>Test</td>
<td>1</td>
<td>12.69</td>
<td></td>
</tr>
<tr>
<td>Subjects X</td>
<td>14</td>
<td>23.19</td>
<td></td>
</tr>
<tr>
<td>Dimensionality</td>
<td>1</td>
<td>4.52</td>
<td>.66</td>
</tr>
<tr>
<td>Subjects X</td>
<td>14</td>
<td>6.87</td>
<td></td>
</tr>
</tbody>
</table>

\*p < .05    \**p < .01
Table Two

Correct Recall of Behavior for Mode of Presentation, Dimensionality and Test

<table>
<thead>
<tr>
<th>Mode of Presentation</th>
<th>2-D</th>
<th>3-D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glasses</td>
<td>Mean (S.D.)</td>
</tr>
<tr>
<td>Spontaneous Recall</td>
<td>7.00 (3.82)</td>
<td>3.63 (4.03)</td>
</tr>
<tr>
<td>Learning Test</td>
<td>10.50 (5.61)</td>
<td>11.13 (3.64)</td>
</tr>
</tbody>
</table>
Figure One
Mean number of behaviors spontaneously recalled and learned from 2-D and 3-D presentation

- **2-D PRESENTATION**
- **3-D PRESENTATION**

**MEAN NUMBER OF BEHAVIORS**

- **SPONTANEOUS RECALL**
- **LEARNING**

**TEST**
DISCUSSION

The finding of greater recall in the Learning than Spontaneous Recall test is consistent with the learning-performance distinction in the assessment of observational learning (e.g., Bandura, 1965, 1969). The finding of greater spontaneous recall of 2-D than 3-D presentation of contents indicates that the observation of three dimensional reality impaired the spontaneous recall of observed events. This is likely due to the presence of novel perceptual qualities in the 3-D presentation. However, when children were provided incentives for describing what they had observed, thereby asking them to focus on the contents rather than the possibly interfering physical sensations and perceptual novelty, there was no difference in learning. It is also possible that 8-10 year olds generally view television contents as unreal, and when 3-D reality is introduced, this produces disbelief and inhibition, e.g., a "puppet theatre" effect (Gabor, 1970). When such reactions are decreased through motivating and disinhibiting children by offering incentives, optimal assessment of observational learning of 3-D events occurs and is comparable to that of 2-D presentations.

One implication of these findings is that the initial effect of introducing 3-D television to children is that it may result in a temporary depression of their spontaneous recall and imitation of observed events. However, as children become accustomed to 3-D presentations, thereby decreasing the novelty of three dimensional reality on television, they may recall and exhibit imitative behaviors as much or more than they would when seeing conventional 2-D programs.
A second implication involves the children distinguishing between 2-D and 3-D presentations in their spontaneous recall of television contents. Past research (Fouts, 1977, 1978) has shown that youngsters between the ages of 8 and 14 years make distinctions between what they see on television and what they see in real life, for example, the enjoyment of observing fighting on television is about four times greater than observing the same fight in reality. It would appear that the youngsters in this study felt that seeing behaviors in three dimensional reality violated the fanciful and enjoyable nature of viewing behaviors which two dimensional, conventional television permits. Therefore, if children shift their fantasy-reality distinction from 2-D and 3-D presentations to the source of presentation (television and reality), the impact of 3-D television should be no greater than conventional television.

Several areas of further research are warranted. First, the effect of 3-D presentation may vary with the type of content, e.g., when depth cues provide important information for understanding and/or later behavioral reproduction, 3-D presentation may facilitate learning. Second, individual differences of viewers may influence the effect of 3-D presentation, e.g., viewers having highly developed spatial abilities may be differently affected than those without such abilities. Third, the effect of 3-D presentations may depend upon the measures employed, e.g., attention, short or long term learning, behavior. Fourth, past experience with 3-D presentation (e.g., movies, comic books) and the amount of such experience may influence the impact of 3-D presentation. These and other areas of research, as well as investigations using larger sample sizes and occurring in different contexts, e.g., home viewing, simulation exercises, pose important paths for future research in this new visual technology.
Footnotes

1 This research was supported by grants to the first author from the Royal Commission on Violence in the Communications Industry (Ontario) and the Alberta Mental Health Advisory Council. Reprint requests may be addressed to the first author, Department of Psychology, Calgary, Alberta. T2N 1N4

2. Two modes of viewing were used in order to determine whether differences might occur between these two modes in terms of difficulty of perceiving depth and distractability. No differences occurred.

References


Herman, S. Principles of binocular 3-D displays with applications to television. *Journal of the Society of Motion Picture and Television Engineers*, 1971, 80, 539 - 544.


Gregory Fouts (Ph.D. University of Iowa, 1970) is professor of Psychology at the University of Calgary. His research interest is in the influence of communications media upon children and the family.

Charlotte Johnston (M.Sc. University of Calgary, 1981) is a Ph.D. candidate at Florida State University. She is majoring in Developmental Psychology including social-emotional development and behavioral assessment of childhood disorders.