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ABSTRACT

The entire educable mentally retarded (EMR) population of three middle and two elementary schools in Indiana were subjects for this interdisciplinary study that addressed the problem of determining what media techniques influence the attention of mildly handicapped learners toward relevant information and away from irrelevant information in instructional media. Conceptually, the techniques were divided into attention-getting and attention-directing and into learned and unlearned cues. Subjects were chosen to reveal any developmental trend. Conclusions reached were that most-influencing techniques used in audiovisual presentations can have an impact upon the behavior of retarded as well as normal learners. Motion, an attention-getting cue, had a strong effect for both EMR and normal learners. Further, printed or spoken instruction to look at an object, an attention-directing cue, made significant difference in both recognition and eye movement patterns in favor of the target object. It was also noted that spatial location in the visual field, especially the upper central position in a frame, has impact upon attention to an object. The most consistent effect of attention-influencing techniques in fixed-pace media was on eye movements, which caused learners to look more quickly and for a longer time at critical information. (MER)

Attention to Instructional Media: What are the Relevant Media Techniques and Learner Characteristics?

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* Attention to Instructional Media:

What are the Relevant Media Techniques and Learner Characteristics?

Visual attention has long been of central interest to the makers and users of instructional media (Ball and Byrnes, 1960; Miller, 1957; Fleming and Levie, 1978) for they have employed numerous techniques, e.g., closeups, underlinings, color cues, etc., in an attempt to make sure their audience notices the important ideas they are presenting. We found that visual attention is also of interest to the Special Education field. According to Crosby and Blatt (1968), "--professional opinion, derived from educational and clinical experience, has long identified impairments of attention as a general trait of the mentally retarded--" and further, "--at least four theorists (Zeaman and House, 1966; O'Connor and Hermelin, 1963; Denny, 1966; Luria, 1963) have posited specific attentional deficits in an attempt to account for certain learning impairments evidenced by retardates as a group." (p 69). We began to wonder how effective our media techniques for attention-getting and directing would be for mildly handicapped children who have difficulty selectively attending to instructional stimuli? This question is particularly pertinent to the current attempt to educate such children in the least restrictive environment i.e. to mainstream them.

The problem this study addressed was: What media techniques influence the attention of mildly handicapped learners toward the relevant information and away from the irrelevant information in instructional media?

The media literature is replete with references to such techniques and includes some studies which find learners attending unpredictably to unintended information. For example, an early study (Neu, 1950) showed that

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attention-gaining techniques employed in a how-to-do-it film actually detracted from effectiveness, i.e., drew attention to themselves and did not increase learning. A more analytical study using eye-movement data (Guba, and others, 1964) found that attention to a televised science demonstration was often focussed on the demonstrator's face (irrelevant) rather than on the science object (relevant) he was discussing.

Some of the media studies finding positive effects on learning are the following, together with the attentional techniques studied: Allen, Cooney, and Weintraub (1968) verbal directions; Gibson (1947) distortion or exaggeration of relevant cues; Lumsdaine, Sulzer and Kopstein (1961) pop-on labels, arrows; Trenchord and Crissy (1951) large size, upper left position, color; Wolf (1971) repetition factors, novelty and complexity.

Other sources list numerous specific techniques presumed or found to influence attention, e.g., Allen and Goldberg (1977) recommend that media producers provide verbal directions, present only critical cues, use visual emphasizers, use motion, use different media; May (1965) refers to color, visual pointers, "implosion techniques," cue familiarization including extreme closeups, subjective camera, inserted questions; Ball and Byrnes (1960) refer to verbal captioning and labelling, eye attractors such as color, brightness, movement, size, white space, shape.

An extensive program of research on retarded children (Zeaman, 1973; Zeaman and House, 1966) ascribes deficiencies in discrimination learning to attentional differences rather than learning process differences. They repeatedly found that stimulus novelty strongly influenced the attention of retarded children. The sudden introduction of novel cues was often accompanied by sudden solutions to discrimination problems.

In another study, Wilhelm and Lovaas (1976) trained both retarded and normal children to accurately distinguish between two pictures. Then they tested the childrens recognition memory for the objects in the pictures. The normal subjects correctly recognized all three objects in the pictures while the mildly retarded recognized an average of 2.1 objects and the severely retarded only 1.6. Apparently the retarded children had selectively attended to only part of the pertinent information.

Hagen (1972) found a development trend in normal children for increased learning of the central information in pictures and decreased learning of incidental information. However, retarded children failed to make this distinction between central and incidental information.

Attentional processes have been more clearly implicated in retardate learning deficiencies where studies have included eye-movement data. For example, Boersma and Muir (1975) found retarded learners to be deficient in visual attention. Their eye fixation patterns indicated they did not select important cues in the pictorial displays. Similarly, Mackworth and Bruner (1970) found that retarded subjects were less likely to look at important areas in pictures than normal subjects.

The weight of the evidence in the preceding is that mildly handicapped children are deficient in their attentional processes, and that this deficit could place severe constraints on their ability to learn from instructional media unless compensated for by special media techniques for influencing attention. However our brief survey of selected videotapes, films, and filmstrips for handicapped learners revealed only spotty and infrequent use of attention influencing techniques.

Our investigation of this problem extended to five exploratory studies, parts of which I will briefly summarize here.

The project was interdisciplinary, the investigators besides myself including Dr. Howard Levie of the Audio-Visual Department and Dr. James McLeskey of Special Education. The several graduate assistants had had experience in one or the other area as well.

The independent variables of greatest interest were the attention-influencing techniques incorporated in media. Over a dozen were tested but primary emphasis was on arrows, contrast, verbal cuing, and motion.

Conceptually the techniques were divided into attention-getting and attention-directing techniques and into learned and unlearned cues. We hypothesized that the learned cues e.g. arrows, would be more effective with older children than younger. In contrast, the unlearned cues (those that appeal to basic attentional processes e.g. changes in brightness, color, or motion) would be equally effective across age groups.

Subjects were chosen to reveal any developmental trend. The sample included the entire EMR (educable mentally retarded) population of the three local middle schools and all of those in the two elementary schools with the largest number of EMR children.

Subjects were individually tested, and each served as his/her own control in a repeated measures design. Stimuli in either slide or motion picture form were rear projected onto a small screen 3 feet in front of the subject.

During stimulus presentation a record of the subject's eye movements was made. Following presentation, either a recognition or recall test was given. Thus the dependent variables were eye-fixation patterns and recognition or recall.

The eye-movement detection equipment was of the corneal reflection type, and the data were recorded on 16 mm film. The subject wore a kind of face mask which weighed about a pound and was fitted securely and comfortably to the head. It was aligned for each subject so that a spot of light directed to the side of the right cornea reflected into a prism system and through fibre optics to the camera. Because the eye ball is egg-shaped instead of round, the position of the reflected spot of light moves as the eye moves. This spot of light, called an eye marker, was superimposed over an image of the scene being viewed, and both were recorded on 16 mm film. (See Figure 1). The result was a film record of the scene with a superimposed white mark intermittently moving and stopping where the subject was looking at any moment. The camera ran at 8 frames/second and thus provided 8 data points a second as to where the subject's eyes were fixated.

An initial exploratory study investigated the effects of attention influencing devices added to instructional materials intended for EMR learners. Frames were selected from a couple of filmstrips to produce a 26-frame sound slide set in two versions composed of control slides (unchanged from the original filmstrips) and experimental slides (altered to include a dozen different attention-influencing devices). This sound slide set was presented individually to 22 EMR subjects divided between elementary and middle school levels. Eye-movement records were made followed by a recognition memory test for selected objects, both those that had been accentuated in the stimuli (target objects) and those that had not (incident objects). Distractors were from the same filmstrips but had not been previously shown. Overall recognition accuracy data were as follows:

	Target objects	Incidental objects
Experimental (accentuated)	94%	42%
Control (not accentuated)	82%	52%

As can be seen the experimental version increased recognition memory for target objects (82% to 94) and reduced memory for incidental objects (52% to 42).

Of the twelve accentuation devices in this preliminary study, those having the largest influence on memory were arrows and audio prompts.

The effect of the attention-influencing techniques on eye-movement patterns was considerable. For nine of the attention-influencing devices studied, the eye movements indicated a positive effect, i.e. accentuated objects were fixated more rapidly and for a longer time than where the same objects were not accentuated. These devices were color, brightness, contrast, sharpness of focus, reduction of irrelevant detail, close-ups, arrows, outlining, direct and indirect auditory cues. For example here is the effect of audio cues on the percent of time the subjects fixated on the accentuated object as compared to the same object without accentuation.

	No audio	Indirect cue (Object named)	Direct Cue (Told to look at object)
Experimental (accentuated)	15%	29%	33%
Control (not accentuated)	12%	12%	7%

Note that auditory verbal cues, both indirect and direct, about doubled looking time on the target object. However, printed verbal labels were not effective, for they were apparently not read by the retarded children in this initial study.

The more effective techniques from this study were examined further in follow up studies, together with one not initially studied: motion.

In one series of studies stimuli were nine slides each containing pictures of three familiar objects arranged in a triangle. See Figure 2. Pictures were line drawings with moderate detail. In one condition an arrow pointed to the target object, in another the target was high contrast (black lines on white ground) while the incidental objects were low contrast (grey lines on white), and in the control condition there was no accentuation.

The dependent variables were eye movements plus recognition memory in one study and name recall in another study. The picture recognition data favored the arrow condition while the name recall data favored the contrast condition particularly for elementary EMR children. The largest effects in the eye-movement data were attributable to spatial location, i.e. 40% of fixations being on the object located upper central in the frame as compared to 25% divided between the objects located lower left and right.

In one follow-up study with similar stimuli the independent variable was verbal instructions, i.e. Look at the ____. Compared were oral, print, oral plus print, and control conditions. Target objects were either lower left or lower right to control for the spatial location effect previously obtained. All the verbal accentuation techniques were highly and equally successful. Twice as many target objects were correctly recognized as compared to incidental objects. The eye-movement data also indicated strong differential attention to the target object where verbally cued, that is more rapid orientation to it and a longer fixation time on it. For example here is a comparison of the on-target fixation times (seconds).

	Elementary EMR	Middle School EMR	Middle School Normal
Print	2.14	1.92	1.78
Oral	2.10	2.25	2.04
Both	2.00	2.05	1.93
Neither	1.07	1.07	1.25

Verbal cueing of all three kinds about doubled the fixation time for both levels of EMR children and, importantly, neutralized the differences due to grade level or ability level as measured by both recognition and eye-movement data.

In the other follow up study, arrow and motion cues were tested. Stimuli consisted of twelve scenes each consisting of a group of eight line drawings of familiar objects. The drawings were sparcely detailed and were arranged in a consistent pattern around the edges of the frame. (See Figure 3).

The task was to find the animal in each scene. In four scenes an arrow accentuated the animal, in four others the animal moved slightly, and in the other four there was no accentuation.

The dependent variables were orientation time (measured by eye-movements) and recognition memory. To make the orientation-time measure more precise each scene was preceded by a blank scene having a blinking star at the edge. Subjects were to look at the star first, thus providing a consistent starting point in the subsequent search for the animal.

Results showed that the animals receiving the accentuating cues were correctly recognized more than those not receiving the cues. However the effect differed across groups, there being no reliable effect for elementary EMR subjects, a significant effect ($p < .02$) for middle-school EMR subjects and a borderline effect ($p < .07$) for the middle school normal subjects. Differences between treatments were in part masked by an overall ceiling effect in recognition memory.

Differences were more apparent in orientation times as indicated by the eye-movement data. Time was measured from the onset of the scene to the first eye fixation on the target animal. As can be seen in Figure 4, the motion condition was significantly more effective overall than the control ($p = .0001$), but there was no difference between the arrow and control conditions. The curves suggest an interaction, with the motion condition largely eliminating the difference between the EMR and normal children. However, statistical analysis failed to show this effect to be reliable.

Several tentative conclusions and recommendations for practice can be drawn from these studies:

1. Most attention-influencing techniques used in instructional audiovisual presentations can have an impact upon the behavior of retarded as well as normal learners. However, these techniques vary in their effectiveness, and may be marginal in some cases. We would speculate that the effectiveness of some techniques is substantially less that supposed by designers and producers of audiovisual materials.
2. Motion, an attention-getting cue, was shown to have a strong effect for both EMR and normal learners, making more rapid their finding of the target object and lengthening their attention to it.
3. Printed or spoken instructions to look at an object, attention-directing cues, made significant differences in both recognition memory and eye-movement patterns in favor of the target objects as compared to the incidental objects. This effect was uniform across all ages tested and eliminated the differences between retarded and normal children on the task.
4. In some circumstances, spatial location in the visual field can also have an important impact upon attention to an object, the upper central position in a frame being a dominant one.

5. The effectiveness of several other types of attention-influencing techniques e.g., arrows, and brightness contrast, was nil in some conditions and only modest in others.
6. There is some evidence that arrows may be less reliable for younger learners and more complex tasks, which is consistent with our prediction that arrows, being a learned or acquired technique, would be developmentally sensitive.
7. The most consistent effect of attention-influencing techniques was on eye-movements, causing learners to look more quickly and for a longer time at the critical information. While these differences were only a matter of seconds, the effect in fixed-pace media, e.g. motion picture or TV, might be important. Scenes in such media are sometimes short, so non-productive looking at irrelevant cues could often be costly, for there is no chance for a second look. This effect would be particularly serious for the young or EMR learner.

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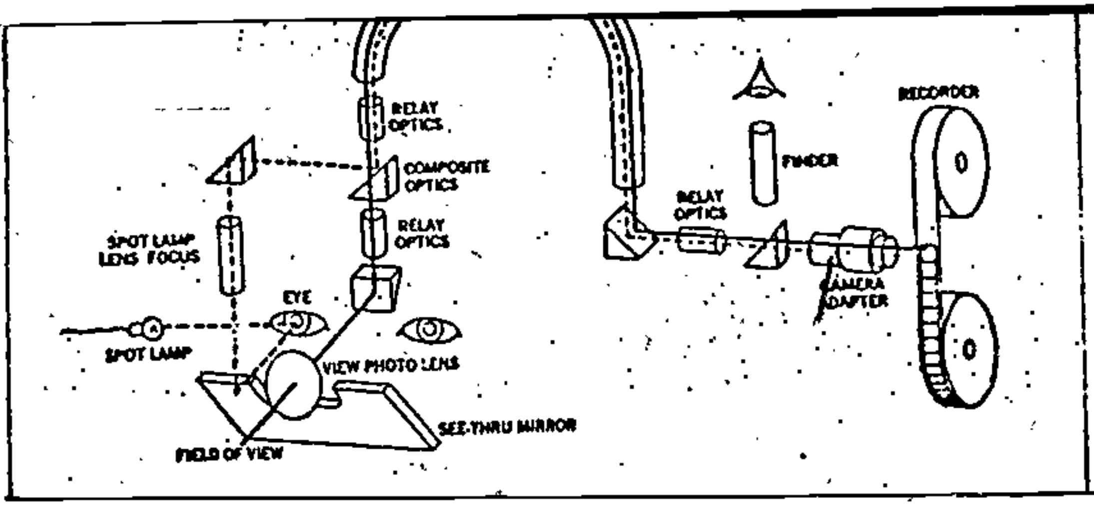

Fig. 1. Schematic of eye-movement detection and recording instrumentation.

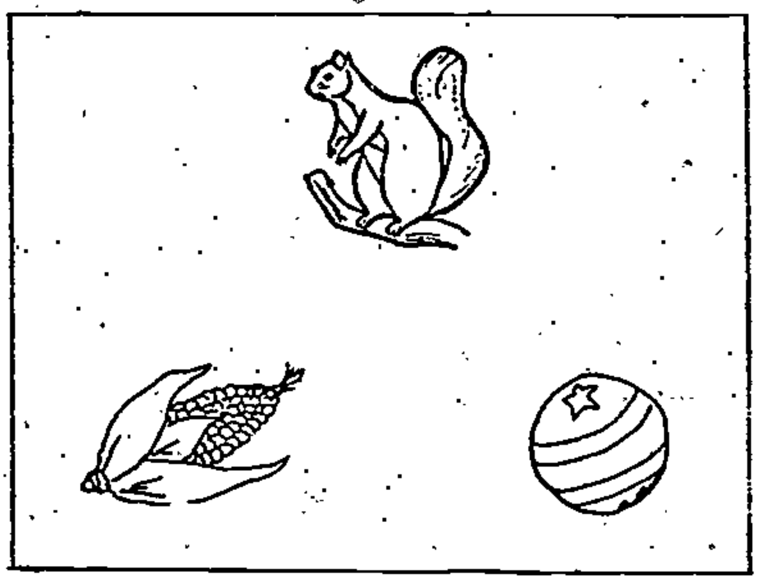

Fig. 2. Example of type of stimulus (control condition) used in studies of arrows, contrast, and verbal instructions as cues to influence visual attention.

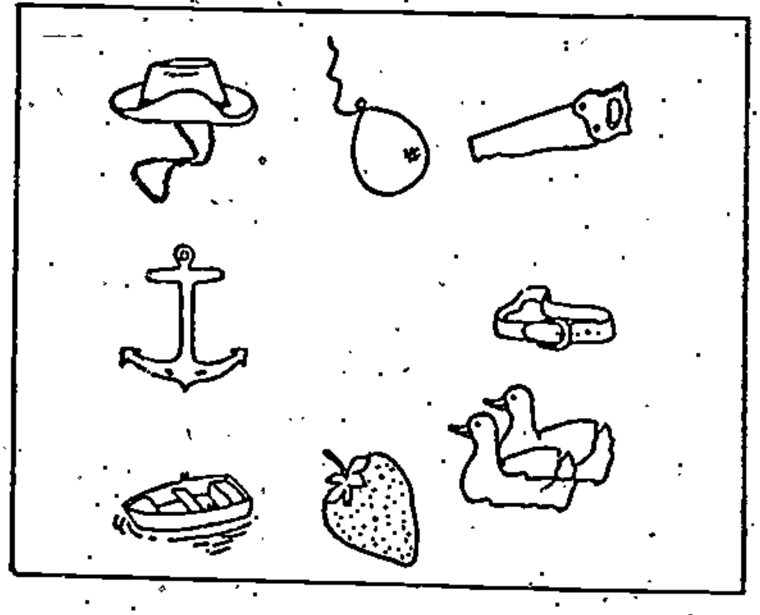

Fig. 3. Example of type of stimulus used in study of arrows and motion (implied in duck) as cues to influence visual attention.

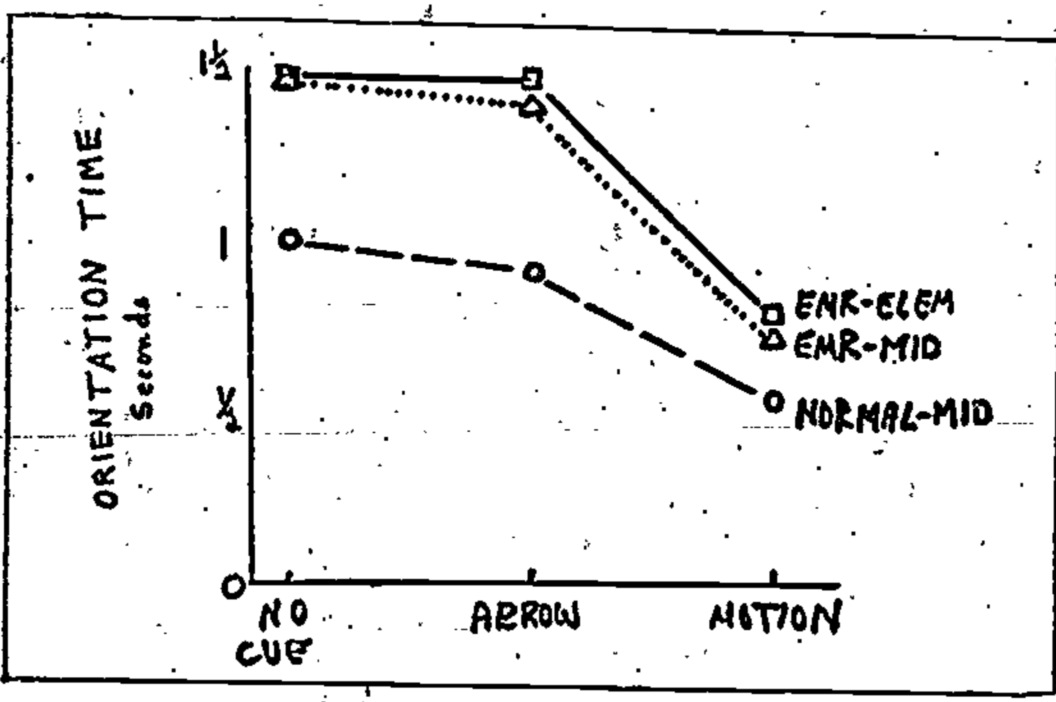

Fig. 4. Orientation times (seconds) to target object for three conditions and three groups: EMR Elementary, EMR Middle School, and Normal Middle School.