

Memory from Presentation Modes: Evidences from Communication, Educational and Media Studies

In comparing reading, listening and TV presentation modes, we are dealing with diverse literature. More interest has been shown in the history to compare learning and memory from reading and listening than any other communication forms. TV invention in 1950s has revolted the convention into a wider dilemma. More recent literature review in comparative media indicates that there are widespread discrepancies among the reports on memories from presentation modes. Various explanations have been put forward to account for these differences. Different accounts portrait various reasons; depending to which decade and to what scope they belong. Literature from education and accounts from media and communication studies raise the issue of channel augmentation, channel enrichment, symbol system, and signal redundancy as the main topics affecting memory from presentation modes. Learning from media is best measured up when recalls from these modes are usually compared. When comprehension and learning mixes with memory issues in the measurement of input processing from each mode, the complicated cognition and its principal information processing measures become of the major concern. This paper shows how research into aspects of bisensory augmentation of TV versus other modes, is sparse, unconvincing and sporadic, and attempts to explain the reasons. To achieve this goal, the shortcomings of the literature with distinct theoretical stands on this subject of channel comparison are identified. It is shown that all these factors have produced a multi-dimensional perspective, convincing that the comparison is too complex to allow a simple evaluation. This paper also explores broad underlying cognitive effects in comparative conditions of presentation modes. In this article brief summary of factors that have not been considered in comparative media are explained. It is suggested that instead of formal comparison of these modes on surface, by looking at the underlying factors and applying cognitive psychological findings to this area can make the borders clearer.

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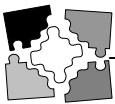
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Conventionally, throughout the literature, reading from a text is usually compared with listening and audiovisual condition of TV. In doing so, traditionally, measuring memories retained from presentation modes has established a long record. When a medium like TV emerged in educational and social life, more tendencies in exploring its audiovisual effects on learning and recalls took over all the literature from communication studies, educational and various parts of psychological

research in vast dimensions. A brief account of these literatures suggests that in comparing TV with reading and listening, there are three distinct views. These three views maintain positive, negative or neutral positions when reading and listening are compared with TV. In the history of media comparison, those who reported the supremacy of print over TV and audio presentation mentioned that the main advantage of print over television and listening is that the reader is self-paced (e.g.



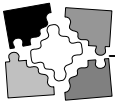
Furnham, Gunter, & Green 1990). Whereas the viewer of TV or the listener of a broadcast is usually presented with material at a rate determined by the presenter. With self-pacing of reading, according to this suggestion, the reader uses more attentional resources in the processing of inputs, and also has a better chance to use more imagery for his comprehension. The second group provided evidence that in comparing media, TV is superior to reading or listening (e.g. Anderson & Burns, 1991; Anderson & Collins, 1988; Calvert, Huston & Wright, 1987). According to this group, both attention and comprehension are guided by the viewer's seeing formal television features, which provide more information than is available in a verbal mode. A third group (e.g. Goodwin, Chu, & Schramm, 1967; William & Brown, 1991; Reeves, 1986) advocate that medium on its own makes no difference, as it is only a neutral carrier of the message. They rely on evidence from educational studies as well as indications from media, news, advertising and psychological studies (e.g. Goodwin, Chu, & Schramm, 1967). According to this group, if there is any difference in recall from different presentations, it can be attributed to the way the content is presented.

In educational and cognitive studies of the impact of pictures on text and listening materials, controversies are also shown. One group (e.g. Hamilton, & Holzman, 1989; Hitch et al., 1989; Margrain, 1967) argues that readers are privileged by using spatial information such as maps or information available from the environment or prior knowledge regarding spatial organisation of the content of presentation to construct an image or a cognitive model of a situation being described (presented). One more argument (e.g. Jacoby, Hoyer, & Zimmer, 1981; Wagenaar & Visser, 1979) was that picture add-ons do not affect the overall recalls in a positive way, but tax memory resources. In this way, divergent findings have been reported in the studies about the modality effects in short-and-long-term memory. Another group (e.g. Berry & Brosious, 1991; Findahl, 1971; Murdock, 1996; 1971; Stauffer et. al., 1981) who were more interested in the effects of differential modality on short-term retention produced yet a further source of literature. Murdock (1966; 1972), for example, reported superiority for the auditory mode of presentation in recall for several seconds after presentation. Margrain (1967), running two experiments concerning short-term memory of audio and visual presentation also found a better short-

term retention of digit list when presented auditorily. The third group advocated that the impact of picture add-ons would depend on the quality of pictures and the relationships that emerge as a result of this combination (e.g. Waddil & Mc Daniel, 1992).

A review of research on single and multiple channel communication, in this way, goes back to the early sixties (e.g. Hartman, 1961b), or even longer before. According to Hartman, research on the channels of communication is much older than the media themselves. Hartman's conclusions from his early review pointed out that audio has obvious advantage for presenting simple material to younger children with undeveloped reading skills. However, as the material becomes more complex, print becomes increasingly advantageous. As more recent literature on this subject (e.g. Mousavi et al, 1995; Quealy & Langan-Fox 1998) have gone too narrow emphasising on attributes of this media comparison, (probably because they have been disappointed with the existing literature), a real perspective of this comparison that can provide a true picture appears to be overlooked. Those who initiated the issue of presentation mode were concerned with the educational context. They were mainly concerned with reading from a text as compared with listening to audiotape and later with other types of audio visual aids. Educational AV media, such as films, slide tapes, overhead projectors, and lately TV, were used for aiding instruction (e.g., Jamison, Supper, & Walls, 1974). Because planning, application, utilisation, and maintenance of this AV material in instructional settings have been always expensive and time consuming, many teachers were reluctant to use them and challenged their usefulness by comparing them with unaided and simple media classrooms. Their argument was that activities, such as reading a text or listening to an audiotape, does not yield a lower average outcome when compared to using expensive audio visual aids. In these studies (See Hartman, 1961a; 1961b; Berry & Brosious, 1991 for details), the AV media, and particularly documentary films, were usually compared with the mono-channel media of reading and listening. While the prediction of many of these studies was negative, others found some positive results (see Hartman, 1961b; and Hsia, 1971 for more details of this review of initial literature).

One main finding that can be inferred from the early literature is that comparison is possible only under exhaustive categorisation of different conditions and approximate equalisation of auditory and visual information. The majority of the early



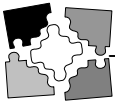
research in comparative media were surveys, concerned with the effectiveness of television as compared with other media (e.g. Barrow & Westley, 1974; Schramm, 1963). According to Hsia (1971), "The only conclusion that can be drawn from nearly a thousand studies surveyed is: no secure general proposition can yet be stated" (p. 52). In the majority of later studies on the comparative effectiveness of auditory, visual, and audio-visually mixed mode of presentation, one major issue was whether or not people can handle the simultaneous presentation of AV material better or worse than a single mode presentation. This argument is best exemplified by the position taken in Broadbent's pioneer work (1958) and Garner's (1962) outline of information theory. Broadbent expounds the single communication channel concept of human information processing system and takes the view that restraints on the human central nervous system constrain the information processing level. His model of human information handling explains the loss of information when information has to queue to be processed. According to the model, the human information-processing rate is not only restricted by the modality capacity of the ears and eyes but is ultimately limited by the capacity of the central nervous system. No input can be consciously processed if it does not receive enough attention. Scientists using this model maintained that in the AV presentation mode redundant information introduced by multi-channels would be competing to get attentional resources and therefore be left in the queue of processing. But neuropsychological evidence indicates that there is an enormous disparity between the information processing capacity of the central nervous system and that of the sensory modalities (see Cohen et al., 1993). Garner (1962) argues that increased dimensionality of information will increase information transmission and reception, and also raises doubts on the validity of the single channel concept by pointing out that "a simple channel capacity is clearly inappropriate" (p. 135).

These seemingly divergent views on the information processing rates held by Broadbent and Garner may not be incompatible after all. People are capable of processing information through multi-channels, so long as the inflow is within the information capacity limit. Garner has presented evidence to substantiate the assertion that an increase in information dimensionality may improve information processing and many studies (e.g. Glenberg & Kruley, 1992) have supported this idea.

More recently, Glenberg and Kruley (1992) comparing pictured textbooks with non-pictured texts have reported audio-visual superiority to a mono channel of reading and listening when AV is perfectly synchronised. This is consistent with Garner, who rejected the limitations on input handling that were suggested to be on our central nervous system.

Another perspective is arisen from media and advertising literature. Researchers (e.g. Berry & Brosious, 1991) involved in media evaluation considered issues such as bisensory augmentation, or channel enrichment in audio-visual media. Bisensory augmentation is meant when another channel is used to present some additional data, which is combined with the inputs from the main channel (e.g., a Slideplus Tape). It must be noted, however, that bisensory augmentation embodies two or more channels of communication in parallel which, in terms of their contents, may or may not be completely congruent to one another. Whereas channel enrichment is when a single channel is enhanced (aided) with the same or different type of content, usually mixed together so that it makes a unique new integrated medium that elaborates the form and content of presentation and is different from its individual components. In channel enrichment, one channel is consistently promoted by the other to produce a harmonious outcome. An example of this is a text, which is enriched with congruent pictures, or a TV programme where the audio and visual effects are mixed together to make one representation.

In psychology, the subject of comparative media has also attracted a lot of applied cognitive psychological research interest in recent years. For example, Mousavi et al. (1995) and Quealy and Langan-Fox (1998) declared that the effectiveness of multimedia presentations in the real world has empirical support. Mousavi and his colleagues reported their findings on the use of a partly auditory and partly visual mode of presentation for geometry worked examples. Their logic was based on the split attention effect and the effect of presentation modality on the performance of working memory (WM). The split attention tasks, which gave participants a heavy cognitive load were used to measure WM capacity when processing information in various modes of presentation. According to their report, the presentation-modality-effect suggests that WM have partially independent processors for handling visual and auditory material. They argued that presenting material in a mixed rather than a



unitary mode might increase effective WM in handling the inputs. Quealy and Langan-Fox (1998), also argued that although it has been asserted that media on their own have no impact on the content, nevertheless, in accordance with dual coding theory of short term memory processing, greater effectiveness of video and audio presentation was obtained from their 3 experiments. With all the above considerations, it is, nevertheless, argued that the outcomes of various types of research have been inadequate and inconclusive due to application of inconsistent theoretical views and different manipulation techniques used to study the related variables. This concern is further seen in various literatures below.

Educational Studies: Evidences from Picture Adding to Print and Auditory Presentation

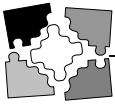
The history of educational-media comparison incorporates several considerations that have been of interest to researchers for many years. Substantial number of educational studies, for example, concerned with channel augmentation of AV media (particularly in TV and film) and its impact on learning and recall compared with single channel instruction, have shown that channel enhancement like adding pictures to print or audio generally increases learning. Some of these studies, however, have isolated more specific effects. For example Haring and Fry (1979) examined whether pictures could help learning from a written form. A prose passage was analysed into 350 idea units, and pictures were interspersed throughout the text. The 150 children between 10 to 12 years old wrote down all they could remember of the story immediately after presentation and again 5 days later. Results of the study indicated that pictures facilitated both immediate and delayed recall of the main ideas but not of the detailed incidentals. These findings, however, were not consistent with Goldberg (1974), who had previously shown that pictures only increased learning of materials not central to the objectives of the lesson.

Research of this kind has led to fundamental inquiries involving the question "do really pictures aid learning from reading?" The role of illustrations in promoting text memory has been of interest to educational researchers for a very long time. Earlier investigations (e.g. Herman, 1965) cast doubt on the beneficial effect of pictures on learning from text. Herman claimed to have substantiated Broadbent's theory and documented the impairment of

performance usually found in dual channel information processing. Later on, when the research methodologies had improved, findings suggested that the effect on learning of adding pictures to text could be valuable if the pictures chosen consistently support the written text. This suggestion soon gathered ample support to the extent that Glenberg and Kruley (1992) argued that "It is a fact that pictures help people to learn from texts" (p.461). However, depending on situational grounds, text illustrations yielded different results in terms of functions they may perform (Haring & Fry 1979).

Several other studies have gone further and isolated these picture-effects when used with written materials. Waddill and McDaniel (1992) examined the kind of information in a prose passage that was remembered better when depictive illustrations were embedded in the passage than when was the passage contained no illustrations. They examined the effectiveness of pictures with expository texts, stories, and materials teaching concepts and rules. Using different picture types, Waddill & McDaniel reported that pictures generally might serve to enable processing in which readers would not necessarily engage under ordinary circumstances. According to them, this positive effect of pictures has been empirically validated across a number of subjects and situational variables. They state that the effects obtained depend on the type of picture in conjunction with the content of the text. They suggested that pictures might, for example, serve to decorate textbooks, they may present additional information by enriching the written text or they may transform the reading into a more memorable form. For mature readers they may help them to organise the text, or interpret the text and derive more inferential ideas. Waddill and McDaniel made a classification of pictures and described their effects on recall from reading. This kind of classification of picture addition to a text is a useful framework from which a systematic study of picture effect can become more feasible. (More details on this classification will be discussed below under the heading of categorisation of picture-additions.)

An early review of literature on the educational aspect of media comparisons (Fleming, 1979), maintains that adding pictures to verbal communication has an absolute effect. Reviewing the preceding 20 years of research on the impact of instructional pictures, Fleming categorised the literature into 3 groups of studies: pictures vs. pictures, pictures vs words, and pictures plus words. He concluded that the pictorial superiority effect is



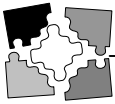
due to processing of information in terms of increasing analytical approaches and changing conceptions. He particularly supported Levin et al's experimental evidence (1976) that pictures strongly promote children's prose learning provided that factual learning is involved and that they are narrative or orally presented and the pictures are consistent with the text content. This view, however, does not exactly say how pictures have this salutary effect and is not unanimously shared among others who were concerned with this subject.

Media Studies: Evidences from Picture Adding to Talking Head News Captions

One of the areas of research that has constantly shown an interest in comparative media has been news and advertising. Communication researchers have usually attempted to find out in what ways and to what extent communication media differ in their effectiveness. However, the question that why they differ in effectiveness is less frequently dealt with and less thoroughly understood. Nonetheless, the difficulty of comparing the relative effectiveness of media has been recognised. Studies on the impact of adding pictures to talking heads of TV have reported results that are inconclusive. Wagenaar and Visser (1979), for example, have compared a radio message (audio only) and three different kinds of television broadcasts. The TV forecasts had different visual components, a talking head, a map with symbols appearing on it as the items were mentioned, and a map with a man pointing to the symbols. They found that the amount of presented material recalled was the same for the radio message and for the map with symbols. Both the talking head and the pointing man acted as distracters and impaired recall. The amount of information retained from weather forecasts was quite sharply limited and gimmicky visual aids were no help. Even Wagenaar, Schreduder, and Van Der Heijden (1985) in their latest study that was directly involved in comparing TV and Radio they failed to obtain any beneficial effects of pictures. Asking whether TV pictures help people to remember the weather forecast, Wagenaar and his colleagues (1985) carried out three experiments. They found that radio presentation lead to quite low recall scores (22-29%). They suggested that it is extremely hard to improve the obtained scores by the addition of TV pictures. According to them it does not help to show the newscaster presenting the message; neither does the addition of geographical maps enhance the subsequent recall. This study showed that the

information recalled from weather forecast was quite limited and adding visual aid did not improve the recalls. This report, however, contrasts with the findings of Berry and Brosious (1991), Findahl (1971) and Stauffer et al., (1981), who all reported a positive impact of bisensory presentation. Berry and Brosious (1991) found that if appropriate film is accompanied by heard news, the topic presented was recalled better than when was a talking head alone was reporting a news story.

However, Wagenaar's is not the only research reporting no effect for bisensory presentation. Other studies in media studies have also reported confusing findings. For example, Wilson (1974), comparing the loss of information from different media, reported that in terms of the level of recall, print was better than both audio-visual and audio only presentation. Furnham, Benson and Gunter (1987) reported a similar result. According to them, when they compared listening to an audio-tape with seeing the same content on television, the audio-visual situation of TV did not produce any better recall than the audio only condition. They report that reading produced significantly better recalls than either TV viewing or listening to an audiotape. They attributed this to more attentional consumption in reading mode producing a more in-depth comprehension. On the same ground, Jacoby, Hoyer, and Zimmer (1981) compared miscomprehension rates from news and advertising messages presented in audio-visual, audio only, and print modalities. They reported that messages conveyed in print were understood significantly better than the same messages received via audio-visual or audio only conditions. According to them, there was no difference in recall rates between audio-visual and audio only conditions, but recall from print improved when readers were given unlimited rather than limited time to read the texts. These controversies, again, may reflect other interfering variables, such as pace of presentation, the type of selected content material, the instructions given, levels of prior knowledge (Berry & Brosious, 1991). Instead of controlling these more obvious potential factors, Furnham and Gunter (1987) suggested that in comparing media, there are so many variables involved that even un-important ones can affect the outcome of a research. They controlled for variables such as time-of-the day and its impact on immediate recall of violent and non-violent news. They reported that both time-of- the day and the level of violence in the programmes influenced the recall from different modes of presentation. In general, the



range of possible interfering variables is vast. Particular variables that affect the qualities of different media or the capacities of the channels may affect the cognitive processes involved in information processing from different modes (Quealy & Langan-Fox, 1998). Or it might be that the underlying cognitive processing of the inputs from different modes can affect the recalls (e.g. Baddeley, 1999).

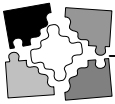
The differences between media revealed by the existing literature of media studies have not entirely been consistent. These inconsistent findings may suggest that apart from media per se, the cognitive process underlying the inputs from them should be carefully understood. Another interesting point would be to control the nature of the audio-visual contents. As discussed above, if better recalls are achieved in a learning situation when the same information is presented via different media, attributes like the mere channel augmentation through picture addition should not be taken as a responsible variable. The interaction between a channel and its content can be of crucial importance (Schramm, 1977). It might be that some of the earlier studies on audio-visual presentation comparisons have used channel-augmentation while others have used channel-enrichment. How these issues can be discounted?

Bisensory Augmentation

Another topic that has dominated the discussions on comparative media is bisensory augmentation. When reading (a visual input) and listening (an audio input) as two single channels that are compared with television and a better recall is emerged in the TV group it can be concluded the sum of AV may be producing a better integrated picture. This conclusion may, however, be well premature as in TV presentation, there are many other variables; such as spatial formal features that in the combination of reading and listening could not be found. In comparing reading and listening with TV presentation, very few control has been seen in the literature about this notion to validate the real value of bisensory augmentation (e.g. Stine et al., 1990). As discussed above, mere channel augmentation in terms of picture addition to the audio or text (or vice versa) cannot be taken as important without paying attention to the type of augmentation. Augmentation, which cannot produce a connectionistic relation, might not be beneficial. Therefore it may be a disadvantage in general. This means that if channel addition cannot merge into a more enhance version

of the stream of inputs, it cannot produce a better processing but exhausting the processing resources. Conversely, as evidenced before, it may even be taken as a disadvantage to a channel.

The view that bisensory presentation aids memory and enhances its processing resources in terms of overall recall has been proposed for a long time (e.g. Goodwin, Chu, & Schramm, 1967; Katz, Adoni & Parness, 1977). Katz et al. considered the importance of presentation mode on recall and asked 200 adults in Jerusalem either to watch the evening news in a normal fashion, or to listen to it but turn away from the screen and not watch the picture. They found that those who watched as they listened were able to recall more news items than those who only listened. They reported that in a similar situation, radio listeners forgot more news items than television viewers, but that individuals who viewed a television news programme performed no better on tests of content recall than individuals who had only listened to the same content. It should be born in mind that in Katz et al.'s experiment all the respondents were exposed to the news materials in their homes. When they compared recall from radio news versus television news, they were unable to control for the number of news reports presented and the length of the news broadcasts. Their radio or television newscast could contain longer or more news items than the other. In another study controlling for this variable, Stine et al. (1990), comparing age difference among younger and older adults, analysed the recall from TV, listening plus reading and listening only conditions. They concluded that channel-augmentation does indeed affect recall in different ways. Younger and older adults listened to segments of television news under three presentation modes: (a) Listening to the segment without visual track; (b) Listening plus reading of the same material concurrently; and (c) Viewing the normal TV condition. They reported that younger adults showed better free recall for the spoken information when it was augmented by the written transcript or video track. Older adults did not show this benefit of bisensory augmentation. Stine et al. also reported that in the normal TV condition, there was a substantial age difference in performance, which could not be accounted for in terms of working memory processing of the inputs. They attributed this variance to mode-of-presentation effect and suggested that the differing involvement of working memory processing at different ages is a function of input modality.



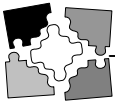
However, while in some instances bisensory augmentation is shown to enhance recall, it may also be taxing to processing resources. Wagenaar et al. (1984) asked 42 younger Dutch adults to remember a series of words and pictures that were presented either auditorily, visually, or in both modalities. They manipulated modes of presentation by presenting the same material via (1) visual alone, (2) auditory alone, (3) auditory plus visual, matching items, same order, (4) auditory plus visual, matching items, non-contiguous order, (5) auditory plus visual, non-matching list, same categories in same order, (6) auditory plus visual, non-matching list, same categories in non-contiguous order and (7) auditory plus visual, non-matching list, visual list non-categorised. In conditions 3 to 7, each auditory stimulus was paired with a simultaneous visual stimulus. The results indicated that, with the exception of condition 5, no cross-modal facilitation of recall occurred in the bisensory presentation of unconnected word sequences. According to Wagenaar and colleagues, the gain that could be obtained by presenting the same piece of information in two modalities was even smaller than could be expected by presenting each item twice, because of the depletion of available resources to participants. These researchers thus reported that the bisensory presentation of words and pictures enhanced recalls relative to the single modalities only when the items from the two modalities represented an elaboration on a single concept. According to them, bisensory presentation does allow for facilitation, but only under conditions under which, simultaneous presentation allows a link to be created between two distinct but relatable stimuli. This may imply that there is no advantage in memory tasks to bisensory presentation per se and that all observed advantages are due to processes of elaboration. Therefore, presenting information in two modalities is not effective unless it is possible to create a new representation that combines material presented separately. They argued that without this sort of elaborative support of one modality for the other, bisensory presentation could produce negative effects by exhausting processing resources. This account is very similar to Waddill and McDaniel's treatment of the types of picture addition in textbooks discussed earlier. However, in considering the outcomes of this research, it should be reflected that the authors' main incentive in running it was to answer the question: "Does bisensory presentation of matching information lead to a cross-modal interaction, such that the amount of information

recalled is larger than what can be expected on the basis of independent combination of the two input channels?"

Both the laboratory and field research reviewed suggests that visual elaboration of auditory information can affect the recall of the receivers. But the way it interacts goes back to the earlier evidences from the educational literature that was discussed above.

Channel Enrichment

As has been mentioned before, considerable research has been devoted to the role of pictures accompanying written text or oral prose. However, the studies have had a variety of interests and few have used channel-enrichment as a theoretical base. Some have compared the learning of word or picture pairs; others have focused on information transmission through single or multiple channels. It can be concluded so far that if channel augmentation is positive and improves learning, the respective channel is enriched via the auxiliary one. Channel-augmentation on its own does not necessarily have a positive effect. If a person reads or listens to the same content, the learning outcome can not be guaranteed to be the same as a TV presentation where motion pictures are augmented by the sound or pictures augment the audio presentation. Channel enrichment, in this way, is a topic that shares the literature of comparative media with channel augmentation in various dimensions. Many of the investigators involved in comparative media studies have tried to reconcile the existing findings by attributing any channel supremacy to enriched capacity. Studies concerned with the impact of channel enrichment, when pictures are added to text and presented either verbally or by reading have mainly supported the beneficial effects of having an enriched channel. But this picture-addition depends on the text-picture relationship that was discussed above. Studies in educational settings have shown that meaningful learning is facilitated by imagery-eliciting strategies such as pictorial attractions, concrete verbal stimuli, and imagery instructions. Many of the studies reviewed above did not distinguish between the type of enrichment that their additional medium provided. This confusion needs to be removed in any research that compares the effectiveness of a single mode of presentation with bimodal presentation.



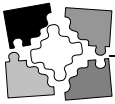
Symbol System

Symbol system has to do with formal aspects of any message contained in each presentation mode. In each condition, communication is shaped with an overall atmosphere that makes a whole of the contents embodied with various formal features of the message in the shape of different icons. This means that information; in order to be conveyed has to be expressed in the form of a message (e.g. Afzalnia, 2000). In order to make a message, information (ideas) have to be physically materialised. They have to be embodied into a physical property of sound, pictures, signs, signals, symbols, etc that with a learnable rules (syntactic) could be (semantically) understandable to other end of the communication link. The way a message is formed can, thus, make a lot difference in decoding its content and making sense of it. The formed message, however, would need a channel or a way to be conveyed to the receiver. This way of presenting a message is forming a medium of presentation. Therefore, there can be separate attributes of media stimuli and the interactions of those components that characterise various media contribute to the learning experience. In terms of media comparison, each mode is capable of using or carrying different messaging system that is made of a formally unique pattern or symbol system (Salomon, 1979). Salomon clearly articulates this position: "Media's ways of structuring and presenting information - this is, their symbol systems - are media's most important attributes when learning and cognition are considered..." (Salomon, 1979, p. 216). A symbol system is, thus, defined as certain semantic and syntactic features that stand as particular icon and can be mastered through learning and practice. It is a set of elements interrelated by syntactic rules or conventions and used in specifiable ways in relation to the referent.

This concept of a symbol system can be applied to the formal aspects of media representation. Linguistic symbol systems are language based, entailing discrete elements, which can be recognised according to clearly defined syntactical rules. Semantic properties, however, can be ambiguous; e.g. the work "fast" can mean a speedy movement or a type of food. Spatial systems, which include pictorial representations such as film techniques, motion, drawing and graphics are characterised by even more ambiguity. In reading, visual icons that stand for verbal meanings shape the form of

communication. In listening and TV, however, we are dealing with formats of icons that are not necessarily the same but follow the same principle. In TV, two modes are presenting parts of the same content but promoting one subject matter that is embedded in the bisensory presentation. TV can present pictures, audio, and print in spatial or linguistic codes, which are perceived, stored, encoded, and retrieved by learners in different ways, and the effectiveness of these various attributes has received some research attention. With this consideration comparative media studies can apply a new concept when comparing comprehension and recall from reading, listening and TV viewing. According to Nugent (1982), the spatial features of pictures can offer many dimensions for coding information. In presenting depth of information, however, they lack the focusing quality of print. A sentence, whether presented auditorily or in writing can concisely convey a piece of information which may be difficult to extract from the many cues provided by the pictures and vice versa; a picture can be louder than a thousand words. Nugent, addressing the question whether presentation by an iconic system (pictures) and linguistic system (print or audio) aid learning, has reported that when content differed between the systems and information was presented simultaneously the processing of information was not effective. In his experiment, the presence of visuals did not interfere with processing the audio, and vice versa. Based upon the symbol system hypotheses, he suggested that if separate information is transmitted via pictures and audio, learners can process each independently, but positive interaction between the two components is minimised. Nugent (1982) concluded that learners process pictorial and linguistic information through interconnected cognitive systems and pointed out the need for further research to define more closely the unique blend of symbol systems that characterises various media.

Salomon has suggested that in a TV situation, where many auditory and particularly visual formal features are shaping a new whole that is more than the mere integration of AV channels, a new symbol system is shaping. This symbol system is more than the combination of audio and visual basics. Integration and synchronisation of AV material before delivering the input to human information processing system makes a new system on its own that can produce one entity and not two parallel ones. According to him, processing information

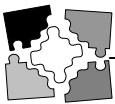


from TV is entirely dependent on a unitary symbol system, which makes retrieval quite different from that in reading or listening. Salomon believes that mastering the symbol systems, which are emphasised by particular medium eases decoding and learning from that medium. The long-term processing of television's formal feature and the syntax of cinematic messages provides a sort of expertise, which eventually might lead to automation. Just as one learns in reading that symbols can stand for thoughts and ideas, so television is a vehicle for different symbol systems (verbal language, colour, space, depth, motion, positions, gestures, visual effects, sound effects, etc.) that are put together with consideration of the two parallel channels. With this new format, TV has formed its own symbol system that is different from its constituents. Hornbook (1978) and others siding with this view, suggest that the message coming from TV is mixed before being delivered to the memory system and thus, makes a sort of enriched one-channel-like situation. Based upon his view, the inputs into the memory system are treated as an integrated symbol system that is more spatial in characteristics and which contains sequences of message that have to be put together in order to make coherent sense. Processing information from TV is dependent on a unitary symbol system, which makes retrieval quite different from that found in reading or listening. This unitary symbol system in TV is made of the AV contents put together via TV techniques (i.e. cuts, fades, dissolves, kro-ma-keys, etc., with TV camera and editing effects mixed with auditory sound effects) that can produce a unique whole body of physically integrated AV inputs. It appears as if this new audio-visual medium, by producing spatial information such as size, level, location, and attractions such as pitch and tone in its audio channel, provides better markers that should help recollection of the input. According to this view, television is a vehicle for different symbol systems (verbal language, colour, space, visual effects, sound effects, etc.). Salomon (1979) argues that "symbols can stand for thoughts and ideas" (p. 229). These codes, therefore, may require different kinds of viewer's knowledge, relying on viewer's background experience and prior knowledge similar to but independent of those relevant to reading and listening. According to Salomon (1984), learning TV is easier than learning to read. Considering television and print as categories for which children have general perceptions, Salomon (1984) reported that children felt more efficacious with TV, and

perceived it as more realistic and easy to understand. Print, according to this research, was reported to demand more effort, but led to better inference making. (However, the replication of this model by Bents [1989a] on Dutch students did not support this theory.)

Although comparative studies provide some evidence as to the relative effectiveness of print, audio, and pictures and give some insight into processing differences, they fail to consider systematically the relationship between the three intermedia attributes and their symbol systems. To maintain experimental control, comparative studies have generally presented redundant content in print, picture, and audio form. Content can be controlled, but since these three components represent different symbol systems, structural redundancy may vary. On the one hand, print and audio can present information that is redundant in both semantics and syntax. Although they are presented and processed via separate sensory modalities, they are both linguistically based systems and structure information in the same way, through words. Pictures, on the other hand, represent an iconic symbol system whose structure differs from print or audio. A sentence can sufficiently convey a piece of information, which may be difficult to extract from the many cues provided by the picture.

In terms of cognitive psychology, there are research indications that pictures may facilitate working memory management in several ways (e.g. Mousavi et al., 1995). For example, pictures can serve as an external memory, so that the reader can avoid searches of long-term memory or the text itself, when information is required (Waddill & McDaniel, 1992; 1998). Glenberg and Langston (1992) have demonstrated that pictures can lead to a reorganisation of information in working memory. In presenting depth of information, however, they lack the focusing quality of print and audio, modalities, which deal with more abstract semantic processing. In Glenberg and Langston's experiment, subjects read texts describing four-step procedures. The texts described both the contents of the steps and the order in which the steps were to be performed. When reading without a picture, subjects tended to represent the steps in the order in which they were presented in the text. When pictures illustrating the order of the steps accompanied the same texts, subjects tended to represent the order of the steps as executed, rather than as described in the text e.g. Radvansky & Zacks, 1997). A sentence can convey a piece of information that may be difficult



to extract from the many cues provided by the picture. On the other hand, according to Burgess and Shallice (1997), in cognitive processing of the inputs from each channel, spatial cues provided by the mental image produce better markers when retrospective memories are needed in recollections. In other words, the markers from the inputs that might form the essentials of the episodic memory (Baddeley et al., 2002). This difference in information retrieval may represent some underlying differences in information processing due to a particular symbol system, which is digested differently via our internal processing.

Factors Affecting Contradictions before, during, and after 1980s

As discussed earlier, most of the early studies in various literatures were mainly concerned with channel supremacy. Nevertheless, part of the reasons that research on learning and memory from the three concerned modes of presentation is inconsistent in its findings, appear to be related to a number of factors, including the following:

Diverse and Sporadic Pre-1980s Literature

One of the main reasons that the studies of 1960s and 1970s were ending up with confusing outcomes is that they were inspired by the previous generation of unsettled comparative media studies. The earlier literature resulted in bewildering reports (Afzalnia, 1992). Nevertheless, some newer studies like those of Furnham and Gunter's group at University College of London during 1980-1990 still tended to imitate the issues raised in previous generation of studies (see Berry & Brosious, 1991, for more details).

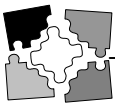
When film and later television entered into this comparative arena, more researchers in media and commercial studies showed a keen interest in the topic of bisensory augmentation that was a supplement to picture-text and text-audio-visual comparisons. In this more recent media literature, the main concern of the researchers was to compare TV news and commercials with radio and press. Their interest was to explain the impact of channel enrichment by adding picture to the talking head news conditions on the one hand (e.g. Berry & Brosious, 1991) and on the other to consider the role of channel augmentation in bisensory studies of recall (e.g. Stine et al., 1990). As discussed before, evidence from these new studies indicated that presentation mode was indeed an important variable affecting recall of the contents. But on the old

question of which channel is superior, there was no unanimous agreement. This may give rise to speculations that the question of medium superiority may be fundamentally a wrong question that has misled the literature for decades.

The Role of Tasks and Intentions in Information Processing from each Mode

Theories of action control suggest the importance of intentions in processing the input information (Goschke & Kuhl, 1993). Anderson (1983a) has developed a model that shows the importance of such goals in adaptive control of thought. According to Anderson's model, so called "goal nodes" are conceived as sources "of high and constant activation" (p. 156). They are described as the only elements in working memory "that sustain activation without rehearsal" (p. 118). One of the essential questions about intention memory related to episodic memory (e.g. Baddeley et al., 2002), is whether representations of intended activities differ in their dynamic properties from other memory contents. Do intentions in real life learning situation produce a persisting task tension that would lead to superior recall of incomplete or even completed activities? Goschke and Kuhl (1993) reported that such goals and intentions are important in maintaining activation in memory. Examining specific hypotheses about intention memory that were derived from more general theories of action control, they maintain that representations of intention show a heightened level of sub-threshold activation in long-term memory that cannot be accounted for by the use of controlled strategies. According to them, most long-term memory goals can be achieved only if one maintains an intention even in the face of momentary distractions and competing action tendencies. The more sustained level of activation of intention representations may thus be a simple yet effective means of inhibiting competing intentions and increasing the probability that the intention will be retrieved when its execution conditions are met.

But the general conclusion that can be driven from the most recent studies reviewed by Burgess & Shallice (1997) proposes that while abilities and functions related to retrospective memory (RM) are distinctly different from prospective memory (PM), retrospective memory has a poor relationship with what we recall in prospective memory. In other words, while remembering things in the future require the memory of the inputs that have happened in the past, the retrospective component is only a small part of what is required in prospective



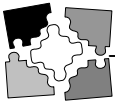
memory. They suggest that "RM abilities are however a pre-requisite for PM behaviour, but not vice-versa." (p.256). They further argue that recollection from any input of data that involves an instruction or a planning, involves stages of forming a description for retrieval, followed by post-retrieval verification procedures. According to them each recollection appears to be a direct consequence of the way event-memories are represented: "Recollection appears not to proceed by the activation of an invariant "record" or an event; the process is more of deliberate reconstruction as many authors have underlined ... recollection occurs through the action of two processes. These nodes are linked by connections of differing associative strength carrying pre-existing semantic association. Recall of semantic information proceeds through activation of these nodes" (pp. 260-261).

With the above explanations, it can be understood that the instructions provided to the participants in different situations could be one of the cognitive factors responsible for setting different goal nodes. These goal nodes attract attentional resources of human cognitive system differently. This can also explain why, in different situations, special instructions have produced differing results. In reviewing the literature, it is found that most of the studies that have compared mode of presentation effect have provided different instructions to their participants at various stages (e.g. Furnham & Gunter 1989). Studies of the memory for courtroom testimonies (e.g. Harris, 1978; Harris & Monaco, 1976) show that memory is influenced by pragmatic implications (Cohen, 1996). When memory is tested for actual words or scenes that have been experienced, people often cannot distinguish between what was explicitly stated and what was only implied. As in the study which was carried out by Harris (1978), a similar tendency seems to be working in medical and legal cases: people tend to make constructive errors even when they are warned to avoid them (Afzalnia, 1988). Afzalnia ran a study on a normal adult group using a listening comprehension situation in which he instructed his participants to repeat verbatim sentences that they heard without a word extra or less. Despite his strong instructions and participants' effort, he found his participants distorted the brief news stories they heard.

Other studies have reported that there is a self-relevance rule in the absence of an active instruction or goal. Self-relevance favours a memory model in which memories are constructions of central control

processes. Memories are transitory mental representations that must be effortfully maintained in working memory if they are to endure for more than a few moments (Cohen, 1996). Anderson and Conway (1997) suggest that aspects of the self may act as goal-activated control processes. They propose that the self constrains the current interpretation placed on a constructed memory, while reciprocally a constructed memory constrains what forms self can take. Kahan and Johnson, (1992) tested this idea of self-reference influencing recall and expressed a similar view, suggesting that the advantage for self-referring material extends to memory. They tested this idea by asking pair of female subjects to hold a conversation on general topics and generate 20 adjectives, 10 that described themselves and 10 that described their companion. Subjects were to report these traits to each other and evaluate them as accurate or inaccurate. Two days later they were unexpectedly recalled and tested individually for free recall of the traits. They were also asked to recall who had generated each trait and whom it referred to. Subjects recalled more of the traits they had generated themselves and their recall of what their partner had said showed a strong self-reference effect. In other words, they remembered far more of what their partner had said about them than what the partner said about herself. These findings confirm the intuition that the self-reference effect operates in conversation. People are particularly interested in what people think about them and can selectively remember what is personally relevant to them.

But again this assertion does not seem to be universally agreed. Researchers studying doctor-patient dialogues, for example, have expressed the view that personal relevance and self-reference are not always enough to ensure good recalls. When patients come back from their consultation, they remember very little of the advice and information they have received (Ley, 1978). Estimates of how much people remember of what the doctor has told them range from 46% to 63%. It should be remembered that in these experiments, the patient's anxiety could have affected the level of recalls. Although the perceived importance of the information does affect recall, patients do not seem to be very good at spontaneously selecting the most important elements of the conversation to remember. Based upon Ley's report, memory for diagnostic information is best and memory for advice and instructions is the poorest, although in practical terms this is the most important. The phenomenon



appears to be largely due to a primacy effect: the first items of information are best retained, and many doctors present their diagnosis first.

Measurement Tools Affecting the Outcomes

In searching for methodological factors contributing to the ambivalence in news and advertising media comparisons, one possibility is the testing procedures. Although results showing that recalls from film presentation were advantageous over those from sound-only channels were reported during 1980s, Gunter and colleagues have later reported evidence of negative effects of film on learning from news (Furnham, & Gunter, 1985; 1987; Gunter, 1979; 1980a; 1980b; 1980c; Gunter & Furnham, 1986; Gunter et al., 1984). In a detailed criticism of factors which contributed to the above inconsistency between the findings of Furnham and his colleagues and the rest of the literature, Berry and Brosious (1991) explain how using interchangeable free and cued recall tests as measures of learning contributed to those outcomes. According to them, Gunter, Furnham and their colleagues, asked what subjects could recall after presentation of materials through different modes of presentation. Apparently because free recall of material in discrete episodes is common in academic studies and because it avoids the need to prepare questions in advance, this method was predominantly used in their research paradigm. But free recall says little about what has been learned when participants are reluctantly expressing their recalls (Berry & Brosious, 1991; Brosious, 1989; Robinson & Levy, 1986). Free recall can be best for measuring tasks related to sequential events (Paivio & Csapo, 1973). It can be more accurate in measuring central issues, but when it comes to non-sequential events and episodic memory is measured, (McDaniel, Kowitz, & Dunay, 1989), it can merely show that little is recalled (Berry, 1983).

Cued recall, on the other hand, produces an elaboration of existing central subjects in memory representation (McDaniel, Kowitz, & Dunay, 1989). McDaniel and his colleagues ran three experiments to investigate the influence of initial recall on memory by assessing delayed recall after different immediate cued-recall tests. In all of their experiments, subjects performed semantic and phonemic encoding tasks on a word list. They then received (i) a cued-recall test that cued the target using the same word as the context word in the encoding task, (ii) a test that cued the target with a word from the same level at which the target was

encoded, (iii) a test that cued the target with a cue from different level at which the target was encoded, or (iv) no immediate-recall test.

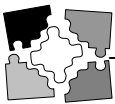
One day later, the subjects performed a final cued-recall test in which the type of cue (semantic or phonemic) was varied. Delayed recall was found to be consistently facilitated, primarily when the cue on the immediate test was from the same level as the cue on the delayed test. This pattern of facilitation suggests that cued-recall produces an elaboration of an existing memory presentation, the effect being closely tied to the type of cue used on the immediate test: recall attempts of previously encoded targets can improve performance on later memory tests for those targets.

It also implies that once an episodic memory representation of an event is established, subsequent retrieval can alter the memory of that event. Consistent with this, there have been other attempts to determine how retrieval of an event may alter the original encoding of the event. Bartlett (1977) presented subjects with lists of six words each, and immediately after presentation of each list, recall was cued with either non-semantic (orthographic or temporal) cues or semantic (category) cues. Initial retrieval with the semantic cues enhanced retention on a subsequent final free-recall test more than did initial retrieval with the non-semantic cues. This finding suggests that initial retrieval operations are guided by the retrieval cues provided with semantic cues prompting deep (semantic) processing and non-semantic cues prompting shallow (non-semantic) processing. Free recall measures have often been found to have low correlation with questions-prompted recalls (e.g. Berry, 1983; Robinson & Levy, 1986).

It can be seen that those who used free recall tests tend to report mixed consequences, whereas the findings reported by those who used cued recall tests emerge as highly consistent (e.g. Edwardson et al., 1976; 1981; Findahl, 1971; Stauffer, et al., 1981). In view of the above, Quealy and Langan-Fox (1998) express their view that early media comparisons were poorly designed and ultimately invalid.

The Influence of the Content of Presentation Mode

Other factors associated with the contradictory reports are related to the type of material or to the kind of content presented. For example Edwardson et al. (1976), who reported no benefit of film over the non-pictorial single channels, used a less interesting film to accompany local news than



Edwardson et al. (1981). Other reports of the negative effects of film reported by Gunter group and his co-workers (e.g. Furnham & Gunter, 1987; Gunter, Furnham & Gietson, 1984; Furnham and Gunter, 1985; Gunter and Furnham, 1986) used a test sequence that was taken from an experimental broadcast satellite. This presentation series was unlike that of normal network broadcast in that no presenter appeared on the screen and only the voice of a single narrator was heard over the film. Other negative findings regarding channel augmentation in film medium, where pictures are mixed with auditory presentation and compared with a single medium of reading or listening only condition, can be explained by the fact that most of these studies included violent items, which appear to impair learning from a voice-over (Gunter, 1987; Gunter & Furnham 1986). However, the reported means for film and sound-only conditions across the four relevant studies by Gunter et al. show little evidence of more film-related impairment with violent items. Seven groups showed superiority of recalls with sound only and two with film, compared with six and two respectively for non-violent items.

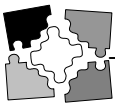
Another criticism that seems to be relevant to the type of material used by Gunter and his colleagues is that they used written material, which involved visualisation. Participants in the research had to use their imagination in visualising the contents. There were many points here and there that need personal interpretation and this could have some confounding effects. Research on memory for prose indicates that imageability of prose is one of the most important elements in comprehension and memory (Brooks, 1967). If the text chosen is of such a character that it requires more imagination in order to understand, this criticism can be of prime importance. Brooks (1967) has reported that if people were given a complex message that needed to be visualised (e.g. verbal description of a layout), recall of the message was enhanced if it was presented solely in auditory mode rather than a combination of auditory and visual modes in which people simultaneously had to listen to and read the message. His earlier series of studies in 1968 and 1967 inspired the idea that inclusion of written material, because it involved visual imagery, apparently interfered with the visualisation needed to recall the message. One possible explanation for these results is that the visual imaging tasks and/or the visual perceptual processing were simply more difficult than were the verbal storage and auditory processing tasks. Another attempt to show the importance of visual

imagery in reading mode and the role it plays in choosing different type of content is Levin and Divine-Hawkins' (1974) experiment. They presented children with prose passages that they either had to listen or to read. Half of the children were requested to visualise the story content. On the subsequent test of content knowledge, children who listened to the story performed better than those who read it but only under visualisation instructions. Visualisation improved performance only when the visual system was not required to process the original material.

A final possible explanation for the discrepant findings in media comparison research can be that in those studies which reported a worse recall in bisensory channels there was poor picture-text correspondence (Goodwin, Chu & Schramm, 1967). As Berry (1983a) believes, part of the reason why Gunter's (1980) report suggests that picture items may inhibit learning of non-pictorial items lies in the nature of the visual material: Gunter's material involved recording a re-written version of the text over the film. It seems now well established that film-text correspondence affects news learning in a positive way (e.g. connectionistic effect e.g. Waddill & McDaniel, 1992). These findings indicate that the kind of content used in experimental studies comparing mode of presentation can have a determining influencing effect on the outcomes.

Age-related factors

It is well established that there is a developmental progression in the way children process and store their perceived messages (e.g. Hitch et al., 1989). For example, it is known that older children make greater use of active mnemonic strategies. Conrad (1971) reported that older children's recall was impaired by phonological similarity among the names of items, but that younger children were insensitive to this manipulation. Results like these have supported the view that older children make use of storage systems that are unavailable to younger children (Baddeley, 1997; Hitch & Holliday, 1983). Hitch et al. (1988) have demonstrated that younger children tend to rely on visual rather than phonological coding. Since there are phonological memory codes for both visual and acoustic information in adult age group (e.g. Hamilton & Holzman 1989; Shulman, 1972), pictures gave rise to higher overall recalls. Hitch et al. (1989) suggested that "at around 5 years of age, visual inputs gain obligatory access to the visual component of working memory, as in adults, but that the control processes necessary for them to gain



access to the phonological storage component have yet to develop” (pp 183-184).

These and other studies have documented that there are different information processing levels that take place during different stages of development. Ackerman (1981), for instance, suggests that there are developmental differences in encoding the sensory and semantic information in stimuli, which may result from differences in the efficiency with which the semantic information in perceived data is processed. He goes on to suggest that young children typically encode stimuli in a fashion that stresses the sensory aspects of the input message and this causes the deficiency of recall on messages that need a more semantic level of recall. According to him, children differ from adults in the relative mix of sensory and semantic information in a stimulus that is encoded. Young children encode relatively more of the sensory information than the semantic information in a stimulus, producing an episodic memory weighted with sensory information. Adults encode relatively more of the semantic information than the sensory information, producing an episodic memory more heavily weighted with semantic information. As a result children consistently show specificity effects of encoding modality for relatively all kinds of stimuli when the encoding activity is unconstrained. Consequently, children may remember the presented events as well as adults do, but in different ways. Therefore, running comparative media research on different age groups may well have established the existing confusion (e.g., Afzalnia, 2000).

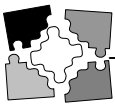
Prior Knowledge Effect

Evidence indicates that prior knowledge has an impact on recall performance. Studies applying more general cognitive model of the memory into this issue have discussed the role of short-term memory access to long term memory resources and emphasised that prior knowledge can affect the processing. It has been suggested that prior knowledge is an influential variable in showing how well participants can understand a content (e.g., Eckhardt, Wood, & Jacobvitz, 1991). Background knowledge is necessary to encode, integrate, and store information in meaningful ways. Knowledge is also important at the time of retrieval. Knowledge cues can influence the type of content that is remembered and the type of errors that are made (Craesser, 1981). The speculations also cover the assumption that the limited capacity (e.g., Baddeley, 1990) of ‘transforming memory’ (described below)

may constrain information processing in TV viewing to an even greater extent than it does in reading or listening because of the receiver’s lack of control over the pace of the inputs (Eckhardt, Wood, & Jacobvitz, 1991). According to Craesser, memory is re-constructive over time. Schema knowledge, which guides the text’s comprehension and interpretation and which allows information to be inferred, becomes more important in guiding retrieval as networked cues are increased.

One role of prior knowledge is to provide expectations or cues about what happens next. A schema not only provides a framework to guide comprehension but also allows inferences to be made to fill in any missing gaps in comprehension. Eckhardt et al. (1991) have argued that both verbal ability and prior knowledge about the topic that has been presented influence adults’ comprehension. They examined the relative contribution of prior knowledge to comprehension and memory for a televised film about the Underground Railway in both immediate and delayed retrieval conditions. Results indicated that people with average to high levels of prior knowledge performed best on the comprehension measure, and those with low levels of prior knowledge had the lowest performance. This variable was a good indicator of comprehension especially in the delayed recall condition. They concluded that prior knowledge provides schemata for retrieval cues that are critical for accessing memory after a delay.

This relationship of prior knowledge to comprehension level is explained by cognitive psychology in terms of information-processing mechanisms in the human memory system. According to Logie (1995) and Bruce (1996), perceptual memory’s way of accessing long term memory affects the quality of comprehension. Therefore, it would be predicted that people less knowledgeable about the topic of presentation, who possibly have less automated processes, will suffer capacity limitations in transforming memory and this can affect their quality of understanding. Apart from the vital role of the background knowledge in recollection, a wide range of cognitive research fails to show that interest in a topic leads to a higher level of recall of a message. Surveys on weather broadcast, for example, shows that most people find weather reports interesting and relevant to their lives, yet all studies of weathercasts show that weather information is poorly recalled (Wagenaar, 1978; Wagenaar & Visser, 1979). Wagenaar’s (1978) study on people’s recall from radio and



television broadcast, shows that the amount of information that people recall may be affected by their background experience and immediate concerns. He used 32 weather-idea units and 70 traffic-idea units and provided information about time and place. Testing memory in a cued recall condition, it was found that the weather report showed a ceiling of about 8-idea unit whereas the longer traffic report had a ceiling of 17 ideas. In general the percentage of a message that was recalled declined with message length. Wagenaar (1978) pointed out that the complex structure of the language made it difficult to select a part without first analysing the whole.

Studies on memories from medical consultations with doctors also show that there are very little that the patients can recall (Ley, 1978). According to Ley patients who have highest interest in their health-related information do not seem to be very good at spontaneously selecting the most important elements of the conversation to remember. Situations like these bring forward the question: how can information be structured or put across so that it is remembered better? What factors influence the amount of information that is recall with fewer errors?

Cultural Bias

The more recent empirical evidence obtained outside Britain in early 1990s (e.g., Afzalnia, 2000 [in England]; Stine et al, 1990 [in USA]; Beentjes & Van der Voort, 1991 [in Holland]; Small et. al., 1993 [in USA]) and most recently (Mousavi et al., 1995; Quealy & Langan-Fox, 1998 [in Australia]) indicate that a more coherent body of empirical evidence needs more cross cultural examination. Afzalnia (1992) revealed that in reporting research outcomes, there is a distinct cultural effect with USA dominating this field. Because the literature is influencing the research trend, cultural bias could hve influenced the existing controversies.

Other Factors not been Considered Fully in the Literature

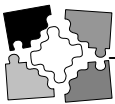
Looking at media comparisons in terms of cognitive psychology, only the recent examination of Quealy and Langan-Fox (1998) has used cognitive models taken from Atkinson and Shiffrin (1968), Wickens (1992), and Baddeley (1986). This examination encourages the notion that instead of studying media on their own, the underlying cognitive functioning should also be brought into consideration. However, Quealy and Langan-Fox's

account in comparing different media was not purely analysing the underlying cognitive effects that would take place in each mode of presentation. Their research, described earlier in this chapter, was specifically related to the notion of whether increasing media complexity would improve learning outcomes as measured by memory and the circumstances under which that improvement may happen. Using computer-assisted instruction as the means for modern educational media, a cognitive mechanism was proposed to account for such improvement.

On the other hand, measures of modality effects have been mainly conducted with short-term memory (see Pezdek, 1977; Pezdek, Lehrer, & Simon, 1984). In order to have a better understanding of true nature of modality effect in applied settings, we need more research investigating the type of learning and comprehension arising from different modes of presentation. No study to our experience has ever compared the longitudinal eefect of medium of presentation on long-term memory. We need to explore how much information is lost in the long run if the impact of a medium on memory is going to be explored.

Summary and Conclusions

This paper's review of the research findings has revealed that in comparative media, there are deep controversies over which medium, if any at all, can be known as a dominant mode of presentation in terms of learning and recalls. However, it was suggested that many studies were poorly designed owing to extraneous variables such as content variance, age difference, instructions provided, for more recent media and measurement tools. The overall results of this review imply that human communication consists of a combination of language and visuospatial formats presented so that the comprehender can develop an understanding of the experience being communicated. Good recall may depend upon the processing of at least two kinds of situational and relational information. Relevant pictures may enhance our comprehension of written texts and auditory materials, but the perceptual and cognitive processes that underlie this effect have not been identified. Because integrating the information contained in a presentation format places demands on transforming memory, the effect of a picture may be to expand the functional capacity of working memory and thereby to facilitate comprehension (e.g. Glenberg & Kruley, 1992;



Mousavi et. al., 1995). A more complete understanding of comprehension and memory processes will depend on revealing the underlying effects, influences, and representations produced by language and visio-spatial entities.

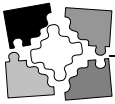
What is learned from the above review on the effectiveness of pictures in an educational setting is that it is probable that certain kinds of pictures facilitate the learning of certain types of objectives for certain people with certain kinds of characteristics. The early meta-analysis of media comparison studies carried out by Schramm (1977) concluded that medium per se was unimportant in instruction or news and advertising media. However, the effort that has been spent on media comparisons in the last fifty years has revealed that the analysis of variables related to the surface of these media cannot be productive. Instead, the underlying cognitive effects, especially attentional aspects, should be more intended. There are more factors below the surface of media comparison, like the precise relationships between the underlying memory processes in relation to various symbol systems have not yet been fully explored.

In comparing recall following reading, listening or TV viewing, various explanations have been put forward to account for the differences reported in the literature. Those who reported the supremacy of print over TV and audio only presentation suggested that the main advantage of print over television and listening is that the reader is self paced, whereas, the viewer or listener of broadcast is usually presented with material at a rate determined by the presenter. But, does this pace really matter? Is it the attentional aspects of processing image that makes the pace so important? Another advantage of print over the other two presentation modes is the imagination that is hypothesised to exist more in reading and listening than in TV viewing, where images are ready-made supplied. Those who contest the supremacy of TV over verbal receptive communication modes argue about other dimensions of the presentation mode. They appear to believe that action, motion, spatial figure and visual images combined with sound-effects and other formal features of TV (like chroma-key, and other cinematic effects) make the presented material more salient in memory. Therefore, they argue that recall from this medium with strong formal (spatial) features will show a better and more long-lasting effect.

The review of the widespread literature on comparative media has shown that what have not received enough attention are (a) the issues of

channel augmentation and symbol system in contrast to channel enrichment, and (b) application of the cognitive models of information processing for the measurement of attentional aspects. Some of the literature reviewed in this paper has shown that cognitive psychologists have seized on the surface differences between linguistic and visuospatial presentations as a useful distinction for guiding and circumscribing research on comprehension and memory. One major topic was the role of adding pictures to a text or narrative. While some researchers like Wagenaar, Varey and Hudson, (1984); Wagenaar, Schreduder and Van Der Heijden, (1985) have asserted that picture in audio visual condition does not help the audience, others have suggested the opposite. Berry and Brosious (1991) in news media studies and Waddill and McDaniel (1992) in educational settings have confirmed that the mnemonic effects of picture adjuncts depend on individual differences in comprehension of the narration. Many other theories of text comprehension also specify that an important aspect of comprehension is the building of a representation (see Glenberg & Kruley, 1992) and that this representation is built with the use of the facilities of working memory. Because working memory has proved to be severely limited in the amount of information that can be represented at one time, the comprehender may find it necessary to pass information into and out of working memory while building the appropriate structure.

In line with the idea that pictures assist comprehension and recall, there was a discussion of the point that that some picture-additions may hinder rather than benefit the objectives. This controversy has produced an informative and rich literature on comprehension of connected discourse and a somewhat less extensive literature on processing and overall retrieval strategies with relation to memory for representational messages. To make things clearer, the issue of the bisensory channel condition of TV and access augmentation of inputs needs to be discounted from channel enrichment when this medium is compared with a single medium like reading and listening. Furthermore, it was noticed that there are controversies over which (channel augmentation or enrichment) does any good, if either. The research has suggested that the application of cognitive psychological strategies in assessing the information processing from each mode would be helpful. In view of these points, it is desirable to replicate the previous studies in comparative (while taking account of the

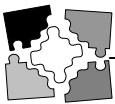


methodological points raised) to furnish a basis for analysing the empirical features involved in media comparison and to relate the outcomes to practical situations as well as to cognitive information processing and recollection models. To explore the

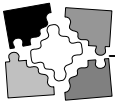
underlying memory and other cognitive psychological factors involved in media comparisons, a model of information processing is required.

REFERENCES

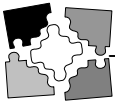
- Ackerman, B. P. (1981). Encoding specificity in the recall of pictures and words in children and adults. *Journal of Experimental Child Psychology*, 31, 193-211.
- Afzalnia, M. R. (1988). *Theories and models of communication*, Unpublished textbook used for teaching the same course title, School of TV & Cinema, Tehran, Iran.
- Afzalnia, M. R. (1992). *A meta-analysis of television studies carried out during 1948-1990*. Paper presented at the British Psychological Society, Social Psychology Section, Hatfield, England.
- Afzalnia, M. R. (2000). *Memory studies from comparative media: Theoretical accounts. A study in cognitive psychology*. A thesis submitted to the Department of Psychology & Speech Pathology, Manchester Metropolitan University for the degree of PhD.
- Anderson, D. R., & Burns, J. (1991). *Paying attention to television*. In D. Zillmann, & J. Bryant (Eds.), *Responding to the screen: Perception and reaction process*. Hillsdale, NJ: Erlbaum.
- Anderson, D. R., & Collins, P. A. (1988). *The impact on children's education: Television's influence on cognitive development*. Washington, DC: U.S. Department of Education.
- Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.
- Anglin, G. J., & Stevens, J. T. (1986). Prose relevant pictures and recall from science text. *Perceptual and Motor Skills*, 63, 1143-1148.
- Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control process. In K. W. Spencer & J. T. Spencer (Eds.), *The psychology of learning and motivation* (vol. 2). Academic Press.
- Baddeley, A. D. (1999). *Essentials of human memory*. Hove, Essex, UK: Psychology Press.
- Baddeley, A. D. (1997). *Human memory: Theory and practice*. Hove: Psychology Press.
- Baddeley, A. D. (1986). *Working memory*. Oxford: Oxford University Press.
- Baddeley, A. D., Conway, M., & Aggleton, J. (2002). *Episodic memory*. Oxford: Oxford University Press.
- Baggett, P. (1979). Structural equivalent of stories in movie and text and the effect of the medium on recall. *Journal of Verbal Learning and Behaviour*, 18, 333-356.
- Bartlett, J. C. (1977). Effects of immediate testing on delayed retrieval: Search and recovery operations with four types of cue. *Journal of Experimental Psychology: Human Learning & Memory*, 3, 719-732.
- Beentjes, J. W. (1989a). Learning from television and books: A dutch replication study based on salomon's model. *Educational Technology Review and Design*, 37, 245-248.
- Beentjes, J. W. (1989b). Television and young people's reading behaviour: A review of research. *European Journal of Communication*, 2, 14-32.
- Beentjes, J. W., & Van der Voort, T. J. A. (1988). Television's impact on children's reading skills: A review of research. *Reading Research Quarterly*, 23(4), 389-413.
- Beentjes, J. W., & Van der Voort, T. J. A. (1991). Television viewing versus reading: Mental effort,



- retention, and inferential learning. *Communication Education*, 42(3), 191-205
- Berry, C. (1983). A dual effect of pictorial enrichment in learning from television news: Gunter's data revisited. *Journal of Educational Television*, 9(3), 171-174.
- Berry, C., & Brosious, H. B. (1991). Multiple effects of visual format on TV new learning. *Applied Cognitive Psychology*, 5, 519-528.
- Berry, C., & Clifford, B. R. (1986). *Learning from television news: Effects of presentation and knowledge on comprehension and memory*. London: IBA and University of East London.
- Boeckmann, K., Nessman, K., & Petermandle, M. (1988). Effects of formal features in educational video programmes on recall. *Journal of Educational Television*, 14(2), 107-122.
- Broadbent, D. E. (1958). *Perception and communication*. London: Pergamon Press.
- Brosious, H. B. (1989). The influence of presentation features and news content on learning from television news. *Journal of Broadcasting and Electronic Media*, 33, 1-14.
- Brooks, L. (1967). The suppression of visualisation by reading. *Quarterly Journal of Experimental Psychology*, 19, 289-299.
- Bruce, V. (1996). *Unresolved mysteries of the mind: Tutorial essays in cognition*. Hove, East Sussex: Erlbaum.
- Burdick, J. G. (1960). A study of cross-section drawings used as technical illustrations in high school science textbooks. Doctoral dissertation, Syracuse University, 1959. *Dissertation Abstracts International*, 20, 2707-2708.
- Calvert, S. L., Huston, A. C., & Wright, J. C. (1987). Effects of television preplay formats on children's attention and story comprehension. *Journal of Applied Developmental Psychology*, 8, 329-342.
- Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, 8, 293-332.
- Clark, R. E., & Salomon, G. (1986). Media in teaching. In M. Wittrock (Eds.), *Handbook of research on teaching* (3rd ed.). New York: Macmillan.
- Conrad, R. (1971). The chronology of the development of covert speech in children. *Developmental Psychology*, 5, 398-405.
- Craesser, A. C. (1981). *Prose comprehension beyond the word*. New York: Springer-Verlag.
- Dommermuth, W. P. (1974). How does the medium affect the message? *Journalism Quarterly*, 51, 441-447.
- Dwyer, F. M. (1968). When visuals are not the message. *Educational Broadcasting Review*, 2, 38-43.
- Eckhardt, B., Wood, M., & Jacobvitz, R. (1991). Verbal ability and prior knowledge: Contributions to adults' comprehension of television. Special issue: Cognitive processing of media. *Communication Research*, 18(5), 636-649.
- Edwardson, M., Grooms, D., & Pringle, P. (1976). Visualisations and TV news information Gain. *Journal of Broadcasting*, 20, 373-380.
- Edwardson, M., Grooms, D., & Proudlove, S. (1981). Television news information gain from interesting video vs. talking head. *Journal of Broadcasting*, 25, 15-24.
- Findahl, O. (1971). *The effect of visual illustrations upon perception and retention of news programs*. Stockholm: Sveriges Radio.
- Foster, J.K., & Jelicic, M. (1999). *Memory: Systems, process, or function?* Oxford: Oxford University Press.
- Furnham, A., & Gunter, B. (1985). Sex, presentation mode and memory for violent and non-violent news. *Journal of Educational Television*, 11, 99-105.
- Furnham, A., & Gunter B. (1987). Effects of time of presentation and medium of presentation on recall



- of violent and non violent news. *Applied Cognitive Psychology*, 1, 255-262.
- Furnham, A., & Gunter, B. (1989). The primacy of print: Immediate cued recall of news as a function of the channel of communication. *Journal of General Psychology*, 116(3), 305-310.
- Furnham, A., Benson, I., & Gunter, B. (1987). Memory for television commercials as a function of the channel of communication. *Social Behaviour*, 2(2), 105-112.
- Furnham, A., Gunter, B., & Green, A. (1990). Remembering science: The recall of factual information as a function of the presentation mode. *Applied Cognitive Psychology*, 4(3), 203-212.
- Furnham, A., Proctor, T., & Gunter, B. (1988). Memory for material presented in the media: The superiority of written communication. *Psychological Reports*, 63, 935-938.
- Furnham, A., & Williams, C. (1987). Remembering commercials in different media. *Journal of Educational Television*, 13, 115-124.
- Gibbons, J., Anderson, D. R., Smith, R., Field, D. E., & Fischer, C. (1986). Young children's Recall and reconstruction of audio and audio-visual narratives. *Child Development*, 57, 1014-1023.
- Glenberg, A. M., & Kruley, P. (1992). Pictures and anaphora: Evidence for independent processes. *Memory & Cognition*, 20(5), 461-471.
- Goldberg, F. (1974). Effects of imagery on learning incidental in the classroom. *Journal of Educational Psychology*, 66, 233-237.
- Goodwin, C., Chu, G., & Schramm, W. (1967). *Learning from television: What research says*, Stanford University: Institute for Communication Research.
- Goschke, T., & Kuhl, J. (1993). Representation of intentions: Persisting activation in memory. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 19(5), 1211-1226.
- Greenfield, P., Farrar, D., & Beagles-Roos, J. (1986). Is the medium the message? An experimental comparison of the effects of radio and television on imagination. *Journal of Applied Developmental Psychology*, 7, 201-218.
- Greenfield, P., Geber, B., Beagles-Roos, J., Farrar, D., & Gat, I. (1981). TV over radio experimentally compared: Effects of the medium on imagination and transmission of content. *Paper presented at the biennial meeting of the Society for Research in Child Development*, Boston.
- Gunter, B. (1979). Recall of television news items: effects of presentation modality, picture content and social position. *Journal of Educational Television*, 5, 22-29.
- Gunter, B. (1980). Remembering television news: Effects of picture content. *Journal of General Psychology*, 102, 127-133.
- Gunter, B. (1988). The importance of studying viewers' perceptions of television violence. Special issue: Violence on television. *Current Psychology Research and Views*, 7(1), 26-42.
- Gunter, B., & Furnham, A. (1986). Sex and personality differences in recall of violent and non-violent news from three presentation modalities. *Personality and Individual Differences*, 7(6), 829-837.
- Gunter, B., Furnham, A., & Gietson, G. (1984a). Memory for the news as the function of channel of communication. *Human Learning*, 3, 265-271.
- Gunter, B., Furnham, A., & Jarrett, J. (1984b). Personality, time of the day and delayed memory for TV news. *Personality and Individual Differences*, 5, 35-39.
- Gunter, B., Furnham, A., & Leese, J. (1986). Memory for information from party broadcast as a function of the channel of communication. *Social Behaviour*, 1, 135-142.
- Hamilton, H., & Holzman, T. G. (1989). Linguistic encoding in short-term memory as a function of stimulus type. *Memory and Cognition*, 17(5), 541-550.
- Haring, M., & Fry, M. A. (1979). Effects of pictures on children's comprehension of written



text. *Educational Communication & Technology*, 27, 185-190.

Hartman, F. R. (1961a). Recognition learning under multiple channel presentation and testing conditions. *Audio Visual Communication Review*, 9(1), 23-43.

Hartman, F. R. (1961b). Single and multiple channel communication: A review of research and proposed model. *Audio Visual Communication Review*, 9(6), 235-262.

Hasher, L., & Zacks, R. T. (1979). Automatic and effortful processes in memory. *Journal of Experimental Psychology: General*, 108, 356-388.

Herman, L. M. (1965). Study of the single channel hypothesis and input regulation within a continuous, simultaneous task situation. *Quarterly Journal of Experimental Psychology*, 17, 37-46.

Hitch, G. J., & Halliday, M. S. (1983). Working memory in children. *Philosophical Transactions of the Royal Society London Series B*, 302, 325-340.

Hitch, G. J., Halliday, M. S., Schaafstal, A. H., & Schraagen, J. M. C. (1988). Visual working memory in young children. *Memory and Cognition*, 16, 120-132.

Hitch, G. J., Wooding, M. E., & Baker, S. (1989). Visual and phonological components of working memory in children. *Memory and Cognition*, 17(2), 175-185.

Holliday, W. G. (1973). Critical analysis of pictorial research related to science education. *Science Education*, 57, 201-214.

Hsia, H. J. (1971). The information processing capacity of modality and channel performance. *Audiovisual Communication Review*, 19, 51-75.

Jacoby, J., Hoyer, W., & Zimmer, M. (1981). *To read, view or listen? A cross media comparison of comprehension*. Graduate School of Business, New York University, 72-81.

Jamison, D., Supper, P., & Walls, S. (1974). The effectiveness of alternative instructional media: A survey. *Review of Educational Research*, 44 (1), 1-67.

Katz, E., Adoni, H., & Parness, P. (1977). Remembering the news: What the picture adds to recall. *Journalism Quarterly*, 54, 231-239.

Levin, J. R. (1973). Inducing comprehension in poor readers: A test of a recent model. *Journal of Educational Psychology*, 65, 19-24.

Levin, J. R., Bender, B. G., & Lesgold, A. M. (1976). Picture, repetition, and young children's oral prose learning. *Educational Communication and Technology*, 24(4), 367-380.

Logie, R. H. (1995). *Visuo-Spatial Working Memory*, Hove: Lawrence Erlbaum Associates, Publishers.

Margrain, S. (1967). Short term memory as a function of input modality. *Quarterly Journal of Experimental Psychology*, 19, 109-114.

Mousavi, S. Y., Low, R., & Sweller, J. (1995). Reducing cognitive load by mixing auditory and visual presentation modes. *Journal Educational Psychology*, 87(2), 319-334.

Murdock, B.B. Jr. (1966). Visual and auditory stores in short-term memory. *Quarterly Journal of Experimental Psychology*, 18, 206-211.

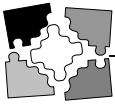
Murdock, B.B. Jr. (1972). Short-term memory. In G. H. Bower (Ed.), *The Psychology of Learning and Motivation: Advances in Research and Theory*, 5, 67-127.

Newton, D. P. (1995). The role of pictures in learning to read. *Educational Studies*, 2(1), 119-130.

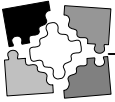
Nugent, G.G. (1992). Pictures, Audio, and Print: Symbolic Representation and Effect on Learning. *Educational Communication and Technology Journal*, 30(3), 163-174.

O'Brien, E. J., Rizzella, M. L., Albrecht, J. E., & Halleran, J. G. (1998). Updating a situation model: A memory-based text processing view. *Journal of Experimental Psychology: Language, Memory and Cognition*, 24(5), 1200-1210.

Paivio, A. (1971). *Imagery and verbal processes*. New York: Holt, Reinhart and Winston.



- Paivio, A., & Csapo, K. (1969). Concrete image and verbal memory codes. *Journal of Experimental Psychology*, 80(2), 279-285.
- Paivio, A., & Csapo, K. (1973). Picture superiority in free recall: Imagery or dual coding? *Cognitive Psychology*, 5, 176-206.
- Pezdek, K. (1977). Cross-modality semantic integration of sentence and picture memory. *Journal of Experimental Psychology: Human Perception and Memory*, 3, 515-524.
- Pezdek, K., Lehrer, A., & Simon, S. (1984). The relationship between reading and cognitive processing of television and radio. *Child Development*, 55, 2072-2082.
- Quealy, J., & Langan-Fox, J. (1998). Attributes of delivery media in computer-assisted instruction. *Ergonomics*, 41(3), 257-279.
- Radvansky, G. A., & Zacks, R. T. (1997). The retrieval of situation-specific information. In Conway M. A. (Ed.), *Cognitive Models of Memory*. Hove East Sussex: Psychology Press.
- Reeves, T. C. (1986). Research and evaluation models for the study of interactive video. *Journal of Computer-Based Instruction*, 13, 102-106.
- Robinson, J. P., & Levy, M. R. (1986). *The main source: Learning from television news*. Beverly Hills: Sage.
- Rohwer, W. D., & Harris, W. J. (1975). Media effect on prose learning in two populations of children. *Journal of Educational Psychology*, 67, 651-657.
- Rusted, J., & Coltheart, M. (1979). Facilitation of children's prose recall by the presence of pictures. *Memory and Cognition*, 7, 354-359.
- Salomon, G. (1979). *Interaction of media, cognition and learning*. San Francisco: Jossey-Bass.
- Salomon, G. (1984). Television is 'easy' and print is 'tough': The differential investment of mental effort in learning as a function of perceptions and attributions. *Journal of Educational Psychology*, 76, 647-658.
- Samuels, S. J. (1970). Effects of pictures on learning to read, comprehension, and attitudes. *Review of Educational Research*, 40, 397-407.
- Schramm, W. (1977). *Big media, little media*. Beverly Hills, CA: Sage Publications.
- Shulman, H. G. (1972). Semantic confusion errors in short-term memory. *Journal of Verbal Learning & Verbal Behaviour*, 11, 221-227.
- Small, M.Y., Dowling, S., & Lovett, S.B. (1981). *semantic elaboration and children's recall of picture and prose information*. Paper presented at the annual meeting of the American Educational Research Association, Los Angeles.
- Small, M.Y., Lovett, S. B., & Scher, M. S. (1993). Pictures facilitate children's recall of un-illustrated expository prose. *Journal of Educational Psychology*, 85(3), 520-528.
- Stauffer, J., Frost, R., & William, R. (1981). *Journal of Broadcasting*, 25(3), 253-62.
- Stine, E. L., Wingfield, A., & Myers, S. D. (1990). Age differences in processing information from television news: The effects of bisensory augmentation. *Journal of Gerontology*, 45(1), 1-8.
- Sweller, J., Chandler, P., Tierney, P., & Cooper, M. (1990). Cognitive load and selective attention as factors in the structuring of technical material. *Journal of Experimental Psychology: General*, 119, 176-192.
- Vernon, M. D. (1953). The value of Pictorial illustration. *British Journal of Educational Psychology*, 23, 180-187.
- Waddill, P.L., & McDaniel, M.A. (1992). Pictorial enhancement of text memory: Limitations imposed by picture type and comprehension skill. *Memory and Cognition*, 20(5), 472-482.
- Waddill, P.L., McDaniel, M.A., & Einstein, G.O. (1988). Illustrations as adjuncts to prose: A text-appropriate processing approach. *Journal of Educational Psychology*, 80, 457-464.
- Wagenaar, W. A. (1978). Recalling messages broadcast to the general public. In M. M. Gruneberg



P. E. Morris & R. N. Skyes (Eds.), *Practical aspects of memory*. London: Academic Press.

Wagenaar, W.A., Schreduder, R., & Van Der Heijden (1985). Do TV pictures help people remember the whether forecast? *Ergonomics*, 28, 765-772.

Wagenaar, W.A., Varey, C. A., & Hudson, P.T.W. (1984). Do Audio visuals Aid? A study of bisensory presentation on the recall of information In H. Bauma & D.G. Bouwhius (Eds.), *Attention and Performance: Control of Language Processes*, 379-391, Hillsdale: Earlbaum.

Wagenaar, W. A., & Visser, J. (1979). The weather forecast under the weather, *Ergonomics*, 22, 909-917.

Wickens, C.D. (1992). *Engineering psychology and human performance*. New York: Harper and Row.

William, C.J., & Brown, S.W. (1991). A review of the research issues in the use of computer related technologies for instruction: An agenda for research. In B. Branyan-Broadbent & R. K. Woods (Eds.), *Educational media and technology yearbook*, Englewood, CO: Libraries Unlimited.

Wilson, C.E. (1974). The effect of medium on loss of information, *Journalism Quarterly*, 51, 111-115.