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THE EFFECTS OF A CAPTION-VIEWING STRATEGY ON HEARING STUDENTS VIEWING CAPTIONED PROGRAMS IN A POSTSECONDARY SETTING

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THE EFFECTS OF A CAPTION-VIEWING STRATEGY ON HEARING
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ABSTRACT

THE EFFECTS OF A CAPTION-VIEWING STRATEGY ON HEARING STUDENTS VIEWING CAPTIONED PROGRAMS IN A POSTSECONDARY SETTING

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The purpose of this study was to determine whether a caption-viewing intervention presented with challenging instructional television program content can benefit hearing students' comprehension performance and improve attitudes toward captioning. A secondary purpose was to determine whether a long caption-viewing practice period results in greater comprehension performance and attitude improvement than does a short practice period.

Subjects were preservice teachers from a Southwestern university. Four treatment conditions were administered. The captions-without-instruction group viewed a captioned program, while the control group viewed a non-captioned program. Neither group received an instructional intervention. The short-practice and long-practice groups both viewed a captioned program following an instructional intervention, which included (a) caption-viewing strategy

instruction and (b) two-minutes of caption-viewing practice for the short-practice group and ten-minutes of practice for the long-practice group. Prior to and following the viewing of the program, all subjects filled out the 10-item Opinions About Captions attitude scale. Post-viewing instruments included a 23-item comprehension posttest and a 6-item Caption-Viewing Survey.

The only significant differences found were pre- to post-treatment attitude increases within the short-practice and control groups. These mean increases of only a few points produced effects sizes of less than 0.5 and were not of practical significance.

Overall, the results revealed that captions, with or without an instructional intervention, did not affect hearing students' comprehension of program content or attitudes toward captions.

CHAPTER 1

THE PROBLEM

The Federal Rehabilitation Act of 1973, Section 504, prohibits organizations that receive Federal funding from excluding individuals with disabilities from participation in their programs. Postsecondary institutions were specifically mentioned in the 1977 Department of Health, Education, and Welfare encodement of this Act, which mandated the inclusion of auxiliary aids to assist individuals with disabilities in classroom learning (Nondiscrimination on the basis of handicap, 1991).

One such auxiliary aid covered under this encodement is captioned instructional television programs for hearing-impaired students (Turley & Beck, 1991). Captioned television programs have been demonstrated to result in higher comprehension for deaf students when compared to non-captioned television programs (Boyd, 1972; National Captioning Institute, 1983) and television programs with a sign language interpreter (Norwood, 1976).

Although captions have been shown to be beneficial to hearing-impaired students, there have been several obstacles that may have prevented the wide use of captioned instructional television programs in mainstreamed classrooms with deaf and hearing students at universities across the country (Carney & Verlinde, 1987; Norwood, 1989; Root, 1970; Ruggiero, 1986a, 1986b, 1986c). Although some of the major obstacles involve the limited availability of technology and equipment (Carney & Verlinde, 1987), negative attitudes on the part of instructors and students toward the use of captions in a mainstreamed classroom have also been of concern (Ruggiero, 1986a, 1986b, 1986c). The purpose of this study was to develop an intervention that might help improve negative attitudes regarding the use of captions in a mainstreamed setting.

As previously mentioned, one major obstacle toward the use of captions in a mainstreamed setting has been a shortage of technology resources. Until recently, there has been a lack of availability of captioned instructional television programs, decoders, and captioning equipment (Carney & Verlinde, 1987). This, however, is changing. The number of available captioned television programs has dramatically increased in recent years. Another breakthrough has been the recent availability of captioning software for sale to the general public (Computer Prompting and Captioning Company, 1993). In addition, the Television Decoder Circuitry Act of 1990 has required that all television sets with screens larger than 13 inches manufactured after July 1993 must include a caption decoder chip. As school television equipment wears out and is replaced, an instructor will be able to open up the captions of a closed captioned instructional television program with the push of a button on a new television set. A special decoder box will not be needed.

As technological barriers are rapidly disappearing, there might be fewer reasons not to use captioned instructional television programs in mainstreamed university classrooms. Unfortunately, there are other barriers that must be overcome. Hearing viewers and educators have expressed concern that captions are distracting to hearing audience members (Root, 1970; Ruggiero, 1986a, 1986b, 1986c). In 1970, a major marketing survey revealed that approximately one-fourth of the members of a hearing television audience stated that they were distracted by the presence of open captions (Root). Network executives' concern for a loss of so many viewers provided the major motivation for the development of closed captions (Norwood, 1989).

Network executives were not the only individuals who expressed concern about possible detriments to hearing viewers. This has been a major concern of educators in postsecondary institutions as well. For example, administrators at California State University at Northridge were considering the segregated viewing of captioned instructional television programs by deaf students as an option, in the event that captions were found to be harmful to the comprehension of hearing students (Ruggiero, 1986a, 1986b, 1986c). California State University at Northridge now has the largest mainstreamed deaf program in the entire country (American Annals of the Deaf, 1991) and serves as a model for mainstreamed programs at other postsecondary institutions.

Demonstrating that captions are not detrimental to the comprehension of hearing students may alleviate educators' concerns. To provide a stronger argument for including captions in a mainstreamed classroom, it might be useful to demonstrate that captions are beneficial to hearing viewers under some conditions.

A few cognitive theories and past empirical findings offer support to the idea that captions should increase the comprehension of instructional television program content for hearing viewers. The between-channel redundancy (BCR) theory states that when information is redundant between two information sources (e.g., captions and dialog), comprehension will be greater than when the information is presented through only one information source (e.g., dialog) (Gibson & Mendleson, 1984; Hanson, 1989, 1992; Hartman, 1961; Hsia, 1974, 1977).

To examine the application of this theory to captioned instructional television programs, several experiments were conducted to examine the effects of captions on hearing viewers. Most of the research was focused on the effects of captions on special-needs hearing students with English reading difficulties. Only three of these special-needs studies compared the effects of captioned and non-captioned programs (Bond, 1974; Koskinen, Wilson, Gambrell, & Jensema, 1986; Neuman & Koskinen, 1992), and only one showed captions to be moderately more effective for special-needs subjects than non-captioned material (Neuman & Koskinen).

Although most of the past captioning research with hearing subjects has focused on a special-needs population, three experiments were conducted using captioned television programs with non-special needs hearing college students (Reese, 1984; Reese & Davie, 1987; Ruggiero, 1986a, 1986b, 1986c). Unfortunately, only one of these three experiments showed increased comprehension performance with captions when compared to non-captioned television programs (Reese & Davie). The successful experiment used brief captions, which use a low presentation rate (number of captioned words presented per minute). In the other two experiments, when the presentation rate was at a medium level (Ruggiero 1986a, 1986b, 1986c) or high level (Reese), the hearing students' comprehension did not improve from the addition of captions to the instructional television program.

One possible explanation for the lack of comprehension improvement from captions for hearing students in two of the experiments can be provided by BCR theory. Hartman (1961) demonstrated that when a related source of information (e.g., picture) has been added to two redundant information sources (e.g., captions and dialog), performance is lower than that generated by the presence of only the two redundant sources (captions and dialog). This suggests that adding the picture to the captions and dialog can weaken the beneficial BCR effect that might result from only captions and dialog.

Although the BCR effect can be weakened, a careful review of past BCR research indicated that the addition of the related information source (picture) did not <u>always</u> weaken the BCR effect enough to eliminate gains in comprehension when captions were added. A comparison of the results of past experiments suggests that there may be an interaction between the interference of the related information source (picture) and the presentation rate used with the captions. In Hartman's (1961) experiment, for example, it was found that the presence of captions, dialog, and picture (in captioned film clips) generated higher performance than did only dialog and picture (in non-captioned film clips). In comparing Hartman's successful experiment with the results from Reese and Davie (1987), it should be noted that both of these studies used low presentation rates (approximately 50 words per minute) for the captions. The studies that failed to show benefit both used increased medium and high presentation rates (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c). It is possible that when the presentation rate is increased, the related information source (picture) interferes with the processing of the redundant information sources (captions and dialog), thereby weakening the BCR effect enough to cause the absence of comprehension gains. With a low presentation rate, the interference of the related information source (picture) might not weaken the BCR effect enough to eliminate comprehension gains with added captions.

In examining the interference of the related information source (picture), processing of the picture may conflict with the processing of the captions, as both picture and captions are visual inputs that compete for available visual processing resources. In order to explore this potential conflict, past empirical findings on divided attention were reviewed. Sutherland (1959) has suggested that each modality (e.g., visual) has its own separate processing capacity. The picture and captions of a captioned television program both require visual processing resources. There is a maximum amount of processing resource available at any given time in the visual modality.

Past findings on divided attention have shown that the limits of dividing attention between two inputs are related to the difficulty of processing one or both inputs (Lindsay, 1970; Moray, 1967; Shaffer, 1971; Triesman & Davies, 1971). Only one difficult task can be processed at a time by one modality, while two or more easy tasks can be simultaneously processed. If too much of a subject's available visual processing resource needs to be allocated to one of the inputs (captions), the other one (picture) cannot be processed adequately without the subject exceeding the processing capacity of the visual modality.

The divided attention findings offer an explanation of the discrepancies in the results of the three previously mentioned captioned television experiments with non-special needs hearing students. When brief captions were used, only a few captions were presented per minute to highlight key points from the dialog (Reese & Davie, 1987). With two easy tasks (attending to brief captions and the picture) the subjects might have been able to effectively process both tasks without exceeding their visual processing capacity. At the medium and high presentation rates used in the other two experiments (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c), the caption reading task might have become increasingly more difficult. It is possible that the hearing subjects could have allocated too much of their visual processing resource to the difficult caption-reading task, which would have caused them to exceed visual processing capacity if an attempt was also made to process the picture.

Unfortunately, the positive results from the brief caption study are not of much benefit in supporting the use of captioned instructional television programs with hearing students. Brief captions (approximately 50 words per minute) are mainly used by news broadcasters to point out key terms and are rarely used with closed-captioned television programs. On the other extreme, the lack of increased comprehension at the high presentation rate (of approximately 200 words per minute) is not of much concern, as this high rate is only used for live or near live broadcast events (Salomon & Freda, 1992; A. M. Salomon, personal communication, August 27, 1993;

G. Freed, personal communication, August 27, 1993[1]). The majority of educational and broadcast television programs are prepared at a medium presentation rate (of approximately 150 words per minute). Therefore, determining whether hearing students achieve comprehension gains from captions presented at this medium presentation rate is an important question.

The medium presentation rate was in fact developed so that a skilled caption reader (one who uses an effective caption-viewing strategy) could effectively process both the picture and captions (G. Freed, personal communication, August 27, 1993; J. Navoy, personal communication, August 27, 1993). Skilled captioned readers have reported little problem in processing both of these visual inputs at a medium presentation rate, while they have reported difficulty when the presentation rate rises to 200 words per minute for live broadcast events (Freed; Navoy). On the other hand, novice caption readers (those who use no strategies or ineffective strategies) report difficulty processing both the picture and captions at the medium presentation rate of 150 words per minute.

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[1]Those individuals who were cited through personal communication were captioning professionals who were employed at major captioning companies or at postsecondary institutions for deaf students. These individuals provided information about the viewing processes of novice and expert caption readers and other topics related to captioning.

In examining the differences between the experts and novices, skilled caption readers report that they quickly glance at the captions and then back up at the picture, while the novices claim to linger on the captions for much longer periods of time, which allows little time left over to attend to the picture (G. Freed, personal communication, August 27, 1993, J. Navoy, personal communication, August 27, 1993).

In view of this caption-reading problem, determining whether teaching an effective caption-viewing strategy would improve the caption-reading skills of hearing novice caption readers becomes important, as these improved skills might result in increased comprehension when captions are added to instructional television programs. Such an intervention would be designed to train hearing novices how to allocate less attention to the captions and more to the picture.

Including a practice period with captioned program segments in the intervention might also help to develop this new skill. Of particular interest would be the amount of practice time needed for this caption-viewing skill to become useful enough to allow the subjects to effectively cope with the difficulties inherent in the divided visual attention task when viewing captions at a medium presentation rate.

A review of the ACT* theory revealed that after learning a new skill declaratively, subjects should practice applying the skill until it becomes proceduralized and useful (Anderson, 1983). It might be that a brief amount of practice for a non-complex skill, such as a caption-viewing strategy, will result in the proceduralization and useful applicability of this skill.

With continued practice, the proceduralized skill might become automatic. An automatic skill requires less conscious effort than does one that is not automated (Anderson, 1990; LaBerge & Samuels, 1974; Shiffrin & Schneider, 1977; Underwood, 1974). The longer the practice period, the more automatic the skill becomes. An automated skill would be developed to a higher level of mastery and would be more useful and effective than would a non-automated skill. Although several hundred hours might be required to reach a high level of automaticity for a caption-viewing strategy (G. Freed, personal communication, August 27, 1993; J. Navoy, personal communication, August 27, 1993), even a brief practice period with this skill should be expected to lead to proceduralization and a small degree of automaticity, so that the skill would become useful. This is because the caption-viewing strategy is a non-complex skill with only three steps.

Apart from providing opportunities for acquisition of the caption-viewing strategy, a brief practice period might provide other benefits as well. Non-special needs hearing students have reported that brief practice provides an opportunity to adjust to initially distracting features of captioned programs, such as caption placement and discrepancies between captions and dialog (Berkay, 1993). It might be beneficial to allow subjects to adjust to these features during practice, rather than during the first few minutes of important stimulus material.

If a brief caption-viewing practice session facilitates skill acquisition and allows for adjustment to unique captioning features, it is likely that a longer practice period would provide more opportunity for these results to occur than would a shorter practice period. A long practice period may not be practical in an educational setting, however. In examining the practicality of using a caption-viewing intervention in a classroom, the shorter the practice period, the more likely the instructor might be to take time out of a busy class schedule to implement a caption-viewing instructional intervention for hearing students before viewing a captioned program. With the two opposing interests of effective skill acquisition with longer practice and the practicality of shorter practice in mind, comparing both a long and short practice period with a caption-viewing intervention may determine whether lengthening the practice really does make a difference in the benefits gained from this intervention. If the length of practice has no effect, then the more practical shorter practice period would be appropriate and effective in a postsecondary classroom.

If a caption-viewing intervention resulted in the improvement of comprehension of program content for hearing students, it may affect a change of attitude about captions used in a mainstreamed setting. As hearing students learn to effectively process both visual information sources, gains in comprehension performance with captions may result. As students begin to perceive a benefit, perhaps fewer of them might find the captions distracting, and there might be less resistance to the use of captions in a mainstreamed setting by both hearing students and instructors.

In designing an experiment to measure the benefits of captions with an appropriate instructional intervention, one other possible explanation of the failure of past captioning research might be examined. A review of the above-described experiments with non-special needs hearing students (Reese, 1984; Reese & Davie, 1987; Ruggiero, 1986a, 1986b, 1986c) revealed that the stimulus materials used consisted of news stories and light documentaries. Most of this information would likely include content familiar to most of the subjects. Past empirical findings on prior domain knowledge have shown that subjects have little difficulty processing and comprehending material in familiar domains, while non-familiar domain material can present difficulties (Bransford, Barclay, & Franks, 1972; Eckhardt, cited in Ellis & Hunt, 1993; Sulin & Dooling, 1974). It could be suggested that the stimulus material used in the past experiments was familiar enough to the subjects to allow for near maximum comprehension without captions. There may have been only minimal gains in comprehension possible when the captions were added because of a possible ceiling effect. In order to achieve gains in comprehension with captions, it may be necessary to present challenging material from an unfamiliar domain to the subjects. This would allow for potential gains in comprehension when captions are added.

Purpose of the Study

The purpose of this study was to determine whether a caption-viewing intervention presented in conjunction with unfamiliar domain program content can benefit hearing students' comprehension performance and improve their attitudes toward captioning when a medium presentation rate is used. A secondary purpose was to determine whether a long caption-viewing practice period with this intervention results in greater comprehension performance than does a short practice period.

Significance of the Study

There are two separate possible benefits from this study:

1. Whether captions are found to be non-detrimental, harmful, or beneficial to non-special needs hearing students, a basis would be found for recommendations regarding the inclusion of captions in a mainstreamed or non-mainstreamed college classroom. This information may be of value to administrators in education who might be faced with decisions regarding the purchase or use of captioned programs or captioning equipment.

2. The results from this study can add to the existing knowledge of how captions affect the comprehension of instructional television programs for hearing students.

Hypotheses

For the purposes of this study, six hypotheses were posed. (The four treatment groups mentioned in these hypotheses are shown in Table 1. A summary of the hypotheses is included in Table 2.)

Table 1

Treatment Groups Used in the Current Study

Group	Inst	Practice	Program format
Cap w/o inst	No inst	2 min-NC 8 min-NC	Cap
Cap with inst/ short pract	Cap viewing inst	2 min-cap 8 min-NC	Cap
Cap with inst/ long pract	Cap viewing inst	2 min-cap 8 min-cap	Cap
Control	No inst	2 min-NC 8 min-NC	NC

Note. Cap = Captions, Inst = Instruction, NC = No Captions, Pract = Practice.

Table 2

Hypotheses Stated in the Current Study

Hypothesis number	Instrument	Groups compared	Prediction
1	Comp post	Cap, cont	No diff bet groups
2	Comp post	SP, cap, cont	SP > cap, cont
3	Comp post	LP, SP, cap, cont	LP > SP, cap, cont
4	Pre/post-treat attit	Cap, cont	No changes within groups
4	Post-treat attit	Cap, cont	No diff bet groups
5	Pre/post-treat attit	SP	Attit increase
5	Post-treat attit	SP, cap, cont	SP > cap, cont
6	Pre/post-treat attit	LP	Attit increase
6	Post-treat attit	LP, SP, cap, cont	LP > SP, cap, cont

Note. Attit = Attitude, Bet = Between, Cap = Captions Without Instruction, Comp = Comprehension, Cont = Control, Diff = Difference, LP = Long-Practice, Post = Posttest, Post-treat = Post-treatment, Pre = Pre-treatment, SP = Short-Practice

Hypothesis 1

Hearing non-special needs subjects viewing medium-presentation-rate captions without an instructional intervention will not generate comprehension scores higher than those viewing a non-captioned program. The underlying rationale for this hypothesis is the findings of similar results in past research using a medium or high presentation rate (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c). Although BCR theory predicts that subjects might benefit from the presence of the two redundant information sources, divided attention findings and reports of novices' difficulties with two visual inputs at a medium presentation rate might suggest that the addition of captions without a caption-viewing intervention might not result in performance gains.

Hypothesis 2

Subjects receiving the caption-viewing strategy with a short practice period will generate higher comprehension scores than those viewing captions without an intervention or those viewing a non-captioned program. Past reports of skilled captioned readers indicate that effective processing of both the captions and picture are possible at a medium presentation rate when a proper caption-viewing strategy is employed. As the hearing subjects learn this strategy, they might be able to effectively process both visual inputs (captions and picture), and the BCR effect might be strong enough to generate performance gains.

Hypothesis 3

Subjects receiving the caption-viewing intervention with the longer practice period will generate higher comprehension scores than those viewing captions with the intervention with the shorter practice period, those viewing captions without an intervention, and those viewing a non-captioned program. The stages of skill acquisition findings suggest that a longer practice period might result in a higher level of skill acquisition for the caption-viewing strategy. An extended practice period might also allow subjects more time to adjust to the initial distractions caused by unique features of the captions.

Hypothesis 4

Subjects viewing captions without an instructional intervention will not hold post-viewing attitudes toward captions that are more positive than those held by subjects viewing a non-captioned program. In addition, there should be no change in attitude from pre- to post-viewing for each group. This hypothesis is partially based on the findings of Ruggiero (1986a, 1986b, 1986c) who discovered no difference in the post-viewing attitudes between two similar groups. The caption-viewing-without-intervention subjects are not expected to benefit from captions. These subjects, as well as the subjects viewing non-captioned materials are likely not to perceive a benefit from captions, as they have not experienced such a benefit.

Hypothesis 5

Subjects receiving the caption-viewing strategy with a short practice period will show a positive pre- to post-viewing attitude change. In addition, these subjects will hold more positive post-viewing attitudes than will those viewing captions without an intervention or those viewing a non-captioned program. As the intervention is predicted to generate performance benefits, it is likely that these benefits will be perceived by the subjects and that their attitudes will improve and be greater than those of subjects not experiencing a benefit.

Hypothesis 6

Subjects receiving the caption-viewing intervention with the longer practice period will show a positive pre- to post-viewing attitude change. In addition, these subjects will hold a more positive post-viewing attitude than will those viewing captions with the intervention with the short practice period, those viewing captions without an intervention, and those viewing a non-captioned program. As greater performance gains might be expected from the long-practice-period group due to extended practice, these subjects might perceive greater benefits than would be perceived by subjects in the other three groups. This might result in a more positive attitude for the long-practice-period subjects when compared to the attitudes of the subjects in the other treatment groups.

Operational Definitions

The operational definitions used in this study are defined in the following sections. (Definitions of key terms are included in Appendix A.)

Attitude toward Captions

For the purpose of this study, attitude toward captions was measured by total scores on the Opinions About Captions scale, which is a revised version of Ruggiero's (1986a, 1986b, 1986c) untitled scale. This scale measures attitudes toward the use of captions with hearing people.

Caption-Viewing Strategy

A caption-viewing strategy is an instructional intervention that teaches a student how to use captions to the best advantage. Such strategies include practice viewing sessions of captioned television programs and instructions on how to effectively divide visual attention between the captions and the picture.

Mainstreamed Classroom

For the purpose of this study, a mainstreamed classroom will be defined as one that enrolls both deaf and hearing students.

Non-special Needs Hearing Students

For the purpose of the current study, non-special needs hearing students are defined as those hearing students who are members of a population that as a group has not been identified as having English reading difficulties. The reading abilities of individual members have not necessarily been identified.

Performance

For the purpose of this study, performance was defined as comprehension of the instructional television program content as measured by pencil-and-paper comprehension test items administered after viewing the program.

Special-Needs Hearing Students

For the purposes of this study, special-needs hearing students are members of a group of individuals who have been identified as having English reading difficulties. Populations examined in this study include (a) learning disabled students, (b) remedial readers, (c) adult literacy students, (d) English-as-a-second-language (ESL) students, and (e) educable mentally handicapped students.

Limitations of the Study

Prior to the collection of data, a few potential limitations of this study were predicted. As the subjects in this experiment were primarily juniors and seniors from a preservice teachers program at a Southwestern university, it was realized that the ability to generalize the findings of the current study to populations from other colleges, other class levels, or other university settings would be limited.

A second projected limitation was related to the inability to randomly sample subjects, as subjects were volunteers receiving class credit for participation. To compensate for a possible threat to independence of observations, it was determined that subjects would be randomized into treatment groups. Also, the researcher planned to watch for obvious signs of dependence of scores. For example, it was determined that subjects would be discouraged from consulting one other when completing test and scale items.

Overview of the Remainder of the Dissertation

Chapter 2 presents a literature review related to (a) closed captioning legislation and history, (b) the effects of captions on hearing viewers, (c) cognitive theory related to the viewing and comprehension of captioned programs by hearing viewers, and (d) the initial caption viewing processes of hearing viewers.

Chapter 3 outlines the method of testing the hypotheses explained in Chapter 1. Included is a description of the instruments used to measure the attitudes toward captioning and comprehension performance of the hearing subjects examined in this study. A description of the subjects and an outline of the statistical procedures utilized was also included.

In Chapter 4, the results revealed by the data are presented, along with an analysis and an interpretation of the results.

In Chapter 5, the last chapter, the results and their implications are discussed with suggestions for their applicability to the use of captioned instructional television programs in mainstreamed and non-mainstreamed classrooms. Recommendations for future research are also presented.

CHAPTER 2

A REVIEW OF THE LITERATURE

Introduction

Although much has been written on the use of captions with videotaped programs and films, there is a paucity of research examining cognitive theory and cognitive empirical findings as they relate to caption viewing. In this literature review, an attempt was made to examine cognitive theories and findings that may provide possible explanations for past results of captioning research.

After conducting an extensive literature review, it was discovered that there was also a paucity of captioning research conducted with non-special needs hearing subjects, which is the target population for the current study. In order to expand this review, research examining the captioning effects on special-needs hearing subjects was also reviewed.

At the beginning of this literature review, background information on captioning is presented. This is followed by a review of past research on the effects of captioning on the comprehension and attitudes of hearing individuals. Next, cognitive theories and cognitive findings relevant to caption viewing are presented, and connections between these theories and findings and the results of past captioning research are suggested. Then, a qualitative study that examined non-special needs hearing subjects' initial caption-viewing processes is reviewed. The chapter concludes with a brief summary of the literature review.

This chapter is divided into nine sections. These nine areas were chosen for review because they are all related to either the availability of captions in an educational setting or the use of captions with a hearing population. The following is a list of the sections and the rationale for inclusion of each area:

Section One discusses legislation related to providing captioned television programs to special-needs populations. This legislation was examined with an emphasis on the educational setting. Existing laws have provided the motivation for inclusion of captioning in a mainstreamed classroom with deaf and hearing students.

Section Two relates a brief history of closed captioning in the United States. This was reviewed in order to provide a background of the past development of captioning technology, as it is important to understand the technological context in which this experiment is being conducted.

In Section Three, research on captioning effects on hearing special-needs students is discussed. The populations examined were (a) learning disabled students, (b) remedial readers, (c) adult literacy students, (d) English-as-a-second-language (ESL) students, and (e) educable mentally handicapped students. Although these populations were not the focus of the current study, it was hoped that some of the methodology employed in the special-needs studies might inform the methodology in the current study.

In Section Four, research on captioning effects on non-special needs hearing students is described. Although benefits for this population have not been examined, a few studies have been conducted to assess possible detrimental effects of captioning on this population. Although these studies examined detrimental effects, they were reviewed here because of their potential for revealing instructional benefits of captions as well.

Section Five explains between-channel redundancy (BCR) theory, one of the central theories examined for this study. BCR theory states that redundant information presented simultaneously through two channels (e.g., audio and visual) enhances comprehension of the material. This theory is applicable to captioned instructional television program viewing by a hearing audience as subjects are exposed to two redundant information sources: (a) audio-verbal (dialog) and (b) visual-verbal (captions).

In Section Six, empirical findings on divided attention are described. This research was reviewed in order to discover whether hearing subjects viewing captions should be expected to experience difficulty processing two input sources (captions and picture) through one modality (visual).

In Section Seven, empirical findings on prior domain knowledge are explained. This literature was reviewed in order to determine whether substantial gains in comprehension performance might be expected when adding captions to television programs that contain domain-familiar material. This topic is important to the current study because the few caption experiments previously conducted with a non-special needs hearing population appeared to use domain-familiar material.

In Section Eight, the literature on the stages of skill acquisition is discussed. This literature was explored in order to determine the extent to which practice of a new skill is expected to lead to the proceduralization and automation of the skill. As a caption-viewing technique will be taught to some of the subjects in the current study, this literature was expected to inform decisions on the use of practice periods to proceduralize and automate this new skill.

Finally, Section Nine reviews the findings from a qualitative study that examined non-special needs hearing students' reports of the cognitive processes that occurred during initial caption viewing. As caption-viewing practice prior to the viewing of captioned stimulus material would be an initial caption viewing experience for most of the subjects in the current study, these findings were reviewed to determine the cognitive processes that might be expected to occur during such practice.

Legislation

The Federal Rehabilitation Act of 1973, Section 504, prohibits organizations receiving Federal funding from excluding handicapped individuals from participation in their programs. Although this section does not mention specific special-needs groups or accommodations, the Department of Health, Education, and Welfare encoded several detailed provisions under this Act in 1977 (Nondiscrimination on the basis of handicap, 1991). Subpart E of this code applies to institutions of postsecondary education, and one of its sections (84.44) requires "auxiliary aids [that] may include taped texts, interpreters or other effective methods of making orally delivered materials available to students with hearing impairments" (p. 368). Although captions were not available when this language was written, they would certainly be included in any current interpretation of this statute (Turley & Beck, 1991).

Another Act that will influence the presence of caption equipment in the classroom is the Television Decoder Circuitry Act of 1990. This Act requires that all television sets with screens larger than 13 inches manufactured in or imported into the United States after July 1, 1993, must include a caption decoder chip. Most newly manufactured televisions purchased by educational institutions will include a button that can be pushed to display closed captions.

History of Closed Captioning

Although closed captions were not available at the time of the Department of Health, Education, and Welfare's 1977 encodement, they were certainly in development (Cronin, 1980). In 1971, the National Bureau of Standards (NBS) developed the open-caption concept, and that same year, the Public Broadcasting System (PBS) in Boston began to show television programs with the captions opened (Carney & Verlinde, 1987). At that time, some hearing television audience members objected to the presence of open captions, claiming that they were distracting. In order to continue to provide captions for a hearing-impaired television audience, a closed-captioning system was proposed by the networks, and in 1972, PBS began to develop the technology (Cronin). Line 21 of the vertical blanking interval of the television signal was set aside in 1976 by the Federal Communications Commission (FCC) for closed-captioned television. By 1980, PBS, the American Broadcasting System (ABC), and the National Broadcasting System (NBC) aired 20 hours per week of closed-captioned programming. The captions were opened by consumers through the use of decoders manufactured and marketed by the National Captioning Institute (NCI). Some pre-recorded videotapes rented or sold in stores started to become closed captioned in 1981 (Carney & Verlinde), and a live captioning system was available by 1982 (Block & Okrand, 1983). Three major events that used live closed-captioning in 1982 were the Academy Awards, the launch of the space shuttle Columbia, and ABC's World News Tonight. The 1990's have found a great increase in the amount of captioned network programming, and as of July 1993, caption decoder boxes were replaced by decoder chips built into newly manufactured television sets, as mandated by Federal law (Gallaudet University, 1992; The Television Decoder Circuitry Act of 1990).

Hearing Special Needs Populations

Even though captions were developed for hearing-impaired individuals, other groups have been examined for possible benefits from captions. An extensive review of the literature revealed that from the early 1970's through the early 1990's, researchers have been examining the potential benefits of captions for improvement of the reading skills of special-needs populations who experience difficulty in reading English (Adler, 1985; Bean & Wilson, 1989; Bond, 1974; Goldman & Goldman, 1988; Grimmer, 1992; Jensema, Koskinen, & Wilson, 1984; Koskinen, Wilson, Gambrell, & Jensema, 1986; Koskinen, Wilson, & Jensema, 1985; Mehler, 1988; Neuman & Koskinen, 1992; Reilly & Barber-Smith, 1982).

The Television Decoder Circuitry Act of 1990 states that the special-needs hearing population with English-reading difficulties is one group that would benefit from captions. It might be suggested that the abundance of captioning research with special-needs populations may have helped to convince the United States Senate and House of Representatives to include this statement in the Act. This is curious because past research has not supported the hypothesis that this population would gain any benefit from the addition of captions. This is revealed in the special-needs studies described below, which include captioning research with children and teenagers who were (a) learning disabled students, (b) educable mentally handicapped students, (c) ESL students, and (d) remedial readers. Research on adult special-needs populations includes (a) ESL students and (b) adult-literacy students. (Please note that illogical pairings of groups under headings below were necessary at times, as single studies were conducted in some instances with two different populations.)

Children and Teenagers

Learning Disabled

Two empirical studies were conducted with learning-disabled populations. In one study, subjects viewing a captioned film demonstrated lower word recognition performance than those reading the film's transcript (Reilly & Barber-Smith, 1982). In this study, a movie with captions written on a primary reading level was used. The subjects were 13- to 15-year-old learning-disabled students who read at a second- or third-grade level. There were four classes of students, and each class was administered one of the following treatments: (a) captioned film, (b) film transcript, (c) captioned film and transcript, or (d) normal reading lesson (control).

Prior to viewing the film or reading the lesson, all subjects were given a word-recognition pretest that included 25 words from the film. Following the treatment, all subjects completed an identical posttest. It was determined that the captioned-film-and-transcript group subjects achieved the greatest increase in percentage of words recognized from the pretest to posttest, followed by the film-transcript subjects, and the captioned-film subjects. Although these three groups showed improvement, the subjects in the control group did not. Significance for differences in word-recognition score increases between groups was not reported.

In a second study, Koskinen et al. (1986) discovered that captioned television was no more effective than non-captioned television when used to improve reading skills of learning-disabled children. The subjects were 77 learning-disabled children, ages 9 to 13, who were reading at two or more years below their grade level. Subjects were randomized into one of four treatments as follows: (a) captioned television with sound (captions with sound), (b) captioned television without sound (captions without sound), (c) non-captioned television with sound (no captions with sound), and (d) caption script. Four segments of an educational program were used to assess the effects of captions on word recognition, comprehension, and reading fluency. Each subject had four lessons during four separate sessions over a period of three weeks. Following the viewing of the stimulus material, all subjects completed word recognition, recall, cloze, and oral reading posttests. Overall, the captions-with-sound subjects' scores were significantly higher than those of the caption-script subjects. It should be noted however, that the captions-with-sound treatment did not result in significantly higher scores when compared with the no-captions-with-sound treatment scores.

Educable Mentally Handicapped

A comparison of the effects of captioned and non-captioned films on educable-mentally-handicapped (EMH) subjects revealed that captioned films were no more effective than non-captioned films for this population (Bond, 1974). In order to explore the use of captioned films with EMH children, a Science film was shown to two classes of EMH subjects (n's unknown) from each primary and intermediate grade level. One class from each level viewed a captioned version of a film, while the other class viewed a non-captioned version. Following the viewing of the film, all subjects were administered an (unspecified) 11-item cognitive test. Data analysis revealed no significant differences in performance between the captioned and non-captioned group subjects.

Remedial Readers and ESL Students

In addition to learning-disabled and EMH students, other hearing special-needs populations were also examined. A review of the literature revealed one experimentally designed study with a remedial-reading population that showed that captions and printed text together were more beneficial than printed text alone. Adler (1985) examined the effects of captioned programs and printed text on sight vocabulary learning with children who were remedial readers. The subjects were 36 third and fourth graders with reading difficulties. There were two treatments: (a) captions with transcript and (b) transcript. The caption-with-transcript subjects viewed a captioned program with sound and then viewed the program again while reading a transcript of the program. The transcript subjects merely read the transcript. All subjects were given a sight vocabulary posttest. Data analysis revealed that the captions-with-transcript subjects' scores were significantly higher than those of the transcript subjects on both an immediate recall test that followed the viewing and a delayed recall test given the next day.

A second study did show moderate positive effects of captioned over non-captioned programming with ESL students. Neuman and Koskinen (1992) were interested in determining whether these students could learn vocabulary words and conceptual information from captioned programs through context without formal instruction. The subjects were 129 bilingual seventh and eighth graders, Hispanic and Asian, who were two to three years below their grade level in academic performance. All subjects were enrolled in a bilingual program. For the stimulus material, nine short segments from a children's program were selected. There were three units representing three different science topics, with three segments per unit. For each of the nine weeks of instruction, one segment was presented twice. Each of four intact classes was randomly assigned one of the following treatments: (a) captioned television program (captions), (b) non-captioned television program (no-captions), (c) caption script, and (d) textbook.

All subjects completed a battery of posttests to measure comprehension of the program content. The posttests included word recognition, word anomaly, word definition, and content recall items. Data analysis revealed that for most of these measures, the mean scores for the captions group were higher than those of the no-captions group, although only half of these differences were significant (Mean ES = .32).

In addition to the above-described experimentally designed studies, a few studies examining student and teacher reaction to the use of captions with ESL students and remedial readers were also discovered. In one article, two studies examined instructor and student reaction to the use of captioned programs to teach reading skills to hearing remedial-readers and ESL students (Jensema et al., 1984). In the first study, one ESL teacher and one remedial-reading teacher used closed-captioned programs with instruction to teach vocabulary, comprehension, and reading fluency to first- through sixth-grade elementary school children. Although performance data were not collected for this study, both instructors rated the learning quality and student motivation as "excellent." (A definition of "learning quality" was not provided by the author.)

In the second study with second- through sixth-grade remedial-reading students in a summer reading clinic, captioned programs and caption scripts were used to teach vocabulary, comprehension, and reading fluency skills. Again, performance data were not collected. In this study, the instructors and the students filled out reaction forms concerning the captioned programs. On a five-point Likert scale (with 5 as "Excellent"), 100% of the instructors rated the quality of learning at 3 ("Good") or above and student motivation at 4 ("Very Good") or above. All ten instructors also rated the usefulness of the caption scripts at 4 ("Very Good") or above. It was also discovered that 100% of the students liked the captions, 89% believed that they helped them learn more words, 77% believed that they helped with comprehension, and 89% would like captioned lessons in school.

One final study described the impact of captioned films on the school attendance of hearing remedial readers (Goldman & Goldman, 1988). All participants were high school students in a remedial-reading program who read at least two years below their grade level. The authors introduced captioned network television programs into the classroom lessons to teach vocabulary, comprehension, and writing skills. Although performance data were not included in this study, the instructors observed a high level of enthusiasm for captioned lessons on the part of the students. It was also noted that since the captioned programs were shown, student tardiness and absentee rate dropped.

Adults

ESL and Adult Literacy

Although much research has been conducted with captioning effects on special-needs children, only a limited amount of captioning research has been conducted with hearing adult special-needs populations. Only two adult groups have been studied in the literature: ESL and adult-literacy students. One article that discusses both of these populations was written by Mehler (1988), who emphasized the difference between caption use with ESL and adult-literacy students. For ESL students, captions are used to reinforce information in the dialog and picture, whereas for adult-literacy students, the dialog and picture are used to reinforce the information in the captions. It was cautioned that different instructional interventions need to be designed for each group.

ESL instructors appeared to be somewhat receptive to using captions with their students, but there were some reservations. There was concern by one ESL developer that captions would distract students from important audio information, and they should be used only for more advanced learners. Another ESL educator thought that captions could be used if varying language levels and presentation rates were available to suit the level of the learner.

Adult-literacy providers were much more resistant to the use of captions than those providing ESL instruction. They were concerned that their students might be intimidated by the technology. These educators preferred one-to-one tutoring with printed reading materials. An important concern with these educators was that the students would obtain information only through the audio channel and tune out the captions.

Mehler (1988) strongly suggested that captioned television programs be used by adult-literacy and ESL students primarily in the classroom with instructional intervention. Home use should be limited to supplemental learning. Grimmer (1992) disagreed and suggested that all ESL students can benefit from viewing English-language captioned television programs at home, as captions without instruction can provide valuable incidental language learning through context.

In addition to the above-described opinion papers, one experiment conducted with an adult-literacy population showed no performance differences between subjects viewing captions and those reading printed text (Bean & Wilson, 1989). The effects of captions on word recognition and reading fluency performance of adult-literacy students were examined using 24 Job Training Partnership clients (23 black and 1 white; 15 males and 8 females). All subjects read below a seventh-grade level and qualified for a ten-week job skills training program. Subjects were randomly assigned to one of three treatment groups: (a) captioned television program with instruction, (b) caption script with instruction, and (c) captioned television program without instruction.

All subjects received five lessons over a three-week period. For the two groups who viewed captions, each lesson contained a two-to-three-minute captioned segment from an instructional television program. The subjects receiving the caption-script treatment read the caption script in lieu of viewing the actual program.

An analysis of word recognition posttest scores and reading fluency posttest scores revealed no significant differences between groups. Students were also surveyed for their attitudes toward the instruction. It was discovered that 100% of the subjects who viewed captions liked the lessons, while only 75% of the caption-script subjects enjoyed their instruction.

Caption Effects on Non-special Needs Hearing Individuals

Although a good number of studies on the effects of captions on hearing special-needs subjects have been conducted, only a few have been conducted with non-special needs hearing subjects. A review of the literature revealed that most of the existing research appears to have been motivated by concerns for possible detriments to hearing students' comprehension resulting from captions, rather than interest in the possible benefits of captions.

These concerns for detriment date back more than two decades. During the early 1970's, before closed captions were developed, technology was available for the use of open captions (Carney & Verlinde, 1987). Based on the success of captioned films for the deaf, deaf professionals were determined to have open captions used with television programming (Norwood, 1989). Captioning professionals realized that before network executives would proceed with using open captions on their programs, they would need to be convinced that the presence of captions would not be distracting to hearing viewers.

In order to determine the reaction of hearing viewers to open television captions, Root (1970) surveyed hearing cable television subscribers who viewed open captions. Questionnaires were mailed to 552 families for completion by all viewers over 12 years old. A total of 229 subjects from 124 families responded (24% response rate). Subjects were requested to view two captioned Disney films broadcast locally. It was revealed that for one film, 30% of the respondents claimed to be bothered by the captions, 53% were not bothered, while only 17% claimed to benefit. For the second film, 24% stated that they were bothered by the captions, 58% were not bothered, while only 18% claimed to benefit. Although approximately one-fourth of the respondents stated that they were distracted, only 10% objected to <u>selective</u> open captioning of a <u>few</u> broadcast television programs.

After reviewing the results of Root's (1970) study, the network executives objected to using open captions, as the loss of even a small percentage of hearing viewers could negatively impact ratings and advertising revenue (Norwood, 1989). The networks' rejection of open captions provided the major motivation for developing closed captioning technology.

Possible distraction from open captions for a hearing audience was not only of concern to network executives. Educators expressed concern as well. Ruggiero (1986a, 1986b, 1986c) conducted a study to examine the potential detrimental effects of captions on the attitudes and comprehension of hearing students. In his introduction, the author suggested that if captions were found to be detrimental to hearing students, a strong case would be presented for segregated captioned television program viewing for deaf students.

In order to examine the effects of captions on a hearing population, Ruggiero (1986a, 1986b, 1986c) used 80 hearing undergraduate subjects from a general education class. A 30-minute instructional television program entitled <u>The New Literacy</u> was used with two treatments: (a) captioned and (b) non-captioned. From the description of the stimulus material, it appears that the captions were presented at a medium presentation rate.

Subjects were randomized into treatment groups, and a 35-question posttest was administered after the viewing of the stimulus material. An attitude scale with 12 items concerning (a) the use of captions with hearing people and (b) separate caption-viewing facilities for deaf people was also administered after the viewing. Three neutral items regarding the sound and picture quality were also included with this scale to detract from the caption issue. A fourth neutral item asked the subjects to state whether they read the captions while viewing a captioned program. This resulted in a total of 16 items. A five-point Likert scale was used with this attitude scale, which is reproduced in Appendix B. (The scale is included because a revised version was used in the current study.)

A factor analysis of the attitude scale revealed two factors. The general factor included nine items that referred to captioning of television programs without reference to deaf people (Items 1, 2, 4, 5, 7, 8, 9, 12, and 13). The segregated factor contained three items that mentioned captioned programs in relation to deaf people (Items 11, 14 and 16).

An analysis of the data from the attitude scale revealed that there were no significant differences found between the captioned and non-captioned subjects in overall responses to the attitude scale for the general factor or the segregated factor. Although the attitudes of both groups were not significantly different, it is difficult to know whether the overall attitudes were negative or positive, as it was not indicated whether a high score on the scale represented a more or less positive attitude than did a low score. Also, the possible range of scores was not provided. Only group means were reported. In view of this missing information, the attitudes of hearing students in both groups in this study may have been equally negative, equally positive, or equally neutral.

In addition to the analysis of the scale data, the 35-item comprehension test was also analyzed. No statistically significant differences were found in test performance between the captioned and non-captioned treatment groups. These findings may indicate that the presence of captions did not negatively affect the comprehension of hearing subjects.

Similar findings on comprehension performance were discovered in another study by Reese (1984). The effects of captioned news stories on the recall, error, and comprehension of hearing students was examined using 100 University of Wisconsin undergraduates. Subjects were randomized into captioned and non-captioned treatment groups, and each subject was shown four video news stories. The first two stories were approximately two minutes in duration, while the third and fourth stories lasted about five minutes each. The first story was not included in data analysis and was not captioned for the subjects receiving the captioned treatment. This first story was a dummy story used to help the subjects become accustomed to watching news stories.

Data from the second, third, and fourth stories were analyzed individually and collectively. To measure comprehension, subjects were asked to write the main points of each story. A limited number of multiple-choice questions were used to test recall and error for each story. "Recall" was measured by the number of correct responses selected, while "error" was measured by the number of distractors selected. (Subjects had the option of selecting "I don't remember.")

A data analysis revealed that the captions had no significant <u>overall</u> effect on comprehension, recall, and error. Performance on Story Two (the first to be viewed with captions) was significantly impaired for those viewing captions, however. Recall and comprehension were significantly lower and errors were higher for the captioned group. Performance on Stories Three and Four was not affected by the presence of captions, as significant differences between treatment groups were not generated from these stories.

Subjects evaluated the stories using a semantic differential scale. The only story receiving a negative evaluation was Story Two. The captioned-group subjects gave this story negative ratings on easiness, reliability, and clarity. (The author did not define these categories.)

One interesting point about Reese's (1984) study was that the performance for the caption treatment subjects improved by the second captioned story (Story Three) when compared to performance resulting from the first captioned story (Story Two). This might suggest that novice caption readers could benefit from practice with captioned material.

It should be noted that in Reese's (1984) study, the captions were 100% verbatim. This type of captioning uses a presentation rate of approximately 200 words per minute (G. Freed, personal communication, August 27, 1993; A. M. Salomon, personal communication, August 27, 1993), and even the most skilled caption readers report difficulty in dividing their attention between the captions and picture at this presentation rate (Freed; J. Navoy, personal communication, August 27, 1993).

When interpreting the comprehension performance results of the two studies described above, it is important to note that instruction in dividing attention between the captions and picture was not provided to any of the caption-group subjects. It should also be noted that in both of the above studies, which used medium and high presentation rates, the addition of captions to a program did not appear to benefit the performance of the hearing subjects.

In another study with a lower presentation rate, however, the addition of captions <u>did</u> appear to be beneficial. The effects of brief captions on the comprehension of television program content were examined by Reese and Davie (1987) using 100 undergraduate students as subjects. This experiment included two factors: (a) story type (visual vs. verbal) and (b) captions vs. no captions. Each group viewed five brief news stories, each one from one to two minutes in length. The first story was a dummy story used to test the success of the randomization process. For the four remaining stories, the visual-story subjects viewed television new stories that were primarily communicated visually (e.g., a fire), while the verbal-story subjects viewed television news stories that were primarily verbally oriented (e.g., an AIDS story). Students in the captioned treatment conditions viewed news stories that had only 7 brief captions per story that highlighted key points, while the subjects in the non-captioned conditions did not view captions. These two factors resulted in four treatment groups: (a) visual story with captions, (b) visual story without captions, (c) verbal story with captions, and (d) verbal story without captions.

Following each story, a one-minute distractor test was given to clear short-term memory. Then each subject took a visual recall test that required identifying which of seven freeze-frame visuals were viewed in the story. Next the subjects were asked to state the main point of the story, and finally, they were given three or four multiple-choice questions to test for verbal recall. After completing all posttests for the fifth story, all subjects took a two-minute distractor test. To test for delayed verbal recall, a multiple-choice test with questions from all five stories was given.

An analysis of the data revealed that for the combined verbal recall scores (immediate and delayed), the captioned group subjects' scores were significantly higher than those of the non-captioned subjects. There were no significant differences in verbal recall scores between the visual and verbal story group subjects. When examining only the immediate verbal recall scores, the captioned subjects' scores were significantly higher than those of the non-captioned subjects. There were no significant differences found between the captioned and non-captioned group for the delayed verbal recall test.

An examination of the verbal recall scores of the visual-story subjects revealed no significant differences between the captioned and non-captioned subjects on the immediate, delayed, and combined scores. An examination of the verbal recall scores of the verbal-story subjects revealed that for immediate recall, delayed recall, and combined recall, the captioned subjects significantly outperformed the non-captioned subjects.

The results from the story comprehension test revealed that captioning had no overall significant effect on performance. When examining only the visual subjects' scores, however, the non-captioned group subjects' scores were significantly higher than those of the captioned group subjects. There were no significant differences for the verbal-story subjects.

For the scores on the visual recall test, the captions did not significantly affect performance. It was determined, however, that the visual-story subjects' scores were significantly higher than those of the verbal-story subjects.

When examining the visual recall scores of the visual-story subjects, there were no significant differences found between the captioned and non-captioned groups. Significant differences were also not discovered for the verbal-story subjects between the captioned and non-captioned groups.

Based on these results, the authors suggested that captions improved verbal recall on verbally oriented stories, but not on visually oriented stories. It was also suggested that story understanding of visually oriented stories might be harmed by the presence of captions. This might suggest that for a hearing population, captions might be avoided when most of a program's content is conveyed through the pictorial source (picture). Segments with car chases, fights, or sports competitions are example of such programs.

It is interesting to note that with the low presentation rate generated by brief captions in the above-described studies, the novice caption readers were able to benefit from the addition of captions with verbally oriented programs. With the medium and high presentation rates used in the first two studies, the novice caption readers failed to benefit from the addition of captions.

Between-Channel Redundancy Theory

The results from the brief-caption experiment described above (Reese & Davie, 1987) suggest that, under some circumstances, hearing subjects might benefit from the redundant information provided by the dialog and captions in a captioned television program. One theory that might serve to explain this benefit is the between-channel redundancy (BCR) theory. Broadly defined, BCR theory states that when redundant information is presented through two or more channels (audio, visual, taste, touch, or smell), then comprehension and retention of the information will be greater than when the same information is presented through a single channel (Gibson & Mendleson, 1984; Hanson, 1989, 1992; Hartman, 1961; Hsia, 1974, 1977).

One major controversy in the field of BCR is that researchers do not agree on operational definitions. Hanson (1989, 1992) criticized BCR researchers for inconsistent definitions of "redundancy." Some researchers refer to related information, such as that found in a program's picture and dialog, as being "redundant." Other researchers use the term "redundant" to mean identical information in two information sources, such as that found in the dialog and captions of a captioned program. As the latter definition is related to the reinforcement of dialog by captions in captioned television programming, this is the definition that will be used in the current study.

Additional operational definitions related to BCR are provided by Hartman (1961) who explained the different types of relationships of information sources (e.g., captions) between and within channels (e.g., visual). Redundant information is identical information in two or more sources, such as captions and dialog. Related information consists of similar, but not identical information, such as words and pictures describing the same object. Unrelated information consists of sources with unconnected information, such as the number 9 and a drawing of a tree. Contradictory information can be related, but conflicting, such as showing the caption "woman" while speaking the word "man." The author states that redundant and/or related information sources are commonly found in educational audiovisual media.

Hsia (1974, 1977) quantified BCR by defining it as the percentage of redundancy between the information presented by two or more information sources (e.g., captions and dialog) through two or more channels (e.g., visual and audio). When the information is completely identical, then BCR is in unity. When information is completely different, BCR is zero. BCR in unity facilitates information processing, while zero BCR results in the occurrence of interference (Hsia, 1968a, 1968b, 1971, cited in Hsia, 1977).

Hsia (1977) also stated that BCR is effective only when information being presented through different channels is in sync. Lag time may cause interference with information processing.

There is one limitation to BCR. If the sum of information being presented through all channels involved exceeds the human information-processing capacity, then information processing will be impeded (Hsia, 1977).

Two previous studies have provided support for the BCR theory as it applies to the unique features of captioned television. The study most highly related to captioned television programs was conducted by Hartman (1961). This experiment examined the BCR effect between audio-verbal and visual-verbal information (dialog and captions) presented through two channels (audio and visual) in the presence of a related visual-pictorial source (picture) presented through the visual channel.

In order to examine the effects of BCR, 1,184 University of Pennsylvania freshmen were used as subjects. The stimulus material consisted of a film of 25 human models (13 males and 12 females). The captioned version with pictures and dialog included a film clip of each model with a fictitious name captioned at the bottom of the screen and an announcer reading the name as the caption appeared. The subjects were randomized into one of seven treatment conditions: (a) audio, (b) captions, (c) picture, (d) audio and captions, (e) audio and picture, (f) captions and picture, and (g) audio and captions and picture. To create treatments with one or more information sources missing, either the picture and/or audio were turned off and/or the captions were blocked. To administer the treatments, the experimenter brought each group of subjects into a viewing room and showed the stimulus material under one of the seven treatment conditions.

In order to examine performance under audio, picture, and captioned testing conditions, the same seven combinations of the three inputs used in the treatment conditions were used in the testing conditions. This was done over the course of three experiments. Experiment One provided testing under separate audio, picture, and captioned testing conditions. Experiment Two used audio, pictures, and captions in one testing condition, while Experiment Three examined paired testing conditions (audio and captions, audio and picture, and captions and picture).

After viewing the stimulus material, the seven treatment groups were each randomly subdivided into the appropriate number of test-condition groups, and each subject went into the room that administered the appropriate test condition. (Experiment Two did not require a subdivision, as there was only one testing condition.)

All subjects were administered a recognition test that consisted of 75 film clips (similar to the 25-clip stimulus material). The test included the 25 human models from the stimulus material and 50 distractor models. Each subject was asked to correctly identify which models were viewed in the stimulus material. A score was assigned based on the number of correct guesses out of 75.

The data were analyzed and group comparisons were made for each treatment and testing condition. Only a few are of interest for the current study. In support of the advantage of captions over non-captioned audiovisual material, overall, the audio-and-captions-and-picture subjects significantly outperformed the audio-and-picture subjects.

In support of the BCR theory, overall, the audio-and-captioned subjects significantly outperformed the audio subjects. It was also discovered that the BCR effect from the two redundant verbal sources (captions and dialog) was weakened in some instances by the addition of the related pictorial source (picture). This was demonstrated when the captioned-and-audio subjects produced significantly higher test scores than did the captioned-and-audio-and-picture subjects for both the captioned and audio-and-captioned test conditions.

Overall, the results of these three experiments supported the superiority of captioned vs. non-captioned audiovisual material. Also supported was the BCR effect for the two verbal sources (captions and dialog) together, when compared with the audio source (dialog) alone. The results also suggest that, in some instances, adding a related source of information to two redundant sources can weaken the between-channel redundancy effect. This might be because one of the redundant information sources (captions) is competing with a related source (picture), as they are both sharing visual processing resources.

A second study supported the BCR effect with redundant visual-verbal and audio-verbal information sources (captions and dialog), although a related visual-pictorial information source (picture) was not included in the experiment. Hsia (1974) examined the effects of audiovisual BCR using 24 high school students. In one experiment, subjects were presented with a series of 2, 4, 8, or 12 letters presented visually and orally. The audio and visual information sources were alternated as the dominant information source. In each treatment, the dominant information source presented 100% of the letters, while the redundant information source presented either 25%, 50%, 75%, or 100% of the letters. (For example, if the picture was the dominant information source and the audio was 25% redundant, then all letters would be shown and only 25% of them would be spoken.) All subjects viewed the stimulus material under all 28 possible combinations of (a) number of letters presented and (b) percentage of redundancy.

After viewing the stimulus material, subjects were given a recall posttest. An analysis of the data determined that when the pictorial information source (picture) was dominant, an increased level of BCR did not significantly improve recall. Higher levels of BCR did significantly improve recall performance, however, with the audio (dialog) as the dominant information source. The author suggested that with a sole visual-verbal information source, subjects can backscan the text (captions). Adding an audio-verbal information source (dialog) might not enhance performance. With a sole audio-verbal source, backscanning is not possible. Adding visual text in this instance might enhance information processing and recall. It should be noted that when the audio information source was dominant, BCR only resulted in significantly higher recall for 8- and 12-letter items. The author suggested that with a minimal amount of information, the redundancy was not needed to adequately process the letters.

This study supported the BCR theory in instances when a dominant audio-verbal information source (dialog) is supplemented by a redundant visual-verbal information source (captions) in the presence of at least a moderate amount of verbal information (8 or more letters at a time). It may be noted that captioned television programs include these conditions.

In addition to the BCR theory, a search of the literature revealed another theory that might serve to explain the benefits of redundant information between channels. The multitrace strength theory by Wicklegren (1970) states that redundant information presented through two or more channels might result in the formation of multiple memory traces and enhance retrieval during recall and recognition tasks. The author explained that for an event or an association between events, memory traces are created separately by each applicable modality (visual, audio, etc.).

Memory traces are then retrieved during a recall or recognition task. During retrieval, a combination is made of the strengths of all traces for all modalities involved in an event or association between events. This total strength becomes a single dimension that is used for recognition and recall tasks. The multitrace strength theory basically states that if information is processed through multiple modalities, multiple memory traces will be formed. The sum of the strength of the multiple traces will be greater than the strength of a single trace processed through only one modality. The stronger the total strength, the greater the probability that an event or association will be recalled or recognized.

Although this proposed theory might provide a good explanation for the possible benefits of redundant information presented through multiple channels, an extensive search of the literature failed to reveal any experiments that tested the multitrace theory with redundant information simultaneously presented through two or more channels.

Divided Attention

While BCR theory may provide an explanation for the benefits of two redundant verbal information sources (captions and dialog), the possible difficulty caused by adding a related visual information source (picture) to these two redundant sources can be explained by past empirical findings on divided attention. The findings have shown that the limit of dividing attention between two inputs is related to the difficulty or complexity of processing one or both of the inputs (Lindsay, 1970; Moray, 1967; Shaffer, 1971). The perceptual system as a whole has a limited processing capacity. The total processing resource can be allocated to one difficult task or two or more simple tasks.

Sutherland (1959) has suggested that one central processing system does not exist. Instead, each modality has its own separate processing system and processing capacity. This would suggest that there is much more processing resource available when input is presented to two different modalities, rather than to one. Triesman and Davies (1971) supported Sutherland's hypothesis by demonstrating that a greater amount of information was recalled when two input sources were presented to two separate modalities, rather than to one single modality.

The divided attention findings might explain why the hearing subjects in the previously described studies were able to benefit from captions presented at a low presentation rate, while not at a medium or high presentation rate. It might be assumed that the medium and high presentation rates offered more difficult processing tasks than did the low presentation rate associated with brief captions. According to divided attention findings, the two easy tasks of attending to brief captions and the picture could be processed simultaneously in the same visual modality without exceeding the visual processing capacity (Lindsay, 1970; Moray, 1967; Shaffer, 1971; Sutherland, 1959). The more difficult caption-processing task presented by medium or high presentation rates might have required a greater amount of the visual processing resource, leaving little visual resource available to process the picture. When a subject tries to process both visual inputs, the visual processing capacity might be exceeded (Sutherland).

It has been reported that at a medium presentation rate, skilled caption readers have developed a strategy for coping with this increased visual processing demand, while novice caption readers have not (G. Freed, personal communication, August 27, 1993; J. Navoy, personal communication, August 27, 1993). At a medium presentation rate, novices report spending longer amounts of time reading the captions than do skilled caption readers. In the framework of the divided attention findings, the novices might be allocating more of the available visual processing resource to the captions than is allocated by a skilled caption reader. This might cause the novice reader to exceed the visual processing capacity with a medium presentation rate, while the skilled reader might be below or near capacity (Sutherland, 1959). This could mean that the skilled caption reader might effectively process both visual inputs with a medium presentation rate, but the novice might be forced to choose between the two visual inputs in order to effectively process at least one.

The above findings would also explain why a high presentation rate might cause even skilled caption readers difficulty. Visual processing capacity might be exceeded when a skilled caption reader attempts to process both a high quantity of captions and a picture simultaneously while viewing captioned television programs with a high presentation rate.

Prior Domain Knowledge

Although BCR theory and divided attention findings provide the major explanation for what occurs when hearing people view captions, past empirical findings on prior domain knowledge might explain why, in past captioning experiments with hearing subjects, gains in comprehension did not result when captions were added to programs containing domain-familiar content. Eckhardt (1991, cited in Ellis & Hunt, 1993) explained that when new information is encountered, the amount of assimilation is a function of the amount of prior knowledge in the target domain. Subjects with minimal or no prior knowledge in the target domain have difficulty assimilating the new information, while those with a considerable amount of prior knowledge in the target domain can easily assimilate much of the new information. With an increased amount of assimilation, comprehension of new information is enhanced (Bransford, Barclay, & Franks, 1972; Sulin & Dooling, 1974).

When prior target-domain knowledge is held, text processing results in higher comprehension. Cognitive demands on the reader are also reduced (Graesser, 1981; Kintsch, 1974; McFarland; 1986; Van Dijk & Kintsch, 1983). In addition, it has been discovered that the amount of time needed to read a passage is reduced when prior target-domain knowledge is possessed by a subject (Just & Carpenter, 1984; Miller & Kintsch, 1980; Van Dijk & Kintsch).

These findings might suggest that the non-challenging documentaries and news stories used in past captioning research conducted on non-special needs hearing subjects presented simple tasks that could have resulted in high comprehension without captions. When captions were added, a possible ceiling effect might have limited potential gains in comprehension.

Stages of Skill Acquisition

In order to effectively use a caption-viewing strategy, it might be recommended that a novice practice viewing captions using the new strategy. To understand why practicing a new skill might be of value, the literature on skill acquisition was examined. In his ACT* model, Anderson (1983) described the three stages of skill acquisition which are (a) the cognitive stage, (b) the associative stage, and (c) the autonomous stage.

In the cognitive stage, the learner encodes the procedure for a new skill on a declarative level. For a complex skill, the learner uses domain-general problem-solving strategies or heuristics in an early attempt to perform the skill. A heuristic is not sufficient for adequate skill performance.

In the associative stage, errors in the skill performance are eliminated, and the declarative knowledge of the skill is transformed into a procedure. Rather than using a domain-general heuristic, the learner develops and uses a domain-specific algorithm to perform the skill. At the end of this stage, the proceduralized skill begins to become automatic, and it can be adequately performed by the learner.

Anderson (1990) stated that it is better to consider automaticity (the automization of a skill) in degrees, rather than at one extreme or the other. The more practice acquired, the more automatic a task becomes, the easier the task is to execute, and the less attention it requires (LaBerge & Samuels, 1974; Shiffrin & Schneider, 1977; Underwood, 1974). In the autonomous stage, the procedure is practiced to a greater level of automaticity, as it becomes increasingly more automatic and rapid.

Anderson (1990) emphasized that the associative and autonomous stages are not distinctly separate and that differing levels of automaticity may occur in both stages. Although the skill becomes automatized with practice in both of these stages, a greater level of automaticity is achieved in the third stage when tuning of the procedure is said to take place (Anderson, 1982).

The ACT* model can be used to explain the process involved with learning to use an effective caption-viewing strategy. When the caption-viewing strategy is taught on a declarative level, the learners begin to move through the cognitive stage of skill acquisition. A task analysis of this strategy revealed that there are three steps involved with this skill. They are as follows:

1. When a captioned television program begins, look at the picture.

2. When a caption appears on the screen, quickly glance down at the caption and then back up at the picture until the next caption appears.

3. Repeat Step 2 each time a caption appears on the screen.

As this is a non-complex skill with a few steps, the subjects should be expected to move rapidly through the cognitive stage into the associative stage and proceduralize this skill. Thus, a few minutes of practice might allow the subjects to move through the associative stage of skill acquisition. At this point the performance of the caption-viewing strategy would become adequate and automatized to some extent. During the autonomous stage, learners continue to practice for several hours in order to become expert caption readers. As they move to the conclusion of this stage, the skill reaches a high level of automaticity.

In the current study, the subjects would not be expected to become expert caption readers and move through the autonomous stage. It has been reported that a high level of automaticity of the caption-viewing strategy requires several hours of caption viewing with an appropriate strategy (G. Freed, personal communication, August 27, 1993; J. Navoy, personal communication, August 27, 1993). It has also been reported, however, that this non-complex skill does not require a considerable amount of conscious attention, even in the initial stages of skill acquisition (Freed; Navoy).

In the current study, it would be expected that a brief practice period could be beneficial, as it may allow the subjects to proceduralize the caption-viewing strategy and begin to automatize it, so that it may be performed on an adequate level while viewing the stimulus material.

Initial Caption Viewing

A qualitative study conducted by this author (Berkay, 1993) provided further support for the possible benefits of brief caption-viewing practice for hearing novice caption readers. One of the purposes of the qualitative study was to examine the caption-viewing processes of non-special needs hearing students. In this study, eight preservice teachers (1 male and 7 females, ages 20-22) were interviewed with open-ended questions following the viewing of captioned episodes of Beverly Hills, 90210 and Melrose Place. The subjects' viewing time ranged from 15 minutes to 2 hours, depending on the order in which they were interviewed. (Those interviewed first had the shortest viewing time.) A caption-viewing strategy was not presented to these subjects, and they were not tested on the content of the stimulus material. Six of these subjects had no previous caption-viewing experience, and two had estimated a few hours of prior caption viewing. One additional subject from a community college psychology program (male, age 20) had participated in the piloting of the open-ended questions used for the interviews during this study. His comments were also included in the data analysis for this study.

Although several findings related to the caption-viewing processes of non-special needs hearing students were determined, a few of the findings related to the initial caption-viewing process are of interest to the current study. Subjects reported that for the first few minutes of viewing, their focus was directed toward unique characteristics of the captions, rather than toward processing the content of the stimulus material. After a few minutes, the subjects reported that they were able to shift their focus to the program content. More specifically, the following processes were reported to occur during the first few minutes of caption viewing for these novice viewers:

1. The subjects struggled to find an appropriate caption-viewing strategy.

2. The subjects proceduralized the strategy.

3. The subjects were initially distracted by unique features of the captions, specifically: (a) placement of the captions and (b) discrepancies between verbal information in captions and dialog (resulting from editing to reduce presentation rate).

In order to allow novices to focus on the content of a captioned program, it might be suggested that these three processes are dealt with prior to the viewing of important content. In order to deal with Item 1 above in the current study, the expert caption-viewing strategy will be taught to the subjects prior to viewing, so that they won't be forced to try several different strategies during their first caption-viewing experience. Items 2 and 3 will be dealt with during a brief practice period. During that time, subjects will be allowed to proceduralize the new strategy and will also be given an opportunity to overcome the initial distractions caused by unique characteristics of the captions.

Based on the findings of this qualitative study, it might be suggested that caption-viewing practice would help subjects to get over the novelty effect of the captions and to proceduralize the caption-viewing strategy prior to viewing the stimulus material.

Summary

In this chapter, literature relating to (a) captioning legislation and history, (b) effects of captions on hearing viewers, (c) cognitive theories and empirical findings related to caption viewing, and (d) initial captioning-viewing processes has been reviewed. An examination of Federal legislation revealed that captions and other classroom auxiliary aids are mandated under the Department of Health, Education, and

Welfare's 1977 encodement of the Federal Rehabilitation Act of 1973, Section 504 (Nondiscrimination on the basis of handicap, 1991). Another important piece of legislation is the Television Decoder Circuitry Act of 1990, which requires that newly manufactured television sets include a caption decoder chip. These two laws taken together provide both legal motivation for including captions in a mainstreamed classroom and increased availability of captioning equipment for classroom use.

A review of the history of closed captioning briefly traced the development and use of open captions by network broadcasters in the early 1970's through the development and implementation of closed captioning technology for television programs and pre-recorded videotapes in the late 1970's through the early 1990's (Block & Okrand, 1983; Carney & Verlinde, 1987; Cronin, 1980; Gallaudet University, 1992). It appears that the rapid increase in available captioning technology and captioned television programs is a major breakthrough for those promoting the use of captions in mainstreamed classrooms.

Although captions were developed for a deaf audience, captioning professionals attempted to show that captions are beneficial to special-needs hearing individuals as well. Several captioning studies were conducted on special-needs populations that included subjects who were

(a) learning disabled students, (b) remedial readers, (c) adult-literacy students, (d) ESL students, and (e) educable-mentally-handicapped students. In these studies, the effects of captions on the improvement of reading skills for these subjects were examined. Unfortunately, this research did not show significant performance gains when captions were added to instructional television programs. Of the three published studies that compared the effects of captioned vs. non-captioned programs for this population (Bond, 1974; Koskinen et al., 1986; Neuman & Koskinen, 1992), only one showed captioned programs to be moderately more effective (Neuman & Koskinen). In other comparisons, captions were found to be effective for hearing special-needs students when compared to textbooks, caption scripts, and television program transcripts (Adler, 1985; Koskinen et al., 1986; Neuman & Koskinen; Reilly & Barber-Smith, 1982). (A summary of the findings for hearing special-needs subjects is included in Table 3.)

In addition to the abundant research on the effects of captions on hearing special-needs populations, a limited amount of research on hearing non-special needs students was discovered in the literature. The focus of much of this research was on examining possible detrimental effects of captions, rather than on benefits

Table 3

Summary of the Literature on Captioning Research with Hearing Special-Needs Subjects

Author(s)	Year	Pop	Age range	Type of study	Treatment(s)	Measure(s)	Conclusion(s)
Reilly & Barber-Smith	1982	LD	13-15	Empir	(a) Cap (b) Trans (c) Cap/trans (d) Textbook	Word rec pre- and posttests	Cap/trans most effective
Koskinen, Wilson, Gambrell, & Jensema	1986	LD	9-13	Empir	(a) Cap (b) Cap w/o sound (c) NC (d) Script	Word rec, recall, cloze, and reading, posttests	1) Cap w/sound more effective than script 2) Cap w/sound and NC - no difference
Bond	1974	EMH	UNKN	Empir	(a) Cap (b) NC	Comp posttest	No difference
Adler	1985	RR	8- 9	Empir	(a) Cap/trans (b) Trans	Vocab posttest	Cap/trans most effective

Note. AL = Adult Literacy, Cap = Captions, Comp = Comprehension, Descrip = Descriptive, EMH = Educable Mentally Handicapped, Empir = Empirical, ESL = English as a Second Language, Inst = Instruction, LD = Learing Disabled, NC = No Captions, Pict = Pictorial, Pop = Population, Pract = Practice, Rec = Recognition, RR = Remedial Readers, Script = Caption Script, Trans = Program Transcript, UNKN = Unknown, Vocab = Vocabulary.

(table continues)

Table 3 (continued)

Author(s)	Year	Pop	Age range	Type of study	Treatment(s)	Measure(s)	Conclusion(s)
Neuman & Koskinen	1992	ESL	12-13	Empir	(a) Cap (b) NC (c) Script (d) Textbook	Comp, recall, & rec posttests	Cap moderately more effective than NC for 1/2 of measures (Mean ES = .32)
Jensema, Koskinen, & Wilson	1984	ESL RR	6-11	Descrip	Cap	Survey	Teachers rated cap as excellent.
Jensema, Koskinen, & Wilson	1984	RR	7-11	Descrip	Cap/script	Survey	Students & teachers gave cap high rating for learning quality.
Goldman & Goldman	1988	RR	15-17	Descrip	Cap	None	Teachers stated cap resulted in high motivation and reduced absences.

Note. AL = Adult Literacy, Cap = Captions, Comp = Comprehension, Descrip = Descriptive, EMH = Educable Mentally Handicapped, Empir = Empirical, ESL = English as a Second Language, Inst = Instruction, LD = Learing Disabled, NC = No Captions, Pict = Pictorial, Pop = Population, Pract = Practice, Rec = Recognition, RR = Remedial Readers, Script = Caption Script, Trans = Program Transcript, UNKN = Unknown, Vocab = Vocabulary.

(table continues)

Table 3 (continued)

Author(s)	Year	Pop	Age range	Type of study	Treatment(s)	Measure(s)	Conclusion(s)
Mehler	1988	ESL AL	UNKN (Adult)	Descrip	Cap	None	These subjects should use cap only in class with instruction.
Grimmer	1992	ESL	UNKN (Adult)	Descrip	Cap	None	These subjects can benefit from viewing cap at home w/o instruction.
Bean & Wilson	1989	AL	UNKN (Adult)	Empir	(a) Cap/inst (b) Script/inst (c) Cap/no inst	Word rec & reading posttests	No differences

Note. AL = Adult Literacy, Cap = Captions, Comp = Comprehension, Descrip = Descriptive, EMH = Educable Mentally Handicapped, Empir = Empirical, ESL = English as a Second Language, Inst = Instruction, LD = Learing Disabled, NC = No Captions, Pict = Pictorial, Pop = Population, Pract = Practice, Rec = Recognition, RR = Remedial Readers, Script = Caption Script, Trans = Program Transcript, UNKN = Unknown, Vocab = Vocabulary.

for this audience. Three studies were conducted with this population, each using a different presentation rate (the number of captioned words presented per minute). When brief captions with a low presentation rate were used, captioned subjects performed better than non-captioned subjects (Reese and Davie, 1987). When the presentation rate was increased to a medium or high rate, captioned subjects did not produce higher comprehension scores than those of non-captioned subjects (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c). (A summary of the findings for hearing non-special needs subjects is included in Table 4.)

In order to provide an explanation for the results of the above-described captioning experiments with hearing subjects, relevant cognitive theories and empirical findings were reviewed. According to between-channel redundancy (BCR) theory, these hearing subjects should have benefitted from the addition of captions. BCR theory states that when redundant information is presented through two or more channels (e.g., visual and audio), comprehension and retention of the information will be greater than when the same information is presented through a single channel (Gibson & Mendleson, 1984; Hanson, 1989, 1992; Hartman, 1961; Hsia, 1974, 1977). Two studies have provided support for this theory (Hartman;

Table 4

Summary of the Literature on Captioning Research with Hearing Non-special Needs Subjects

Author(s)	Year	Pop	Age range	Type of study	Treatment(s)	Measure(s)	Conclusion(s)
Root	1970	Cable Sub-scribers	12-Adult	Survey	NA	Attitude survey	Approx. 1/4 of subjects claimed to be distracted by cap.
Ruggiero	1986	Under-graduate students	UNKN	Empir	(a) Cap (b) NC	Attitude scale and comp posttests	No differences
Reese	1984	Under-graduate	UNKN	Empir	(a) Cap (b) NC	Comp and recall posttests	<u>Overall</u> no differences
Reese & Davie	1987	Under-graduate students	UNKN	empir	(a) cap/visual story (b) NC/visual story (c) cap/verbal story (d) NC/verbal story	Verbal/ visual recall & comp posttests	Cap more effective for verbal recall of verbally oriented stories

<u>Note</u>. Cap = Captions, Comp = Comprehension, Empir = Empirical, NC = No Captions, Pop = Population, Rec = Recognition, UNKN = Unknown.

Hsia 1974). In these studies, it was discovered that information from two redundant sources (dialog and captions) presented through two channels (audio and visual) generated higher recognition and recall performance than did information from only one source (dialog) presented through one channel (audio). It was also discovered that when a related information source (picture) was added to the two redundant sources (dialog and captions), performance scores were lower than those generated from only the two redundant sources (Hartman).

The weakening effect of the related picture source on BCR was further explained through the examination of past findings on divided attention. These findings have shown that there is a limited processing capacity for each modality (e.g., visual) (Lindsay, 1970; Moray, 1967, Shaffer, 1971; Sutherland, 1959; Triesman and Davies, 1971). The limit of dividing attention between two inputs (e.g., captions and picture) is related to the difficulty of the task. Either one difficult task or multiple simple tasks can be attended to at one time. This might explain why subjects in past experiments benefitted from the BCR effect with low-presentation-rate captions (Reese and Davie, 1987), as attending to both the brief captions and the picture might have been considered two simple tasks. When the presentation rate was medium or high (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c), the caption-reading task might have become difficult. Subjects might not have been able to attend to processing high- or medium-presentation-rate captions _and_ the picture without exceeding the visual processing capacity.

It has been reported that at a medium presentation rate, skilled caption readers have developed a strategy of allocating less visual processing resource to the captions by quickly glancing at them, rather then slowly reading them, as novices do (G. Freed, personal communication, August 27, 1993; J. Navoy, personal communication, August 27, 1993). This strategy allows for effective processing of both visual inputs (captions and picture) without exceeding the visual processing capacity. Novice caption readers report difficulty in reading captions presented at a medium presentation rate (Freed; Navoy). The divided attention findings might suggest that novice caption readers do not benefit from the BCR effect with a medium presentation rate because they have not learned to effectively allocate visual attention to both visual inputs. This allows the related source (picture) to interfere with effectively processing the two redundant sources (captions and dialog).

A few other relevant cognitive theories and findings were also examined. Past empirical findings on prior domain knowledge were reviewed. These findings might serve to explain why in past captioning research with hearing subjects, gains in comprehension were not found when captions were added. Prior domain knowledge findings have shown that when subjects have previous knowledge in a target domain, it is easier to assimilate and comprehend new information than when subjects have little or no prior knowledge in the target domain (Bransford, Barclay, & Franks, 1972; Eckhardt, cited in Ellis & Hunt, 1993; Sulin & Dooling, 1974). These findings suggest that the non-challenging stimulus material used in past captioning research with non-special needs hearing subjects presented simple tasks that could have resulted in high comprehension of program content without captions. When captions were added, a possible ceiling effect might have limited potential gains in comprehension.

Also reviewed was the ACT* model (Anderson, 1983), in which the three stages of skill acquisition were described. This model was examined in order to determine the effects of practice on learning a new skill, such as a caption-viewing strategy. It was explained that a new skill is learned declaratively and attempted with a heuristic in the cognitive stage. Then the skill is proceduralized in algorithmic form and partially automated in the associative stage. Finally, the skill is further automated and fine tuned during the autonomous stage. A highly practiced task becomes automatic and requires less conscious effort, while a low-practiced or unpracticed task requires considerable conscious attention (Anderson, 1990; Ellis & Hunt, 1993; LaBerge & Samuels, 1974; Shiffrin & Schneider, 1977, Underwood, 1974). Although a high degree of automaticity for the caption-viewing strategy requires several hundred hours of practice (G. Freed, personal communication, August 27, 1993; J. Navoy, personal communication, August 27, 1993), a brief caption-viewing practice period might be expected to result in proceduralization and some degree of automatization of this skill.

To provide further support for the use of a brief caption-viewing practice period, a qualitative study that examined non-special needs hearing students' initial caption-viewing processes was reviewed (Berkay, 1993). The subjects reported that during the first few minutes of viewing they were engaged in (a) finding a caption-viewing strategy, (b) proceduralization of the strategy, and (c) becoming accustomed to initially distracting unique characteristics of the captions. It was suggested that a caption-viewing strategy could be taught to students and then brief caption-viewing practice might result in the proceduralization of the strategy and the fading of the distraction caused by unique features of the captions. These findings provide further support for the use of a brief caption-viewing practice period prior to the viewing of stimulus material.

CHAPTER 3

METHODS AND STATISTICAL PROCEDURES

This chapter describes the methods used for data collection and analysis and the statistical procedures employed in this study. The information is presented in the following two sections: (a) Method and (b) Statistical Procedures. The first section explains the methods that were used for (a) the selection of subjects; (b) the development of the measurement instruments, stimulus material, practice material, instruction, and seating arrangement; (c) the experimental design and treatment groups; and (d) the administration of the treatment conditions. The second section outlines the statistical procedures that were used to compare comprehension performance and captioning attitudes among the four groups of subjects.

Method

Subjects

Subject Selection

The subjects were primarily undergraduate hearing students enrolled in a preservice teachers program at a

Southwestern university. (A few of the subjects were graduate students seeking certification in the same program.) All subjects were volunteers who agreed to participate in this experiment in exchange for course credit. Participants were recruited from several upper-division undergraduate courses, including courses in (a) Media and Technology; (b) Computer Literacy; (c) Early Childhood Development; (d) Learning, Motivation, and Cognition; (e) Reading Methods; (f) Science Methods; and (g) Language Arts Methods.

Demographics

In order to be able to sufficiently describe the characteristics of this sample, background information was collected from each subject during the experiment. Demographic categories included gender, age, ethnicity, class level, major, highest obtained degree, grade-point average, and previous experience with deaf people. The Background Information sheet used in this experiment can be found in Appendix C.

A total of 96 students (16 males and 80 females, ages 19-52) agreed to participate in this study. The frequencies and percentages for the demographics reported on the Background Information sheets are included in Appendix D. The majority of the subjects (based on the highest frequency for each category) were caucasian (89%)

female (83%) college seniors (75%) with high school diplomas as their highest degree (83%). Elementary Education majors had the highest representation in this sample (47%). The average age was 26, while the average grade point average was 3.32. Most of the subjects reported to have known a deaf person (63%). Although there was a disproportionate number of caucasian female subjects, this sample appeared to be representative of a typical upper-level preservice teacher program population. This sample's representativeness of a typical undergraduate population may be in question.

Protection of Human Subjects

In compliance with University of Oklahoma regulations, human subjects approval was obtained from the Research Department prior to the collection of data. A copy of the approval form is included in Appendix E. A subject consent form was also developed and is included in Appendix F.

Sample Size

In order to determine the sample size for each of the four treatment conditions, a power analysis was conducted using STPLAN: Calculations for sample sizes and related problems (Brown et al., 1990). Although McNamara (1992) suggested an effect size criterion of 0.5 for educational research, a large effect size of 0.8 was used in the power calculation formula as a more stringent criterion was desired. Using an alpha level of .05 and power of .80, the calculated sample size per cell was 25 subjects.

When the preservice teacher subject pool was previously used by the author, there was a substantial number of no-shows. It was decided that in anticipation of this circumstance, 30 (rather than 25) subjects would be recruited for each treatment condition.

For the experiment, the captions-without-instruction group had 26 subjects, the short-practice group had 21 subjects, the long practice group had 22 subjects, and the control group had 27 subjects. (Descriptions of the treatments for each of these groups are included in the Methodological Approach section that appears later in this chapter.)

Instrumentation

Variables of Interest

The four dependent variables used in this experiment were the scores from (a) the declarative knowledge sub-test, (b) the intellectual skills sub-test, (c) the pre-treatment attitude scale, and (d) the post-treatment attitude scale.

Comprehension Posttest

The declarative knowledge sub-test (14 items) and the intellectual skills sub-test (9 items) were used to measure comprehension of the content of the instructional television program (stimulus material).

Attitude Scale

The 10-item Opinions About Captions attitude scale was administered twice to measure pre-treatment and post-treatment attitude toward the use of captions with hearing people.

Caption-Viewing Survey

Open-ended and categorical response items from the 6-item Caption-Viewing Survey were used to assess subjects' reactions to and experience with the caption-viewing process.

Stimulus Material Comprehension Measures

Description

The subjects' comprehension of the instructional television program was measured through a pencil-and-paper posttest that was administered following the viewing of the stimulus material. In the literature on Instructional Design, a distinction is made between declarative knowledge skills and intellectual skills (Gagne, Briggs, & Wager, 1992; Smith & Ragan, 1993). For the former, the declarative information learned is restated or summarized, while for the latter, the declarative information learned is manipulated. Both types of learning from the stimulus material were assessed on the posttest. In this instrument, there were 14 declarative knowledge skills items and 9 intellectual skills items for a total of 23 items (see Appendix G). All items were written in a multiple-choice format. Each subject received two performance scores from this test: (a) declarative knowledge skills performance and (b) intellectual skills performance.

Development Process

The development process for the comprehension posttest is described below.

Purpose. The purpose of the comprehension performance measure development process was to create a criterion-referenced test that could be used to evaluate students' comprehension of the content from a 20-minute segment of an instructional television program entitled Development (Page & Hutton, 1988).

Pilot version. First, a content analysis was conducted to determine all of the content in the 20-minute segment of the stimulus material. Then, a decision was made as to the content that would be used in the comprehension posttest. Test item specifications and a test blueprint were written to guide the writing of the comprehension posttest. It was determined that all items would be multiple-choice with four foils. Although the declarative knowledge and intellectual skills sub-tests were to be scored and analyzed separately, it was determined that the items would be presented on one single instrument. Items were not identified as declarative knowledge items or intellectual skills items on the instrument. A pilot version of the comprehension assessment was written with 58 items (30 declarative knowledge and 28 intellectual skills items).

Expert review. In order to establish the content validity of this test, three content experts and one test construction expert reviewed the test, test specifications, and blueprint. The three content experts were instructors who taught Human Development, Child Development, and/or Adolescent Development courses at a university or community college level. The test construction expert was a university professor with extensive test development experience. These judges evaluated the items to determine whether they would be challenging for the subjects in the preservice teachers program. The judges also commented on technical problems with the items, including (a) items that cued responses to other items, (b) items with multiple correct responses, (c) items with correct responses that were technically incorrect, and (d) items that were poorly written.

Based on the comments from the expert review process, four intellectual skills items and three declarative knowledge items were eliminated. A total of 51 items was retained for piloting, which included 27 declarative knowledge items and 24 intellectual skills items.

Final version. Following two pilots of this instrument, there were 23 items retained for the final version, including 14 declarative knowledge items and 9 intellectual skills items. A copy of this version is included in Appendix G.

Attitude Measure

Description

Attitudes about the use of captions with hearing people were measured before and after the treatments were administered. A revised version of Ruggiero's (1986a, 1986b, 1986c) untitled attitudes toward captioning scale was used. In the original scale, there were 16 items, including (a) four neutral items (not counted in scoring), (b) nine items in a general factor, and (c) four items in a segregation factor. The general factor measures general attitudes toward the use of captions with hearing people, while the segregation factor measures attitudes toward the use of separate caption-viewing facilities for deaf people. In a previous experiment, the reliability for the general factor was found to be .89, while the segregation factor held a reliability of .63 (Ruggiero, 1986a, 1986b, 1986c).

Revision Process

Before using this scale in the current study, a few adaptations had to be made as follows:

1. The untitled scale was given the title "Your Opinions about Captions."

2. Instructions were added that eliminated consideration of foreign films with subtitles. Also, the subjects were asked to only consider the use of captions with a hearing audience, rather than a deaf audience.

3. The scale anchors were changed from numbers to letters that represent the level of agreement or disagreement (e.g., "SA" stands for "strongly agree").

4. The direction of the scale and scoring method was not indicated by Ruggiero (1986a, 1986b, 1986c). For the revised scale, it was determined that a higher score would reflect a more positive attitude than would a lower score. It was also decided that each item would receive equal weight when scoring.

5. A few items needed to be re-written, as they were either ambiguous or too long.

6. Three of the four neutral items from the original scale were eliminated, and one neutral item was re-written and retained. Justification for these actions is presented below. The original scale was used only as a post-viewing measure in Ruggiero's (1986a, 1986b, 1986c) study and included three neutral items (Items 6, 10, and 15) that referred to a recently viewed captioned program. As the scale in the current study was used as a pre- and post-viewing measure, it would not make sense to include these three neutral items before viewing a captioned program. As the pre- and post-viewing scale needed to be identical, these three neutral items were eliminated. A fourth neutral item (Item 3) did not reference a recently viewed program. This item was re-written and retained. This left a total of 13 items for the revised version of the scale that was submitted for expert review prior to piloting. A copy of this revised scale is included in Appendix H. This version reflects the changes that were made following the expert review process described in the next section.

Expert Review

Procedure. Prior to piloting the 13-item Opinions About Captions scale, the scale was distributed to captioning professionals for expert review. First, individuals at three institutions that employed captioning professionals were contacted by telephone to ask if they would participate in this process. Following the phone calls, the scale was sent by fax along with instructions to the reviewers. The experts were asked to review the attitude scale to determine whether they believed that the items measure a general attitude toward the use of captions with hearing people and an attitude toward the use of separate caption-viewing facilities for deaf people. The experts were asked to write their comments on copies of the scale and to fax the copies back to the author.

Response. Four individuals faxed back their comments. Three of the respondents were faculty members with captioning expertise who were employed at postsecondary institutions for deaf students. A fourth respondent worked in the customer relations department of a major company that captioned television programs.

Feedback and revisions. The expert reviewers all agreed that the items measured a general attitude toward the use of captions with hearing people and an attitude toward the use of separate caption-viewing facilities for deaf people. A few changes to items were suggested as follows:

1. In the instructions, the subjects are asked to "consider captioned programs used with people who have normal hearing." Item 4 stated: "Captions would interfere with my [emphasis added] enjoyment of a program." The word "my" would direct the respondent to only consider him- or herself and not other hearing people as well. This item was revised with the removal of the word "my."

2. There were two items that had double-barrelled statements. Both of these items were revised to include only one concept.

3. One awkwardly worded item was re-written.

All of the above revisions were incorporated into the 13-item scale before it was piloted.

Final Version

As the impact of the above scale revisions on the original reliability and factor analysis study is unknown, a new reliability and factor analysis pilot was conducted with the revised scale. As a result of this pilot and other pilots, a 10-item version of this scale was developed for use in the experiment. A copy of the revised 10-item scale is included in Appendix I.

In this experiment, the revised 10-item scale was administered both prior to and following the administration of the treatments. Each subject received a pre-treatment scale total score and a post-treatment scale total score. (As only one factor was determined from the factor analysis conducted during the pilot and experiment, individual factor scores were not used.)

Caption-Viewing Survey

In order to obtain information from the subjects about their caption-viewing processes and previous experience with captions, a six-item Caption-Viewing Survey was administered to each subject after the viewing of the stimulus material. The items examined (a) percentage of attention allocated to captions vs. picture, (b) ability to attend to captions, picture, and dialog simultaneously, (c) frustration with the caption-viewing task, and (d) prior caption-viewing experience. A copy of this survey is included in Appendix J.

Stimulus Material

The development of the stimulus material is described below.

Selection Criteria

For the stimulus material, the author searched for a 20-minute segment of a captioned instructional television program with challenging material predicted to be in a domain unfamiliar to most of the undergraduate students who participated in this study, as determined by expert review. It was determined that the stimulus material would contain content that was relevant to the curriculum of the subjects (preservice teachers). In a normal classroom situation, instructors typically show programs relevant to course curriculum. There was concern that the use of irrelevant program content in the current study might elicit different behavior than that elicited by relevant material. In order to allow for generalization of the results of this experiment to a typical classroom setting, an instructional television program related to the subjects' normal course of study was sought by the author.

Program Selected

In searching for an instructional program that would meet the requirements of the experiment, the author located a captioned program entitled Development (Page & Hutton, 1988). The author examined the captions that were created for this program and determined that they met an acceptable criteria to serve as the stimulus material for this experiment as follows:

1. The program was professionally captioned by the National Captioning Institute (NCI), which is one of the

two leading captioning companies in the country. (The quality of captions produced by other companies might be in question by those in the captioning field.)

2. The captions were produced off-line. They were properly timed and placed under the speaker.

3. The presentation rate was estimated to range from 150 to 180 words per minute, which is in the range of a medium presentation rate typical of most instructional television programs.

4. The captioner used standard white captions on a black background.

Expert Review

In order to select a 20-minute segment of this 60-minute program that would contain unfamiliar domain content for the target population for this study, an expert review process was conducted. Four instructors who taught Adolescent and Child Development courses to members of the potential subject pool reviewed the 60-minute instructional television program. One expert was a professor who taught Development courses and supervised teaching assistants. The other three judges were graduate student teaching assistants who taught courses in Development.

While viewing the program in the presence of the researcher, the experts indicated on a form whether each of the 21 segments would be considered challenging or non-challenging to members of the preservice teachers program. It was determined that only segments deemed challenging by unanimous agreement of the four judges would be selected for the 20-minute stimulus material segment. Seven segments met this criteria. The total running time of these segments was approximately 22 minutes.

The major selection criteria for selecting approximately 20 minutes of material from these seven segments was that the segments used could be put together in a manner that would not interrupt the continuity of the program. The use of a group of segments that appeared sequentially in the 60-minute program was thought to be more desirable than individual segments scattered throughout the program, as showing scattered segments might result in jumpy, choppy stimulus material. Based on this criteria, five of the seven segments were selected for the stimulus material. This resulted in 18 minutes and 38 seconds of challenging content. With the opening and closing credits, the stimulus material was 20 minutes and 20 seconds in length. The topics included (a) prenatal development, (b) the effects of fetal alcohol syndrome, (c) cognitive capabilities of new-born babies, and (d) the brain's commitment to language.

Practice Material

Selection Criteria

A two-minute and an eight-minute captioned segment from an educational program were sought to allow subjects in the caption-viewing strategy groups to practice their newly acquired skill. (The stages of skill acquisition literature has not established precise guidelines regarding the length of differing practice sessions and their effects on acquisition of a skill. In addition, the self-reports of non-special needs hearing subjects did not suggest a precise practice time needed to adjust to the unique characteristics of captions during initial caption viewing. In the absence of specific guidelines, two-minute and ten-minute practice periods were selected, as these time lengths were judged to be substantially different.) As the purpose of this practice was to concentrate on mastering the caption-viewing strategy, rather than on learning challenging material, the author sought segments that included non-challenging content, presented in a domain predicted to be familiar to most of the undergraduate students who participated in this study, as determined by expert judges.

Program Description

In searching for an instructional program that would meet the requirements of this experiment, segments from

Development (Page & Hutton, 1988) that were deemed non-challenging by the expert judges were used. According to the feedback from the four judges, the 60-minute program appeared to have a wide range of content. Some segments were highly technical and contained unfamiliar or challenging content for the subjects in the target population. Other segments contained light human interest stories or content that was covered in Development courses taken by the students in the preservice teachers program.

Expert Review

The researcher had determined that only segments deemed non-challenging by unanimous agreement of the four judges would be selected for the two- and eight-minute practice segments. A total of 11 segments met this criteria. The total running time was approximately 21 minutes for these segments.

A two-minute segment and an eight-minute segment were needed for the experiment. All subjects would see both segments, either captioned or non-captioned depending on the treatment. The short-practice subjects would need to see two minutes captioned and eight minutes non-captioned. If a continuous ten-minute segment were shown to the short-practice subjects and captions suddenly disappeared after two minutes, this could cause a great distraction.

These two segments needed to appear distinctly separate and be separated by a few seconds of black.

The major selection criteria for the two-minute segment was that it be a short and separate unit. One segment, which ran 2 minutes and 30 seconds was selected for this segment. The major selection criteria for the eight-minute practice segment was similar to the criteria for the selection of the 20-minute stimulus material. The segments used should be put together in a manner that would not interrupt the continuity of the eight-minute segment. The use of a group of segments that appeared sequentially in the 60-minute program was desired. Four segments were selected because they were continuous. This resulted in an eight-minute practice segment.

Caption-Viewing Strategy Instruction

A caption-viewing strategy was taught to those subjects who received the instructional intervention. This instruction was aimed at teaching novice caption readers how to allocate less attention to the captions so that both the captions and picture could be effectively processed.

The caption-viewing strategy can be described as follows: The viewer should watch the picture until a caption pops up. The appearance of a new caption can be seen with the viewer's peripheral vision. When a new caption appears, the subject should quickly glance down at the caption and then look back up at the picture until the next caption appears.

A supplementary skill that was taught involved using the captions as a back-up for missed spoken content. If dialog is unintelligible, the viewer could quickly re-scan a caption before it disappears to determine the unintelligible spoken words.

Those subjects receiving the instructional intervention were shown a videotape of the instruction spoken by the experimenter. This videotape was created for the purposes of standardization of the instruction. The instructional script (included in Appendix K) reflects changes that were made after the pilot of this instruction.

Seating Arrangement

It was important to ensure that the room set-up used for the experiment would not prevent caption-viewing subjects from reading captions. For this reason, a seating arrangement was designed that would allow the subjects an unobstructed view of the captions. A diagram of the seating arrangement is included in Appendix L.

Pilots of the Instruments

Six pilots of the instruments were conducted prior to the collection of data as follows: (a) comprehension posttest, (b) comprehension pretest/posttest, (c) attitude scale reliability, (d) attitude scale roleplay, (e) attitude scale expert, and (f) caption-viewing strategy instruction and seating chart. The final versions of the instruments were developed from these pilot studies. These pilots are described in Appendix M.

Methodological Approach

Two different research designs were used for this study. In order to examine the variable of attitude toward the use of captions with hearing people, a pretest-posttest control-group design was used to determine pre- and post-treatment differences in attitudes among groups. To examine the comprehension of the stimulus material, a posttest-only control-group design was used, in order to examine post-treatment differences among groups.

Four treatment conditions were administered as follows: (a) captions without instruction, (b) captions with instruction/short practice (short practice), (c) captions with instruction/long practice (long practice), and (d) control. The captions-without-instruction group viewed a captioned program without an instructional intervention. The short-practice group and the long-practice group both viewed a captioned program following an instructional intervention, which included a caption-viewing strategy and practice period. The short-practice group received a two-minute practice period, while the long-practice group received a ten-minute practice period. The control group viewed a program without captions and did not receive an instructional intervention. (A listing of the treatment groups, as well as the treatment and measurement instruments that were administered to each group, is included in Table 5.)

Although it was intended that both research designs be experimental, they were quasi-experimental, due to the shortage of treatment rooms and video equipment. Rather than randomizing subjects into one of the four treatment groups, two sessions were conducted with two treatment groups per session. Subjects signed up for one of the two sessions. During each session each subject was randomized into one of the two scheduled treatment groups upon arrival.

Administration Procedures

Administrators and Assistants

The researcher and another doctoral student from the same program administered the treatments during each session. Four assistants helped set up the experiment and randomize subjects into treatment groups. These

Table 5

Listing of Treatment Groups and the Treatment and Measurement Instruments Administered to Each Group

Group	Attitude scale	Inst	Practice	Program format	Test	Attitude scale	Survey	Background sheet
Cap w/o inst	Pre-treatment scale	No inst	2 min-NC 8 min-NC	Cap	Post test	Post-treatment scale	Post-treatment survey	Background sheet
Cap with inst/ short pract	Pre-treatment scale	Cap viewing inst	2 min-cap 8 min-NC	Cap	Post test	Post-treatment scale	Post-treatment survey	Background sheet
Cap with inst/ long pract	Pre-treatment scale	Cap viewing inst	2 min-cap 8 min-cap	Cap	Post test	Post-treatment scale	Post-treatment survey	Background sheet
Cont	Pre-treatment scale	No inst	2 min-NC 8 min-NC	NC	Post test	Post-treatment scale	Post-treatment survey	Background sheet

Note. Cap = Captions, Cont = Control, Inst = Instruction, NC = No Captions, Pract = Practice.

assistants were recruited from the subject pool in the preservice teachers program and received course credit for their assistance. The researcher met with the other administrator and the assistants for a training session on Friday, January 28, 1994, one week prior to data collection.

Randomization of Subjects

Two classrooms in two separate buildings were used simultaneously for the two treatment groups scheduled for each session. The subjects were instructed to report to the computer lab of the education building, rather than one of the buildings that housed the treatment rooms. There was concern that if students were told to report to one of the treatment rooms, latecomers might disrupt the experiment.

As subjects arrived at the computer lab for each session, the researcher checked each subject's name on the sign-up sheet. This was done to ensure that subjects did not arrive for the wrong session.

A total of 75 subjects signed up for Session 1. Only 56 showed up for the session, which left a no-show rate of 25%. Only 53 of these subjects were able to participate in this session. One subject was hearing-impaired and was not an appropriate subject for this study. A second subject had already participated in the pilot, while a third subject arrived late and missed the randomization process. These three subjects were given surveys to complete for another study.

A total of 80 subjects signed up for Session 2. Only 47 showed up, which left a no-show rate of 41%. Only 43 of these subjects were able to participate in this session. Two subjects had arrived during Session 1 and could not stay for the second session. A third subject had already participated in the pilot, while a fourth subject arrived late and missed the randomization process. These four subjects were given surveys to complete for another study.

Those subjects whose names appeared on the sign-in sheet and were not disqualified from the study were escorted into the computer lab, where each subject was given an index card from a randomized card stack. There were two different colors of cards in the stack. Prior to the experiment date, the researcher took pairs of cards (one of each color) and shuffled each pair behind his back. Each pair was placed in the stack after being shuffled. Randomizing the cards in pairs, rather than shuffling the entire stack, ensured that the cell sizes for the two treatment groups in each session would be equal (or unequal by no more than one subject). For Session 1, the 53 subjects were randomized into the captions-without-instruction group (n = 26) and the control group (n = 27). For Session 2, the 43 subjects were randomized into the long-practice group (n = 22) and the short-practice group (n = 21).

After receiving an index card, the subjects were directed to either one side of the room or the other, depending on the color of the card. This was done to make sure that all subjects with the same color card were in the same end of the room. The assistants prevented the subjects from going over to the other group on the other end of the room and swapping cards with subjects from that group. This was done to maintain the randomization. There was concern that if the groups were not separated, subjects might swap cards in order to go with their friends.

A separate sign-in sheet for each group was placed on each end of the room. There was concern that if one sign-in sheet was placed in the middle of the room, subjects might cross over into another group while signing in. After signing in, each subjects completed a consent form. A copy of this form is included in Appendix F.

For each session, each administrator took one intact group (with all subjects holding the same color index card) and walked the subjects to one of the two treatment rooms in another building. To prevent subjects from changing groups, one administrator left with his group first. When that group was gone, the other administrator took the second group to the treatment room using a different set of stairs than the one used by the first group.

Arrival at Treatment Rooms

Prior to the subjects' arrival at the treatment rooms for the first session, two of the assistants set up the chairs in the rooms according to the seating chart. When the groups arrived, each administrator went into the room first. The administrator handed each subject a folder with all of the materials needed for the experiment. The administrator also told each subject to sit either in the front, back, or middle of the room, depending on the subject's height. The tallest subjects were sent to the back, while the shortest subjects were sent to the front of the room.

It should be noted that the treatment room used for the captions-without-instruction and short-practice groups was small and uncomfortably warm, while the treatment room used for the other two groups was large and cool.

Treatment Administration

Treatment Lengths

Once the subjects were seated, the treatments were administered. Each treatment took approximately one hour.

Visibility Check

After a brief introduction and explanation of the treatment procedure, a videotape from a television news program with a stock exchange crawl was shown to determine whether all subjects could clearly see the television screen and read captions. After one minute of viewing, the administrator left the videotape running and asked subjects who could not see the picture or read the crawl to raise their hands. For all four treatment groups, no subject raised his or her hand.

Pre-treatment Attitude Scale

Next, all subjects were asked to turn past the blank cover sheet on the top of the packet and pull out the pre-treatment attitude scale reproduced on pink paper. The blank cover sheet was placed over this scale to prevent subjects from reading the scale items before being asked to do so. They were instructed to complete every item in the scale and not to discuss the items amongst themselves. Subjects were also told not to write their name on this scale or on any other form in the packet. After the subjects had completed this scale, it was collected by the administrator. There was some concern that if the pre-treatment attitude scale was left in the subjects' packets, they could try to match up the responses from this scale when completing the post-treatment scale.

Caption-Viewing Strategy

After the pre-treatment scale was completed and collected, the subjects in the long- and short-practice groups were told that they would learn an effective strategy for viewing captions. These subjects were shown the caption-viewing strategy instructional videotape and provided with an opportunity to ask questions about the intervention following the screening of the videotape. This instruction was not presented to the subjects in the other two treatment groups.

Practice Material

Next, all four treatment groups were shown the two-minute and eight-minute practice videotape segments. All subjects were told that they would not be tested on this material. The long-practice group viewed both segments with captions. The short-practice group viewed the two-minute segment with captions and the eight-minute segment without captions. The captions-without-instruction and control groups viewed both segments without captions. The practice segments were shown to all four groups in order to control for the effect of viewing additional program content prior to viewing the stimulus material.

Prior to viewing the two-minute segment, the long-practice group was informed that they would view two captioned segments in order to practice the caption-viewing strategy. During the black between the two- and eight-minute segments, the subjects were told that the next segment would give them more time for practice.

Prior to viewing the two-minute segment, the short-practice group was told that they would view a captioned segment in order to practice the caption-viewing strategy. During the black between the segments, the subjects were told that the next segment was uncaptioned and would give them a chance to get into a television-viewing mode. (This excuse was invented so that the subjects would not wonder why the second segment was uncaptioned.)

Prior to viewing the two-minute segment, the captions-without-instruction group subjects were told that they would be viewing two program segments without captions to give them a chance to get into a television-viewing mode. (This excuse was used so that the subjects would not wonder why they were watching non-captioned practice segments prior to viewing captioned stimulus material.) During the black between segments, the subjects were informed that the next non-captioned segment lasted about eight minutes.

Prior to viewing the two-minute segment, the control group subjects were informed that they would be viewing two program segments to give them a chance to get into a television-viewing mode. (This excuse was invented so that the subjects would not wonder why they were watching practice segments. As captions were not being shown with the stimulus material for this group, no mention was made that the program segments were uncaptioned. The researcher believed that making mention of captions might confuse the subjects in this group, as captions were not involved with their treatment.) During the black between segments, the subjects were informed that the next program segment would last eight minutes.

Although an announcement between segments was only needed for the short-practice group to warn the subjects of the disappearance of the captions, an announcement was made between segments for each group. This was done to control for a possible effect of having an announcement between practice segments. During the black between segments, all subjects were reminded that they would not be tested on the next practice segment.

Stimulus Material

At this point, the subjects were informed that they would be shown the 20-minute stimulus material and that they would be tested on the content with a 23-item multiple-choice test following the viewing. They were asked not to talk during the program. The control group viewed a non-captioned version, while the other three groups viewed a captioned version.

Comprehension Posttest

After the viewing of the stimulus material had concluded, the subjects were asked to remove the comprehension posttest from their packets. They were told that the test was not timed, and they could take as much time as they needed to complete the test. They were asked not to discuss the items amongst themselves. All subjects were instructed to record each answer twice, once on the scantron sheet provided and once on the test. The double recording was requested to ensure that tests would not need to be discarded due to missing responses. In the event that a subject failed to record an answer on the scantron, the researcher could examine the test to determine the subject's response. Subjects were told to sit quietly after completing the test. It was requested that the subjects did not attempt to examine or complete other forms in the packet until instructed to do so.

After receiving all of these instructions, the subjects were told to break the seal on the test and begin. (A blank sheet of paper was taped onto the front of the test to prevent subjects from looking at items prior to the viewing of the stimulus material. There was concern that if the test was not covered, subjects might glance at items and be cued to the test content prior to viewing.) After all subjects completed the test, they were told to place their tests and scantron sheets face down on the bottom of the packet. This was done to prevent subjects from working further on the test after the test period was completed.

Post-treatment Attitude Scale

Following the completion of the posttest, the subjects were asked to remove the staple from the post-treatment attitude scale that was reproduced on blue paper and to fill out the scale. (The scale was stapled shut in order to prevent the subjects from filling out items prior to the completion of the treatment.) The same direction given for the pre-treatment scale were given for the post-treatment scale. After all subjects completed this scale, they were told to place it face down in the packet.

Caption-Viewing Survey and Background Information Sheet

Finally, the subjects were asked to fill out the Caption-Viewing Survey and Background Information sheet. They were reminded not to discuss the items amongst themselves and to complete every item.

Closing

When all forms were completed, the subjects were told to place all forms in their folder. The administrator collected all of the folders and thanked the subjects for their participation. Subjects were informed that they could find out the results of the experiment in a few weeks by calling the phone number on their copy of the consent form. At this point, all subjects were excused.

Subject Behavior

As assistants were not available to take notes during the treatment sessions, only limited notes on subject behavior were taken by the administrators. The researcher took more extensive notes than did the other administrator. The following notes were recorded:

Captions-without-instruction group. Subjects whispered a little during the practice tape. They were reminded by the administrator not to talk when the program was being screened.

Short-practice group. Toward the beginning of the treatment session, a few subjects complained that the room was too hot. The researcher turned on the air conditioning. One subject was nodding off to sleep and failed to look at the screen when the stimulus material was being shown. During the viewing of the stimulus material, the subjects in this group appeared a little less attentive than did the subjects from the first session.

Differences in Administration Style

Upon comparing notes after the experiment, the administrators discovered that they had different approaches to handling subjects who took extensive time to finish the posttest. When it appeared that most subjects had finished the posttest, the researcher tended to ask if anyone needed additional time. In both of the researcher's sessions, one subject took longer than the others, and the other subjects appeared to be restless. The researcher allowed the straggler to continue with the posttest, while the other subjects moved on and completed the post-treatment attitude scale. The other administrator did not ask the subjects whether more time was needed. He walked around the room and waited until he was certain that everyone had completed their posttest before moving on to the post-treatment scale. The effects that these different approaches had on the subjects' performance is unknown.

Statistical Procedures

An alpha level of .05 was used for each statistical test conducted in this study. The statistical procedures employed for each of the six hypotheses are set forth in the sections immediately following this paragraph.

Hypotheses 1, 2, and 3

Hypotheses 1, 2, and 3 were combined for statistical analysis, as they were to be tested by one statistical procedure. These three hypotheses are:

1. Hypothesis 1: The captions-without-instruction subjects will not generate comprehension scores higher than those of the control subjects.

2. Hypothesis 2: The short-practice subjects will generate comprehension scores higher than those of the captions-without-instruction subjects and the control subjects.

3. Hypothesis 3: The long-practice subjects will generate comprehension scores higher than those of the short-practice subjects, the captions-without-instruction subjects, and the control subjects.

For each subject, the proportion of correct responses for the separate declarative knowledge and intellectual skills comprehension sub-tests was determined. A MANOVA was used to compare the declarative knowledge and intellectual skills sub-test means among groups. A Bonferoni t was planned to determine group mean differences if the MANOVA was found to be significant.

Hypotheses 4, 5, and 6

Hypotheses 4, 5, and 6 were also combined for statistical analysis, as the same statistical procedures were used to test these three hypotheses. The hypotheses are:

1. Hypothesis 4: The captions-without-instruction subjects will not hold post-treatment attitudes toward captioning that are more positive than those held by the control subjects. In addition, there should be no change in attitude from pre- to post-treatment for each group.

2. Hypothesis 5: The short-practice subjects will show a positive pre- to post-treatment attitude change. In addition, these subjects will hold more positive post-treatment attitudes than will the captions-without-instruction and control subjects.

3. Hypothesis 6: The long-practice subjects will show a positive pre- to post-treatment attitude change. In addition, these subjects will hold a more positive post-treatment attitude than will the short-practice

subjects, the captions-without-instruction subjects, and the control subjects.

For each subject, the number of total points was determined for both the pre- and post-treatment scales. A higher score indicated a more positive attitude than did a lower score. In addition to computing the group mean total scores for the complete scale, group mean scores were also calculated for each scale item. The following statistical tests were conducted:

1. A one-way ANCOVA was used to compare post-treatment attitudes among groups. The covariate was the scores on the pre-treatment attitude scale. A Bonferoni t was planned to determine group mean differences if the ANCOVA was found to be significant.

2. A t-test of correlated means was used to compare pre-treatment and post-treatment attitudes within each group to determine whether one or more of the groups experienced a significant attitude change in either direction.

CHAPTER 4

RESULTS

In this chapter, the results and statistical analyses are summarized. Presentation of data will be according to the order of the hypotheses introduced in Chapter 1. A supplemental analysis is also included that includes (a) data analysis of the Caption-Viewing Survey and (b) reliability and factor analysis of the pre-treatment attitude scale across treatment groups.

Hypotheses

Hypotheses 1, 2, and 3

For Hypotheses 1, 2, and 3, differences in comprehension posttest scores among the four treatment groups were examined. There were 14 possible points on the declarative knowledge sub-test and 9 points possible on the intellectual skills sub-test.

An examination of outlying scores revealed that some subjects generated extremely low scores. As there was concern that these low-scoring subjects did not take the test seriously, it was decided to eliminate all subjects receiving 4 points or less on the 14-item declarative knowledge sub-test, as this was the easiest of the two sub-tests. Such low scores were achieved by six subjects (one from the captions-without-instruction group, three from the short-practice group, one from the long-practice group, and one from the control group). These subjects also received low scores of 3 points or less on the 9-item intellectual skills sub-test. These six subjects' scores were eliminated from the data analysis for both sub-tests.

Group mean proportions of correct responses were determined for each sub-test and are shown in Table 6. For the captions-without-instruction group (n = 25), the mean proportion of correct responses for the declarative knowledge skills sub-test was .65 (SD = .14), while the mean proportion of correct responses for the intellectual skills sub-test was .57 (SD = .16). For the captions-with-instruction/short-practice (short-practice) group (n = 18), the mean proportion of correct responses for the declarative knowledge skills sub-test was .66 (SD = .18), while the mean proportion of correct responses for the intellectual skills sub-test was .56 (SD = .26). For the captions-with-instruction/long-practice (long-practice) group (n = 21), the mean proportion of correct responses for the declarative knowledge skills sub-test was .70 (SD = .17), while the mean proportion of correct responses for the intellectual skills sub-test was .60 (SD = .16).

Table 6

Declarative Knowledge and Intellectual Skills Sub-test Proportions of Correct Responses for the Captions-Without-Instruction, Short-Practice, Long-Practice, and Control Groups

	Captions (n = 25)		Short-Pract (n = 18)		Long-Pract (n = 21)		Control (n = 26)	
Sub-Test	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dec	.65	.14	.66	.18	.70	.17	.60	.13
Int	.57	.16	.56	.26	.60	.16	.52	.17

Note. Captions = Captions Without Instruction, Dec = Declarative Knowledge Sub-test, Int = Intellectual Skills Sub-test, Pract = Practice.

For the control group (n = 26), the mean proportion of correct responses for the declarative knowledge skills sub-test was .60 (SD = .13), while the mean proportion of correct responses for the intellectual skills sub-test was .52 (SD = .17).

A MANOVA was used to compare the group means using the two separate declarative knowledge and intellectual skills sub-tests as dependent variables. The differences between these groups were not statistically significant for the declarative skills sub-test ($F[3, 86] = 1.74$, $p > .05$) or for the intellectual skills sub-test ($F[3, 86] = 0.69$, $p > .05$). The absence of significant differences indicates that subjects in these four groups did not perform significantly differently on the declarative knowledge and intellectual skills sub-tests.

Hypotheses 4, 5, and 6

For Hypotheses 4, 5, and 6, differences between pre-treatment and post-treatment attitude scores within each group were examined. Differences in post-treatment attitude scores among the four treatment groups were also examined. The possible range of scores for the 10-item Opinions About Captions scale was 10 to 50, with 50 reflecting the most positive attitude.

Comparisons of Pre- and Post-treatment Means Within Groups

A t-test of correlated means was used to compare each group's mean pre- and post-treatment scale scores. In order to achieve an improved attitude score, a group's post-treatment score would need to be significantly higher than the pre-treatment score. The group mean pre- and post-treatment scale total scores, standard deviations, t scores, difference scores, and effect sizes are included in Table 7. For the captions-without-instruction group (n = 26), the mean post-treatment attitude score (33.65, SD = 8.44), was not significantly different than the mean pre-treatment score (33.00, SD = 7.29) ($t[25] = 0.53$, $p > .05$) (ES = 0.09). For the short-practice group (n = 21), the mean post-treatment attitude score (34.38, SD = 8.10), was found to be significantly higher than the mean pre-treatment score (31.05, SD = 6.83) ($t[20] = 2.31$, $p < .05$) (ES = 0.49). For the long-practice group (n = 22), the mean post-treatment attitude score (31.09, SD = 6.28), was not significantly different than the mean pre-treatment score (30.82, SD = 6.70) ($t[21] = 0.22$, $p > .05$) (ES = 0.04). For the control group (n = 27), the mean post-treatment attitude score (33.41, SD = 5.72), was found to be significantly higher than the mean pre-treatment score (31.33, SD = 6.04) ($t[26] = 3.66$, $p < .05$) (ES = 0.34).

Table 7

Pre-treatment and Post-treatment Attitude Scale Total Scores for the Captions-Without-Instruction, Short-Practice, Long-Practice, and Control Groups

Treat group	n	Pre-treat Mean	Pre-treat SD	Post-treat Mean	Post-treat SD	t score	Diff score	ES
Cap	26	33.00	7.29	33.65	8.44	0.53	0.65	0.09
SP	21	31.05	6.83	34.38	8.10	2.31*	3.33	0.49
LP	22	30.82	6.70	31.09	6.28	0.22	0.27	0.04
Cont	27	31.33	6.04	33.41	5.72	3.66*	2.08	0.34

Note. Cap = Captions Without Instruction, Cont = Control, Diff = Difference, ES = Effect Size, LP = Long Practice, Pre-treat = Pre-treatment, Post-treat = Post-treatment, SP = Short Practice, Treat = Treatment.
*$p < .05$.

From the results of this data analysis, it appeared that the short-practice group and the control group means were significantly higher on the post-treatment scale than on the pre-treatment scale, which reflected an improved attitude score following the treatment. The effect sizes for the short-practice and control groups (0.49 and 0.34 respectively) were no greater than one-half of a standard deviation. This is lower than the standard of 0.8 that was established for practical significance prior to the collection of data (see Chapter 3). The short-practice group mean increased by approximately 3 points, while the control group mean increased by 2 points. The means of both the pre-treatment and post-treatment scales for both groups were close to the neutral point of the scale (30 points). These increases do not reflect great changes in attitude and do not appear to be of practical significance.

In order to determine the specific items for which attitudes improved for each group, the group pre- and post-treatment attitude means were determined for each item. A t-test of correlated means was used to compared these group means. The pre- and post-treatment item means, standard deviations, _t_ scores, difference scores, and effect sizes are included in Table 8. For the short-

Table 8

Pre-treatment and Post-treatment Attitude Scale Item Scores for the Captions-Without-Instruction, Short-Practice, Long-Practice, and Control Groups

Item no.	Pre-treat Mean	Pre-treat SD	Post-treat Mean	Post-treat SD	t score	Diff score	ES
Captions-Without-Instruction Group (n = 26)							
1	3.08	1.06	2.81	1.02	-1.19	-0.27	-0.25
2	2.65	0.85	2.54	0.99	-0.59	-0.11	-0.13
3	2.77	1.03	3.08	1.02	1.32	0.31	0.30
4	3.42	1.07	3.62	1.02	0.89	0.20	0.19
5	3.62	0.98	3.77	0.95	0.85	0.15	0.15
6	3.69	0.88	3.58	0.99	-0.77	-0.11	-0.13
7	3.35	0.98	3.54	1.07	0.96	0.19	0.19
8	3.37	1.03	3.80	1.12	0.49	0.48	0.47
9	3.19	0.94	3.35	0.98	1.07	0.16	0.17
10	3.46	1.07	3.54	1.07	0.37	0.08	0.07
Short-Practice Group (n = 21)							
1	2.62	1.02	2.95	1.12	1.38	0.33	0.32
2	2.86	1.01	3.10	1.09	0.93	0.52	0.51
3	2.76	1.00	3.38	1.02	2.91*	0.62	0.62
4	3.19	0.98	3.52	1.03	1.92	0.33	0.34
5	3.14	1.01	3.57	1.08	1.91	0.43	0.43
6	3.33	0.91	3.71	0.85	2.36*	0.38	0.42
7	2.95	0.74	3.33	0.91	1.90	0.38	0.51
8	3.52	1.08	3.86	1.11	1.67	0.34	0.31
9	3.10	0.70	3.38	0.81	1.37	0.28	0.40
10	3.57	1.12	3.57	0.98	0.00	0.00	0.00

Note. Diff = Difference, ES = Effect Size, Pre-treat = Pre-treatment, Post-treat = Post-treatment.
*$p < .05$.

(table continues)

Table 8 (continued)

Item no.	Pre-treat Mean	Pre-treat SD	Post-treat Mean	Post-treat SD	t score	Diff score	ES
			Long-Practice Group (n = 22)				
1	2.50	0.86	2.27	0.83	-0.96	-0.23	-0.27
2	2.60	0.96	2.64	0.73	0.24	0.04	0.04
3	2.64	1.00	2.95	1.05	1.50	0.31	0.31
4	3.05	1.00	3.27	1.03	1.00	0.22	0.22
5	3.23	0.97	3.45	0.80	0.93	0.22	0.23
6	3.68	0.84	3.59	0.96	-0.46	-0.09	-0.11
7	3.23	0.97	3.18	0.80	-0.20	-0.05	-0.05
8	3.55	1.10	3.63	1.00	0.57	0.08	0.07
9	3.00	0.82	2.82	0.80	-0.89	-0.18	-0.22
10	3.36	0.79	3.27	1.03	-0.38	-0.09	-0.11
			Control Group (n = 27)				
1	2.37	0.89	2.52	0.98	2.13*	0.15	0.17
2	2.63	0.97	3.04	0.85	2.51*	0.41	0.42
3	2.70	0.99	2.70	0.91	0.00	0.00	0.00
4	3.15	0.86	3.48	0.85	3.12*	0.33	0.38
5	3.30	0.82	3.63	0.74	2.79*	0.33	0.40
6	3.63	1.04	3.89	0.85	1.57	0.26	0.25
7	2.93	0.87	3.30	0.91	3.41*	0.37	0.43
8	3.89	1.09	4.04	0.98	2.13*	0.15	0.14
9	3.00	0.73	3.11	0.85	0.77	0.11	0.15
10	3.74	0.71	3.70	0.67	-0.25	-0.04	-0.06

Note. Diff = Difference, ES = Effect Size, Pre-treat = Pre-treatment, Post-treat = Post-treatment.
*$p < .05$.

practice group, two item means significantly increased from pre- to post-treatment as follows:

1. The mean for Item 3 increased from 2.76 (SD = 1.00) to 3.38 (SD = 1.02) ($t[20] = 2.91$, $p < .05$) (ES = 0.62). This scale item states that captions interfere with enjoyment of a program. Disagreement with this item indicates a positive attitude.

2. The mean for Item 6 increased from 3.33 (SD = 0.91) to 3.71 (SD = 0.85) ($t[20] = 2.36$, $p < .05$) (ES = 0.42). This item indicates objection to seeing instructional programs with captions displayed. Disagreement with this item indicates a positive attitude.

For the control group, six item means significantly increased from pre- to post-treatment as follows:

1. The mean for Item 1 increased from 2.37 (SD = 0.89) to 2.52 (SD = 0.98) ($t[26] = 2.13$, $p < .05$) (ES = 0.17). This item states that captions are not distracting. Agreement with this item indicates a positive attitude.

2. The mean for Item 2 increased from 2.63 (SD = 0.97) to 3.04 (SD = 0.85) ($t[26] = 2.51$, $p < .05$) (ES = 0.42). This item indicates a preference for viewing captioned instructional programs in class. Agreement with this item indicates a positive attitude.

3. The mean for Item 4 increased from 3.15 (SD = 0.86) to 3.48 (SD = 0.85) ($t[26] = 3.12$, $p < .05$) (ES = 0.38). This item indicates that captions interfere with learning. Disagreement with this item indicates a positive attitude.

4. The mean for Item 5 increased from 3.30 (SD = 0.82) to 3.63 (SD = 0.74) ($t[26] = 2.79$, $p < .05$) (ES = 0.40). This item indicates that captions decrease learning. Disagreement with this item indicates a positive attitude.

5. The mean for Item 7 increased from 2.93 (SD = 0.87) to 3.30 (SD = 0.91) ($t[26] = 3.41$, $p < .05$) (ES = 0.43). This item indicates that captions reinforce the content of a program. Agreement with this item indicates a positive attitude.

6. The mean for Item 8 increased from 3.89 (SD = 1.09) to 4.04 (SD = 0.98) ($t[26] = 2.13$, $p < .05$) (ES = 0.14). This item indicates support for having separate caption-viewing facilities for deaf students. Disagreement with this item indicates a positive attitude.

It appears that only a few attitude scale item means became significantly more positive for the short-practice group. Those were related to (a) captions interfering with enjoyment and (b) objecting to viewing captions with instructional television programs. A greater number of attitude scale item means became significantly more positive for the control groups. They were related to (a) distractibility of captions, (b) preference for captions with instructional programs, (c) the effects of captions on learning, and (d) separate viewing facilities. However, for both groups, the effect sizes were quite small for these items. They ranged from 0.42 to 0.62 for the short-practice group and from 0.14 to 0.43 for the no-captions group. These were below the effect size of 0.8 that was established as a standard of practical significance for this experiment (see Chapter 3).

Comparisons of Post-treatment Means Among Groups

A one-way ANCOVA was used to compare the group mean post-treatment scale scores using the pre-treatment scale scores as a covariate. The differences between these groups were not statistically significant ($F[1, 3, 91] = 1.43$, $p > .05$). The absence of significant differences indicates that subjects in these four groups did not have significantly different post-treatment attitude scale scores.

Caption-Viewing Survey

A data analysis was conducted on the Caption-Viewing Survey responses. This survey, which was administered to the captions-without-instruction group ($n = 26$), short-practice group ($\underline{n}$ = 21), and long-practice group ($\underline{n}$ = 22) is reproduced in Appendix J. The control subjects did not complete this survey, as they did not view captions and would have no basis for responding to the items.

In Appendix N, the frequencies and percentages of responses by group for each item are presented. For Item 6, frequencies and percentages were presented for this item for the three caption-viewing treatment groups combined ($\underline{n}$ = 69), as well as for the individual groups. Also presented are descriptive statistics for Items 1 and 2 and a content analyses of open-ended responses for Items 4 and 5.

Analysis

One-way ANOVA's were conducted to determine significant differences in percentages of time that subjects reported viewing captions (Item 1) or focusing on the picture (Item 2). To determine whether the group categorical responses for Items 3 through 6 were significantly different, a chi-square test of independence was used for each item.

Results

The results for each item are summarized below:

Item 1

Item 1 requested the subjects to report the percentage of time that they focused on reading the captions. Subjects were asked to circle a number from 10 to 100 (presented in increments of 10), rather than write an open response. The mean percentage was 44.62 (*SD* = 29.01) for the captions-without-instruction group, 44.71 (*SD* = 19.64) for the short-practice group, and 48.64 (*SD* = 22.53) for the long-practice group. A one-way ANOVA was used to determine whether these means were significantly different. Significant differences were not found ($F[2, 66] = 0.17$, $p > .05$).

Item 2

Item 2 requested the subjects to report the percentage of time that they focused on looking at the picture. Subjects were asked to circle a number from 10 to 100 (presented in increments of 10), rather than write an open response. The mean percentage was 66.54 (*SD* = 26.52) for the captions-without-instruction group, 62.38 (*SD* = 19.98) for the short-practice group, and 56.36 (*SD* = 21.50) for the long-practice group. A one-way ANOVA was used to determine whether these means were significantly different. Significant differences were not found ($F[2, 66] = 1.16$, $p > .05$).

Item 3

Item 3 asked the subjects whether they were able to listen to the dialog and read the captions at the same time. Table 9 contains the frequencies and percentages for each of the three caption-viewing groups. Significant differences were not determined ($\chi^2[2, N = 69] = 3.18$, $p > .05$). It was revealed that a majority of the subjects responded "yes." The percentages of "yes" responses across these three groups was 78%. This indicates that most of the subjects believed that they were able to listen to the dialog and read the captions at the same time.

Item 4

Categorical Responses

Item 4 asked the subjects whether they experienced frustration while watching the captioned television program. If a subject responded "yes," he or she was directed to provide the reason for this response. Table 10 contains the frequencies and percentages for each of the three caption-viewing groups. Significant differences were not determined ($\chi^2[2, N = 69] = 0.60$, $p > .05$). It is interesting to note that 49% of the subjects across groups indicated frustration, while 51% did not.

Table 9

Contingency Table for the Comparison of the Long-Practice, Short-Practice, and Captions-Without-Instruction Groups on "Yes" and "No" Responses for Item 3

	Yes	No	Row total
Long Practice	15 68%	7 32%	22 32%
Short Practice	19 91%	2 9%	21 30%
Captions Without Instruction	20 77%	6 23%	26 38%
Column total	54 78%	15 22%	69 100%

$\chi^2(2, \underline{N} = 69) = 3.18, \underline{p} > .05$

Table 10

Contingency Table for the Comparison of the Long-Practice, Short-Practice, and Captions-Without-Instruction Groups on "Yes" and "No" Responses for Item 4

	Yes	No	Row total
Long Practice	12 55%	10 45%	22 32%
Short Practice	9 43%	12 57%	21 30%
Captions Without Instruction	13 50%	13 50%	26 38%
Column total	34 49%	35 51%	69 100%

$\chi^2(2, \underline{N} = 69) = 0.60, \underline{p} > .05$

Open-ended Responses

An inspection of the summary of the comments made by those subjects responding "yes" revealed the following:

1. Across the three treatment groups, similar comments were made about (a) the captions and dialog, (b) the captions and picture, (c) the captions, and (d) the content. A few miscellaneous comments were also made.

2. In commenting on the captions and dialog, four subjects commented on the lack of <u>exact</u> verbal matching and lack of <u>exact</u> synchronization between captions and dialog.

3. In commenting on the captions and picture, four subjects stated that they could not tune out the captions and focus on the picture. Six subjects also commented that it was difficult to watch the picture and read the captions at the same time. Four subjects commented that the captions blocked important parts of the picture.

4. In commenting on the captions, ten subjects commented that the captions were distracting and disappeared too fast.

5. In commenting about the content, four subjects found that they were not able to focus on the verbal content.

6. Three subjects stated that they had eyestrain or a headache.

Item 5

Categorical Responses

Item 5 asked the subjects whether they believed that there was enough time to read the captions and look at the picture without missing most of the information. Each subject was also directed to provide a reason for the response. Table 11 contains the frequencies and percentages for each of the three caption-viewing groups. Significant differences were not determined ($\chi^2[2, N = 69] = 5.03, p > .05$). Across all groups, 70% of the subjects believed that both the captions and picture could be viewed without missing most of the information.

Open-ended Responses

"Enough time" responses. A "yes" response to Item 5 indicates the belief that there was enough time to read the captions and view the picture without missing most of the information. An inspection of the summary of the comments made by those subjects who replied "yes" revealed the following:

1. Those subjects who responded "yes" provided twice as many comments than those who responded "no."

Table 11

Contingency Table for the Comparison of the Long-Practice, Short-Practice, and Captions-Without-Instruction Groups on "Yes" and "No" Responses for Item 5

	Yes	No	Row total
Long Practice	18 82%	4 18%	22 32%
Short Practice	16 76%	5 24%	21 30%
Captions Without Instruction	14 54%	12 46%	26 38%
Column total	48 70%	21 30%	69 100%

$\chi^2(2, N = 69) = 5.03, p > .05$

2. Across the three treatment groups, a varied number of comments were made about (a) the captions and dialog, (b) the captions and picture, (c) the captions, (d) the content, and (e) the dialog.

3. With respect to the captions and dialog, four subjects commented that captions helped when the dialog was unintelligible, unfamiliar, or unclear.

4. With respect to the captions and picture, 12 subjects commented that it was easy to read the captions and watch the picture.

5. With respect to the captions, both negative and positive comments were made. Four subjects stated that the captions were short and/or easy to read. Five subjects commented about the distractibility of the captions and the desire to tune out the captions.

"<u>Not enough time" responses</u>. A "no" response to Item 5 indicates the belief that there was <u>not</u> enough time to read the captions and view the picture at the same time without missing most of the information. An inspection of the summary of the comments made by those subjects who replied "no" revealed the following:

1. Very few comments were made by those subjects answering "no" to this question.

2. The subjects commented primarily about (a) the captions and dialog, (b) the captions and picture, and (c) the captions.

3. In commenting on the captions and dialog, the most common statement across groups was that the captions were not in sync and didn't match the dialog (5 subjects).

4. Only the captions-without-instruction group commented on the captions and the picture. Four subjects stated that when they tried to read the captions, they missed the picture. Three subjects stated that they could not read the captions and look at the picture.

5. In commenting on the captions, six subjects stated that the captions were too fast.

<u>Item 6</u>

Item 6 asked the subjects whether this was the first time that they viewed a captioned program for a hearing-impaired audience. If a subject answered "no," he or she was directed to circle the number of hours spent in previous caption viewing. (The choices were presented in increments of two hours, except for the bottom and top of the range, which stated < 1 and > 10.)

Previous Caption Viewing Experience

For the "yes" and "no" responses, Table 12 contains the frequencies and percentages for each of the three

Table 12

Contingency Table for the Comparison of the Long-Practice, Short-Practice, and Captions-Without-Instruction Groups on "Yes" and "No" Responses for Item 6

	Yes	No	Row total
Long Practice	8 36%	14 64%	22 32%
Short Practice	10 48%	11 52%	21 30%
Captions Without Instruction	13 50%	13 50%	26 38%
Column total	31 45%	38 55%	69 100%

$\chi^2(2, N = 69) = 0.98, p > .05$

caption-viewing groups. Significant differences were not determined (χ^2[2, N = 69] = 0.98, p > .05). This was to be expected as subjects were randomized into treatment groups. Almost half of the subjects across groups (45%) had previously viewed captions.

Hours of Previous Caption Viewing

For those subjects who answered "no" to Item 6, the hours of previous experience were reported. Table 13 contains the frequencies and percentages for each of the three caption-viewing groups. Significant differences were not determined (χ^2[10, N = 69] = 9.40, p > .05). An inspection of the frequencies reveals that only four subjects (6%) across groups had reported more than four hours of caption-viewing experience. A total of 49% of the subjects reported four hours or less of previous caption-viewing, while 45% reported no previous caption viewing. Although approximately half of the subjects in the three caption-viewing treatment groups had reported previous caption-viewing experience, most of these subject had very limited exposure to the captions. Only one of the 69 subjects in these three groups reported greater than 10 hours of previous caption viewing. The responses to Item 6 indicate that the subjects who viewed captions during the experiment possessed little or no caption-viewing experience.

Table 13

Contingency Table for the Comparison of the Long-Practice, Short-Practice, and Captions-Without-Instruction Groups on Number of Hours Previously Spent Viewing Captions

	< 1	1-2	3-4	5-6	> 10	NA	Row total
Long Practice	5 23%	5 23%	2 9%	2 9%	0 0%	8 36%	22 32%
Short Practice	2 9%	3 14%	5 24%	0 0%	1 5%	10 48%	21 30%
Captions W/O Instruction	5 19%	3 12%	4 15%	0 0%	1 4%	13 50%	26 38%
Column Total	12 17%	11 16%	11 16%	2 3%	2 3%	31 45%	69 100%

$\chi^2(10, N = 69) = 9.40, p > .05$

Pre-treatment Attitude Scale

Rationale

A separate data analysis of the pre-treatment attitude scale was conducted across all four treatment groups (n = 96). As this scale was administered prior to each treatment, all of these subjects could be considered to be members of one sample for the purposes of this data analysis. A similar data analysis was not conducted across treatment groups for the post-treatment attitude scale. As the four treatments had already been administered prior to completion of that instrument, the subjects could not be considered to belong to one large group for the purposes of data analysis.

There was one primary reason for conducting this analysis, separate from directly answering the questions posed in the hypotheses. A factor analysis needed to be conducted in order to determine whether separate factors existed during this administration. If different factors existed, then this would have necessitated the analysis of attitude scale scores for each separate factor.

Other data analyses was conducted with the data from the pre-treatment attitude scale because such an analysis of a large sample of subjects (n = 96) might provide useful information on hearing students' attitudes about the use of captions with hearing people. Results of the data analyses are summarized below and fully described in Appendix O.

Data Analysis

Measures

Descriptive statistics were determined for the subjects' total scores and for the frequencies of responses selected by item (see Table O-4 in Appendix O). In addition, the data were analyzed for internal and item-total reliability. The reliability analysis used a covariance matrix to determine (a) Cronbach's alpha, (b) Guttman's split-half coefficient, and (c) item-total correlations. A factor analysis was also conducted using a principal components analysis without iteration and a varimax rotation using Kaiser Normalization to extract factors with eigenvalues of 1.00 or greater. Those factors with eigenvalues less than 1.00 were eliminated from the final analysis with this method.

Descriptive Statistics

The total scores by subject were determined. The mean total score was 31.60 (SD = 6.67). This mean was very close to the neutral point of the scale. The range of scores was 15 to 47 points (with a possible range of 10 to 50 points). The standard error of measurement for this scale was 2.21 with a 95% confidence interval of ± 4.34.

Reliability Analysis

Coefficient alpha was .89, while the Guttman split-half reliability coefficient was .85. The item-total correlations ranged from .37 to .82. Only one item had a correlation below .40.

Factor Analysis

The factor analysis yielded one factor with an eigenvalue greater than 1.00. Factor 1 was the most explanatory one with an eigenvalue of 5.15, which accounted for 51.5% of the variance of the scores in the scale. An examination of the factor matrix revealed that all 10 items correlated the highest with Factor 1. These item loadings ranged from .45 to .88.

CHAPTER 5

DISCUSSION, RECOMMENDATIONS, AND APPLICATIONS

Discussion

The Effects of Captions on Comprehension

The four treatment groups did not generate significantly different scores on the declarative knowledge and intellectual skills comprehension sub-tests. Hypotheses 1, 2, and 3 are discussed individually below:

Hypothesis 1

Hypothesis 1 stated that there would be no posttest performance differences between the captions-without-instruction and control groups. The results of this study did support this hypothesis, as the MANOVA did not determine significantly different comprehension posttest scores among groups. These results were similar to those found in past studies that compared captions and no-captions treatment groups' comprehension performance (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c). In this study, students who viewed the instructional television program with captions and without an intervention did not have higher posttest scores than students who viewed the identical television program without captions.

Hypothesis 2

Hypothesis 2 stated that the short-practice group subjects would have higher posttest scores than would the captions-without-instruction and control groups. This hypothesis was not supported, as the MANOVA did not determine significantly different comprehension posttest scores among groups. Students who were trained to effectively view captions and received a short practice period did not have higher posttest scores than those students who received no training or practice.

Hypothesis 3

Hypothesis 3 stated that the long-practice group subjects would out perform the subjects in the other three groups on the posttest. This hypothesis was not supported, as the MANOVA did not determine significantly different comprehension posttest scores among groups. Students who received caption-viewing instruction with a long practice period did not have higher posttest scores than those students who received the instruction with a short practice period and those who received no instruction and no practice period. It appears that the caption-viewing intervention used in this study did not benefit these students.

Discussion

The results of this study appear to support the past findings on the use of medium or high-presentation rate captions with non-special needs hearing students (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c). Similar to past findings, the addition of captions to an instructional television program did not appear to increase comprehension of program content in this study. In past research studies, the subjects were not presented with a caption-viewing strategy or practice time for viewing captions. Although such an intervention was presented to the subjects in this study, it did not result in increased comprehension of the program content when captions were added.

In reviewing the past studies (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c), the possibility was considered that comprehension gains might not have been achieved when captions were added because the stimulus material was non-challenging and familiar to the subjects. This may have lead to a ceiling effect on test performance without captions that would limit a comprehension increase when captions were added. In order to eliminate the possibility of such a ceiling effect, this study used stimulus material that was predicted to be challenging and unfamiliar to the potential subjects. A challenging comprehension assessment instrument was presumably created, and only difficult test items were retained for the revised test. Even though the stimulus material and comprehension assessment appeared to be challenging, the addition of captions still did not lead to an increase in comprehension of program content. In light of the past findings and the results of the current study, it is possible that the use of captions, even with the presentation of a caption-viewing instructional intervention, does not lead to significant comprehension gains in program content for non-special needs hearing students, even if the content is challenging.

The concern to avoid non-challenging stimulus material and test items in the current experiment might have resulted in the failure to find significant differences among groups. In order to create challenging test items, it was decided that the items would have a difficulty index range from .40 to .80. There was concern that items below or above this range would be either too difficult or too easy. The difficulty indices on the final version of the posttest ranged from .34 to .77. For these multiple-choice items with four foils, items at the bottom of this range had indices that were close to the probability of guessing (.25). This might indicate that some of these items were so difficult that subjects could only respond correctly by guessing.

The subjects' poor performance on this posttest provided evidence that the test was overly difficult. The group mean proportions of correct responses ranged from .52 to .70. These ranges indicated that the average student missed approximately one-half to one-fourth of the items. Shrock and Coscarelli (1989) suggested that items used on a mastery-oriented criterion-referenced assessment have difficulty indices of .90 and above. The difficulty indices for the comprehension posttest used in this study are well below this standard. It is possible that a floor effect might have prevented all subjects from performing well on this test, regardless of the treatment that was administered.

Between-Channel Redundancy Effect

The results of this experiment and other past findings might indicate that an interaction exists between the between-channel redundancy (BCR) effect and the presentation rate of the captions. When a low caption presentation rate (approximately 50 words per minute) was used, subjects appeared to benefit from the BCR effect, as evidenced by the generation of higher comprehension posttest scores for those subjects with captions (Hartman, 1961; Reese & Davie, 1987). When the captions were presented at a high or medium presentation rate (Reese, 1984; Ruggiero, 1986a, 1986b, 1986c), the subjects who viewed captions failed to generate higher comprehension posttest scores than did those subjects who did not view captions. Collectively, the results from the current study and past studies suggest that when the presentation rate reaches a high or medium level, the BCR effect fails to operate.

The Effects of Captions on Attitudes

The four treatment groups did not generate significantly different post-treatment attitude scale scores. All group mean pre- and post-treatment attitude scale scores were around the neutral point of the scale (30 points). Hypotheses 4, 5, and 6 are discussed individually below:

Hypothesis 4

Hypothesis 4 stated the following:

1. The captions-without-instruction group would not hold higher post-viewing attitudes about captions than those held by the control group.

2. There should be no change in attitude from pre- to post-viewing for either the captions-without-instruction or control groups.

Component 1 above was found to be supported. A one-way ANCOVA determined that the captions-without-instruction group subjects did not hold post-treatment attitudes toward captions that were more positive than those held by the control group subjects. These findings are similar to the ones found in Ruggiero's (1986a, 1986b, 1986c) study, in which there were no post-treatment attitude differences found between captions and no-captions groups.

Component 2 of Hypothesis 4 was only partially supported. Although a t-test of correlated means determined no significant differences in pre- and post-treatment attitude scale means for the captions-without-instruction group, a significant positive attitude increase was determined for the control group. It was discovered, however, that the control group increase was only two points, and the effect size was .34. This did not meet the effect size criteria of .8 that was established prior to the collection of data for this experiment (see Chapter 3), and the increase did not appear to be of practical significance.

<u>Hypothesis 5</u>

Hypothesis 5 stated the following:

1. The short-practice group would show a positive post-viewing attitude change.

2. The short-practice group will hold a more positive post-viewing attitude than will the captions-without-instruction and control groups.

Component 2 above was not supported. A one-way ANCOVA determined that short-practice subjects did not hold post-treatment attitudes that were more positive than those held by the captions-without-instruction and control subjects. It appears that exposure to captions with caption-viewing strategy instruction and a two-minute practice period did not improve attitudes about captions.

Component 1 above of Hypothesis 4 was supported by the study. A t-test of correlated means determined a significant positive attitude increase from pre- to post-treatment for the short-practice group. It was discovered, however, that the mean increase was only three points, and the effect size of was .49. This did not meet the previously established effect size criteria of .8, and the increase did not appear to be of practical significance.

Hypothesis 6

Hypothesis 6 stated the following:

1. The long-practice group would show a positive post-viewing attitude change.

2. The long-practice group will hold a more positive post-viewing attitude than will the short-practice group,

the captions-without-instruction group, and the control group.

In this study, Components 1 and 2 above were not supported. A one-way ANCOVA determined that long-practice subjects did not hold post-treatment attitudes that were more positive than those held by the short-practice, captions-without-instruction, and control subjects. A t-test of correlated means determined no significant difference in pre- and post-treatment scale means for the long-practice group.

Discussion

It appears that brief exposure to captions did not improve attitudes about the use of captions with hearing people. This finding appears to be consistent with the finding of a similar experiment in which a different version of the Opinions About Captions scale was used to measure post-treatment attitudes (Ruggiero, 1986a, 1986b, 1986c). The subjects in the current experiment tended to have neutral attitudes on this topic prior to the treatments and maintained these neutral attitudes following the treatments.

Possible explanations for the maintenance of neutral attitudes are described below. One possibility is that those subjects viewing captions did not achieve comprehension gains and consequently perceived that captions were neither beneficial nor detrimental to their comprehension of the program content. On the other hand, subjects may have had no perception of how captions affected their comprehension, as they did not receive feedback on their comprehension posttest performance. Both of these scenarios might have resulted in the maintenance of a neutral attitude from pre- to post-treatment.

Although neutral attitudes were maintained for the four treatment groups, the attitudes did significantly improve for the short-practice and control groups. Although these attitude improvements were not of practical significance, the significant increase for the control group might be puzzling, in the absence of a captioned treatment. One possible explanation might be related to the discrepancy in cell sizes among the four treatment groups. The cells sizes for the captions-without-instruction group, the short-practice group, the long-practice group, and the control group were 26, 21, 22, and 27 respectively. In relation to the short- and long-practice groups, the control group had greater power. This higher power might have resulted in the determination of significance for trivial differences in pre- and post-treatment attitude means within the control group. The higher power would also increase the probability for a

Type I error, wherein differences attributed to chance or error were determined to be significant. On the other hand, the lower power for the long-practice group might have resulted in a Type II error, wherein an actual attitude increase might not have been detected. Such a variance in the cell sizes may have resulted in the false detection of differences within the control group and the failure to detect differences within the long-practice group.

Caption-Viewing Survey

For the Caption-Viewing Survey, there were no significant differences among the captions-without-instruction, short-practice, and long-practice group means for the percentages of time that subjects reported to have spent reading captions and focusing on the picture. There were no significant differences in the frequencies of responses among the captions-without-instruction, short-practice, and long-practice groups for (a) beliefs about the ability to listen to dialog and read captions simultaneously, (b) feelings of frustration with the caption-viewing task, (c) beliefs about the ability to read captions and look at the picture without missing information, and (d) reports of previous caption-viewing experience. Most of the responses to the open-ended questions on the Caption-Viewing Survey were similar across the captions-without-instruction, short-practice, and long-practice groups. There were few responses that were unique to a specific treatment group.

The results of the Caption-Viewing Survey provided support for the lack of effects of the instructional intervention. There were no significant differences among caption-viewing groups in the categorical responses to survey items that solicited reactions to the caption-viewing process. In addition, the responses to the open-ended questions on this survey appeared to solicit similar responses from the three caption-viewing groups. The fact that the response frequencies were not significantly different provides evidence that the caption-viewing interventions did not affect the subjects' caption-viewing experiences. Those subjects who received instruction did not generate significantly different responses than those who did not receive instruction.

Although significant differences among groups were not found in the responses to items from this survey, some of the comments generated from the open-ended items might shed some light on how to improve caption-viewing strategy instruction for future experiments. Subjects commented that the captions and dialog didn't match exactly. They also commented that they were distracted by the captions moving to different parts of the screen to follow the speaker. These comments suggest that further information might be added to the instruction to address the unique and initially distracting features of the captions.

More effective caption-viewing strategy instruction might advise the subjects about these features so that they are prepared for them. If these features are expected, they might not prove so distracting.

In addition to preparing the subjects to expect these features, the instruction might provide explanations about why these features are necessary. It could be explained that the medium-presentation-rate captions and dialog do not match because of the need for editing captions for presentation rate. If the subjects understood that a 100% match in the captions and dialog might result in an unmanageable caption information load, the subjects might appreciate, rather than resent, the editing that is done. If the placement of the captions was explained, the subjects might understand that it is necessary to place the captions under the speaker so that deaf viewers will know who is speaking. Caption-viewing strategy instruction could also include an explanation of why the captions often appear before the dialog and linger after the dialog has disappeared. If the subjects understood that the longer presence of captions on the screen allows for more opportunity to read the captions, then they might appreciate the fact that the captions and dialog are not exactly in sync.

Practice of the Caption-Viewing Strategy

Possible reasons for the failure to achieve comprehension gains in this experiment should be considered. One possibility is that the subjects were not given sufficient practice time with the caption-viewing strategy. In the ACT* model, Anderson (1983) explains that initial practice during the cognitive and associative stages results in proceduralization and initial automation of a new skill. In the autonomous stage, subjects practice the new skill to a high level of automaticity.

It has been reported that in order to achieve a high level of automaticity for the caption-viewing strategy, subjects must watch several hundred hours of captioned programming using an effective viewing strategy (G. Freed, personal communication, August 27, 1993; J. Navoy, personal communication, August 27, 1993). It might be possible that with the brief practice period offered in the current experiment, the subjects did not automate the caption-viewing strategy to the degree that it could be used effectively to deal with the divided attention task of viewing the captions and the picture. Perhaps with a greater degree of practice and greater automaticity of this skill, comprehension gains might be obtained when captions are added to instructional television programs.

If greater practice time does lead to comprehension gains with captions, then an intervention might be needed that would allow for several hours, rather than a few minutes, of practice. Of course, such an intervention would be impractical for classroom use, unless instructional television programs were an extensive part of the course curriculum and were shown over several class sessions. In this case, subjects would have extensive opportunity to practice viewing captions, and an intervention with several hours of practice might be practical. For those who view instructional television programs at home, a long practice intervention might be practical, as subjects could practice for several hours on their own. If there is a positive relationship between long-term caption-viewing practice, automaticity of the caption-viewing strategy, and increased comprehension when captions are added, a long-term instructional intervention might be of value for home study or for courses using an extensive amount of instructional television programming.

Although a relationship between automaticity of this skill and increased comprehension might be discovered through further research, it could be possible that such a relationship does not exist. Perhaps those hearing individuals who possess full automaticity of this skill might not achieve gains in comprehension when captions are added to instructional television programs. It might be possible that there is little or no connection between full automaticity of the caption-viewing strategy and comprehension gains.

Further research in this area might reveal that when captions are presented at or above a medium presentation rate (between 150 to 180 words per minute), even a subject who has fully automated the caption-viewing strategy might not be able to cope with the divided visual attention task. There might be a point at which the caption information load is so intense that it will not allow a subject to effectively deal with the picture and captions to the extent that comprehension gains might be achieved, no matter how automated the caption-viewing skill becomes.

Absence of Detrimental Effects

Although this experiment failed to produce comprehension gains and attitude improvements, the results of this study also failed to provide evidence that captions are harmful to the comprehension of non-special needs hearing students. The results of this experiment also suggest that viewing captions did not cause a decrease in attitudes toward the use of captions with hearing students. As the addition of captions have not been demonstrated to cause benefit or detriment to hearing students, it does not seem to matter to these subjects whether captions are present or absent. Although the results of this study do not support the addition of captions to classroom instructional television programs when deaf or hard-of-hearing students are not present, this research has provided support for including captioned programming in a mainstreamed classroom, as the addition of captions did not appear to harm the performance of hearing students, even with challenging material. This would strengthen the argument for not creating or maintaining separate caption-viewing facilities for deaf students.

Recommendations

Addressing Limitations of this Study

Because of the limitations involved in this study, it is recommended that future research be conducted. Some of the limitations and possible solutions are as follows:

1. Due to limited room and video equipment availability, it was not possible to use a full experimental design with each subject being randomized to one of the four treatment groups. This study was quasi-experimental, as there were two sessions, and subjects were randomized into one of two scheduled treatments per session. In the future, this study could be replicated

with a controlled study that uses a full experimental design.

2. Another limitation related to the availability of classrooms was that the two treatment rooms varied greatly in size. For the captions-without-instruction and short-practice treatments, a small, cramped room was used, while a large room was used for the subjects in the other two treatment groups. The effects of these room sizes on the results of this study are unknown. A future study might utilize four rooms that are the same size, or the four treatments could be conducted in the same room at different times.

3. Due to the limited availability of subjects, classrooms, and video equipment, the two treatment sessions were administered at different times of the day. The researcher noticed that subjects appeared to be less attentive during the second session. In order to control for the variable of time of day in a future study, it might be desirable to have the four treatments administered in different rooms simultaneously. If this is not possible and different treatments times are needed, they could be scheduled on different days at a similar time of day.

4. The subjects in this study were primarily caucasian female students. As these subjects were not

representative of a general undergraduate student population, the generalizability of the results of this study to other populations of undergraduate students is in question. Future research might be conducted with a more diverse sample of undergraduate students, in order to increase the generalizability of results.

5. The subjects in this study were required to participate in a research project outside of their regular class time. One possible explanation for poor test performance may have been that some of the subjects resented the requirement to appear outside of class time and intentionally withheld effort when completing the test items. In a future experiment, it might be desirable to administer a treatment during the subjects' regularly scheduled class time.

6. The course credit received for participation was not contingent upon the subjects' performance on the comprehension posttest. Some of the subjects may been unmotivated to perform well on the posttest, in the absence of negative consequences resulting from poor performance. In a future experiment that takes place during the subjects' regularly scheduled class time, motivation to exert effort might increase if the subjects' test performance is graded and the subjects are informed that the grade will be used as part of the course grade.

7. The range of difficulty indices (.34 to .77) for the comprehension posttest items (described in the Discussion section above) may have resulted in a test that was overly difficult for these subjects. This may have created a floor effect that resulted in overall poor performance for all groups, regardless of the treatment. In order avoid a floor effect in a future study, items that are too difficult might be eliminated if the bottom of the difficulty index range was increased to .50 or .60.

Directions for Future Research

Some new research questions that might be posed as the result of this study are as follows:

1. In order to explore the relationship between automaticity of the caption-viewing strategy and increased comprehension of instructional television program content when captions are added, it might be possible to locate hearing individuals who claim to have fully automated the caption-viewing strategy through extensive caption viewing. Subjects could be divided into two treatment groups to determine whether adding captions increases comprehension of challenging stimulus material with subjects who have fully automated this strategy.

2. It might be of interest to conduct longitudinal research with novice caption readers to determine how many hours of caption-viewing are required to achieve full

automaticity of the caption-viewing strategy. With such long-term tracking, it might be possible to determine whether there are incremental increases in comprehension gains when captions are added in relation to incremental increase in automaticity of the caption-viewing strategy.

3. In responding to the Caption-Viewing Survey, a number of subjects stated that the captions were useful as a back-up when the audio was unclear or when the speaker spoke English with a thick accent. It might be of interest to conduct a study using stimulus material with inferior audio or unclear dialog to determine whether comprehension gains would be achieved when captions are added. It might be discovered that for television programs that have audio problems or unclear dialog, showing an open-captioned version could be beneficial to non-special needs hearing students.

4. The attitudes toward captions examined in the current experiment may not have been directly influenced by an awareness of the needs of deaf students, as deaf people were not present during the experiment. In a future study on attitudes toward captions, one factor that might vary could be the presence or absence of deaf students during the viewing of stimulus material. It might be possible that hearing students' attitudes toward

the use of captions are influenced by observing deaf students benefiting from the captions.

5. In the current experiment, subjects were examined following a one-shot treatment in a laboratory setting. It might be of interest in a future study to conduct multiple-session treatments in a classroom setting. For example, four different captioned instructional television programs could be viewed over the course of a semester. A comprehension posttest could be administered following each viewing. One factor that might vary could be the use of a practice session before the viewing of each of the four captioned programs vs. only one practice session offered prior to the first program. This might reveal whether multiple practice sessions spaced over a period of time result in greater comprehension gains than does a single practice session.

6. The current study used only one content domain with one population. The stimulus material used in the current study focused on the development of the human brain, and the subjects were all preservice teachers. In future research, stimulus material from different domains can be used with different populations to determine whether these variations generate results different than those found in the current study.

Applications of Findings

The following recommendations can be made based on the findings of this study. Due to the limitations on the generalizability of the results of this study to undergraduate students other than those in a preservice teachers program, the applicability of these findings must be used with caution.

1. It might be recommended that captions not be used with non-special needs hearing students in a non-mainstreamed setting. They do not appear to benefit this population.

2. As the presence of captions do not appear to be harmful to non-special needs hearing students, it might be recommended that captions be used in a mainstreamed setting when deaf or hard-of-hearing students are present. The creation or maintenance of separate caption-viewing facilities for deaf student does not appear necessary in light of the findings from past research and the current study.

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APPENDIX A

APPENDIX A

DEFINITIONS OF KEY TERMS

American Sign Language

American Sign Language (ASL) is the native or first language used by approximately 250,000 to 500,000 deaf people in the United States and Canada (Baker & Cokely, 1980). Its grammar structure is not based on the English language. ASL is a visually-based, rather than aurally-based, language.

Closed Captions

Closed captions are encoded on Line 21 of the vertical blanking interval of the television signal (Gallaudet University, 1992) and remain invisible unless a decoder is connected to the cable converter or other tuning source (National Captioning Institute, 1991).

Deaf

Although a deaf person may be able to hear speech, he or she finds it generally unintelligible. Some oral deaf people communicate strictly through lipreading and speech, but the majority of deaf Americans use ASL as the primary mode of communication.

Decoder

A decoder is a computer chip, computer card, or box that opens up the captions of a closed-captioned television program.

Delay Time

Delay time is the amount of seconds between the utterance of dialogue and the appearance of the text in a captioned television program.

Edited Captions

Edited captions are those that reduce the language level as well as the presentation rate of the captions (Verlinde & Schragle, 1986).

Encoder

An encoder is a computer chip or card that allows closed captions to be placed on the 21st vertical line in the television signal.

Hard of Hearing

Hard-of-hearing individuals are usually able to hear and understand speech with amplification. The primary modes of communication for most hard-of-hearing individuals in America are lipreading and speech.

Hearing Impaired

Hearing-impaired individuals include deaf and hard-of-hearing people.

Language Level

The language level of a captioned television program is established primarily through the grade level of the captioned text (Braverman, 1980; Braverman & Hertzog, 1980).

Live Display

With a live display captioning system, the captions are produced off-line, but generated live (Albright, 1993). During the broadcast of the program, the captions are punched up live by the captioner.

Loose Verbatim Captions

Loose verbatim captioning is a process that retains close to the exact utterances while omitting many superfluous words (K. O'Connor, personal communication, February 11, 1993; D. Veltry, personal communication, February 19, 1993; R. Verlinde, personal communication, February 26, 1993). Omissions with loose verbatim captioning are done solely for purposes of reducing the presentation rate.

Newsroom Computer Captioning

The newsroom computer captioning system is only used for news programs that utilize a teleprompter (a screen that displays the script for the newscasters to read during the broadcasting or recording of the program). The newsroom computer captioning system involves the use of a computer that sends previously prepared teleprompter text simultaneously to a teleprompter and to the television signal used to transmit closed captions (A. M. Salomon, personal communication, August 27, 1993; Salomon & Freda, 1992).

Off-line Captioning

Off-line (or prerecorded) captions are generated <u>after</u> the production of a television program (Gallaudet University, 1992). With an off-line captioning system, the captions are carefully edited to eliminate typographical errors (National Captioning Institute, 1991).

Open Captions

Open captions are placed directly on to a television program without encoding. A decoder is unnecessary when viewing these captions (Gallaudet University, 1992).

Pop-on Captions

With pop-on captions, each new caption appears and then disappears (Gallaudet University, 1992). Captions pop on at the left, right, and bottom center of the screen to indicate the physical location of the speaker (Verlinde & Schragle, 1986).

Presentation Rate

The presentation rate of the captions is determined by the number of words per minute appearing on the screen in a captioned television program (Braverman, 1980; Braverman & Hertzog, 1980). Five characters (including internal spaces and punctuation) count as one word (G. Freed, personal communication, August 27, 1993; A. M. Salomon, personal communication, August 27, 1993). Brief captions, which are only used to highlight key words on a program, use a low presentation rate of approximately 50 words per minute (Reese & Davie, 1987). A medium presentation rate of approximately 150 words per minute is used as an industry standard for off-line captioning (Freed; Salomon). Most instructional television programs use the medium presentation rate. A high presentation rate of approximately 200 words per minute is undesirable and is only used with real-time, live display, and newsroom computer captions for live or limited-turn-around-time programs.

Real-Time Captioning

With real-time captioning, the captions are produced and generated live (Gallaudet University, 1992). A court stenographer generates stenotype that is transformed into captions by computer software. The text is then displayed on the screen.

Real-Time Graphics Display (RTGD)

Real-Time Graphics Display (RTGD) is a live captioning system used primarily for lectures and meetings. Unlike the live captioning system used for broadcast television, the RTGD captions take up several lines on the screen, and a picture is not present.

Roll-up Captions

Roll-up captions continuously scroll up from the bottom of the screen, and three to four lines of captions are present at all times (Gallaudet University, 1992). With this system, the captions are not placed directly under the current speaker.

Sign Insert

A sign insert is created by a special effect that superimposes a sign language interpreter into the corner of a television screen.

Strict Verbatim Captions

Strict verbatim captioning results in an exact transcript of uttered dialog. (K. O'Connor, personal communication, February 11, 1993; D. Veltry, personal communication, February 19, 1993; R. Verlinde, personal communication, February 26, 1993).

APPENDIX B

APPENDIX B

POST QUESTIONNAIRE

Developed by Ruggiero (1986a, 1986b, 1986c)

Answer the questions by circling the appropriate number on the scale. Please answer every item.

		Disagree				Agree
1.	Captions on instructional television programs are not distracting.	1	2	3	4	5
2.	When viewing an instructional video program in class, I prefer viewing the program with captions displayed.	1	2	3	4	5
3.	While viewing a program with captions, I read the captions.	1	2	3	4	5
4.	Captions would interfere with my enjoyment of a program.	1	2	3	4	5
5.	Captions interfere with learning when watching an instructional television program.	1	2	3	4	5
6.	The video portion (picture) of the program was clear.	1	2	3	4	5
7.	Captions decrease learning when watching an instructional television [sic].	1	2	3	4	5

		Disagree				Agree
8.	I object to seeing an instructional video program with the captions displayed.	1	2	3	4	5
9.	Captions reinforce the content of a program.	1	2	3	4	5
10.	I was attentive to the audio portion of the program.	1	2	3	4	5
11.	Separate viewing facilities should be maintained for hearing-impaired students so that they could watch captioned video programs outside of class time, <u>instead of</u> showing them in a regular class with the captions displayed.	1	2	3	4	5
12.	Captions increase learning when watching an instructional television program? [sic]	1	2	3	4	5
13.	Captions interfere with a person's ability to understand the content of a program.	1	2	3	4	5
14.	If a hearing-impaired student were in my class, I would object to seeing a video program with captions showing.	1	2	3	4	5
15.	The audio portion of the program was clear and understandable.	1	2	3	4	5
16.	Separate video facilities would be worthwhile, even if it means that funds would be taken from other instructional programs.	1	2	3	4	5

APPENDIX C

APPENDIX C

BACKGROUND INFORMATION

Please answer the following questions:

1. Gender: ______________ 2. Age: ________________

3. Major: ____

4. Class level: (Circle one)

   Fresh Soph Jr. Sr. Masters Doctoral

   Not in School

5. Highest Degree Currently Held: (Circle one)

   High School A.A. Bachelors Masters Doctoral

6. Ethnic Category: (Circle one)

   Caucasian African American Native American Asian

   Hispanic Other ________________________________

7. Have you ever known a deaf person?

   _____ Yes _____ No

8. Current Cumulative Grade-Point Average ___________

APPENDIX D

APPENDIX D

SUBJECT DEMOGRAPHICS

Table D-1

Frequencies for Gender Across Treatment Groups (n = 96)

Gender	Frequency	Percent
Male	16	16.7
Female	80	83.3
TOTAL	96	100.0

Table D-2

Frequencies for Age Across Treatment Groups (n = 96)

Age	Frequency	Percent
19	1	1.0
20	6	6.3
21	2	30.2
22	2	22.9
23	6	6.3
24	5	5.2
25	2	2.1
26	1	1.0
28	1	1.0
29	1	1.0
30	1	1.0
31	2	2.1
32	4	4.2
34	1	1.0
35	2	2.1
36	2	2.1
38	2	2.1
42	1	1.0
43	1	1.0
44	2	2.1
46	1	1.0
48	1	1.0
50	1	1.0
52	1	1.0
TOTAL	96	100.0

Table D-3

Frequencies for Major Across Treatment Groups (n = 96)

Major	Frequency	Percent
Early Childhood	20	20.8
Elementary Education	45	46.9
Secondary Education	21	21.9
Other	9	9.4
Unreported	1	1.0
TOTAL	96	100.0

Table D-4

Frequencies for Class Level Across Treatment Groups (n = 96)

Class level	Frequency	Percent
Sophomore	2	2.1
Junior	15	15.6
Senior	72	75.0
Graduate	3	3.1
Other	3	3.1
Unreported	1	1.0
TOTAL	96	100.0

Table D-5

Frequencies for Highest Degree Currently Held Across Treatment Groups (n = 96)

Highest degree	Frequency	Percent
High School	80	83.3
Associate	7	7.3
Bachelors	8	8.3
Masters	1	1.0
TOTAL	96	100.0

Table D-6

Frequencies for Ethnic Category Across Treatment Groups (n = 96)

Ethnic category	Frequency	Percent
Caucasian	85	88.5
African American	3	3.1
Native American	3	3.1
Asian	4	4.2
Hispanic	1	1.0
TOTAL	96	100.0

Table D-7

Frequencies for "Yes" and "No" Responses to "Have You Ever Known a Deaf Person?" Across Treatment Groups (n = 96)

Response	Frequency	Percent
Yes	60	62.5
No	36	37.5
TOTAL	96	100.0

Table D-8

Frequencies GPA Across Treatment Groups (n = 96)

GPA	Frequency	Percent
2.5	1	1.0
2.6	3	3.1
2.7	4	4.2
2.8	4	4.2
3.0	13	13.5
3.1	3	3.1
3.2	15	15.6
3.3	9	9.4
3.4	12	12.5
3.5	8	8.3
3.6	4	4.2
3.7	3	3.1
3.8	7	7.3
3.9	6	6.3
4.0	4	4.2
TOTAL	96	100.0

APPENDIX E

APPENDIX E

HUMAN SUBJECTS APPROVAL LETTER

On the following page is a copy of the human subjects approval letter that was obtained for the current study.

The University of Oklahoma

OFFICE OF RESEARCH ADMINISTRATION

January 17, 1994

Mr. Paul James Berkay
Department of Educational Psychology
University of Oklahoma

Dear Mr. Berkay:

SUBJECT: "The Effects of a Caption-Viewing Strategy on Hearing Students Viewing Captioned Programs in a Postsecondary Setting"

The Institutional Review Board has reviewed and approved the requested revisions to the subject protocol.

Please note that this approval is for the protocol and informed consent form initially reviewed by the Board in October, 1993, and revisions included in your request dated December 27, 1993. If you wish to make any changes, you will need to submit a request for change to this office for review.

If you have any questions, please contact me at 325-4757.

Sincerely yours,

Karen M. Petry

Karen M. Petry
Administrative Officer
Institutional Review Board-Norman Campus

KMP/dkj

cc: Dr. Eddie Carol Smith, Chair, IRB
Dr. Raymond Miller, Educational Psychology

APPENDIX F

APPENDIX F

CONSENT FORM

Consent for Participation in a Research Project

You are going to participate in a study to examine opinions and viewing strategies related to captioned television programs. The study is being conducted by Paul Berkay, a doctoral student in the Instructional Psychology and Technology Program.

First, you will fill out a scale about caption viewing. You will then view a ten-minute segment from an instructional television program that you will not be tested on. This will be followed by a 20-minute instructional television program segment that you will be tested on. Then you will take a multiple-choice scantron test based on material from the 20-minute program. Once the test is completed, you will fill out another scale about caption viewing and a brief form that will tell us about your background and experience.

You will not be taking any risk or be harmed by this research. This study will help us find out about opinions and viewing strategies related to captions.

Your participation is voluntary. You can stop at any time and will not be penalized in any way. To make sure your responses are confidential, your name will not go on the forms you will fill out.

If you have any questions about this research, you may contact Paul Berkay.

****

I agree to participate in this study. I understand all of the above statements.

Name ____________________ Date ______________

APPENDIX G

APPENDIX G

REVISED COMPREHENSION POSTTEST (23 ITEMS)

(Note: Correct responses are underscored, and intellectual skills items are indicated with an asterisk.)

Please circle the letter that corresponds to the correct response for each of the following multiple-choice items. Then, darken the bubble on the scantron sheet that corresponds to the correct response. You will record each answer twice: once on the test and once on the scantron sheet. Please use the Number 2 pencil provided. This is not a timed test. Please take all the time that you need. Each item is worth one point toward your total score.

Early Brain Development

1. In the first sequence of the program, which describes early brain development, it was stated that the most vulnerable period for exposure to environmental insults is when:

   A. the fertilized egg divides into a ball of many cells.

   B. the tube begins to form.

   C. <u>glial cells and neurons interact</u>.

   D. the divided cells begin to assume roles.

Fetal Alcohol Syndrome

Discovery of Fetal Alcohol Syndrome

2. Fetal alcohol syndrome was first discovered by looking at children who were born:

   A. prematurely.

   B. small for their gestational age.

   C. to an alcoholic mother.

   D. with deformations.

3. It was stated that the severity of the effects of alcohol on a developing fetus depends on:

   A. how much the mother drinks, when she drinks, and the size of the fetus.

   B. the type of alcohol the mother drinks, when she drinks, and the size of the fetus.

   C. how much the mother drinks, when she drinks, and the vulnerability of the fetus.

   D. the type of alcohol the mother drinks, the mother's blood alcohol level, and the vulnerability of the fetus.

Case Study - Angela

4. The statement that best summarizes Dr. Aronson's prediction about Angela's future is: Her new environment will:

   A. reverse the brain damage.

   B. prevent worsening of the brain damage.

   C. worsen the brain damage.

   D. moderate the brain damage.

Research with Monkeys

*5. Fetal alcohol exposure caused the baby monkeys to:

A. become hyperactive.

B. become inactive.

C. become self-destructive.

D. attack other monkeys.

Autopsy Photos

6. The autopsy photos showed that compared to the fetal alcohol syndrome infant's brain, the normal infant's brain had:

A. fewer gaps and more white matter.

B. more gaps and more white matter.

C. fewer gaps and less white matter.

D. more gaps and less white matter.

*7. When Dr. Clarren looked at the autopsy photos of the brain, he could see:

A. the physical effects of fetal alcohol syndrome and the destruction process involved.

B. the destruction process involved, but not the physical effects of fetal alcohol syndrome.

C. the physical effects of fetal alcohol syndrome, but not the destruction process involved.

D. something other than the physical effects of fetal alcohol syndrome and the destruction.

<u>Microscopic View</u>

8. Dr. Clarren noticed that during migration, cells of the brain erupted on to the surface through what he described as:

   A. walls.

   B. holes.

   C. <u>bridges</u>.

   D. gaps.

9. In the microscopic view of the fetal alcohol syndrome infant's brain we observed:

   A. under-migration of cells and malformed cells.

   B. <u>over-migration of cells and misplaced cells</u>.

   C. over-migration of cells and malformed cells.

   D. under-migration of cells and misplaced cells.

*10. When Dr. Clarren looked at the fetal alcohol syndrome brain tissue under the microscope, he could see:

   A. the destruction process involved, but not the physical effects of fetal alcohol syndrome.

   B. the physical effects of fetal alcohol syndrome, but not the destruction process involved.

   C. <u>the physical effects of fetal alcohol syndrome and the destruction process involved</u>.

   D. something other than the physical effects of fetal alcohol syndrome and the destruction process involved.

<u>Effects of Alcohol vs. Radiation</u>

11. In the discussion of the effects of alcohol vs. radiation, it was explained that each had a different effect on cell:

    A. <u>migration</u>.

    B. mortality.

    C. formation.

    D. division.

<u>Later Stages of Prenatal Brain Development</u>

*12. The segment on the later stages of prenatal brain development showed a process of:

    A. abnormal brain development.

    B. <u>normal brain development</u>.

    C. both abnormal and normal brain development.

    D. neither normal nor abnormal brain development.

Brainstem Preparation

<u>Responding to the Environment after Birth</u>

13. When a normal baby is born, the brain development process:

    A. continues in a smooth manner after a major interruption.

    B. <u>continues in a smooth manner with only a minor interruption</u>.

    C. is complete, as the brain is fully functional.

    D. is the most vulnerable to environmental insults.

*14. The examples that showed how the newborn baby responded to the environment:

A. supported the notion that babies are brainstem preparations.

B. neither supported nor refuted the notion that babies are brainstem preparations.

C. <u>refuted the notion that babies are brainstem preparations</u>.

D. proved the notion that babies are brainstem preparations.

Mouse Experiment

15. Consider the mouse who had a set of its whiskers removed at birth. When its brain was examined under a microscope, the barrels corresponding to the removed whiskers were:

A. <u>missing</u>.

B. present.

C. malformed.

D. misplaced.

16. Consider the mouse who had a set of its whiskers removed at six days old. When its brain was examined under a microscope, the barrels corresponding to the removed whiskers were:

A. missing.

B. <u>present</u>.

C. malformed.

D. misplaced.

Language Experiment

Indian Language

17. For the language experiment, the researcher found the Indian language useful because, when compared to English, it has different:

    A. vowels.

    B. vowels and consonants.

    C. meanings.

    D. consonants.

18. In the language experiment, the two words that the Indian woman spoke repeatedly differed by:

    A. a vowel.

    B. a consonant.

    C. a vowel and a consonant.

    D. meaning only.

*19. In the language experiment, the researcher chose two words in the Indian language that met a certain criteria. Which of the following pairs of English words would meet the same criteria?

    A. black, block

    B. bear, bare

    C. bleed, blood

    D. bloom, broom

Baby Experiment

20. In the language experiment, which baby or babies turned after the sound changed?

    A. the older baby.

    B. the younger baby.

    C. both babies.

    D. neither baby.

*21. Based upon the results of the language experiment, it might be suggested that language commitment occurs:

    A. between eight months and one year after birth.

    B. prior to eight months after birth.

    C. following one year after birth.

    D. at birth.

Overview

*22. The group or pair of experiments that showed examples of a loss of flexibility in the brain were:

    A. the mouse experiment and the language experiment.

    B. the monkey experiment and the language experiment.

    C. the monkey experiment and the mouse experiment.

    D. the mouse experiment, the language experiment, and the monkey experiment.

*23. Early in the program, the term "environmental insults" was used. An example from the program of an environmental insult that could harm the brain during its most vulnerable period of development is:

A. a bad home life during infancy.

B. premature birth.

C. harmful remarks from other children.

D. <u>radiation</u>.

APPENDIX H

APPENDIX H

YOUR OPINIONS ABOUT CAPTIONS (13-ITEM VERSION)

We are asking for your opinions about programs captioned for a hearing-impaired audience. We are not talking about foreign films with subtitles. When reading the items, please consider captioned programs used with people who have normal hearing, not with hearing-impaired individuals.

To indicate your opinion, please circle:

SA	If you strongly agree
A	If you agree
N	If you are neutral or have no opinion
D	If you disagree
SD	If you strongly disagree

Please complete all items. There are no right or wrong answers.

1.	Captions on television programs are not distracting.	SA	A	N	D	SD
2.	When viewing an instructional video program in class, I would prefer to view the program with captions displayed.	SA	A	N	D	SD
3.	While viewing a program with captions, I would read the captions.	SA	A	N	D	SD
4.	Captions would interfere with enjoyment of a program.	SA	A	N	D	SD
5.	Captions interfere with learning when watching an instructional television program.	SA	A	N	D	SD

6.	Captions decrease learning when watching an instructional television program.	SA	A	N	D	SD
7.	I would object to seeing an instructional program with the captions displayed.	SA	A	N	D	SD
8.	Captions reinforce the content of a program.	SA	A	N	D	SD
9.	Deaf students should have separate caption-viewing facilities, so that hearing students are not required to view captions in a regular classroom.	SA	A	N	D	SD
10.	Captions increase learning when watching an instructional television program.	SA	A	N	D	SD
11.	Captions interfere with a hearing person's ability to understand the program.	SA	A	N	D	SD
12.	If a deaf student were in my class, I <u>would</u> object to seeing a video program with captions showing.	SA	A	N	D	SD
13.	In order to build separate caption-viewing facilities for deaf students, it would be acceptable to take funds from other instructional programs.	SA	A	N	D	SD

APPENDIX I

APPENDIX I

YOUR OPINIONS ABOUT CAPTIONS (10-ITEM VERSION)

We are asking for your opinions about programs captioned for a hearing-impaired audience. We are not talking about foreign films with subtitles. When reading the items, please consider captioned programs used with people who have normal hearing, not with hearing-impaired individuals.

To indicate your opinion, please circle:

SA	If you strongly agree
A	If you agree
N	If you are neutral or have no opinion
D	If you disagree
SD	If you strongly disagree

Please complete all items. There are no right or wrong answers.

1.	Captions on television programs are not distracting.	SA	A	N	D	SD
2.	When viewing an instructional video program in class, I would prefer to view the program with captions displayed.	SA	A	N	D	SD
3.	Captions would interfere with enjoyment of a program.	SA	A	N	D	SD
4.	Captions interfere with learning when watching an instructional television program.	SA	A	N	D	SD
5.	Captions decrease learning when watching an instructional television program.	SA	A	N	D	SD

6.	I would object to seeing an instructional program with the captions displayed.	SA	A	N	D	SD
7.	Captions reinforce the content of a program.	SA	A	N	D	SD
8.	Deaf students should have separate caption-viewing facilities, so that hearing students are not required to view captions in a regular classroom.	SA	A	N	D	SD
9.	Captions increase learning when watching an instructional television program.	SA	A	N	D	SD
10.	Captions interfere with a hearing person's ability to understand the program.	SA	A	N	D	SD

APPENDIX J

APPENDIX J

CAPTION-VIEWING SURVEY

Please answer the following questions related to the process you used when you viewed the captioned program.

1. Of the total viewing time, what percentage of the time did you focus on reading the captions? (Please circle one answer below.)

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. Of the total viewing time, what percentage of the time did you focus on looking at the picture? (Please circle one answer below.)

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. Were you able to listen to the dialog and read the captions at the same time?

   Yes ____ No _____

4. Did you experience any frustration when watching the captioned videotape?

   Yes ____ No _____

   If you checked "Yes," please explain the reason below.

   ____
   ____
   ____
   ____
   ____

5. Did you believe that there was enough time to read the captions and look at the picture without missing most of the information?

   Yes ____ No _____

   Please explain the reason for your answer below.

   ____
   ____
   ____
   ____
   ____

6. Is this the first time that you have viewed a program that was captioned for a hearing-impaired audience? (Please do not confuse this with viewing a foreign film with subtitles.)

   Yes ____ No _____

   If you checked "No," please circle below the number of hours that you have spent viewing a program that was captioned for a hearing-impaired audience.

   Less than 1 1-2 3-4 5-6 7-8 9-10 More than 10

APPENDIX K

APPENDIX K

SCRIPT FOR CAPTION-VIEWING STRATEGY INSTRUCTION

With the increased use of captioning technology, at some point in the future, it is likely that you will find yourself viewing a captioned television program in a classroom or other setting. Today, you will learn about an effective technique for viewing captions.

In a few minutes, you will view a captioned program with sound. Before you do this, I am going to teach you a strategy that will help you use the captions to your best advantage. When most people read captions for the first time, they try to slowly and carefully read the captions. This takes too much of your time and attention and will not allow you enough time to look at the picture on the screen. Today, I want you to try a different approach. This is how an experienced caption-reader views captions. When the program starts, you should look at the picture. When you see a caption appear at the bottom of the screen out of the corner of your eye, you should _quickly_ glance down at the caption. Don't read it slowly. After quickly glancing at the caption, look back up at the picture until the next caption appears. This way, you can switch back and forth between the captions and the picture without missing information. You should trust in your ability to be able to take in much of the information in the captions with a quick glance. You may not catch <u>every</u> captioned word, but you will catch enough to help you reinforce what the speaker is saying.

One more tip: If you miss a word or two that the speaker has said, you can always quickly look back down at the caption before it disappears from the screen. In many cases, a caption will remain on the screen for a few seconds <u>after</u> a word is spoken. Take advantage of this.

At this point, we will stop the tape so that your administrator can answer any questions you may have about the caption-viewing strategy.

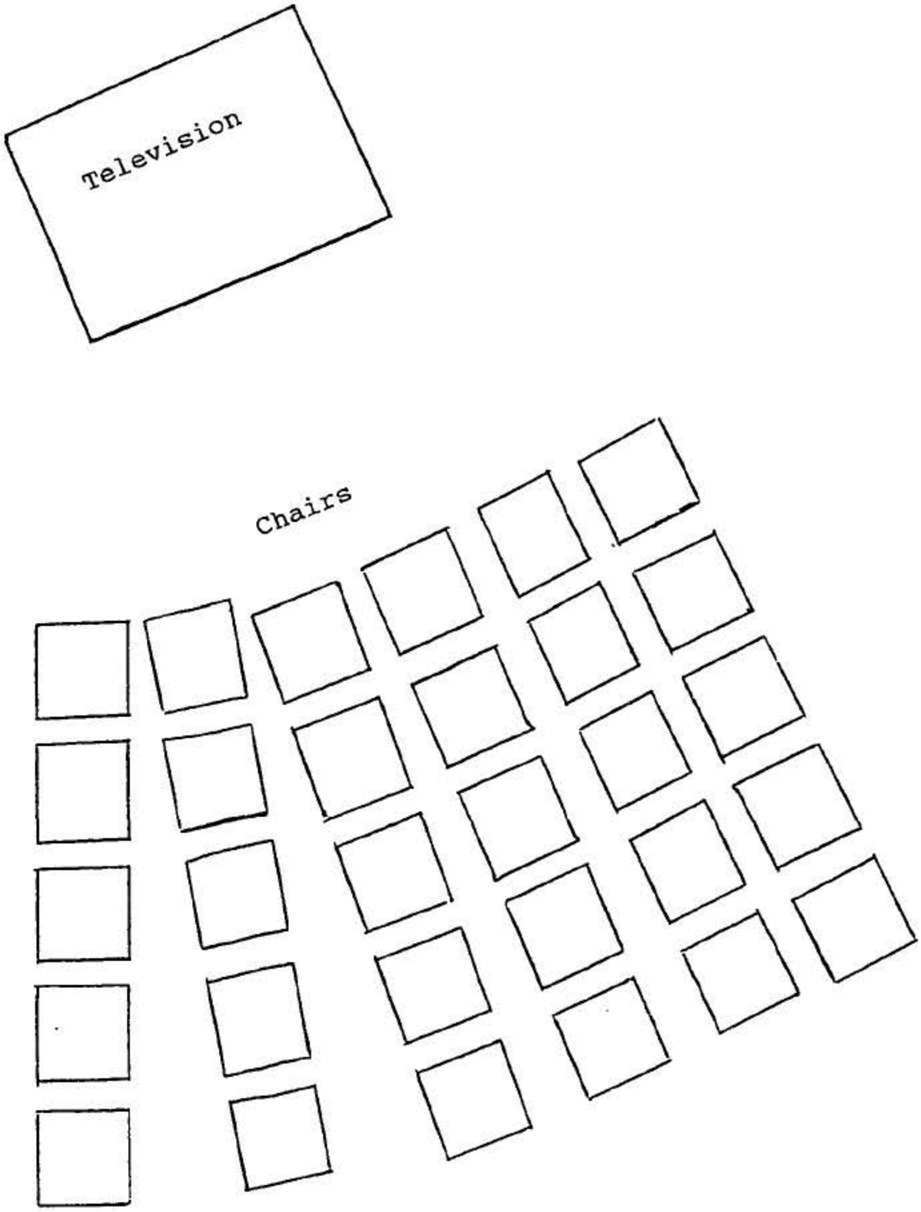
APPENDIX L

APPENDIX L

SEATING CHART

On the following page is the seating chart that was used for the current study.

Front of Room



APPENDIX M

APPENDIX M

PILOTS OF THE INSTRUMENTS

Six pilots of the instruments were conducted prior to the collection of data as follows: (a) comprehension posttest, (b) comprehension pretest/posttest, (c) attitude scale reliability, (d) attitude scale roleplay, (e) attitude scale expert, and (f) caption-viewing strategy instruction and seating chart. The final versions of the instruments were developed from these pilot studies.

Comprehension Posttest Pilot

Subjects and Administration

The 51-item pilot version of the comprehension test was administered as a posttest to 35 students (5 males and 30 females, ages 19-38) from the preservice teachers program. Subjects were shown the 20-minute non-captioned version of the instructional television program entitled Development (Page & Hutton, 1988). Then the subjects completed the 51-item pilot version of the comprehension posttest.

Data Collection

A separate data analysis was conducted for each of the two sub-tests, as they were considered separate instruments. Total scores and proportions of correct responses for the declarative and intellectual skills sub-tests were determined. The possible range of scores on the declarative knowledge sub-test was from 0 to 27, while the possible range for the intellectual skills sub-test was 0 to 24. Subjects received one point for each correct answer, as all items had equal weight.

Measures

Data analysis was conducted on both the 51-item and 23-item (final version) of the test. Descriptive statistics were determined for the subjects' total scores and proportions of correct responses for the separate declarative knowledge and intellectual skills sub-tests. An item analysis was also conducted to determine (a) discrimination indices, (b) frequency of distractor selection, and (c) difficulty indices. A reliability analysis was conducted in order to determine the item total-correlations and the phi coefficient.[1]

[1]The phi coefficient is a measure of internal consistency for a criterion-referenced test. It examines the consistent classification of mastery and non-mastery level performance on halves or parallel forms of a test.

Results (51-Item Version)

For the 27-item declarative knowledge sub-test, the mean proportion of correct responses was .63 (SD = .13), and the range was from 9 to 24 points. The standard error of measurement was determined to be 2.25 with a 95% confidence interval of ± 4.41. The discrimination indices ranged from -.18 to .45, while the difficulty indices ranged from .11 to .94. Four items had two unselected distractors. The reliability analysis resulted in item-total correlations ranging from -.26 to .44 and a phi coefficient of .30, which is less than acceptable for this type of criterion-referenced test. (Shrock and Coscarelli [1989] stated that a phi coefficient of less than .50 is unacceptable.)

For the 24-item intellectual skills sub-test, the mean proportion of correct responses was .53 (<u>SD</u> = .12), and the range was from 6 to 17 points. The standard error of measurement was determined to be 2.20 with a 95% confidence interval of ± 4.31. The discrimination indices ranged from -.15 to .53, while the difficulty indices ranged from .06 to .87. Two items had two unselected distractors. The reliability analysis resulted in item-total correlations ranging from -.09 to .36 and an unacceptable phi coefficient of .27.

Item Eliminations

Items were eliminated based on (a) low item-total correlations, (b) low discrimination indices, (c) multiple non-selected distractors, and (d) high or low difficulty indices (outside of the range of .40 to .80). As challenging items were needed for this instrument, those items with difficulty indices greater than .80 were considered for elimination because they were believed to be too easy. Items with indices less .40 were considered for elimination as these were believed to be too difficult. The test blueprint specifications were also considered when eliminating items.

As the result of the above data analysis, it was decided to retain 14 declarative knowledge items and 9 intellectual skills items for the experiment (for a total of 23 items). (There were fewer intellectual skills items retained because several of the pilot items needed to be eliminated in order to increase the internal reliability of the intellectual skills sub-test.) The revised 23-item test is included in Appendix G.

Results (23-Item Version)

For the 14 items retained for the declarative knowledge skills sub-test, the mean proportion of correct responses from this pilot was .61 (SD = .20), and the range was from 2 to 13 points. (The possible range was from 0 to 14 points, as each item was worth one point.) The standard error of measurement was determined to be 1.69 with a 95% confidence interval of ± 3.30. The discrimination indices ranged from .11 to .35, while the difficulty indices ranges from .40 to .77. Two items had two unselected distractors. The reliability analysis resulted in item-total correlations ranging from .16 to .42 and a phi coefficient of .59, which is more than acceptable for this type of criterion-referenced test.

For the 9 items retained for the intellectual skills sub-test, the mean proportion of correct responses was .54 (SD = .25) and the range was from 0 to 9 points (which represented the full possible range of scores). The standard error of measurement was determined to be 1.33 with a 95% confidence interval of ± 2.60. The discrimination indices ranged from .14 to .71, while the difficulty indices ranged from .34 to .74. One item had two unselected distractors. The reliability analysis resulted in item-total correlations ranging from .20 to .42 and an acceptable phi coefficient of .65.

Summary

Although the instruments produced in this study contain fewer items than required by the test blueprint (15 for each sub-test), both the declarative and intellectual skills sub-tests possess adequate reliability. All negative correlations and negative discrimination indices have been eliminated. These two separate sub-tests appear to be valid and reliable.

Comprehension Pretest/Posttest Pilot

Rationale

A further validity study was conducted with the 51-item pilot version of the comprehension posttest in order to determine whether the sub-tests were assessing mastery of information learned from the program entitled Development (Page & Hutton, 1988). In this study the subjects were given the 51-item test prior to and following the viewing of the stimulus material. (The 23-item revised version of this test was unavailable at the time that the materials were being prepared for this pilot. Instead, the 51-item version was used. During data analysis, the 23-items used in the revised version were analyzed separately.) If the sub-tests were, in fact, assessing mastery of the stimulus material, the mean proportions of correct responses were expected to increase significantly from pretest to posttest administrations.

Subjects and Administration

A total of 17 students (2 males and 15 females, ages 20-42) from the preservice teachers program participated in the pretest/posttest pilot. Subjects first filled out the 51-item comprehension test as a pretest. Next, the subjects were shown the 20-minute non-captioned version of the instructional television program entitled Development (Page & Hutton, 1988). After viewing the stimulus material, the subjects were administered the 51-item comprehension test as a posttest.

Data Collection

Total scores for the declarative knowledge and intellectual skills sub-tests were determined for the 51-item pretest and posttest and for the revised 23-item version.

Measures

The pretest and posttest mean scores for the separate declarative knowledge and intellectual skills sub-tests were determined for both the 51-item and 23-item versions of this test. In order to compare pretest and posttest means, a t-test of correlated means was used. As the sample size for this pilot (n = 17) might be considered too small to allow for the use of a parametric test, the Wilcoxon Matched-pairs Signed-ranks Test (a non-parametric test) was also used to compare pretest and posttest means. An alpha level of .05 for a two-tailed test was used for both the parametric and non-parametric tests.

Results (51-Item Version)

For the 27-item declarative knowledge skills pretest, the mean proportion of correct responses was .34 (SD = .09), and the range of correct responses was from 5 to 15 points. The mean proportion of correct responses for the declarative knowledge skills posttest was .71 (SD = .16) with a range of 9 to 25 points. For the parametric comparison of the pretest and posttest means, the posttest mean (.71) was significantly higher than the pretest mean (.34) ($t[16] = 9.42$, $p<.05$). For the non-parametric comparison of the pretest and posttest means, the mean rank was 9.00 for the posttest and 0.00 for the pretest. The difference between these mean ranks was statistically significant ($z = 3.62$, $p<.05$).

For the 24-item intellectual skills pretest, the mean proportion of correct responses was .42 (SD = .11), and the range of correct responses was from 6 to 15 points. The mean proportion of correct responses for the intellectual skills posttest was .58 (SD = .16) with a range of 5 to 21 points. For the parametric comparison of the pretest and posttest means, the posttest mean (.58) was significantly higher than the pretest mean (.42) ($t[16] = 5.30$, $p<.05$). For the non-parametric comparison of the pretest and posttest means, the mean rank was 8.97 for the posttest and 1.50 for the pretest. The difference between these mean ranks was statistically significant (z = 3.44, p<.05).

Results (23-Item Version)

For the 14-item declarative knowledge skills pretest, the mean proportion of correct responses was .31 (SD = .12), and the range of correct responses was from 2 to 7 points. The mean proportion of correct responses for the declarative knowledge skills posttest was .70 (SD = .17) with a range of 5 to 9 points. For the parametric comparison of the pretest and posttest means, the posttest mean (.70) was significantly higher than the pretest mean (.31) (t[16] = 7.93, p<.05). For the non-parametric comparison of the pretest and posttest means, the mean rank was 9.50 for the posttest and 1.00 for the pretest. The difference between these mean ranks was statistically significant (z = 3.57, p<.05).

For the 9-item intellectual skills pretest, the mean proportion of correct responses was .42 (SD = .16), and the range of correct responses was from 1 to 6 points. The mean proportion of correct responses for the intellectual skills posttest was .65 (SD = .21) with a range of 1 to 9 points. For the parametric comparison of the pretest and posttest means, the posttest mean (.65) was significantly higher than the pretest mean (.42) (t[16] = 4.42, p<.05). For the non-parametric comparison of the pretest and posttest means, the mean rank was 8.85 for the posttest and 2.50 for the pretest. The difference between these mean ranks was statistically significant (z = 3.12, p<.05).

Summary

The results of the pretest/posttest pilot provided evidence for the presence of content validity for this assessment instrument. The sub-tests appear to assess mastery of the stimulus material, rather than prior knowledge or extensive guessing. For both the 51-item and 23-item tests, the declarative knowledge and intellectual skills mean scores increased significantly from the pretest to posttest administration.

Attitude Scale Reliability Pilot

Subjects and Administration

The 13-item version of the Opinions About Captions attitude scale that was revised following expert review was administered to 106 students (37 males and 69 females, ages 20-42) from a Media and Technology course in the preservice teachers program. The scale was administered to one large group following the administration of an exam.

13-Item Version

Scoring

Total scores for the 13-item scale for each subject were determined. A high score reflected a positive attitude, while a low score was indicative of a negative attitude. The following points were assigned for positive statements: Strongly Agree-5, Agree-4, Neutral-3, Disagree-2, Strongly Disagree-1. For the negative statements, the scale was reversed to assign the following points: Strongly Agree-1, Agree-2, Neutral-3, Disagree-4, Strongly Disagree-5. The possible range of scores on the scale was from 13 to 65.

Measures

Descriptive statistics were determined for the subjects' total scores for the 13-item revised scale. In addition, the data were analyzed for internal and item-total reliability. A factor analysis was also conducted with a principal components analysis without iteration.

Results

The mean total score was 46.82 (SD = 7.46), while the range was from 24 to 64. The standard error of measurement was determined to be 2.89, and the 95% confidence interval is 5.66. The reliability analysis resulted in a coefficient alpha of .85 and a Guttman split-half reliability coefficient of .75. The item-total correlations ranged from .17 to .69, with three items below .30. Although four factors with eigenvalues greater than 1.00 (accounting for 71% of the variance) were revealed, only one had an eigenvalue over 2.00. Factor 1 was the most explanatory with an eigenvalue of 5.17, accounting for 39.8% of the variance of the scores in the scale. An examination of the factor matrix revealed that all 10 of the items correlated the highest with Factor 1, which measured a general attitude toward the use of captions with hearing people. These item loadings ranged from .59 to .79. Items 3, 12, and 13 correlated .22, .33, and .16 respectively with Factor 1 and correlated higher with other factors. These were the same three items that had low item-total correlations.

Elimination of Items

Following data analysis, it was decided to retain the 10 items correlating the highest with Factor 1. The three items with low factor loadings and low item-total correlations were discarded. The new 10-item version of the scale had a possible total score range of 10 to 50.

10-Item Version

Scoring

Total scores for the 10-item scale were determined for each subject. The scale was scored with the same method used to score the 13-item scale.

Measures

Descriptive statistics were determined for the subjects' total scores for the 10-item revised scale. In addition, the data were analyzed for internal and item-total reliability. A factor analysis was also conducted with a principal components analysis without iteration.

Results

The mean total score was 34.94 (SD = 6.68), while the range was from 16 to 50. The standard error of measurement was determined to be 2.21, and the 95% confidence interval is 4.33. The reliability analysis resulted in a coefficient alpha of .89 and a Guttman split-half reliability coefficient of .82. The item-total correlations ranged from .49 to .72. Although two factors with eigenvalues greater than 1.00 (accounting for 62.9% of the variance) were revealed, only one had an eigenvalue over 2.00. Factor 1 was the most explanatory with an eigenvalue of 5.03, accounting for 50.3% of the variance of the scores in the scale. An examination of the factor matrix revealed that all 10 items correlated the highest with Factor 1. These item loadings ranged from .58 to .79.

The reliability and factor analyses have revealed that the revised 10-item attitude scale has strong internal reliability and measures a single factor. This revised scale, which was retained for the experiment, is reproduced in Appendix I.

Attitude Scale Roleplay Pilot

Rationale

In order to establish construct validity for the 10-item Opinions About Captions attitude scale, it was necessary to administer the scale to a group of individuals who hold negative attitudes about the use of captions with hearing people and a group of individuals who hold positive attitudes. If the scale group means reflected negative attitudes for the negative group and positive attitudes for the positive group, and the means were significantly different, then this would provide evidence for construct validity. Although it was possible to identify a small group of individuals who held positive attitudes about using captions with hearing people, individuals with a negative attitude have not been identified in the literature on captioning or by captioning professionals.

In the absence of an identifiable group that would hold a negative attitude toward caption use with hearing students, it was decided to conduct a pilot in which the subjects were asked to roleplay the negative and positive attitudes. Each subject was presented with a scenario representing either a negative or positive position and told to fill out the scale according to that belief. To provide evidence for the construct validity of this scale, the subjects roleplaying negative attitudes were expected to generate negative scores on the scale, while those roleplaying positive attitudes were expected to produce positive scores. The means for these two groups should be significantly different.

Subjects

The 10-item version of the Opinions About Captions scale with negative and positive roleplay scenarios was administered to 40 students (25 males and 13 females, 2 gender unreported, ages 19-45) from two intersession courses. As subjects from the preservice teachers program were not available during the intersession, subjects outside of that pool were used. The subjects for this pilot were from a Star Trek course ($\underline{n}$ = 23) and a Virtual Reality course ($\underline{n}$ = 17). The scale was administered during the subjects' regularly scheduled class time.

Administration

Each subject filled out the 10-item Opinions About Captions attitude scale after reading either a negative or positive scenario. The scenarios (20 negative and 20 positive) were randomly placed in a stack prior to the pilot administration. Each subject randomly received either the negative or the positive scenario attached to his or her scale. The subjects were told that they should read the scenario and roleplay the attitude of the character described while filling out the attitude scale.

Scenarios

One scenario instructed the negative group subjects to play the attitude of someone who thinks that captioned television programs are very harmful to hearing people. The other scenario instructed the positive group subjects to play the attitude of someone who thinks that captioned television programs are very beneficial to hearing people. The scenarios are included below:

Negative Attitude

When completing the scale on the following page, you will roleplay the attitude of someone who thinks that captioned television programs are very harmful to hearing people. This character strongly believes that:

1. Captions are highly distracting to hearing people and make programs greatly unenjoyable.

2. It is difficult for a hearing person to understand the content of a captioned television program, because the captions are a great distraction.

3. Captions on an instructional program greatly interfere with a hearing person's ability to learn from the program.

One time, you walked out of a class because the teacher was showing a captioned instructional television program. When you later confronted the teacher, he told you that there was a deaf student who needed the captions. You told the teacher that the deaf student should watch a captioned version in a separate facility because the captions bothered the hearing students. The next day, you called your local congressman to get a bill sponsored that would require separate caption-viewing facilities for deaf students.

In order to defend your position, you gave the congressman the following information from journal articles:

1. One study found that hearing students who viewed instructional television programs with captions scored much lower on performance tests than students who viewed uncaptioned programs.

2. A survey of 1,000 college students nationwide revealed that 99% found captions on television programs distracting.

****

Now it is time for you to roleplay the character who is against the use of captions with hearing students. As you complete each item on the scale that follows, please answer each question as this character would, not as you would answer.

Positive Attitude

When completing the scale on the following page, you will roleplay the attitude of someone who thinks that captioned television programs are very beneficial to hearing people. This character strongly believes that:

1. Captions are not distracting to hearing people and make programs greatly enjoyable.

2. Captions help hearing students to understand the content of a captioned television program, because the captions reinforce the content of the program.

3. Captions on an instructional television program greatly improve a hearing person's ability to learn from the program.

One time, you walked out of a class because the teacher refused to show a captioned version of a program for the benefit of a deaf student in the class. When you later confronted the teacher, he told you that the deaf student should watch the captioned version in a separate facility because the captions bothered the hearing students. The next day, you called your local congressman to get a bill sponsored that would require teachers to show a captioned version of a program in a class when deaf students are present. This bill would prohibit forcing deaf students to use separate viewing facilities.

In order to defend your position you needed to show that captions did not harm hearing people. You gave the congressman the following information from journal articles:

1. One study found that hearing students who viewed instructional television programs with captions scored much higher on performance tests than students who viewed uncaptioned programs.

2. A survey of 1,000 college students nationwide revealed that 99% found captions on television programs <u>not</u> distracting.

****

Now it is time for you to roleplay the character who supports the use of captions with hearing students. As you complete each item on the scale that follows, please answer each question as this character would, not as you would answer.

Scoring

Total scores for the 10-item scale for each subject were determined. A high score reflected a positive attitude toward the use of captions with hearing subjects, while a low score was indicative of a negative attitude. The possible range of scores on the scale was from 10 to 50.

Measures

Descriptive statistics were determined for the subjects' total scores for the 10-item revised scale across groups (n = 40) and for the negative (n = 20) and positive (n = 20) groups. In addition, the data were analyzed for internal and item-total reliability. A factor analysis was also conducted with a principal components analysis without iteration.

Results

The mean total score across groups was 29.53 (SD = 17.18), while the range was from 10 to 50. The negative group mean was 13.25 (SD = 4.64), while the positive group mean was 45.80 (SD = 5.16). The standard error of measurement was determined to be 1.72, and the 95% confidence interval is ± 3.37. The reliability analysis resulted in a coefficient alpha of .99 and a Guttman split-half reliability coefficient of .98. The item-total correlations ranged from .83 to .97. Only one factor with an eigenvalue greater than 1.00 (accounting for 90% of the variance) was revealed. An examination of the factor matrix revealed that the item loadings for Factor 1 ranged from .91 to .99. A t-test of independent means was used to determine whether the differences in the negative and positive group means were significant. It was determined that the positive group mean (45.80) was significantly higher than the negative group mean (13.25) ($\underline{t}[38] = 20.98$, $\underline{p}<.05$).

The range of 10 to 50 points covered the full range of possible scores. This indicated that there were subjects scoring on the most negative and most positive ends of the attitude scale. The internal reliability of this scale was found to be quite high for this pilot, and the sole factor (Factor 1) accounted for a considerable percent of the variance (90%). The most important finding for this pilot was that the negative and positive group means were found to be significantly different. This provided evidence of the construct validity of this scale. The positive group mean was close to the positive end of the scale and was significantly higher than the negative group mean, which was near the negative end of the scale.

Attitude Scale Expert Pilot

Rationale

To provide further evidence for the construct validity of the 10-item attitude scale, it was decided that a group of individuals who were identified as having positive attitudes about the use of captions with hearing people would complete the scale. If the scale scores reflected positive attitudes from these individuals, then this would provide evidence for the construct validity of this instrument.

Through an extensive review of the captioning literature, the author was able to identify a small group of researchers who published studies aimed at supporting the benefits of captions with hearing students. A few captioning professionals who held a positive attitude about the use of captions with hearing people were also identified through telephone conversations with the author.

Subjects and Administration

The author contacted some of the individuals identified as having strong positive attitudes about the use of captions with hearing people. Individuals from a few deaf organizations that had national visibility were also contacted in the event that they might know individuals who hold this positive attitude. Individuals contacted included:

1. Three authors of scholarly journal articles that examined the benefits of captions for hearing people.

2. One captioning professional from a major captioning company and one captioning professional from a major postsecondary institution for deaf students.

3. Two professors from a major postsecondary institution for deaf students.

4. Six research professors from a national research center that focused on deaf-related research.

A total of 13 captioning professionals (8 males and 5 females, ages 27-55) completed the 10-item attitude scale. All scales were completed and returned anonymously.

Scoring

Total scores for the 10-item scale for each subject were determined. The possible range of scores on the scale was from 10 to 50.

Measures

Descriptive statistics were determined for the subjects' total scores for the 10-item scale. With this small sample, the data were not analyzed for internal and item-total reliability, and a factor analysis was not conducted.

Results

The mean total score was 45 (SD = 4.43). The range of scores was from 36 to 50 points, with only one score falling below 40.

The limited range of 36 to 50 indicated that these subjects scored primarily on the positive end of the attitude scale. The mean of 45 was only a few points away from the most positive end of the scale (50), and scores on the neutral or negative end were not obtained. As subjects identified to have positive attitudes about caption use with hearing people scored on the positive end of the scale, this provided evidence of the construct validity of this scale.

Caption-Viewing Instruction and Seating Arrangement Pilot

Rationale

Two components from the experiment were examined together in this pilot. They were (a) the caption-viewing strategy instruction and (b) the seating arrangement. The former was piloted to determine problems with the instructions, such as lack of clarity. The latter was piloted to ensure that for the experiment a seating arrangement was used that would allow all caption-viewing subjects to clearly view and read the captions.

Subjects and Administration

The pilot was administered to 35 students (4 males and 31 females, ages 20-40) from the preservice teachers program. The room was arranged according to the seating chart designed for the experiment (See Appendix L). A total of 30 subjects sat in the chairs shown in the seating chart. Five additional subjects sat in extra chairs pushed to the back of the room and only participated in the pilot of the caption-viewing strategy instruction.

For the caption-viewing strategy instruction pilot, the subjects listened to the researcher read the brief caption-viewing strategy instruction. Then the subjects filled out a feedback form that contained three items that solicited comments on the instruction. The first item asked the subjects to list the main points of the caption-viewing strategy instruction. The second item asked the subjects to state anything that they found unclear about the instruction. The third item solicited suggestions for changes to improve the instruction.

With this portion of the pilot completed, the 5 subjects seated in the extra chairs at the back of the room were excused. The other 30 subjects were asked to stay. Next, the 30 remaining subjects were told that they would watch approximately ten minutes of an open captioned version of an episode of Melrose Place. They were told to read the captions while viewing. After a ten-minute segment of the program was completed, the researcher turned down the volume and asked any subjects who could not clearly read the captions to raise their hands. As a few subjects raised their hands, changes were made in the seating arrangement while the program continued. The subjects were again asked to raise their hands if they could not clearly read the captions. As no hands were raised, the seating chart was documented and the subjects were excused.

Results of the Instruction Pilot

A content analysis was performed on the subjects' feedback forms to determine their understanding of the instruction. It was determined that 91% of the subjects correctly identified some or all of the components of the caption-viewing strategy instruction that was presented. Only 26% found components of the instruction unclear, while 37% suggested changes to the instruction.

Although most of the subjects reported that they clearly understood the instruction, the following revisions were made to the caption-viewing strategy instruction script based on the feedback and comments of the subjects:

1. Explanation of why the instruction is needed was added to the beginning of the instructional script.

2. Information was added in the instruction that explained that subjects would be viewing a program with captions and audio.

3. The researcher attempted to be more animated and to talk slower when videotaping the caption-viewing instruction for the experiment.

Results of Seating Chart Pilot

The subjects who claimed that they couldn't clearly see the picture or read the captions informed the researcher that it had nothing to do with the distance from the television set. The subjects who raised their hands were primarily shorter individuals sitting in the last few rows of chairs. They were being blocked by taller subjects seated in front of them. The researcher moved the shorter subjects to the front rows and moved the taller subjects to the back rows. The stimulus material was shown for a while longer, and all subjects claimed that they could clearly read the captions.

It was determined that the seating arrangement was acceptable, as long as short subjects were not blocked by tall subjects. For the experiment, it was decided that the chairs would be placed according to the previously designed seating chart (see Appendix L). The subjects did not choose their own seats. As the subjects arrived to the treatment rooms, the administrators tactfully seated the shorter subjects in the front and the taller subjects in the back without explaining the seating criteria to the subjects. A program with stock exchange information crawling across the bottom of the screen was shown to each group after the subjects were seated to determine whether they could all see the television and read the print without obstruction. (A captioned program was not used. As one of the treatment groups did not view captioned stimulus material, it might have appeared strange to show that group a captioned program to check the seating arrangement.)

Summary

As the result of this pilot, it was determined that the caption-viewing strategy instruction was clear to most subjects, although a few minor changes were made before videotaping the instruction for the experiment. The seating chart was found to be acceptable, as long as tall subjects were seated in the back, and short subjects were seated up front.

APPENDIX N

APPENDIX N

CAPTION-VIEWING SURVEY WITH FREQUENCIES AND PERCENTAGES OF RESPONSES BY GROUP

The following are the frequencies and percentages of responses to each item for the captions-without-instruction group (n = 26), the short-practice group (n = 21), and the long-practice group (n = 22). The frequencies are followed by the percentages in parenthesis. Descriptive statistics are also included for Items 1 and 2. For Items 4 and 5, the comments from the open-ended components of these questions are summarized. The comments listed are paraphrased and do not represent actual quotes. Each comment was made by one person, unless indicated by a frequency of respondents placed in parenthesis following the comment. For Item 6, frequencies and percentages are also listed for the total caption-viewing group (n = 69).

1. Of the total viewing time, what percentage of the time did you focus on reading the captions? (Please circle one answer below.)

%	Captions-without-instruction group	Short-practice group	Long-practice group
10	4 (15)	2 (10)	1 (5)
20	5 (19)	1 (5)	2 (9)
30	5 (19)	3 (14)	4 (18)
40	1 (4)	4 (19)	4 (18)
50	1 (4)	4 (19)	2 (19)
60	0 (0)	3 (14)	4 (18)
70	5 (19)	3 (14)	2 (9)
80	3 (12)	1 (5)	1 (5)
90	1 (4)	0 (0)	2 (9)
100	1 (4)	0 (0)	0 (0)
Mean	44.62	44.71	48.64
SD	29.01	19.64	22.53
Min	10	10	10
Max	100	80	90

2. Of the total viewing time, what percentage of the time did you focus on looking at the picture? (Please circle one answer below.)

%	Captions-without-instruction group	Short-practice group	Long-practice group
10	0 (0)	0 (0)	0 (0)
20	3 (11)	0 (0)	2 (9)
30	2 (8)	2 (10)	1 (5)
40	2 (8)	2 (10)	5 (22)
50	1 (3)	5 (23)	2 (9)
60	2 (8)	4 (14)	4 (18)
70	2 (8)	2 (10)	4 (18)
80	6 (23)	3 (14)	2 (9)
90	6 (23)	4 (19)	1 (5)
100	2 (8)	0 (0)	1 (5)
Mean	66.54	62.38	56.36
SD	26.52	19.98	21.50
Min	20	30	20
Max	100	90	100

3. Were you able to listen to the dialog and read the captions at the same time?

Response	Captions-without-instruction group	Short-practice group	Long-practice group
Yes	20 (77)	19 (91)	15 (68)
No	6 (23)	2 (9)	7 (32)

4. Did you experience any frustration when watching the captioned videotape?

Response	Captions-without-instruction group	Short-practice group	Long-practice group
Yes	13 (50)	9 (43)	15 (68)
No	13 (50)	12 (57)	7 (32)

If you checked "Yes," please explain the reason below.

Captions-Without-Instruction Group Responses

Captions and Dialog

1. The captions and dialog did not match.

2. I was distracted because the captions gave away the end of the spoken sentence.

Captions and Picture

1. I had trouble ignoring the captions and focusing on the picture. (4 subjects)

2. I found switching back and forth between the captions and the picture distracting.

3. I couldn't read the captions and watch the picture at the same time.

4. The captions blocked important parts of the picture. (2)

Captions

1. The change in caption placement from top to bottom was distracting.

2. The captions were distracting. (2)

3. I wasn't used to reading captions.

4. The captions disappeared too fast.

Content

1. I wasn't able to focus on the content. (3)

Miscellaneous

1. It gave me a headache.

2. There was too much going on at once.

Short-Practice Group Responses

Captions and Dialog

1. I had trouble hearing the dialog and reading the captions at the same time.

2. The captions helped me to understand English dialog spoken with an accent.

Captions and Picture

1. I couldn't watch the captions and picture at the same time. (2)

2. The captions blocked important parts of the picture.

Captions

1. I tuned out the captions.
2. The captions were distracting. (2)
3. The captions were too fast.
4. Sometimes I missed what the captions said.

Picture

1. I prefer just to watch the picture.

Miscellaneous

1. The mouse sequence was confusing.
2. I have trouble with English.
3. The captions gave me a headache.

Long-Practice Group Responses

Captions and Dialog

1. The captions were behind the dialog.
2. The captions and dialog didn't match.
3. I read the captions when the dialog was not on.

Captions and Picture

1. The captions took too much attention away from the picture. (2)
2. The captions blocked important parts of the picture.
3. I can't watch the captions and picture at the same time.

Captions

1. The change in caption placement from top to bottom was distracting. (2)

2. Reading captions is not relaxing or enjoyable. (2)

3. I felt obligated to read the captions. (2)

Content

1. I wasn't able to focus on the verbal content. (3)

Miscellaneous

1. My eyes became tired.

2. Reading the captions prevented me from elaborating.

5. Did you believe that there was enough time to read the captions <u>and</u> look at the picture without missing most of the information?

Response	Captions-without-instruction group	Short-practice group	Long-practice group
Yes	14 (54)	16 (76)	18 (82)
No	12 (46)	5 (24)	4 (18)

Please explain the reason for your answer below.

<u>Captions-Without-Instruction Group - "Yes" Responses</u>

Captions and Dialog

1. The captions helped me understand the dialog spoken with foreign accents.

2. Sometimes I focused on the dialog and sometimes on the captions.

Captions and Picture

1. It was easy to read the captions and watch the picture. (5)

Captions

1. I didn't like having to read the captions.

2. The captions were simple and easy to read.

3. The captions were not too long.

Miscellaneous

1. (No explanation) (3)

2. I read fast. (2)

3. The reading task would be too fast for a slow reader.

Captions-Without-Instruction Group - "No" Responses

Captions and Dialog

1. I only read the captions when the spoken content was difficult.

2. The captions didn't match the dialog.

3. The captions and dialog were not in sync.

Captions and Picture

1. When I tried to read the captions, I missed the picture. (4)

2. I couldn't see people pointing at charts <u>and</u> read the captions.

3. I couldn't read the captions and look at the picture. (3)

Captions

1. The captions were too fast. (2)

2. I tuned out the captions.

Content

1. I wasn't able to focus on the content.

Dialog

1. It was okay when the speaker was speaking slowly.

<u>Short-Practice Group - "Yes" Responses</u>

Captions and Dialog

1. The captions helped me to spell new words that were spoken.

2. The captions helped me understand unclear dialog.

Captions and Picture

1. There was enough time to read the captions and watch the picture. (3)

2. I could switch back and forth easily from the captions to the picture.

3. After I relaxed, I could read the captions and see the picture.

Captions, Dialog, and Picture

1. The captions reinforced the dialog and picture.

Captions

1. The captions were clear and easy to read.

2. I focused on reading only the important words.

Picture

1. The picture didn't change too fast.

Dialog

1. The dialog was not too fast. (2)

Miscellaneous

1. I couldn't perform this task all the time.
2. A slow reader would get frustrated.
3. I have trouble with English.
4. (No explanation) (2)

<u>Short-Practice Group - "No" Responses</u>

Captions and Dialog

1. Spoken words were omitted in the captions.
2. Some irrelevant spoken words appeared in the captions.
3. Listening to the dialog and reading the captions hindered learning.

Captions

1. The captions were too fast. (2)

Picture

1. I missed some information in the picture.

Miscellaneous

1. (No explanation)

Long-Practice Group - "Yes" Responses

Captions and Dialog

1. The captions appeared after the dialog began and/or lingered on the screen after the dialog ended. (4)

2. I could look back at the captions if I missed information in the dialog.

Captions and Picture

1. The captions blocked important parts of the screen.

2. I could view both the captions and the picture when using the caption-viewing strategy I was taught. (2)

Captions

1. The captions were short.
2. Sometimes I tuned out the captions.
3. I would prefer not to read captions.
4. I can tune out the captions.
5. It was impossible to tune out the captions.
6. I quickly glanced at the captions. (2)
7. The captions were a distraction.

Content

1. I missed some information, but not most.

2. It would be more difficult not to miss information if I were deaf.

3. This task limited my time for elaborating on the content.

Miscellaneous

1. I am a fast reader.

2. (No explanation) (3)

Long-Practice Group - "No" Responses

Captions and Dialog

1. The captions and dialog didn't match.

Captions

1. The captions were too fast. (2)

2. The captions ran together.

6. Is this the first time that you have viewed a program that was captioned for a hearing-impaired audience? (Please do not confuse this with viewing a foreign film with subtitles.)

Response	Captions-without-instruction group	Short-practice group	Long-practice group	Three groups combined
Yes	13 (50)	10 (48)	8 (36)	31 (45)
No	13 (50)	11 (52)	14 (64)	38 (55)

If you checked "No," please circle below the <u>number of hours</u> that you have spent viewing a program that was captioned for a hearing-impaired audience.

Hours	Captions-without-instruction group	Short-practice group	Long-practice group	Three groups combined
< 1	5 (19)	2 (9)	5 (23)	12 (17)
1 - 2	3 (12)	3 (14)	5 (23)	11 (16)
3 - 4	4 (15)	5 (24)	2 (9)	11 (16)
5 - 6	0 (0)	0 (0)	2 (9)	2 (3)
7 - 8	0 (0)	0 (0)	0 (0)	0 (0)
9 -10	0 (0)	0 (0)	0 (0)	0 (0)
> 10	1 (4)	1 (5)	0 (0)	2 (3)
NA	13 (50)	10 (48)	8 (36)	31 (45)

APPENDIX O

APPENDIX O

DATA ANALYSIS OF PRE-TREATMENT ATTITUDE SCALE

A separate data analysis of the pre-treatment attitude scale was conducted across all four treatment groups ($\underline{n}$ = 96). The results of this analysis are described below:

Measures

Descriptive statistics were determined for the subjects' total scores and for the frequencies of responses selected by item. In addition, the data were analyzed for internal and item-total reliability. The reliability analysis used a covariance matrix to determine (a) Cronbach's alpha, (b) Guttman's split-half coefficient, and (c) item-total correlations. A factor analysis was also conducted using a principal components analysis without iteration and a varimax rotation using Kaiser Normalization to extract factors with eigenvalues of 1.00 or greater. Those factors with eigenvalues less than 1.00 were eliminated from the final analysis with this method.

Descriptive Statistics

The following descriptive statistics were obtained for the 10-item scale:

Total Scores by Subject

The total scores by subject were determined. The possible range of scores on the scale was from 10 to 50. The range from this sample was from 15 to 47 points. The mean total score was 31.60 with a standard deviation of 6.67. The skewness was -.35, and the kurtosis was -.33. The standard error of measurement for this scale was 2.21 with a 95% confidence interval of ± 4.34. The frequencies and percentages for each total score are listed in Table O-1, while a histogram with the total score frequencies is included in Table O-2.

Item Descriptive Statistics

Means and Standard Deviations

The means and standard deviations for each item are included in Table O-3. The means ranged from 2.65 to 3.70, while the standard deviations ranged from 0.80 to 1.07. These means tended to lean toward the neutral point of the scale.

Frequencies

Table O-4 displays the frequencies and percentages of responses by item. All of the items solicited a varied

Table O-1

Frequencies for Total Pre-treatment Attitude Scale Scores Across Treatment Groups (n = 96)

Score	Frequency	Percent
15	1	1.0
16	0	0.0
17	2	2.1
18	0	0.0
19	1	1.0
20	1	1.0
21	4	4.2
22	5	5.2
23	1	1.0
24	1	1.0
25	1	1.0
26	5	5.2
27	2	2.1
28	2	2.1
29	5	5.2
30	7	7.3
31	5	5.2
32	8	8.3
33	7	7.3
34	2	2.1
35	5	5.2
36	8	8.3
37	6	6.3
38	2	2.1
39	3	3.1
40	6	6.3
41	2	2.1
42	1	1.0
43	2	2.1
44	0	0.0
45	0	0.0
46	0	0.0
47	1	1.0
TOTAL	96	100.0

Table O-2

Frequency Histogram for Total Pre-treatment Attitude Scale Scores Across Treatment Groups (n = 96)

Score	Frequency
15	1
16	0
17	2
18	0
19	1
20	1
21	4
22	5
23	1
24	1
25	1
26	5
27	2
28	2
29	5
30	7
31	5
32	8
33	7
34	2
35	5
36	8
37	6
38	2
39	3
40	6
41	2
42	1
43	2
44	0
45	0
46	0
47	1

Table O-3

Pre-treatment Attitudes Scale Scores by Item Across Treatment Groups (n = 96)

Item no.	Mean	SD
1	2.65	0.98
2	2.68	0.93
3	2.72	0.99
4	3.21	0.97
5	3.33	0.95
6	3.59	0.92
7	3.11	0.90
8	3.70	1.07
9	3.07	0.80
10	3.54	0.93

Table O-4

Pre-treatment Attitude Scale Frequencies of Responses by Item Across Treatment Groups (n = 96) and Scale Items Descriptions

Item no.	Strongly agree		Agree		No opinion		Disagree		Strongly disagree	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
1	3	3	18	19	25	26	42	44	8	8
2	1	1	21	22	27	28	40	42	7	7
3	9	9	36	38	25	26	25	26	1	1
4	4	4	20	21	29	30	38	40	5	5
5	4	4	14	15	30	31	42	44	6	6
6	1	1	14	15	20	21	49	51	12	12
7	3	3	33	34	35	37	22	23	3	3
8	3	3	12	12	19	20	39	41	23	24
9	2	2	27	28	44	46	22	23	1	1
10	1	1	15	16	22	23	47	49	11	11

Item no.	Content
1	Captions are not distracting.
2	I would prefer to view a captioned program in class.
3	Captions would interfere with program enjoyment.
4	Captions interfere with learning.
5	Captions decrease learning.
6	I would object to seeing a captioned instructional program.
7	Captions reinforce program content.
8	Deaf students should have separate caption-viewing facilities.
9	Captions increase learning.
10	Captions interfere with understanding the program.

Note. Freq = Frequency.

range of responses, although most of the responses were not on the extreme ends of the scale ("strongly agree" or "strongly disagree"). The percentage of subjects selecting extreme responses ranged from 1 to 12, with the exception of Item 8. A total of 24% of the respondents strongly disagreed with this item, which advocated the use of separate caption-viewing facilities for deaf students.

Reliability Analysis

The following results were obtained from the reliability analysis:

Reliability Coefficients

Coefficient alpha was .89, while the Guttman split-half reliability coefficient was .85.

Correlation Matrix

The correlation matrix is included in Table O-5. There are no negative or near-zero correlations between items. The correlations range from .19 to .81.

Item-Total Correlations

The item-total correlations are shown in Table O-6. These correlations ranged are from .37 to .82. Only one item was below .40.

Table O-5

Correlation Matrix for Pre-treatment Attitude Scale Across Treatment Groups (n = 96)

Item no.	1	2	3	4	5	6	7	8	9	10
1	1.00									
2	0.31	1.00								
3	0.32	0.46	1.00							
4	0.31	0.54	0.59	1.00						
5	0.30	0.49	0.48	0.81	1.00					
6	0.36	0.35	0.48	0.63	0.61	1.00				
7	0.25	0.49	0.29	0.52	0.47	0.53	1.00			
8	0.19	0.31	0.34	0.37	0.30	0.53	0.29	1.00		
9	0.22	0.44	0.39	0.69	0.61	0.54	0.67	0.40	1.00	
10	0.24	0.42	0.51	0.67	0.55	0.63	0.34	0.39	0.50	1.00

Table O-6

Item-Total Correlations and Factor 1 Loadings for Pretreatment Attitudes Scale Items Across Treatment Groups ($n = 96$)

Item no.	Item-total corr	Item-factor corr
1	0.37	0.45
2	0.59	0.67
3	0.60	0.68
4	0.82	0.88
5	0.73	0.81
6	0.74	0.80
7	0.59	0.69
8	0.47	0.56
9	0.70	0.78
10	0.67	0.75

Note. corr = correlation.

Factor Analysis

The factor analysis uncovered only one factor with an eigenvalue greater than 1.00. Factor 1 was the most explanatory one with an eigenvalue of 5.15, which accounted for 51.5% of the variance of the scores in the scale. An examination of the factor matrix revealed that all 10 items correlated the highest with Factor 1. These item loadings ranged from .45 to .88 (see Table O-6).

Interpretation of Data Analysis

Descriptive Statistics

The mean total score of 31.60 indicated that the average attitude tended to lean toward the neutral point of the scale. The mean total score across groups is similar to the group mean total scores that were obtained from the pre- and post-treatment attitude scale. Most of those means were found to be either at or slightly above the neutral point of the scale. While the range of 15 to 47 approached the full range of possible scores (10 to 50), it was discovered that few individuals selected the extreme responses of "strongly agree" or "strongly disagree." This provides further indication that the subjects' scores tended to be toward the neutral end of the scale. Item 8 elicited the highest percentage of "strongly disagree" responses (24%). This item suggested separate viewing caption-viewing facilities for deaf students. For students in a preservice teachers program, it might be assumed that agreement with this item would be a socially unacceptable response.

Reliability

The coefficient alpha of .89 and Guttman split-half reliability coefficient of .85 are more than acceptable for this type of instrument. They both provide strong support for the internal consistency of this scale. The lack of negative or near-zero item-total correlations provide further support for the strong reliability of this scale.

Factor Analysis

The fact that only one general factor (Factor 1) was determined from the principal components analysis provides strong support that all items on this scale measure one general attitude toward the use of captions with hearing people. This factor accounted for approximately one-half of the variance of the scores. All factor loadings were above .40 for Factor 1, and no other factors with eigenvalues above 1.00 were discovered.