THE EFFECTS OF EMBEDDED QUESTION TYPE AND LOCUS OF CONTROL ON PROCESSING DEPTH, KNOWLEDGE GAIN, AND ATTITUDE CHANGE IN A COMPUTER-BASED INTERACTIVE VIDEO ENVIRONMENT

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(ABSTRACT)

The differential effectiveness of two types of adjunct embedded questions in facilitating deep processing, increased knowledge gain, and increased positive attitude change was examined in this two-session laboratory study. In session one, subjects completed a measure of locus of control (LOC) orientation, as well as measures of pretest knowledge and attitudes regarding drinking. Two weeks later, stratified assignment was used to place 33 subjects (ages 12 to 15) in one of the three levels of question condition (no questions, factual questions, and inference questions) to study a computer-based instructional program about alcohol education during the second session.

Subjects assigned to either of the two embedded question conditions were asked to answer ten questions embedded between segments of interactive video. Depending on question condition, subjects were asked to provide factual information or draw inferences and conclusions regarding the previous video segment. After each question, subjects were asked to rate the amount of effort required to answer the preceding question. Control group subjects viewed interactive video without embedded questions or effort rating scales. Reaction-time trials were distributed throughout the multimedia program and were received by all subjects to establish a baseline reaction-time measure. Immediately following the instructional program, subjects completed posttest measures of knowledge and attitudes regarding alcohol.

Results provided limited support for the hypothesis that embedded questions would facilitate positive attitude change; however, embedded questions did not appear to facilitate knowledge gain. Results also provided support for the hypothesis that subjects with internal LOC orientations would be associated with greater positive changes in knowledge gain. Other hypotheses related to depth of processing were not supported by the results of this study. No differences were observed between embedded question types on the reaction-time and mental effort rating measures of depth of processing. Furthermore, no differences were observed across LOC orientation on either of the depth of processing measures. A number of methodological issues are thought to have contributed to this limited support of the hypotheses in this study. These issues, and their potential impact and solutions are discussed with respect to future research.

This work is dedicated to Tom and Jody Mitchell, my loving and supportive parents.

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And of course, to Elvis.

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CHAPTER 1

INTRODUCTION

Recent technological developments are finding their way into the ever changing field of education. Educators, interested in providing more effective instruction, are continually introducing state-of-the-art technology into the learning environment (Cennamo, Savenye, & Smith, 1991). The emergence of computer-based technologies such as computer-assisted-instruction (CAI), interactive videodisc, compact disc-interactive (CD-I) and digital video interactive (DVI), has produced unprecedented interest within the instructional community regarding the role of such technologies in instructional and training system design.

Computer-based interactive video (CBIV) is another relatively new instructional medium which holds considerable promise for improved instruction. Due to its complimentary blend of computer control and video, CBIV offers a great degree of flexibility, making its application appropriate for several types of learners, subject matter areas, and types of learning. In addition, there exists a growing body of research which supports the contention that interactive video learning is effective (Evans, 1986).

Although these technological advances show great promise in the field of education, their use alone does not guarantee improved instruction or learning (Hannafin & Rieber, 1989b). Research directed at issues such as the instructional methods employed, the cognitive processes engaged, and the effectiveness of content structuring should be conducted to help determine how and when such advancements would prove most beneficial in the educational arena (Jost, 1992).

Research and evaluation of such new educational technologies has typically involved experimental and quasi-experimental designs to compare one instructional technology with another. Although this paradigm has been in place for at least 30 years, it has met with rather unfavorable criticism and produced few useful results (Clark, 1983; Hoban, 1958; Reeves, 1986). Evans (1986) suggests that rather than simply comparing interactive video learning with more traditional forms of instruction, research on interactive video should focus on those attributes which can maximize the effectiveness of the medium, and the interaction of those attributes with different learner characteristics across various applications. As learner involvement is essential to any instructional program and interactive video is a medium based on interactivity, it would follow that determining how interactivity can best be used in the creation of meaningful involvement should be a major focus of the research in this area (Evans, 1986).

Based on the levels of processing viewpoint put forth by Craik and Lockhart (1972), this study investigated the utility of two different types of embedded questions for increasing meaningful involvement with the instructional materials in terms of facilitating deeper processing and improved learning of those materials. Furthermore, the interaction between embedded question type and the learner characteristic of locus of control (LOC) orientation was investigated as it is believed to effect motivation and ability to learn (Goldstein, 1993), as well as the depth at which information is processed (Thal, Harris, & Stock, 1983). More specifically, the purpose of this research was to investigate the effects of embedded question type (factual vs. inference) on processing depth, knowledge gain, and attitude change regarding alcohol use among adolescents of varying LOC orientation.

The domain of instruction for the current study involved adolescent alcohol education and was presented using a computer-based multimedia program involving text, graphics, linear video, and interactive video. This multimedia program was developed by the author while employed by American Research Corporation of Virginia (ARCOVA), Radford, Virginia, under contract for the National Institute on Alcohol Abuse and Alcoholism. The instructional domain of alcohol education was selected due to the author's familiarity with the project and topic area, as well as its relative importance to adolescent well-being.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Information Processing

The notion of stimulus response and reinforcement was central to the understanding of learning by early theorists. It was argued that a person responds to a given stimulus and, when reinforcement was provided for that response, a connection between the stimulus and response would be formed. It was further believed that continual reinforcements of the response would strengthen the neural connections such that the desired behavior would occur whenever that stimulus was presented. However, many modern psychologists see this explanation for behavior to be largely inadequate, failing to explain more complex human behaviors such as thinking and decision making (Goldstein, 1993). More recent cognitive theories view humans as information processors, actively attending to stimuli, accessing existing knowledge structures to relate new information, realigning the structure of existing knowledge to accommodate the newly acquired information, and encoding restructured knowledge into memory (Jonassen, 1985a). A learner's active participation in the construction of this new knowledge is viewed as a critical component for accessing and retrieving prior knowledge in the interpretation of new information (Weinstein, 1978).

2.1.1 Model of information processing. The study of how humans process and remember information has been an active area of psychological research for over 100 years (Sanders & McCormick, 1987). During that time, a number of models have been presented to help conceptualize how people process and store information. One such model is presented in Figure 2.1 (Wickens, 1992) and is a composite of those presented by a number of previous investigators (e.g., Broadbent, 1958; Smith, 1968; Sternberg, 1969; Welford, 1976). This model assumes that each stage of processing performs some transformation of the data and demands some time for its operation.

According to this model, as an incoming stimulus is sensed by the appropriate sensory system, or *modality*, the stimulus is held in its original form in a short-term sensory store (STSS) for that modality. These stores are preattentive, meaning that if a stimulus arrives while attention is focused elsewhere, its representation will be prolonged for a short period of time until attentional resources are available for further processing by progressively higher centers of the nervous system. The stimulus is said to be perceived or recognized as it is compared to existing knowledge in long-term and working memory in order to assign the physical stimulus to a perceptual category. Once categorized, a decision of what to do with the stimulus must be made. If the decision

requires that a response be executed, then a sequence of steps is summoned to initiate that response. Once the response has been executed, the consequences of that response will be monitored forming the closed-loop feedback structure depicted in Figure 2.1. If, however, the decision is made to commit the information to memory, the information flow is directed to the memory structure (Wickens, 1992).

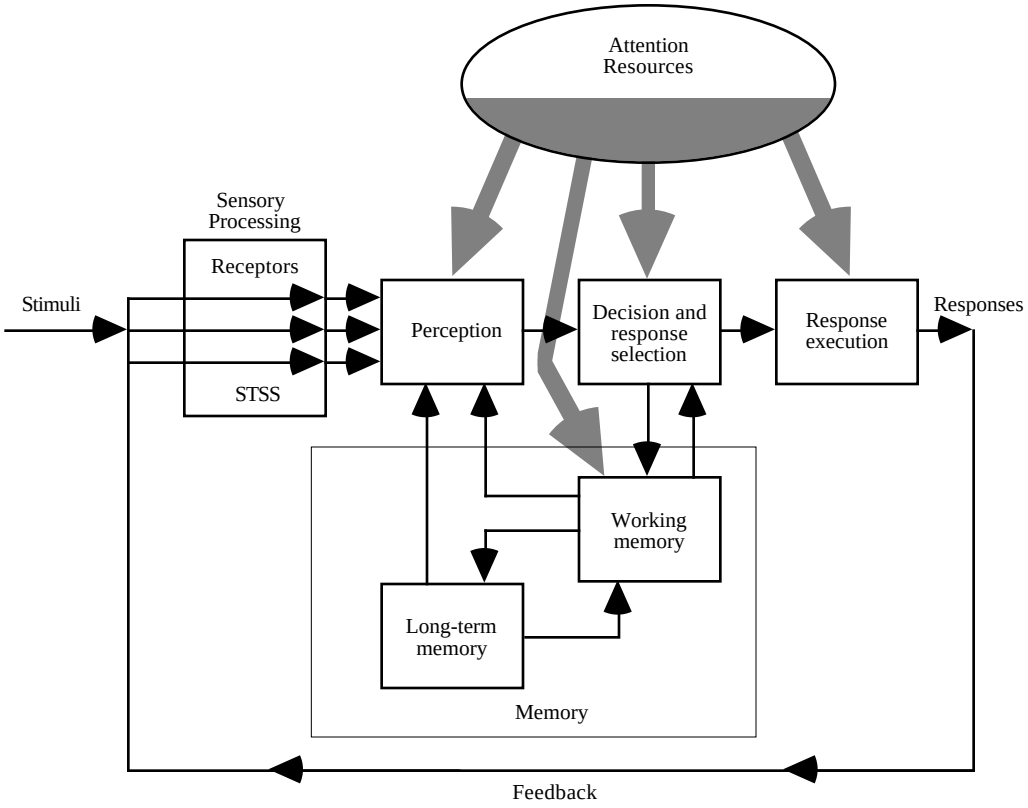

Figure 2.1. A model of human information processing showing the major processes, or stages, and the interrelationships. (Source: Wickens, 1992; Figure 1.3.)

As Figure 2.1 illustrates, attention is required for much of the processing that occurs after the STSS. In this context, Wickens (1992) noted that attention can be though of as both a searchlight that selects sources of information to process and as a resource of limited availability, as shown at the top of the Figure. If some processes require more of this limited resource, less is available for other processes, whose performance will deteriorate as a result (Wickens, 1992).

The only way to encode and transfer information from sensory storage to working memory and to maintain information in working memory is by rehearsal, which requires that attentional resources be directed to the process (Sanders & McCormick, 1987). However, even with rehearsal, information in working memory can decay over time. Information in working memory is transferred to long-term memory by supplying meaning to the information and relating it to information already stored in long-term memory (i.e., semantically encoding it).

Information in working memory is thought to involve three types of codes: visual, phonetic, and semantic. Visual and phonetic codes are visual or auditory representations of stimuli; semantic codes are abstract representations of the meaning of a stimulus and are especially important in long-term memory. Although there is a natural progression of coding from the physical codes (visual and phonetic) to semantic codes, there is evidence that all three codes for a particular stimulus can exist, at some level of strength, at the same time in working memory (Sanders & McCormick, 1987).

2.1.2 Levels of processing framework. Until the early 1970s, models of human memory had been dominated by the concept of memory stores and the transfer of information among them. Although these multistore theories of memory have their utility, Craik and Lockhart (1972) suggested that rather than concentrating on a structural view of memory, it would be more beneficial to concentrate on the processes that contribute to remembering. In the levels of processing framework, Craik and Lockhart endorsed the view that the cognitive system is organized hierarchically and that incoming stimuli are processed to different levels of analysis, such that the products of early (i.e., shallow) sensory analyses serving as the input to later (i.e., deeper) semantic analyses. In general, it was believed that deeper analyses required more attentional resources unless the stimuli are expected or are very common, such as the person's own name.

Craik and Lockhart's (1972) levels of processing framework retained the concept of a short-term or "primary memory" that is separate from long-term memory. This primary memory is similar to the "working memory" presented earlier in the Wickens (1992) model. In Craik and Lockhart's view, however, the rehearsal which takes place in working memory could usefully be broken down into two main types: Type I processing (or maintenance rehearsal), which involves maintained processing at the same level of analysis, and Type II processing (or elaborative rehearsal), which involves deeper or more extensive processing of the stimulus. According to this view, if memory performance is a function of the deepest level of analysis achieved, only the second type of rehearsal should lead to an improvement in memory.

Although the levels of processing framework has gained considerable popularity since its introduction, it has not been without its critics (Baddeley, 1978; Eysenck, 1978; Nelson, 1977). Lockhart and Craik (1990) note that the most persistent criticisms of levels of processing have been the lack of an independent index of depth and the subsequent threat of circular reasoning. Critics claim that without an independent index of depth the logic is circular, in that depth must be defined in terms of its alleged effects. For example, the framework postulates that deeper processing is associated with long-lasting memory traces; however, in the absence of an independent index of depth, there is a tendency to conclude that well-remembered events must therefore have been deeply processed. Nelson (1977) claimed that such circularity makes levels of processing unfalsifiable and thus scientifically meaningless. Lockhart and Craik contended that the accusation of circularity is, at most, only partially justified. They noted that the distinction of qualitatively different domains of processing, such as semantic versus phonemic, can be made independently of any effects such processing might have on memory performance and that the hypothesis that processing to a semantic level yields better free recall than processing to a phonemic level is quite falsifiable.

2.1.3 Processing level assessment. Although no formal mechanisms exist to assess the level at which information is processed, a sizable body of researchers and theorists adhere to views related to levels of processing (Hannafin & Rieber, 1989a). As mentioned, the major prediction from the levels of processing approach -- that retention should be a positive function of processing depth -- has proven to be rather difficult to test due to the absence of an independent

index of depth. However, Eysenck and Eysenck (1979) believe it is possible that processing depth is related to processing effort. If so, a number of measures of processing effort exist which might reflect the depth at which something is processed.

For instance, a secondary task technique to measure spare capacity might effectively be used as behavioral indices of effort. The rationale for such a method is that the more cognitive capacity being used for a primary task, the less that is available for a secondary task and the slower the reaction will be to the secondary stimulus (Kahneman, 1973; Wickens, 1992). The measurement of cognitive capacity engagement using response-latency is relatively straightforward: As the primary task (e.g., answering an embedded question) is taking place, an auditory signal (probe) occurs and the reaction-time to the signal (secondary-task) is measured (Posner & Boies, 1971). Although it is possible that the use of the secondary-task technique may interfere with and disrupt performance of the primary task (Wickens, 1992), this obtrusiveness should not be a major issue in the current study as the primary task is non-critical (such as driving or flying) and the amount of disruption suffered by the primary task would be identical across experimental conditions.

In addition, subjective ratings of task difficulty represent perhaps the most acceptable measure of workload from the perspective of the actual system user who is typically comfortable with simply stating or ranking the subjective feelings of "effort" or attentional demands encountered in performing a given task or set of tasks (Eggemeier, 1981; Moray, 1982; Reid, Shingledecker & Eggemeier, 1981). In fact, some have argued that subjective measures come the nearest to tapping the essence of mental workload (Sheridan, 1980). It is important, however, to know how accurately one can assess the demands imposed upon his limited resources, what the dimensions underlying his ratings might be, and how these are scaled.

The benefits of subjective techniques are apparent. They are relatively easy to derive and they do not disrupt primary-task performance. Their costs relate to the uncertainty with which one's verbal statement truly reflects the availability of or demand for processing resources. Thus, subjective measures of workload seem well suited to assess varying levels of effort expended on embedded questions in an interactive video environment.

Given the benefits of the quantitative reaction-time measure, and the relative ease of incorporating a subjective measure of mental effort, a combination of the aforementioned methods were used in the current study.

2.2 Learning From Media

The shift in paradigm from behavioral oriented to more cognitive based theories of learning and memory can also be seen in research concerning instructional media (Clark & Salomon, 1986). Until around the mid-1970s, media comparison studies dominated the research journals under the behavioral paradigm, emphasizing the comparison of traditional media such as classroom instruction with newer media such as television. With the shift toward the more cognitive paradigm, however, media comparison issues have slowly been discarded in favor of identifying how the critical attributes of media interact with cognitive processes to influence learning (Clark & Sugrue, 1989). In their summary of instructional media research, Clark and Sugrue (1989) concluded that the learning that occurs from well-constructed media presentations is due to three types of variables: (a) learning task type, (b) individual learner traits, and (c) instructional method. They contended that over the next decade, instructional technology research would benefit from a focus on the interactions between these variables.

The ability to present highly engaging instructional material across a myriad of applications contributes to CBIV's potential in educational settings; however, no firm conclusions regarding its efficacy as a medium of instruction have been drawn (Bosco, 1986; McNeil & Nelson, 1991; Smith, 1987). Hannafin (1985) noted that the face validity of interactive video appears to have preempted the developmental research needed to empirically validate the instructional effectiveness of the technology itself. Schaffer and Hannafin (1986) suggested that research related to the two technologies which comprise CBIV, computer-assisted instruction (CAI) and video-based instruction, may provide some insights into the instructional effectiveness of interactive video.

2.2.1 Learning from video. In general, research in video-based instruction has proven video to be an effective tool for enriching the learning environment. For example, children's informal learning from instructional television has, in large part, been attributed to the en-route comprehensibility of the content (Anderson & Lorch, 1983), as well as the ability of the learner to selectively attend to and process certain types of information (Calvert, Huston, Watkins, & Wright, 1982; Lorch, Anderson, & Levin, 1979).

Although some researchers would argue that such screen-based instruction is largely a reactive or passive learning experience (Bandura, 1977; Lesser, 1977), Schaffer and Hannafin (1986) suggested that instructional procedures which direct attention to the intended information might help to reduce such passivity and improve comprehension. Such a direction of effort, it is suggested, might be accomplished by embedding questions in interactive video, which could potentially increase learner involvement with instruction. This would require learners to invest greater mental effort, thereby ensuring spontaneous, en-route learning of video instruction (Hannafin, Garhart, Rieber, & Phillips, 1985).

2.2.2 Learning from computer-based instruction. The results of studies investigating the effects of computer-based instruction are predominantly positive with regards to achievement gains and attitudes toward the learning process (Martorella, 1989). In their meta-analysis of 42 controlled evaluations of computer-based education (CBE), Bangert-Drowns, Kulik and Kulik (1985) found CBE to have generally positive effects on achievement and attitudes of junior and senior high school students, with some of the more notable effects occurring in studies focusing on disadvantaged students.

Computer-based instruction (CBI) offers several benefits as an instructional medium. Users are able to proceed at their own pace, becoming actively involved in the experience, making it nearly impossible for the student to become a passive element in the learning process (Farrell, 1991). In fact, it is this very activity and involvement that is said to facilitate learning (Chambers and Sprecher, 1980). Students can study tutorial sections to gain an understanding of facts and concepts, or engage in drill-and-practice activities which can develop and sharpen skills. Furthermore, students using CBI are able to take part in simulations allowing them to explore complex situations and receive immediate feedback, improving the reinforcement of learning (Farrell, 1991).

Although CBI can be an effective and efficient medium for tutorial and drill-and-practice activities, its lack of video and audio capabilities severely limits "its ability to simulate events that elicit performance and provide informative feedback in terms of the real world experiences of learners" (Reeves, 1986, p. 105). It is at this point that the benefits of a complimentary marriage between CBI and instructional video become evident.

2.2.3 Learning from interactive video. Computer-based interactive video (CBIV) is a relatively new instructional technology that many believe holds great promise for improving the

effectiveness of instruction and learning (Chen, 1990; Evans, 1986; Hannafin, 1985; Seal-Wanner, 1988; Smith, 1987). Although there seems to be no agreed upon definition of interactive video, it is generally the combination of computer control with some form of video -- be it via tape-based, Laserdisc, Compact-Disc Interactive (CD-I), or Digital Video Interactive (DVI) -- in which the sequence and selection of video segments are determined by user response.

Much of the excitement regarding CBIV centers upon the interactive capability of the computer in concert with the unique properties video presentation offers. It is thought that the combination of such capabilities might help overcome the individual limitations inherent to CBI and instructional video (Chen, 1990). Indeed, CBIV seems to be a complementary union of these two useful technologies, with the strengths of one medium offsetting the limitations of the other. For example, realistic depictions, the ability to represent motion, and the provision for high quality audio are clearly video's principal strengths; however, an inflexible linear presentation and an inability to effectively engage the learner as an active element in learning severely limit it as an instructional medium. On the other hand, although typically limited by a lack of realism and dramatic power, computers can offer non-linear flexibility, varying levels of control and adaptability, and the ability to engage the learner in the learning process.

CBIV enables the creation of learning environments that can actively engage the learner, allowing them to take control of their own instruction. Add to this environment the ability to manipulate high-resolution images and full-motion video, as well as adapt to learner characteristics and you have an extremely potent source of learner empowerment. In addition, Jost (1992) noted that the combination of characteristics that CBIV offers enables the teaching of higher order concepts, principles, procedures, and motor skills, as well as instruction dealing with attitudinal issues.

Furthermore, CBIV is able to provide the additional advantage of magnifying "live" demonstrations, allowing users to pause, rewind or replay events in slow motion, and even zoom-in for detailed close-ups, all of which could aid students in internalizing complex skills and ideas (Jost, 1992). Ehrmann (1990) further contended that CBIV can offer applications in a variety of contexts to aid in the transfer of skills to multiple situations, providing students with an environment in which they are able to think at their own pace and can reflect upon their own learning.

2.3 Interactivity

In an effort to develop a useful framework in which to conduct empirical research on interactive video, Hannafin (1985) suggested a number of propositions for empirical investigation. Many of these propositions focused on the widely held premise that the greater the level of interactivity involved in the instruction, the greater the benefit to learning. Researchers generally believe that the more mentally active learners are as they process information from instructional materials, the more likely they are to generate meaning from those materials (Jonassen, 1985b). More specifically, it is thought that "where the learner reacts to or interacts with the criterial stimulus, learning is facilitated, and that facilitation increases with the degree of learner activity or involvement" (Fleming & Levie, 1978, p. 138).

Jost (1992) noted that the nature of the interaction between learner and medium can be viewed in terms of the task involved, the level of processing required in completing the task, and the context in which the instructional program will be used. In designing programs for CBIV, Jost suggested that the interactive and adaptive capabilities of the medium be exploited to mentally

engage the learner by providing activities that promote the construction of the learner's own understanding, rather than merely presenting information to be absorbed.

Based on the premise that increased interaction with instructional materials produces greater learning, Schaffer and Hannafin (1986) investigated the effects of four progressively enhanced levels of interactivity on learning from interactive video. The study compared students' recall and comprehension after video instruction with increasingly interactive exercises. The *video-only* condition involved a 13.5 minute, fixed-rate linear video tape presentation on the production of TV graphic special effects. At five points during the same video presentation, the *video-plus-questions* condition embedded three questions pertaining to the factual and thematic content of the video. The *video-plus-questions-plus-feedback* condition added feedback regarding the accuracy of the learner responses to the embedded questions, as well as the correct choice for incorrect student responses. Finally, the *fully-interactive* condition also added video branching to repeat video segments for which accurate learning was not demonstrated. This video branching was repeated until correct responses were made by the student. As expected, recall was significantly affected by the amount and type of interactivity provided, such that progressively interactive video instruction yielded increasingly greater learning, with subjects in the fully-interactive condition yielding the greatest recall of all experimental groups.

Based on the findings of this study, an improvement in learning may be expected in proportion to the amount and type of interactivity provided. Consistent with research in video-based instruction (Calvert et al., 1982; Lorch, Anderson, & Levin, 1979), interactive video appears to effectively focus attention on intended learning by isolating important information, querying learners, and in the case of the Schaffer and Hannafin (1986) study, providing feedback and remediation as needed.

Exactly what is interactivity, and how is it measured? Hannafin (1989) established a crucial distinction between quantitative and qualitative interaction with emerging technologies. Quantitative measures merely provide evidence that interaction has taken place and emphasize the rate at which students interact with the computer, rather than whether the learner has processed the information at any depth. Alternatively, qualitative measures of interaction focus on how effective interaction engages the learner. The emphasis in this case is placed on the learner as an active processor of information. In this qualitative view, the extent to which the learner engages in deep processing is of greater importance than the rate of response. Hannafin further noted that such engagement is influenced by a number of factors, including the nature of the presentation, the processing requirements of the task, and consequences of the response.

2.3.1 Embedded questions. A number of researchers have investigated the role of questions in facilitating information processing. Based on reviews of this research (Anderson, 1970; Bull, 1973; Frase, 1970; Gall, 1970; Kumar, 1971; Ladas, 1973), Wager and Wager (1985) concluded that questions serve three general functions in the learning process: (a) to establish and maintain attention, (b) to facilitate the encoding of information, and (c) to provide for rehearsal. Questioning techniques, such as embedded questions, influence the quality of cognitive engagement and the subsequent strength of encoding (Wager & Wager, 1985), with high-level questions, such as those requiring inferences or conclusions, being more likely to deepen cognitive processing and enhance retention than low-level questions, such as those asking for purely factual information (Hannafin & Rieber, 1989a).

In general, depth is thought to increase as new information is directly compared with and contrasted to prior knowledge. Increased depth of processing can be facilitated by requiring learners to make elaborations on material, inducing cognitive dissonance, and other manipulations

that encourage direct comparison with prior knowledge (Hannafin & Rieber, 1989a). For example, the use of embedded questions strategically distributed throughout instruction can promote deeper learning by eliciting high levels of association with prior knowledge, especially when inferences, opinions, or conclusions are requested of the user (Hannafin & Rieber, 1989a). Such use of elaborative embedded questioning supports Hannafin's (1989) definition of qualitative interaction, which emphasizes the cognitive activity involved in effective instruction.

Hannafin and Carney (1991) investigated the effects of elaboration strategies (behavioral vs. cognitive) on both learning outcomes and depth of processing during computer-based instruction. Behavioral review strategies involve imposed methods of elaboration that elicit desired responses, typically improving learning by establishing explicit cues that help strengthen relationships among content contained within the lesson. Conversely, those instructional strategies based in the cognitive domain are presumed to increase the depth at which lesson information is processed, improving the quantity and quality of encoded knowledge (Hannafin & Rieber, 1989b). This strategy emphasizes methods designed to relate lesson content to the existing knowledge within individual learners. These cognitive methods induce learners to identify known events that relate to lesson content conceptually, procedurally, or chronologically, and to generate elaborations that strengthen the relationships between new and previously existing knowledge.

As predicted, Hannafin and Carney (1991) found that those subjects in the cognitive review strategy condition yielded significantly greater personal elaboration, whereas those in the behavioral strategy condition elicited greater contextual elaboration, although posttest achievement was largely unaffected by the different review strategies. Though different strategies may inherently increase the quantity of elaborations, as was the case in this study, the different nature of the question-induced elaborations suggests that quality can be influenced as well. Simply increasing responses is unlikely to improve learning in the absence of deeper understanding. On the other hand, strategies that encourage additional processing without reference to how new knowledge can be associated with existing knowledge are likely to prove equally ineffective. It is important that elaborations support the meaningful integration of new knowledge within existing knowledge. To do so, learners need to acquire or be provided methods with which to assimilate new knowledge.

Effective instructional transactions "require a student response based upon the information, events, or processes depicted via technology and the appropriate cognitive restructuring associated with the transaction" (Hannafin, 1989, pp. 172-173). Embedded questions that require elaboration on the part of the learner facilitate the integration of the new knowledge with existing knowledge. As this new information is assimilated, a cognitive restructuring is said to occur. Elaborations are defined by Hooper and Hannafin (1991) as additional information available during encoding that is either elicited through instruction or spontaneously invoked by students. An issue for instructional designers is whether to impose, induce, or simply allow learners to create their own elaborations.

Imposed elaboration strategies generally involve explicit elaboration activities thought to be effective for remembering lesson information and offer increased precision when teaching unfamiliar concepts. Unfortunately, imposed elaborations are inherently limited by their inability to ensure meaningful associations across diverse learners. Alternatively, induced elaborations tend to be nonspecific and are generally integrative in nature. Although they are still purposefully embedded by the designer, they cause learners to generate elaborations that are based upon their own individual cognitive structures.

Reder, Charney, and Morgan (1986) suggested that both designer and learner-generated elaborations facilitate performance. Others, however, contend that induced, learner-generated

elaborations are often most effective (McFarland, Frey, & Rhodes, 1980). Learner-generated elaborations may result in deeper processing due to the considerable mental effort required to generate suitable elaborations while remaining sufficiently nonspecific to avoid interference with intact cognitive structures (McFarland, Frey, & Rhodes, 1980).

Instructional technologies such as CBIV can facilitate the process of generating personally relevant elaborations. Students may be asked to generate hypotheses and supporting rationales during a lesson or to associate to-be-learned information with individually relevant, familiar events, and to enter their responses into the computer. Inducing individuals to make predictions or to recall a personal experience in which certain concepts apply capitalizes on the uniqueness of individually assigned meaning.

2.4 Locus of Control

Research on interactive video should focus on those attributes that can maximize the effectiveness of the medium and on the interaction of those attributes with different learner characteristics across various applications (Evans, 1986) . Due to its strong relationship with motivation and learning, this research will investigate the interaction of the learner characteristic of LOC orientation with different types of adjunct questions embedded in interactive video instruction.

LOC has been defined as the degree to which people believe themselves to be in control of their own fates. Specifically, an internal LOC orientation denotes a self-perception that one's own efforts lead directly to desired reinforcers. Conversely, an external orientation refers to the personal belief that one's reinforcers are dispensed by chance, luck, or powerful others (Rotter, 1966). Individuals can be viewed as distributed along a continuum of LOC according to their self-perceptions.

Internality has consistently been shown to increase with age (Nowicki & Strickland, 1973), continuing through adolescence into adulthood. It is speculated that this developmental change in LOC reflects children's growing independence from parental dominance and increased exploration of the environment, both of which serve to heighten awareness that they are increasingly responsible for the reinforcement they receive (Gilmor, 1978).

An individual's LOC orientation is believed to affect his or her motivation and ability to learn (Goldstein, 1993). Since internally oriented individuals perceive feedback and reinforcement as a function of their own actions or characteristics, they are more likely to exhibit high levels of motivation to learn in a training program because they are more likely to accept feedback and take action to correct performance problems (Noe & Schmitt, 1986). Conversely, an externally oriented individual's perceived lack of power to control reinforcement would lead to the belief that such reinforcements are a function of external agents such as fate, luck, chance, or powerful others (Gilmor, 1978), destroying the individual's motivation to learn.

Internals have also been shown to exhibit more effective coping behaviors in the environment than externals. In his review of research concerning LOC, Phares (1976) concluded that individuals with an internal LOC orientation attain this greater mastery of coping partly as a function of their more active and efficient attempts to process and retain information. Consistent with this conclusion, early investigations revealed that hospital patients (Seeman & Evans, 1962) and prison inmates (Seeman, 1963) with an internal LOC orientation acquired and retained more information relevant to their current and future status than did externally oriented individuals. In addition, college students with an internal LOC orientation have been found to seek more

information (Davis & Phares, 1967), to organize information more efficiently (Phares, 1968), and to excel in inferring rules that aid in problem solution (DuCette & Wolk, 1973). Furthermore, research that has more directly addressed memory differences has suggested that internals recall more than externals on some tasks requiring memory of relevant information (Wolk & DuCette, 1974).

Due to the differing sets of expectations, perceptions, and levels of motivation held by individuals with different LOC orientations, it is further thought that internals and externals might actually process information differently, with externals encoding stimuli more superficially than internals. A study conducted by Thal et al. (1983) examined the relationship between LOC and memory performance from the perspective of a levels of processing memory paradigm. The study assigned 153 sixth-grade students to one of four processing conditions and instructed them to encode a word list semantically, acoustically, orthographically, or idiosyncratically (i.e., any way they wished) and to retain the list for a later recognition test. The study hypothesized that children's recognition memory would vary as a function of LOC orientation and the type of processing employed during learning. Subject's LOC was hypothesized to mediate encoding activities employed when allowed to encode as they wish, such that internals were expected to engage in deeper levels of analysis and externals were expected to engage in shallower levels of analysis. No differences between groups were expected under the obligatory encoding conditions.

After completing an intentional-learning task, the number of target words recognized on a subsequent memory task was used to identify absolute memory differences among subject groups as well as encoding effects across all groups. Subjects' false recognition data were examined for preponderances of each of four distractor types: semantic (synonyms), acoustic (rhyming words), orthographic (look-alike words), and neutral (unrelated words) distractors. These distractor choices were hypothesized to reflect previous encoding activity and thereby serve as an index of depth of processing.

Results of the study support the contention that externals encode stimuli in more superficial ways than internals. Furthermore, encoding conditions were shown to have a marked effect on retention such that those receiving semantic instructions retained significantly more list items than those receiving either orthographic instructions or idiosyncratic instructions, with the lowest retention observed for subjects receiving acoustic instructions. The researchers note that this pattern was generally consistent with expectations and with the depth of processing viewpoint. Finally, as expected, false distractor choices appeared to reflect the level at which stimulus words were encoded.

In designing CBIV, several issues must be taken into account. An issue of primary concern is how user characteristics interact with the critical attributes of the instructional media and the effect that interaction has on meaningful learning (Evans, 1986). Traits such as motivation (Tennyson & Rothen, 1979), field dependence and independence (Couch, 1990), and prior knowledge of a topic area (Gay, 1986), have all been shown to impact the effectiveness of computer-based instruction. Based on the literature, it is likely that LOC orientation and the associated differences in learning strategies employed would impact the effectiveness of learning from computer-based interactive video instruction.

A number of instruments have been created to measure the construct LOC. Based on several reviews of the extensive literature on LOC and its measurement (Gilmor, 1978; Kendall, Finch, Little, Chirico, & Ollendick, 1978; MacDonald, 1973), the Children's Nowicki-Strickland Internal-External Locus of Control Scale (CNS-IE) (Nowicki & Strickland, 1973) was selected to

determine measures of LOC orientation in the current study, due to the instrument's outstanding reliability and validity.

2.5 Theoretical Model

The content of the multimedia application program used in the current study was targeted for adolescents in grades 7, 8, and 9, and was based on the Multi-Component Motivational Stages (McMOS) model -- a multi-element, integrative theoretical framework for the development of prevention strategies and content which are matched to the developmental stages of drug use among youth (Werch, Anzalone, Castellon-Vogel, Carlson, Brokiewicz, & Felker, 1995). This age group was specified by the National Institute on Alcohol Abuse and Alcoholism contract under which the multimedia program was created.

The stages are theorized to be discrete steps in the process of all intentional behavior change. Specifically, the McMOS framework describes two continua of stages: the stages of habit acquisition and the stages of habit change (Werch & DiClemente, 1994).

The five developmental stages of drug use habit acquisition posited within the McMOS model are (Werch and DiClemente, 1994):

1. *precontemplation* - not considering use
2. *contemplation* - seriously thinking of initiating use
3. *preparation* - intending to use in the near future
4. *action* - initiating actual use
5. *maintenance* - continuing use.

The five stages of drug use habit change within the McMOS model entail (Werch and DiClemente, 1994):

1. *precontemplation* - not considering stopping use
2. *contemplation* - seriously thinking about stopping use
3. *preparation* - intending to stop use in the near future
4. *action* - making attempts to stop use
5. *maintenance* - continuing nonuse.

An underlying assumption of the stage model is that different learning and motivational processes are needed, depending upon the youth's stage of change. The utility of employing a theoretical approach founded upon a stage model lies in the ability to match prevention strategies and content to each adolescent's developmental stage of drug use. Intervention delivery channels, techniques, and messages could therefore be responsive to the stage of readiness of the individual, whether it be habit acquisition or habit change.

2.6 Purpose

The domain of instruction for the current study is alcohol education for adolescents. Unlike computer-based instruction and interactive video on topics such as math or science which focus primarily on knowledge gain within a particular subject domain, alcohol education places additional emphasis on attitude and behavioral change. Although computer-based interactive video (CBIV) seems inherently beneficial due to its flexibility and combination of effective instructional media, it may or may not be appropriate for all content areas and varying types of learning tasks (Hannafin, 1985). It is therefore imperative that the conduct of future empirical investigations focus on the attributes that make this particular instructional medium uniquely beneficial, as well as the interaction of those attributes with different learner characteristics across various applications. Therefore, the purpose of this research is to investigate the effects of embedded question type and LOC orientation on processing depth and changes in knowledge and attitude regarding alcohol.

2.7 Research Hypotheses

Hypothesis 1: Embedded questions will have a generally facilitative effect as evidenced by significantly greater positive changes in attitude constructs and knowledge gain for groups receiving interactive video with embedded questions as compared to a control group receiving interactive video only (i.e., no questions group).

Hypothesis 2: Positive changes in knowledge gain and attitude constructs will be significantly greater for participants receiving inference questions as compared to those receiving factual questions.

Hypothesis 3: Subjective mental effort ratings will be significantly higher for participants in the inference questions condition as compared to mental effort ratings in the factual question condition. It is expected that reaction-times will be positively correlated with the mental effort ratings; therefore, a similar significant increase in reaction-time for subjects in the inference questions condition is expected.

Hypothesis 4: Subjective mental effort ratings will be significantly higher when participants receive personally relevant questions as compared to when they receive generally relevant questions. Again, it is expected that reaction-times will be positively correlated with mental effort ratings, such that reaction-times will be greater when subjects are answering personally relevant questions as compared to when they are responding to generally relevant questions.

Hypothesis 5: Greater positive changes in knowledge gain and attitude constructs will be seen for participants who have an internal locus of control orientation as compared to those who are externally oriented.

Hypothesis 6: Subjective mental effort ratings will be higher for participants who have an internal locus of control orientation as compared to those who are externally oriented. It is expected that reaction-times will be positively correlated with the mental effort ratings, showing a significant increase in reaction-time for participants with an internal locus of control orientation.

CHAPTER 3

METHOD

3.1 Application Development

The following describes development work on an alcohol prevention program for adolescents entitled *Interactive Multimedia for the Promotion of Alcohol Awareness and Resistance Training - version 1.0©* which will be referred to hereinafter by its acronym, *IMPART 1.0©*. This development work was performed by the author under Phase I SBIR Contract N43AA42010 at the American Research Corporation of Virginia (ARCOVA), Radford, Virginia, for the National Institute on Alcohol Abuse and Alcoholism, Public Health Service, Department of Health and Human Services, Rockville, Maryland. The majority of the author's responsibilities during development of *IMPART 1.0©* took place during Technical Objective 2 of the contract and included: recruitment, auditioning and hiring of talent; direction of talent and film unit; set design and construction; primary videographer; primary video editor; sole multimedia developer and interface designer.

The primary goal of the Phase I research program was to establish the feasibility of interactive multimedia as an effective delivery medium for alcohol education targeted for adolescents in grades 7, 8, and 9. Technical Objective 1 of the contract entailed the development of a comprehensive alcohol education program based on the Multi-Component Motivational Stages (McMOS) model (Werch, Anzalone, Castellon-Vogel, Carlson, Brokiewicz, & Felker, 1995).

Under Technical Objective 2 of the contract, the alcohol prevention curricula developed under Technical Objective 1 was produced into five modules of multimedia instruction which corresponded to the following learning strategies: (a) information about the health and social consequences of drinking; (b) information about alcohol-related misconceptions and social norms; (c) information about specific avoidance actions, mastery of social resistance, and modeling of specific steps to avoid alcohol; (d) peer testimonial about the negative effects of drinking; and (e) training in completing written contracts with clear goals to increase alcohol avoidance behavior.

Further efforts to commercialize the alcohol education program resulted in modifications to the *IMPART 1.0©* application which was updated to *IMPART 1.1©* to run from a CD-ROM under the Macintosh, Windows 3.1, and Windows 95 operating systems. As the current dissertation effort was only concerned with the first and third modules of *IMPART 1.1© (You Make The Decision* and *How To Refuse Alcohol* respectively*)*, an experimental version of the application, entitled *IMPART 1.2©* (see Appendix A), was created to include only that information contained in

modules 1 and 3 of *IMPART 1.1©*, as well as additional data collection mechanics needed for this study.

Module 3 of *IMPART 1.1© (How To Refuse Alcohol)* was divided into two separate modules in *IMPART 1.2©*, the first of which is an introductory section entitled *Tutorial* that includes a number of text and graphic frames introducing effective methods of avoiding and refusing alcohol (see Appendix B). The second module in *IMPART 1.2©*, entitled *Drill & Practice*, includes video examples depicting effective and ineffective methods of refusing alcohol, as well as six short video vignettes presenting a variety of situations where alcohol is offered and refused by adolescents (see Appendix C). Subjects are asked to view each vignette and then rate the effectiveness of the refusal used in that vignette.

The information and video footage contained in Module 1 of *IMPART 1.1© (You Make The Decision)* comprises the third and final *IMPART 1.2©* module, entitled *Interactive Story*. This final module involves a "choose your own adventure" type story which enables the user to make choices for the primary character, and to see the consequences of those choices (see Appendix D).

3.1.1 Embedded question-item development. A pool of 30 question items (15 factual and 15 inference) was created for use as embedded questions in the study. Of these, a total of 10 factual questions (see Appendix F) and 10 inference questions (see Appendix G) were selected for use in the prestudy. Based on mental effort rating scale data obtained during the prestudy, those questions identified as outliers for their respective category were modified or replaced and subsequently retested to determine their inclusion in the primary study. These question items were written at approximately the seventh grade reading level as verified by application of the Flesch-Kincaid readability formula component within Microsoft Word version 6.0.1 for the Macintosh Operating System.

3.1.2 Reaction-time delay development. It was crucial that the secondary-task probe occur at the appropriate moment, when the subjects were certain to be processing the embedded question, rather than still reading the question from the screen or already retrieving their answer from working memory. Based on the model of human information processing (Wickens, 1992), it was reasoned that the optimal moment for the probe to occur was shortly after the subject had finished reading the embedded question. As each of the embedded questions varied in length, it was impossible to select a single set time for the probe to occur after a question had appeared on the screen. Instead, a 12-year old female volunteer was timed with a stopwatch while reading the questions silently, and then aloud, to determine approximately how much time would be required to read each of the embedded questions. This procedure was then repeated using a 16-year old female volunteer. It was determined that, on average, it took approximately one second to read three words (approximately .33 seconds per word). Based on this rough formula, the time-delay for each embedded question to be displayed on the screen before the secondary-task probe sounded was determined and programmed into the test application for the prestudy.

3.2 Prestudy

The purpose of the prestudy was twofold. First, the prestudy served as a dry run for the primary study, providing the opportunity to discover and solve problems in materials, apparatus and procedure. The second purpose of the prestudy was to ascertain whether the inference questions elicited deeper processing than factual questions as determined by subjective mental effort rating scale data as an indicator of cognitive engagement.

One 15 year-old male and one 14 year-old female participated in the prestudy. The male subject was assigned to the inference-question condition and the female subject was assigned to the factual-question condition. Participants were drawn from the same general population of adolescents as the primary study. In general, the prestudy was identical to the primary study in terms of the task, apparatus, and procedure that will be described later. Results from these subjects indicated an apparent difference on the measure of mental effort rating between the two question types. The subject in the inference condition generally rated the questions as requiring a lot of thought to answer ("4" and "5" on the 5-point Likert-type scale), whereas the subject in the factual condition consistently rated that "no thought" or "very little thought" was required in answering the questions ("1" and "2" on the scale, respectively). Based on these same data, outlier cutoff points were determined to identify any factual questions requiring inordinately high levels of processing and any inference questions eliciting inordinately low levels of processing. Two of the inference questions received low mental effort ratings ("1" and "2" on the scale), and were later modified and retested with another participant.

3.3 Experimental Design

This study employed a randomized between-subjects pretest-posttest control-group design (see Figure 2a) involving three levels of question condition (no questions/control group vs. factual questions vs. inference questions). This design was used to investigate whether the presence of different types of embedded questions produces an overall facilitative or interfering effect on either attitude change or knowledge gain as a function of processing depth. In addition, the inference question condition involved two levels of question relevance (general vs. personal). This within-group comparison was intended to determine whether questions that ask for personally relevant inferences elicit greater depth of processing than questions requiring a general inference to be made.

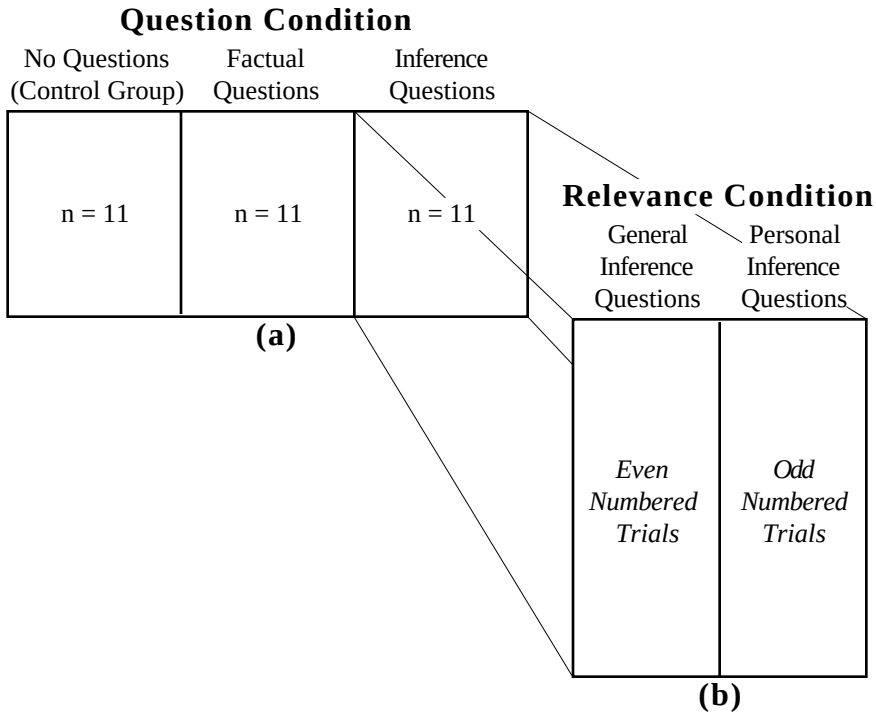

Figure 3.1. Experimental design used in this study.
(a) Between-subjects pretest-posttest control-group design.
(b) Within-subjects design extraction.

3.4 Dependent Measures Overview

The dependent measures used in this study include: average mental effort rating, average baseline reaction-time, average reaction-time, attitude construct differentials, knowledge construct differentials, and response accuracy count.

3.4.1 Average mental effort ratings. Average mental effort rating was obtained by computing the mean across all mental effort rating trials for each subject. There were ten such trials per each subject in either of the two embedded question conditions.

3.4.2 Average baseline reaction-time measures. Average baseline reaction-time was obtained by computing the mean across all baseline reaction-time trials for each subject. There were four such trials distributed throughout the *Tutorial* and *Drill & Practice* modules (two per module) for each subject in the study. Baseline reaction-time trials for subjects in the control group (no-questions) occurred at the same point in the instruction as trials in the embedded question conditions. Baseline reaction-time was collected for use in between- and within-group baseline comparison analyses.

3.4.3 Average reaction-time measures. Average reaction-time was obtained by computing the mean across all reaction-time trials for each subject. There were four such trials distributed throughout the *Interactive Story* module for each subject in the study. Reaction-time trials for subjects in the control group (no-questions) occurred at the same point in the instruction

as trials in the embedded question conditions and were collected for use in between-group baseline comparison analyses.

3.4.4 Attitude construct differentials. Change in alcohol-related attitudes was calculated by subtracting pretest construct scores obtained on a modified version of the Youth Alcohol & Drug Survey (YADS) from construct scores on the posttest administration of the same survey. These attitude constructs are as follows:

EXP_BEL	Change in expectancy beliefs about the effects of alcohol
SELF_EFF	Change in resistance self-efficacy
PERCSUS	Change in perceived susceptibility to alcohol-related health consequences
PERCSEV	Change in perceived severity of alcohol-related health consequences
BENEFIT	Change in perceived benefits to avoiding alcohol
COMP_YADS	Change in composite attitude score

The YADS is scored such that a higher score indicates greater risk for alcohol and drug abuse (see Appendix I). For the purpose of greater readability in deciphering the results of this study, all resultant attitude construct differential scores have been multiplied by negative one (-1), resulting in positive differential scores for desirable changes and negative differential scores for undesirable changes.

3.4.5 Knowledge construct differentials. Change in knowledge regarding alcohol was calculated by subtracting individual knowledge construct scores obtained on the Alcohol Knowledge Questionnaire (AKQ) pretest from construct scores on the posttest administration of this measure (see Appendix J). These knowledge constructs are as follows:

RECOG	Change in recognition component of knowledge survey
RECALL	Change in recall component of knowledge survey
COMP_AKQ	Change in composite knowledge score

3.4.6 Response accuracy count. A final answer key was constructed to judge the relative accuracy of responses given to each of the embedded questions (see Appendices F and G). This measure was collected as a check for consistent effort across embedded question conditions, and to shed light on any unexpected findings which might be attributed to other factors.

3.5 Participants

Thirty-three adolescents (18 males and 15 females), ages 12 to 15, participated in this study. Participants were recruited through a number of adults in the community having contact with groups of adolescents. Due to this method of recruitment, four general subgroups of subjects emerged: (a) ten of the subjects were on the local swim team, (b) nine were recommended by a local school teacher, (c) eight were involved in community theater, and (d) the remaining six were recruited through miscellaneous friends and neighbors. Participants were assigned to experimental conditions using stratified assignment based on gender, age, and subgroup affiliation to ensure

equivalent experimental and control groups. Table 3.1 illustrates the composition of the experimental condition groups with respect to the stratification variables.

Control Condition *n* = 11	**Factual Condition** *n* = 11	**Inference Condition** *n* = 11
Males (*n* = 6) 12 year-old = 2 [b, c] 13 year-old = 1 [d] 14 year-old = 3 [a, b, d] 15 year-old = 0	Males (*n* = 6) 12 year-old = 3 [b, b, c] 13 year-old = 1 [a] 14 year-old = 2 [c, c] 15 year-old = 0	Males (*n* = 6) 12 year-old = 3 [a, b, b] 13 year-old = 1 [d] 14 year-old = 1 [a] 15 year-old = 1 [a]
Females (*n* = 5) 12 year-old = 2 [a, c] 13 year-old = 1 [b] 14 year-old = 0 15 year-old = 2 [a, d]	Females (*n* = 5) 12 year-old = 1 [a] 13 year-old = 1 [d] 14 year-old = 1 [c] 15 year-old = 2 [a, d]	Females (*n* = 5) 12 year-old = 1 [a] 13 year-old = 2 [c, c] 14 year-old = 0 15 year-old = 2 [b, c]

Note: Letters in superscript indicate subgroup affiliation with duplicate letters indicating multiple representatives from that subgroup (a = Swim Team, b = Community Theater, c = School Teacher, and d = Miscellaneous Other)

Table 3.1. Experimental group composition across stratification variables of gender, age, and subgroup affiliation.

3.6 Task

Participants in this study were asked to use the *IMPART 1.2*© multimedia computer application designed to provide basic alcohol education and skill training to 7th, 8th and 9th grade students. All subjects were first presented with the *Tutorial* module of *IMPART 1.2*©, which contained textual and graphic information frames introducing appropriate avoidance methods and effective verbal and non-verbal methods for refusing alcohol (see Appendix B). Subjects were then presented with the *Drill & Practice* module that involved video examples depicting effective and ineffective methods of refusing alcohol, as well as six short video vignettes presenting a variety of situations in which alcohol is offered and refused by adolescents (see Appendix C). Subjects were asked to view each vignette and then rate the effectiveness of the refusal used in that vignette. These ratings were logged in the participant's data file for use in potential post-hoc correlational analyses as needed. Feedback was subsequently provided to explain the relative correctness of their response.

Throughout the *Tutorial* and *Drill & Practice* modules, baseline reaction-time trials occurred at four specified points in the instruction. Subjects had been instructed during the training session to respond to the auditory stimulus by clicking the mouse button as quickly as possible. These baseline trials were included to ensure that no systematic difference existed between any of the condition groups on the measure of reaction-time.

Upon completion of the drill-and-practice activity, all participants were presented with an interactive decision story in which subjects interact by making key decisions for the lead character

at certain points in the story and viewing the consequent outcomes of those decisions (see Appendix D). However, for the purposes of this study only one decision was made available at any given point in the story to ensure that all participants followed an identical path through the video segments (see Appendix E). Due to the recursive nature of this forced viewing path, participants viewed a number of the short video segments twice (namely, segments 1, 3, 5, 6, and 9) as these segments served as the root segment from which sets of decisions stem (e.g., video segment 1 branches to "Don't Go To Tracy's" first, and then to "Go To Tracy's"). Furthermore, the ability to pause, rewind, or fast-forward through any given video segment was disabled in *IMPART 1.2*© to ensure standardized viewing of individual segments throughout the *Interactive Story* module.

After several decision points in the story, as well as at the end of certain story-line branches (i.e., before viewing the narrative summary), participants in the embedded question conditions were presented with a single question frame containing either a factual or an inference question, depending upon their experimental condition (see Appendix E). There were 10 such embedded question trials for subjects in either question condition. As typing ability was likely to vary considerably at these grade levels, participants were instructed to write down the answers to the embedded questions on numbered sheets of paper.

Participants in the factual questions condition received questions asking them to supply or recognize some item of information given in the previously viewed video segment, such as "What does Maria suggest as an option to drinking?" (see Appendix F). Conversely, inference questions required the participant to either draw conclusions, convey their opinions, or state a relationship between elements of the video segment that were implied but not explicitly stated in the segment (see Appendix G).

One-half of the inference questions were *generally relevant*, such as "Why did Maria's refusal to drink alcohol work so well?". These questions were phrased in the second-person perspective and are directly related to the circumstances, actions, and responses of the actors in the previously viewed video segment. The remaining half of the inference questions were *personally relevant*, such as "Why might your parents disapprove of you going to someone's house if their parents were going out of town?". These questions were phrased in the first-person perspective and directly relate to individually relevant, familiar events or situations (either experienced or hypothetical). These generally and personally relevant questions comprise the design extraction described above in the experimental design and are depicted in Figure 3.1.

On four selected embedded question trials (namely, trials 2, 5, 7, and 10), subjects were presented with an auditory probe as part of a secondary-task measurement of processing depth. Subjects were instructed to click the mouse button as quickly as possible whenever they heard the sound and had practiced responding to the tone while using the training application. Two of these trials (even trials 2 and 10) involved generally relevant inference questions, and the remaining two (odd trials 5 and 7) involved personally relevant inference questions. Subjects in the control group received reaction-time trials between the same segments of the interactive story in which embedded questions were appearing in the other conditions -- although no embedded questions were associated with the reaction-time trials for control group subjects.

Immediately following each embedded question frame (10 trials per subject total), a separate frame was presented asking the participant to use a 5-point likert-type scale to rate the amount of thought they felt was required to answer the previous embedded question (see Appendix E). This information was collected as a subjective measure of processing effort. Once the embedded question and subsequent rating scale were completed, the next video segment was presented.

Participants in the control group proceeded on the same forced-path through the *Interactive Story* module without encountering any embedded questions or mental effort rating frames between video segments, although as mentioned, they received all the reaction-time trials.

3.7 Apparatus

3.7.1 Hardware. Participants were seated at a table in front of an Apple Macintosh Quadra 840AV computer, connected to a mouse, keyboard, stereo speakers, and high resolution Apple 16" color monitor (see Figure 3.2). This computer was used to run the multimedia training application and collect participant responses during use of the *IMPART 1.2*© educational software.

Figure 3.2. Subject station.

3.7.2 Software. The *IMPART 1.2*© educational software application, as well as the multimedia application used during the training period, were created using Macromedia's Authorware for Macintosh (version 3.0.1). This software enabled the integration of audio, graphics, and full-motion video, as well as the incorporation of embedded metering for on-line tracking and collection of user's responses. QuickTime 2.1, a Macintosh Operating System extension, was used to allow for full-motion playback of video within the *IMPART 1.2*© application.

3.7.3 Testing materials. The Children's Nowicki-Strickland Internal-External Locus of Control Scale (CNS-IE) was used to determine pretest measures of LOC orientation (Nowicki and Strickland, 1973). The CNS-IE is a 40-item paper-and-pencil test for LOC orientation that is group adminsterable and involves a forced-choice (Yes-No) response requirement (see Appendix H). The instrument is scored such that higher scores indicate greater externality. The CNS-IE has been used extensively with subjects ranging from the third grade through college. MacDonald

(1973) stated that the information on the instrument's "internal consistency reliability, test-retest reliability, and convergent and discriminant validity indicates it to be the best measure of locus of control as a generalized expectancy presently available for use with children" (p. 185). Gilmore (1978), in a review of comparable instruments, stated that "The most attractive choice for measurement of generalized LOC expectancies for administration and continuity for different ages is the CNS-IE…" (p. 26). Similarly, Kendall, Finch, Little, Chirico and Ollendick (1978) have stated that the CNS-IE is "the most reliable measure of generalized locus of control appropriate for children of a variety of ages" (p. 590).

A modified version of the Youth Alcohol & Drug Survey (YADS) was used to determine pre- and posttest measures of youth attitudes concerning alcohol (see Appendix I). The original YADS instrument is a 77-item paper-and-pencil survey of what youth are thinking and doing about alcohol and drugs. Like the *IMPART 1.2*© alcohol education program itself, the YADS is based on the Multi-Component Motivational Stages (McMOS) model by Werch and DiClemente (1994). The original YADS instrument adopts several standardized questionnaire items that possess adequate validity and reliability from previous research on youth alcohol and other drug use prevention to provide measures of alcohol use risk factors. According to Werch et al. (1995), previous studies using these measures indicate test-retest reliabilities ranging from .66 to .96 for many of these items. In addition, Cronbach's alpha reliability coefficients were performed to determine the internal consistency of the proposed measures. The overall alpha coefficient was .88, indicating a high degree of internal reliability across all measures.

The modified version of the YADS instrument was created by removing all behavioral and attitudinal constructs and their related question items that pertain to drug-related attitudes or behavior and alcohol-related behavior. The resulting modified version of the YADS was a 16-item paper-and-pencil survey of what participants are thinking about alcohol. The remaining constructs and related question items assess only alcohol-related attitudes. The scoring procedures for the original instrument are devised such that a higher score is indicative of greater risk for alcohol and drug abuse (Werch, 1995). Identical scoring procedures were used for the modified instrument, such that a higher score is indicative of greater risk for alcohol abuse.

Finally, a 14-item Alcohol Knowledge Questionnaire (AKQ) was created to assess pre- and posttest alcohol-related knowledge (see Appendix J). This measure was designed to test for knowledge of specific information from the instructional materials presented in the *IMPART 1.2*© educational software and involves a multiple-choice recognition component, as well as a short-answer recall component.

3.8 Procedures

Subjects were contacted by phone one to two weeks prior to the study to arrange delivery of an information packet containing the following: introduction to the study (Appendix K), participant and parent/guardian informed consent forms (Appendices L and M, respectively), and a map to be used for the second session of the study. Participants and their parent or legal guardian were asked to read and sign the informed consent forms and were given duplicate originals of these documents. Subjects were scheduled for the first of the study's two experimental sessions at this time.

The first experimental session took place in the subjects' homes and involved the administration of the Children's Nowicki-Strickland Internal-External Locus of Control Scale (CNS-IE), the pretest modified Youth Alcohol & Drug Survey (YADS), and the pretest Alcohol Knowledge Questionnaire (AKQ). To preserve the anonymity of subjects participating in the

study, subjects were identified by their own self-assigned password. Each subject created their own password during this first session and wrote it down on each of the questionnaires in lieu of their name or a subject number. This same password was used to link the data collected in the second session to that obtained in the first session. Only the subject knew his or her password; therefore, anonymity was assured. Upon completion of the aforementioned pretest measures, the subject was scheduled for the second session of the study. Session one took approximately 20 minutes to complete.

Two weeks after completing the first experimental session, subjects were asked to come to the American Research Corporation of Virginia, located in Radford, Virginia, where the second session of the study was conducted. Subjects and their parents were greeted by the experimenter who then escorted the subject to the user-testing room where the remainder of the study took place.

Subjects were seated at a table in front of a computer and asked to complete a brief multimedia training program to become familiar with the Macintosh computer system and multimedia educational software. This training program consisted of three short modules and used an interface identical to that used in the *IMPART 1.2*© educational software. Subjects were first prompted to enter the password they created during the first session of the study. Subjects were then presented with general instructions followed by a Main Menu revealing the three modules they would complete in succession.

Module one simply explained the various on-screen elements and how to navigate between screens of information. Module two explained how to respond to the auditory probe used in the reaction-time trials and allowed subjects to practice responding to the tone they would be hearing when using the *IMPART 1.2*© test application. These five reaction-time practice trials were intended to progress subjects through the initial learning curve associated with the response task, thereby limiting the amount of reaction-time variability due to practice effects. Subjects were instructed that they will need to respond quickly in the actual *IMPART 1.2*© test application and were encouraged to practice responding as quickly as possible throughout this practice period. On-screen instructions asked subjects to place their fingers on the semicircle taped to the front edge of the table before each reaction-time trial (see Figure 3.2). This was done to ensure that subjects would be responding to the "worst-case" reaction trial scenario in which their hands are as far away from the mouse as would be realistically expected during data collection. Finally, module three involved a brief, forced-choice interactive video story using interface elements identical to those found in the *IMPART 1.2*© test application. This final module also included two additional reaction-time trials for further practice.

Once the participant conveyed that he or she was comfortable with using the computer and the training application, and all questions regarding their role in the experiment had been answered, subjects began using the *IMPART 1.2*© test application. Subjects were again prompted to enter the password they created during the first session of the study. Subjects were then presented with on-screen general instructions and then a Main Menu displaying the three modules of *IMPART 1.2*© they would be going through in succession. The beginning of each individual module included explicit on-screen instructions explaining what subjects were to do during that module. These modules have been described in some detail under the Task section above.

Upon completion of the *IMPART 1.2*© test application, subjects completed posttest measures of the modified Youth Alcohol & Drug Survey (YADS), and the Alcohol Knowledge Questionnaire (AKQ). Once these posttest questionnaires were completed, all questions regarding the study were answered and the subjects were paid in cash for their participation in the study. Session two took approximately one hour to complete.

CHAPTER 4

RESULTS

SuperANOVA version 1.11 (Abacus Concepts, Inc., 1991) for the Macintosh was used to apply standard one- and two-way analysis of variance (ANOVA) techniques to the data collected in this study. SAS version 6.12 (SAS Institute, Inc., 1996) was used to apply standard one- and two-way analysis of covariance (ANCOVA) techniques to the data collected in this study. Means separation comparisons were accomplished using SuperANOVA's Student-Newman-Keuls (SNK) procedure. In addition, StatView version 4.01 (Abacus Concepts, Inc., 1993) for the Macintosh was used to conduct correlational analyses and *t*-tests as well as calculate descriptive statistics on the data.

Two separate analyses were performed to address: (a) processing depth, knowledge gain, and attitude change effects in the embedded question-type conditions (control, factual, and inference), and (b) processing depth effects in the question-relevance conditions (general and personal). The results of the experiment are reported in three sections: question-type comparisons, question-relevance comparisons, and summary.

The primary analyses for the question-type comparisons involved between-subjects one-way ANOVAs across experimental group for each dependent variable (Appendix N). As these primary analyses yielded no significant results (see Table 4.1), a number of exploratory analyses were conducted to examine the data collected in this study further: (a) between-subjects one-way ANCOVAs were conducted across experimental group for each dependent variable using LOC score as a covariate (Appendix O), (b) between-subjects two-way ANOVAs were conducted across experimental group and gender for each dependent variable (Appendix P), (c) between-subjects two-way ANCOVAs were conducted across experimental group and gender for each dependent variable using LOC score as a covariate (Appendix Q), (d) between-subjects two-way ANOVAs were conducted across experimental group and the created variable LOC group for each dependent variable (Appendix R), and (e) correlational analyses were conducted to identify other existing relationships in the data (Table CL in Appendix U). The within-subjects comparison between generally- and personally-relevant inference questions consisted of one-tailed paired *t*-tests for mental effort rating and reaction-time variables (Appendix S).

4.1 Question-Type Comparisons

As mentioned, the primary analyses yielded no significant results. Table 4.1 summarizes the observed means for each dependent variable across experimental condition and the associated *F* ratios and *p* values obtained from the one-way ANOVAs conducted for the primary analyses.

Although not included in the hypotheses for this research, the exploratory analyses included gender as a factor due to known differences in risk perception (DeJoy, 1992) and risk-taking behavior between males and females (Cherpitel, 1993; Irwin & Millstein, 1986). In addition, gender has also been shown to play an important role in sexual risk reduction (Cochran & Peplau, 1991) and AIDS education (Hodges, Leavy, Swift & Gold, 1992), and would likely prove to be an important factor in the design of alcohol education programs.

With the exception of those analyses conducted to evaluate experimental group equivalency across LOC score, average baseline reaction-time, and response accuracy, alpha was set at .05 for all statistical tests. Unless otherwise noted, only those results proving to be significant at or beyond the criterion point of $p < .05$ will be presented here. Refer to Appendices N through R for complete summary tables of these analyses.

Dependent Variable	**Control Mean**	**Factual Mean**	**Inference Mean**	***F***	***p***
Average Mental Effort Rating	N/A	2.082	2.500	2.629	.1206
Average Reaction-Time	1.493	1.361	1.297	.234	.7925
Average Baseline Reaction-Time	1.237	.911	1.034	2.262	.1216
Expectancy Belief Differential	-.545	-.364	-.636	.072	.9303
Self Efficacy Differential	.364	0.000	.545	.517	.6018
Perceived Susceptibility Differential	-.182	-.091	-1.000	.894	.4197
Perceived Severity Differential	.545	-.455	.091	1.580	.2227
Perceived Benefit Differential	-.818	.273	.727	2.313	.1163
Composite Attitude Differential	-.636	-.636	-.273	.021	.9788
Recognition Differential	.727	1.636	1.727	1.086	.3504
Recall Differential	1.909	1.818	2.091	.044	.9567
Composite Knowledge Differential	2.636	3.455	3.818	.446	.6442

Table 4.1. Overall summary table for dependent variables across experimental condition.

4.1.1 Locus of control. Standard one- and two-way ANOVAs were conducted on the measure of LOC score to ensure equivalent experimental groups (see Tables CQ and CR in Appendix U). Each of these analyses were conducted at $p < .20$ as a means of indirectly reducing the probability of Type II error. As expected, no significant difference in LOC score was found at this criterion level across experimental groups. Additional two-tailed unpaired *t*-tests conducted across experimental group further confirm the relative equivalency of these experimental groups (see Table CS in Appendix U).

Descriptive statistics revealed that LOC scores were positively skewed (skewness = .941, see Table CM in Appendix U), indicating that the subjects used for this study were generally more internal in their LOC orientation with respect to the overall internal-external continuum (see Figure 4.1).

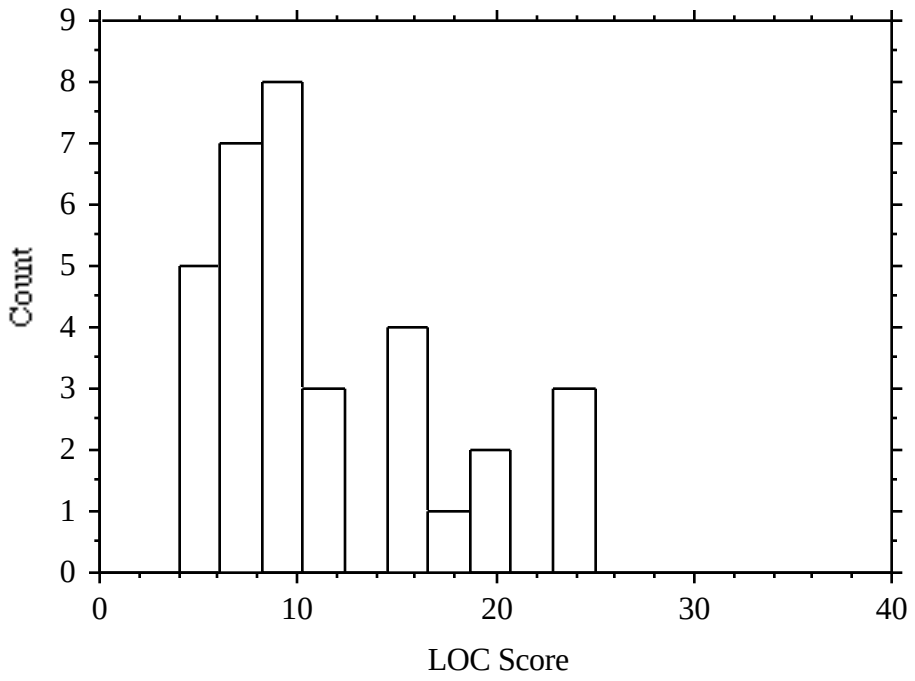

Figure 4.1. Histogram of LOC scores for subjects in this study.

LOC score was used as a covariate in the exploratory ANCOVAs conducted on the data. This allowed the portion of within-cell variance that was attributed to the LOC score to be partialled out, thereby increasing the sensitivity of the test of main effects and interactions by reducing the error term.

The nominal variable LOC group was created for use in another set of exploratory analyses to investigate the interaction between question-type and LOC orientation to the fullest extent possible given the limitations of the data. Due to the distribution of LOC scores, no perfect solution existed for creating such a variable, and a number of concessions had to be made. First, as each question condition involved an odd number of subjects ($n = 11$ per condition) it was decided that the subject with the middle-most LOC score for each condition would be eliminated in the creation of this variable. This was done to allow more powerful analyses to be conducted by using equal sample sizes. The LOC group variable was then created by placing the remaining subjects with the five

lowest LOC scores from each embedded question condition in the internal LOC group, and those with the five highest LOC scores in the external LOC group. Second, separation of LOC scores between internal and external LOC groups was minimal in the control group condition (3-point differential) and inference condition (1-point differential), and an overlap occurred in the factual condition in which three subjects with LOC scores of 10 had to be randomly assigned to internal and external groups (see Table 4.2).

	Control *n* = 10	**Factual** *n* = 10	**Inference** *n* = 10	*Mean*
Internal *n* = 15	4 - 7 *(Mean = 5.2)*	6 - 10 *(Mean = 8.2)*	7 - 11 *(Mean = 8.6)*	*7.333*
External *n* = 15	10 - 25 *(Mean = 15.0)*	10 - 24 *(Mean = 16.2)*	12 - 24 *(Mean = 17.2)*	*16.133*
Mean	*10.1*	*12.2*	*12.9*	*11.733*

Table 4.2. LOC score ranges and cell means across LOC group and embedded question condition.

4.1.2 Mental effort rating. Average mental effort ratings were calculated across the ten mental effort rating trials for each subject in the inference and factual conditions. Contrary to the hypotheses, no significant effects were found for this measure of processing depth in any of the analyses conducted. Furthermore, the expected positive correlation between mental effort rating and reaction-time was not observed in the data (see Table CX Appendix U).

4.1.3 Reaction-time. One reaction-time trial outlier was removed from the dataset prior to statistical analysis. This outlier reaction-time of 41.583 seconds occurred during session two data collection when a subject turned to ask the experimenter a detailed question just as the auditory probe was sounding. The experimenter answered the subject's question and then informed the subject that the auditory probe had sounded. This was an isolated incident and was immediately logged by the experimenter as a probable outlier.

Average reaction-time was calculated across the four reaction-time trials for subjects in each of the three experimental conditions. No significant effects were found for this measure of processing depth to support the research hypotheses in the current study.

Baseline reaction-time data were collected throughout the *Tutorial* and *Drill & Practice* modules of *IMPART 1.2*©. Although it was hoped that there would be no significant differences across experimental groups on the baseline reaction-time measure, some sample bias was anticipated as random selection of subjects was not possible in the current study.

Standard one- and two-way ANOVAs were conducted on the measure of baseline reaction-time to ensure equivalent experimental groups. Each of these analyses were conducted at $p < .20$ as a means of indirectly reducing the probability of Type II error. These analyses revealed a significant difference across experimental groups on this measure (F (2, 30) = 2.262, p = .1216, see Figure 4.2). Additional *t*-tests conducted across experimental group revealed a significant

difference between the factual group and the control group (t (20) = -2.010, p = .0581), indicating that subjects in the factual group were responding significantly faster than subjects in the control group (see Table CA in Appendix T).

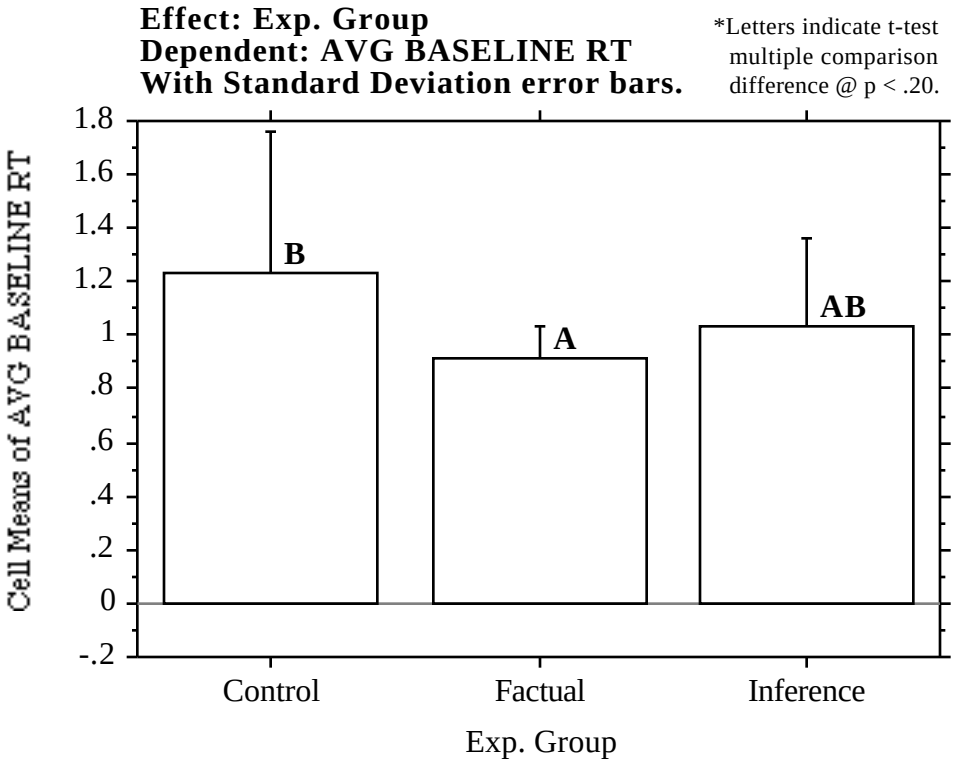

Figure 4.2. Baseline reaction-time across experimental group.

Baseline reaction-time data were also intended to serve as a potential covariate to allow variance attributed to the psychomotor response to the auditory stimulus to be partialled out; however, no significant difference in reaction-time was found across experimental groups or gender when baseline reaction-time differences were removed (see Tables CT and CU in Appendix U).

4.1.4 Attitude constructs. The Youth Alcohol and Drug Survey (YADS) is scored such that a higher score indicates greater risk for alcohol and drug abuse (see Appendix I). For the purpose of greater readability in deciphering the results of this study, all resultant attitude construct differential scores were multiplied by negative one (-1) to yield numerically positive differential scores for changes that are desirable and numerically negative differential scores for changes that are undesirable.

Contrary to expectations, paired t-tests failed to identify significant positive pre- to posttest changes for any of the attitude constructs. Refer to Tables BN through BS in Appendix S for complete summary tables of the attitude construct t-tests, and to Appendices N through R for complete summary tables of the attitude construct differentials analyses.

Unpaired t-tests conducted across experimental group revealed a significant difference in pre- to posttest change in perceived benefit to avoiding alcohol between the inference group and the

control group (t (20) = 2.968, p = .0038, see Figure 4.3). As expected, this result indicates that inference group subjects exhibited significantly greater positive change on this construct than the control group subjects (see Table CF in Appendix U), although the difference between the factual and control groups did not prove significant in these analyses.

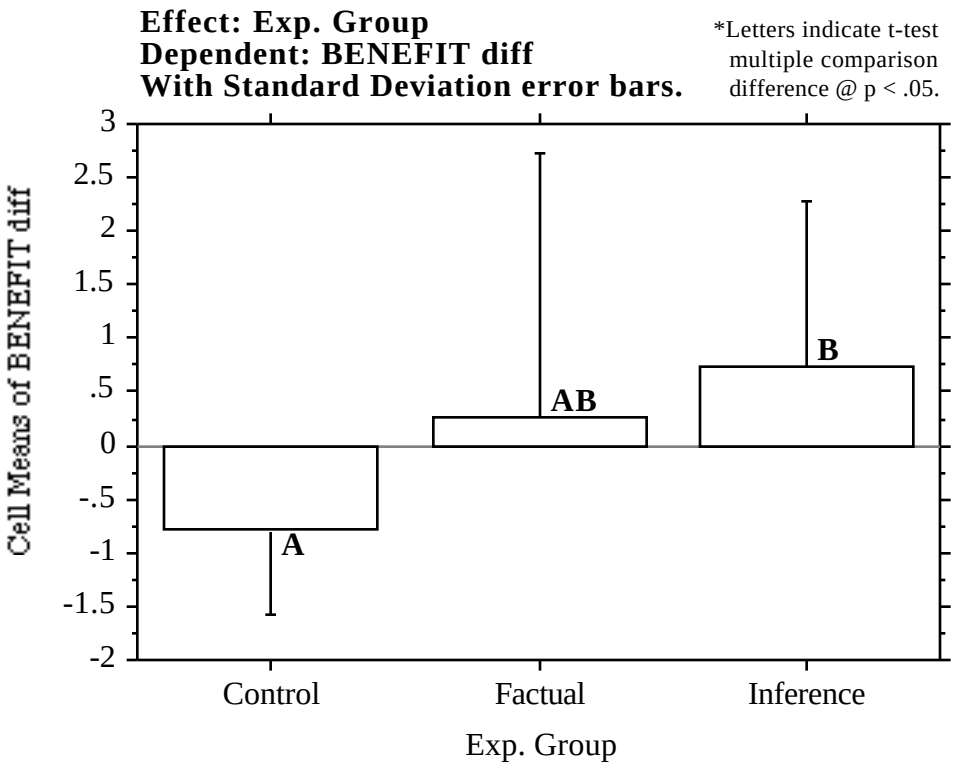

Figure 4.3. Pre- to posttest change in perceived benefit to avoiding alcohol across experimental group.

A two-way ANOVA using experimental group and gender as factors revealed that the change in perceived severity of alcohol-related consequences was significantly affected by gender (F (1, 27) = 4.896, p = .0356, see Figure 4.4). Males perceived alcohol-related consequences as being somewhat more severe in posttest as compared to pretest, whereas females perceived such consequences as being somewhat less severe in posttest.

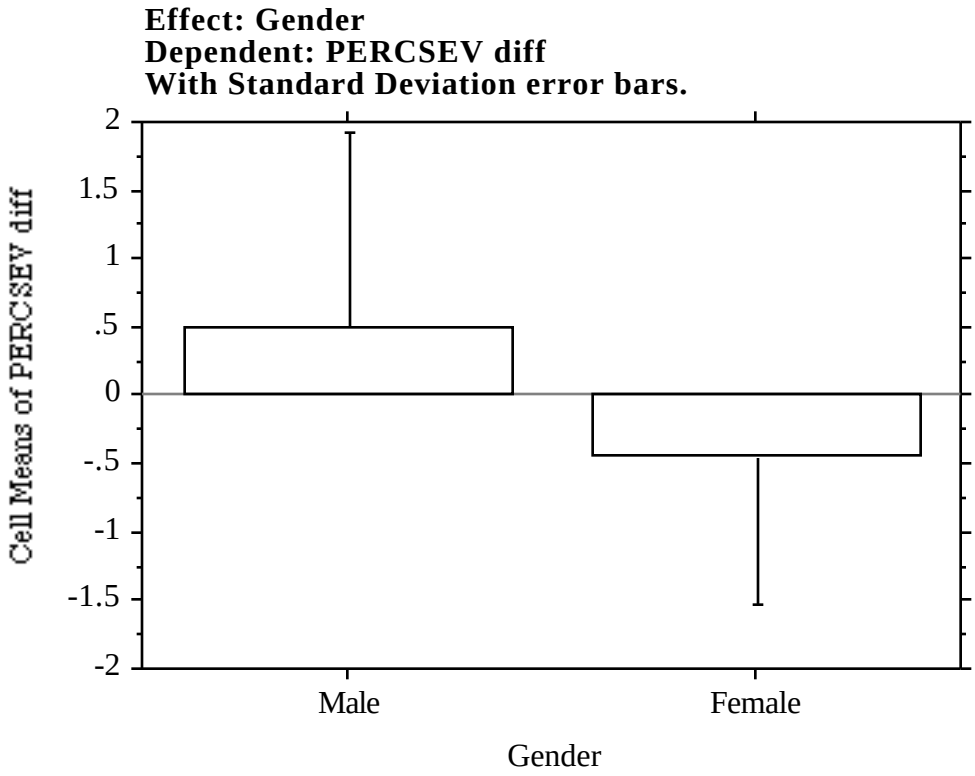

Figure 4.4. Pre- to posttest change in perceived severity of alcohol-related consequences across gender.

Finally, a significant negative correlation was found between gender and PERCSEV differential (r = -.363, p = .0370, see Figure 4.5), indicating that males (coded as 1 for this analysis) were associated with greater positive pre- to posttest changes in perceived severity of alcohol-related consequences. This correlation corresponds with the significant main effect presented in Figure 4.6 above, in which males were shown to perceive alcohol-related consequences as being somewhat more severe in posttest than in pretest, whereas females perceived such consequences as somewhat less severe in posttest as compared to their pretest scores.

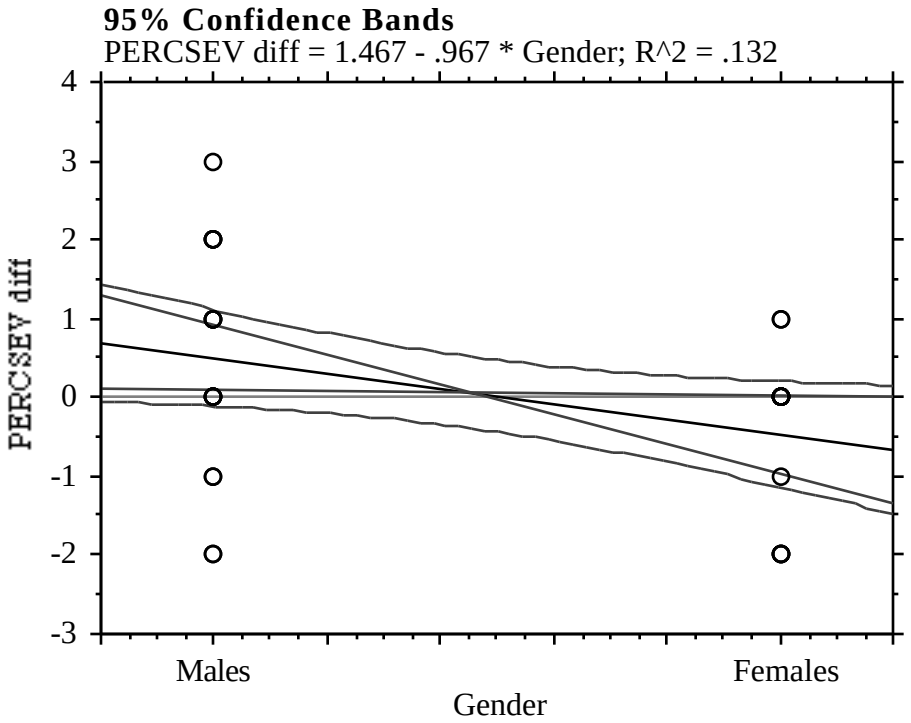

Figure 4.5. Negative correlation between gender and PERCSEV differential.

4.1.5 Knowledge constructs. Pre- and posttest Alcohol Knowledge Questionnaires (AKQ) were scored using the key found in Appendix J. Due to the nature of the instructional material used in this study and the likelihood that many of these adolescent subjects could have been presented with other types of alcohol education, there could easily have been several "correct" answers to any of the open-ended questions in the AKQ. In an effort to identify what was *specifically* being learned from the *IMPART 1.2*© program, the open-ended questions that comprise the recall component of the AKQ were scored such that only information items which were directly contained in the *IMPART 1.2*© program were considered correct.

As expected, paired *t*-tests revealed that posttest scores of each component of the AKQ (recognition and recall) as well as the composite knowledge score were significantly higher than pretest AKQ scores, indicating that significant learning occurred regardless of experimental group affiliation. Refer to Tables BT through BV in Appendix S for complete summary tables of the knowledge construct *t*-tests.

A two-way ANOVA using the created variable LOC group revealed that change in the recall knowledge score was significantly affected by LOC group affiliation (F (1, 24) = 5.481, p = .0279, see Figure 4.6). As expected, subjects with internal LOC orientations exhibited a significantly greater gain on the recall knowledge score than their externally-oriented counterparts.

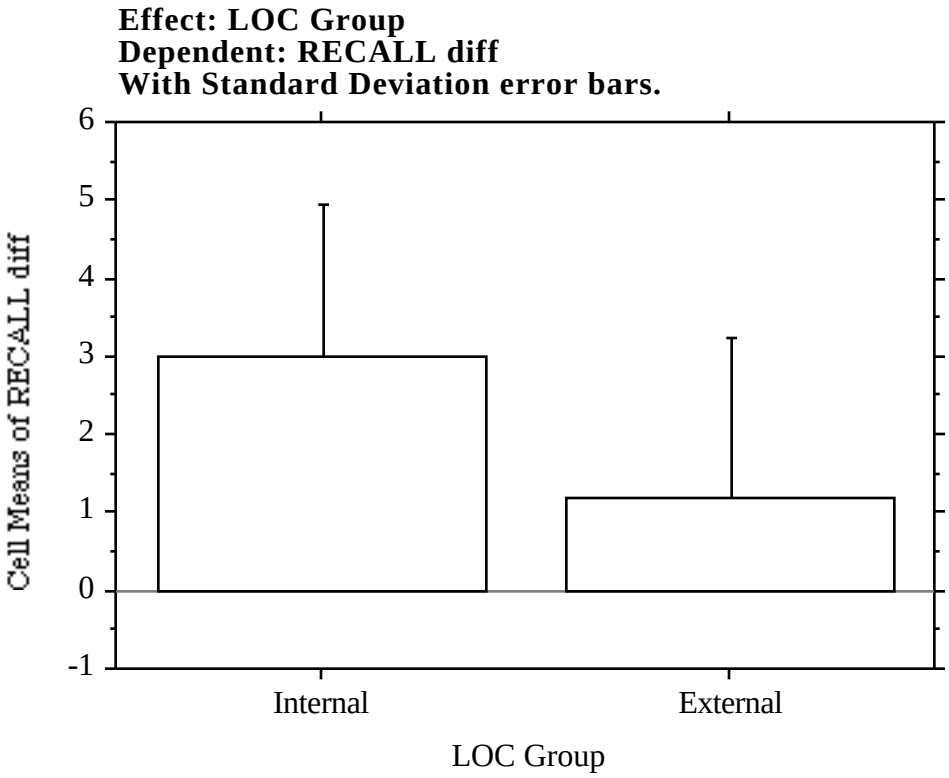

Figure 4.6. Pre- to posttest change in recall knowledge score across LOC group.

A two-way ANOVA using the created variable LOC group revealed that change in composite knowledge score was significantly affected by LOC group affiliation (F (1, 24) = 6.898, p = .0148, see Figure 4.7). As expected, subjects with internal LOC orientations exhibited a significantly greater gain on the composite knowledge score than their externally-oriented counterparts.

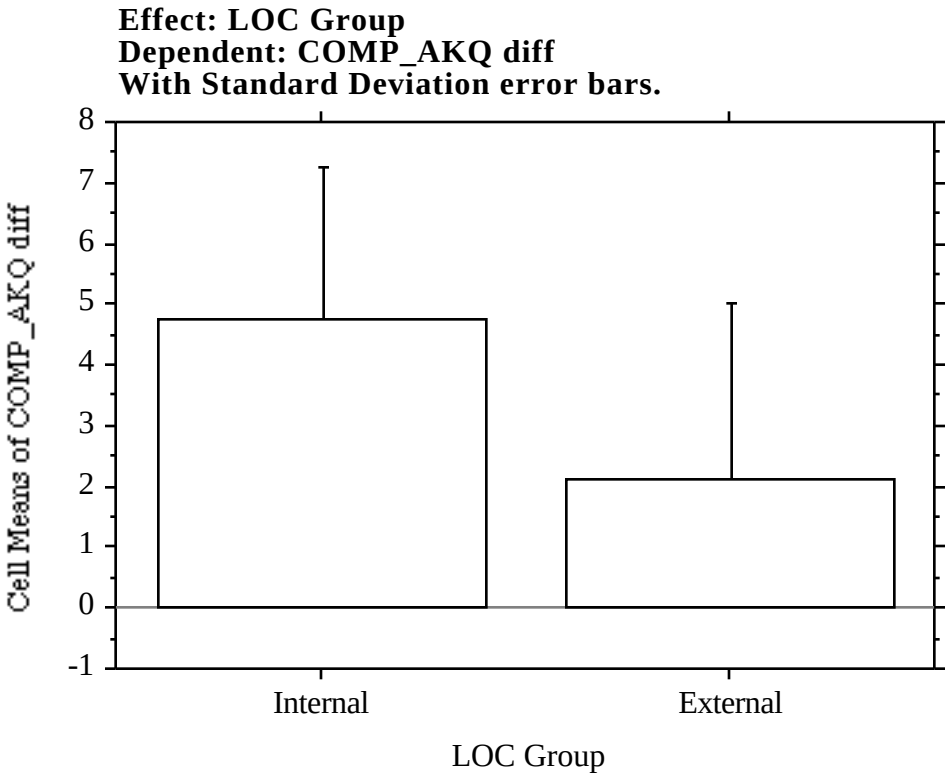

Figure 4.7. Pre- to posttest change in composite knowledge score across LOC group.

Finally, a significant positive correlation was found between age and RECALL differential (r = .456, p = .0069, see Figure 4.8), indicating that older subjects were associated with greater pre- to posttest gains on the recall component of the AKQ.

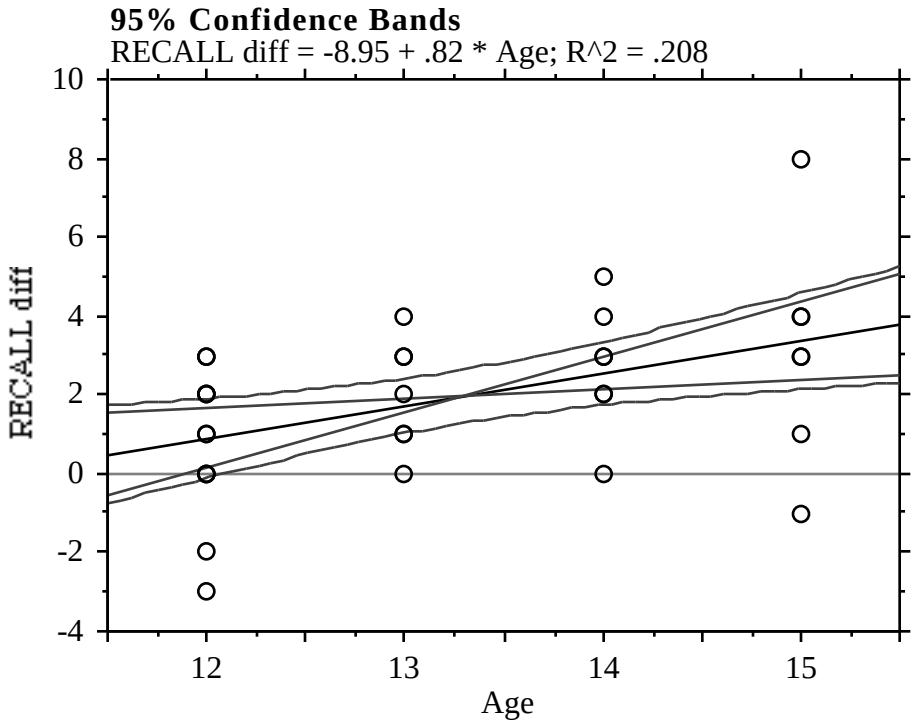

Figure 4.8. Positive correlation between age and RECALL differential.

4.1.6 Response accuracy. The accuracy of responses to the embedded questions was determined by identifying whether the response properly identified the item of information in question that had been presented in the previously viewed video segment (factual condition), or whether the subject had drawn a reasonable conclusion or inference about the elements of the previously viewed video segment that were in question (inference question). These responses were scored as being either correct or incorrect and were merely intended to serve as a check for consistent effort across conditions. Examples of appropriate responses are listed with each embedded question in Appendices F and G.

Standard one- and two-way ANOVAs, as well as two-tailed unpaired *t*-tests were conducted on the measure of response accuracy to ensure equivalent experimental groups. Each of these analyses were conducted at $p < .20$ as a means of indirectly reducing the probability of Type II error. As expected, no significant difference was found between experimental groups on this measure, indicating equal effort across question condition groups.

4.2 Question-Relevance Comparisons

Subjects in the inference question condition received two variations of inference question. Generally-relevant questions were presented on even-numbered trials, phrased in the second-person perspective and directly related to the circumstances, actions, and responses of the actors in the previously viewed video segment. Personally-relevant questions were presented on odd-numbered trials, phrased in the first-person perspective and directly related to individually relevant, familiar events or situations.

StatView, version 4.01 (Abacus Concepts, Inc., 1993) for the Macintosh was used to conduct paired *t*-tests on average mental effort rating and reaction-time measures collected for each of these inference question types. Alpha was set at .05 for all statistical tests. Refer to Tables BW and BX in Appendix S for complete summary tables of these analyses.

4.2.1 Mental effort rating. Average mental effort rating was calculated across the five odd-numbered trials for personally-relevant inference questions and across the remaining five even-numbered trials for the generally-relevant condition. Contrary to the hypotheses, a one-tailed paired *t*-test conducted on data from the within-subjects design extraction revealed no significant difference in average mental effort ratings for personally-relevant inference questions in comparison to generally-relevant inference questions.

4.2.2 Reaction-time. Average reaction-time was calculated across the two odd-numbered reaction-time trials for personally-relevant inference questions and across the two even-numbered reaction-time trials for the generally-relevant condition. Contrary to the hypotheses, a one-tailed paired *t*-test conducted on data from the within-subjects design extraction revealed no significant difference in average reaction-time for personally-relevant inference questions in comparison to generally-relevant inference questions.

4.3 Summary

4.3.1 Question-type comparisons. Contrary to the hypotheses, the primary one-way ANOVAs across experimental group yielded no significant findings. In the exploratory analyses a number of significant findings emerged when portions of the variance were accounted for by including LOC score as a covariate or using a second factor such as gender or LOC group in the analyses. The results from these exploratory analyses were either unexpected or provided only limited support for the research hypotheses, indicating that the use of embedded questions in interactive video, either factual or inference, did nothing to increase knowledge gain and little to affect attitude change on the whole (see Table 4.3).

Hypothesis 1: Embedded questions will have a generally facilitative effect as evidenced by significantly greater positive changes in attitude constructs and knowledge gain for groups receiving interactive video with embedded questions as compared to a control group receiving interactive video only. This hypothesis was partially supported by the data for positive attitude change, but was not supported by the data for knowledge gain. A one-tailed unpaired *t*-test indicated that subjects in the inference condition exhibited a significantly greater positive change in perceived benefit to avoiding alcohol than subjects in the control condition. Unexpectedly, however, subjects in the control condition exhibited a negative change on this attitude construct.

Hypothesis 2: Positive changes in knowledge gain and attitude constructs will be significantly greater for participants receiving inference questions as compared to those receiving factual questions. This hypothesis was not supported by the data for either positive attitude change or knowledge gain.

Hypothesis 3: Subjective mental effort ratings will be significantly higher for participants in the inference questions condition as compared to mental effort ratings in the factual question condition. It is expected that reaction-times will be positively correlated with the mental effort ratings; therefore, a similar significant increase in reaction-time for subjects in the inference questions condition is expected. This hypothesis was not supported by the data for mental effort rating or reaction-time, nor was the expected positive correlation observed between mental effort rating and reaction-time.

Hypothesis 5: Greater positive changes in knowledge gain and attitude constructs will be seen for participants who have an internal locus of control orientation as compared to those who are externally oriented. This hypothesis was supported by the data for positive changes in knowledge gain, but was not supported by the data for attitude change. Using experimental group and the created variable LOC group as factors in a set of two-way ANOVAs, significant main effects across LOC group were observed such that internal subjects exhibited significantly greater pre- to posttest gains than their external counterparts on the recall knowledge construct as well as composite knowledge score.

Hypothesis 6: Subjective mental effort ratings will be higher for participants who have an internal locus of control orientation as compared to those who are externally oriented. It is expected that reaction-times will be positively correlated with the mental effort ratings, showing a significant increase in reaction-time for participants with an internal locus of control orientation. This hypothesis was not supported by the data for mental effort rating or reaction-time, nor was the expected positive correlation observed between mental effort rating and reaction-time.

Using experimental group and gender as factors in a set of two-way ANOVAs, a significant main effect across gender was observed for the pre- to posttest change in perceived severity of alcohol-related consequences, such that males exhibited a positive change and females exhibited a negative change on the construct. In the two-way ANCOVAs a similar pattern of results was observed across gender in the interaction between experimental group and gender on the change in composite attitude score. When the variance due to LOC score was partialled out it was shown that male subjects in the embedded question conditions exhibited a positive change whereas female subjects in the embedded question conditions exhibited a negative change on the measure.

4.3.2 Question-relevance comparisons. Hypothesis 4: Subjective mental effort ratings will be significantly higher when participants receive personally relevant questions as compared to when they receive generally relevant questions. It is expected that reaction-times will be positively correlated with mental effort ratings, such that reaction-times will be greater when subjects are answering personally relevant questions as compared to when they are responding to generally relevant questions. This hypothesis was not supported by the data for mental effort rating or reaction-time, nor was the expected positive correlation observed between mental effort rating and reaction-time.

Hypothesis		Level of Support from Results
H1:	Embedded questions will facilitate significantly greater positive changes in attitude constructs	Partially supported
	Embedded questions will facilitate significantly greater positive changes in knowledge constructs	Failed to support
H2:	Inference questions will facilitate significantly greater positive changes in attitude constructs than factual questions	Failed to support
	Inference questions will facilitate significantly greater positive changes in knowledge constructs than factual questions	Failed to support
H3:	Mental effort ratings will be significantly higher for subjects in the inference questions condition than for subjects in the factual questions condition	Failed to support
	Reaction-times will be significantly longer for subjects in the inference questions condition than for subjects in the factual questions condition	Failed to support
H4:	Mental effort ratings will be significantly higher when receiving personally relevant inference questions than for generally relevant inference questions	Failed to support
	Reaction-times will be significantly longer when receiving personally relevant inference questions than for generally relevant inference questions	Failed to support
H5:	Internal LOC subjects will exhibit significantly greater positive changes in attitude constructs than external LOC subjects	Failed to support
	Internal LOC subjects will exhibit significantly greater positive changes in knowledge constructs than external LOC subjects	Supported
H6:	Mental effort ratings will be significantly higher for internal LOC subjects	Failed to support
	Reaction-times will be significantly longer for internal LOC subjects	Failed to support

Table 4.3. Summary of support for the hypotheses.

CHAPTER 5

DISCUSSION

The purpose of this investigation was to determine the differential effectiveness of two types of embedded questions (factual vs. inference) on processing depth, attitude change, and knowledge gain. Based on the literature (Hannafin, 1989; Hannafin & Rieber, 1989a; Hooper & Hannafin, 1991; Wager & Wager, 1985), it was expected that the addition of embedded questions would enhance the processing of information presented to the subjects via interactive video and that more thought-provoking questions (i.e., those requiring inferences and conclusions) would promote deeper processing than questions that merely required factual information to be provided. It was reasoned that those questions that promote the deepest processing would be associated with the greatest gains in knowledge and attitude change. Further, it was thought that if such thought-provoking questions were designed to direct the subject to draw on personal experience, processing would be further enhanced (McFarland, Frey, & Rhodes, 1980).

Evans (1986) stated that the research in the area of interactive video could best be furthered by investigating the interaction of those characteristics which make the medium unique and user characteristics that might influence the use of such learning environments. As such, this study investigated the effects of subjects' LOC orientation and embedded question type on processing depth, knowledge gain, and attitude change.

5.1 Independent Variables

LOC scores on the Children's Nowicki-Strickland Internal-External (CNS-IE) appeared to be positively skewed (skewness = .941) with the majority of scores falling below 13, and only a few scores appearing above 20. However, the measure of skewness does not account for the general tendency of individuals to become more internal in their LOC orientation as they mature, as manifested by their LOC scores decreasing with age (Nowicki & Strickland, 1973).

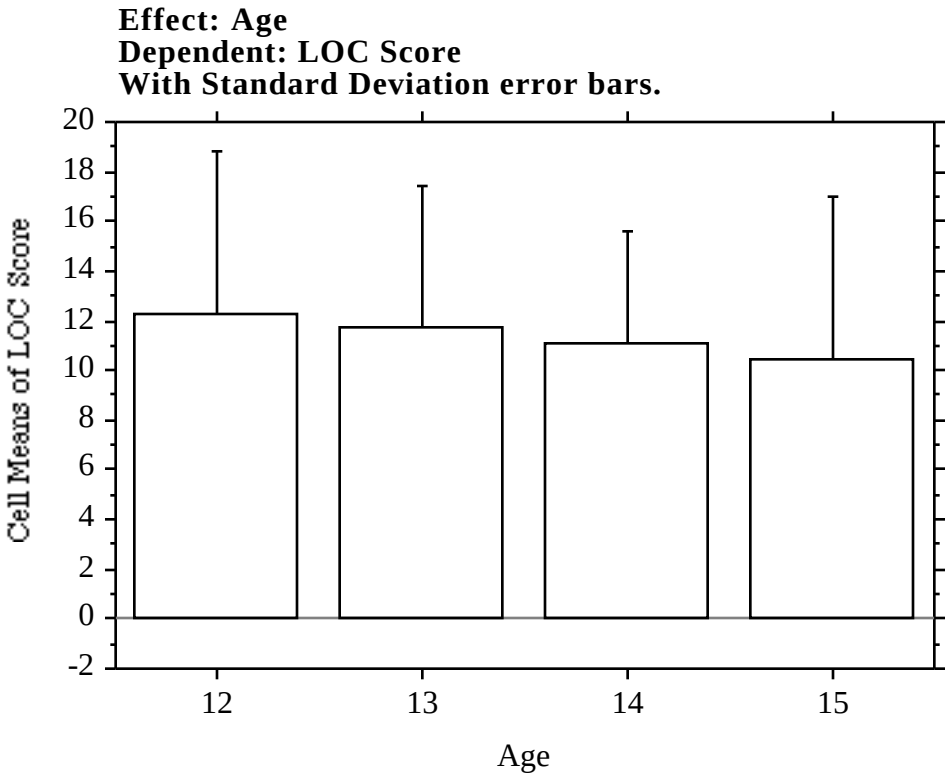

Figure 5.1. Trend indicating decrease in LOC score as age increased.

Although the expected age-related trend was observed for LOC scores in the current study (see Figure 5.1), scores were somewhat lower than those obtained by Nowicki and Strickland (1973) during early validation studies of the CNS-IE measure (see Table 5.1), indicating that subjects in the current study were somewhat more internally oriented than those found in the general population. This could be due to the manner in which subjects were recruited for the study. The majority of adolescents used in the current study were either highly active and involved in extra-curricular activities, such as the local swim team or community theater, or were recommended by a local school teacher who knew them as high-achievers and generally outstanding students. As such, subjects in the current study were not likely to be representative of the general population of adolescents between 12 and 15 years of age.

	Males			Females		
Age	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*
12	13.15 *11.250*	4.87 *5.523*	65 *8*	13.94 *14.250*	4.23 *8.958*	52 *4*
13	14.73 *13.333*	4.35 *6.658*	75 *3*	12.29 *10.500*	3.58 *5.568*	34 *4*
14	13.81 *11.333*	4.06 *4.803*	43 *6*	12.25 *10.000*	3.75 *0.000*	44 *1*
15	13.05 *7.000*	5.34 *0.000*	68 *1*	12.98 *11.000*	5.31 *6.957*	57 *6*

Note: Values in italics were obtained in the current study,
values in plain text were obtained by Nowicki and Strickland (1973).

Table 5.1. Comparison of CNS-IE LOC scores.

LOC score certainly proved useful as a covariate in the analyses as a number of significant findings emerged from the data; however, the much larger questions regarding the interactive effects of question-type and LOC orientation had not yet been addressed. Due in part to the relatively low number of subjects used in this study and the manner in which these subjects were obtained, an irregular distribution of scores resulted that could not easily be classified into high and low LOC categories. However, due to the importance of investigating the interaction between question-type and LOC orientation, an attempt was made to split subjects into high and low LOC groups for further analysis.

Due to the distribution of LOC scores, no perfect solution existed for creating such a variable, and a number of concessions had to be made. First, as each question condition involved an odd number of subjects (n = 11 per condition) it was decided that the subject with the middle-most LOC score for each condition would be eliminated in the creation of this variable. This was done to allow more powerful analyses to be conducted by using equal sample sizes. The LOC group variable was then created by placing the remaining subjects with the five lowest LOC scores from each embedded question condition in the internal LOC group, and those with the five highest LOC scores in the external LOC group. Second, separation of LOC scores between internal and external LOC groups was minimal in the control group condition (3-point differential) and inference condition (1-point differential), and an overlap occurred in the factual condition in which three subjects with LOC scores of 10 had to be randomly assigned to internal and external groups (see Table 4.2 in the previous chapter for specific details). The limited sample size used in this study, coupled with the minimal, and at times non-existent, separation between groups likely contributed to a considerable decrease in the power of these analyses.

5.2 Dependent Variables

5.2.1 Mental effort rating. Rather than simply requiring subjects to provide factual information regarding surface details of material presented in short video segments, inference questions were designed to relate the lesson content to subjects' existing knowledge by encouraging the formation of meaningful conclusions, opinions, and inferences regarding the material. As such, it was expected that inference questions would promote deeper processing and therefore higher mental effort ratings than factual questions. It was further expected that when such inference questions were made to encourage reflection on more individually relevant, familiar events or situations, even deeper processing would result, as manifested by even higher mental effort ratings.

Contrary to the hypotheses, no significant difference was found between factual and inference questions on the measure of average mental effort rating at the $p < .05$ level, nor was there a difference found between the inference question variants (general vs. personal relevance conditions). However, if alpha were to be relaxed to the $p < .10$ level, average mental effort rating would be significant (F (1, 18) = 3.139, p = .0934, see Figure 5.2) across question type in the expected direction, suggesting that the power of the study needed to be increased either by using more subjects or, ideally, increasing the effect size by using more difficult questions in the inference condition (see Table AA in Appendix P).

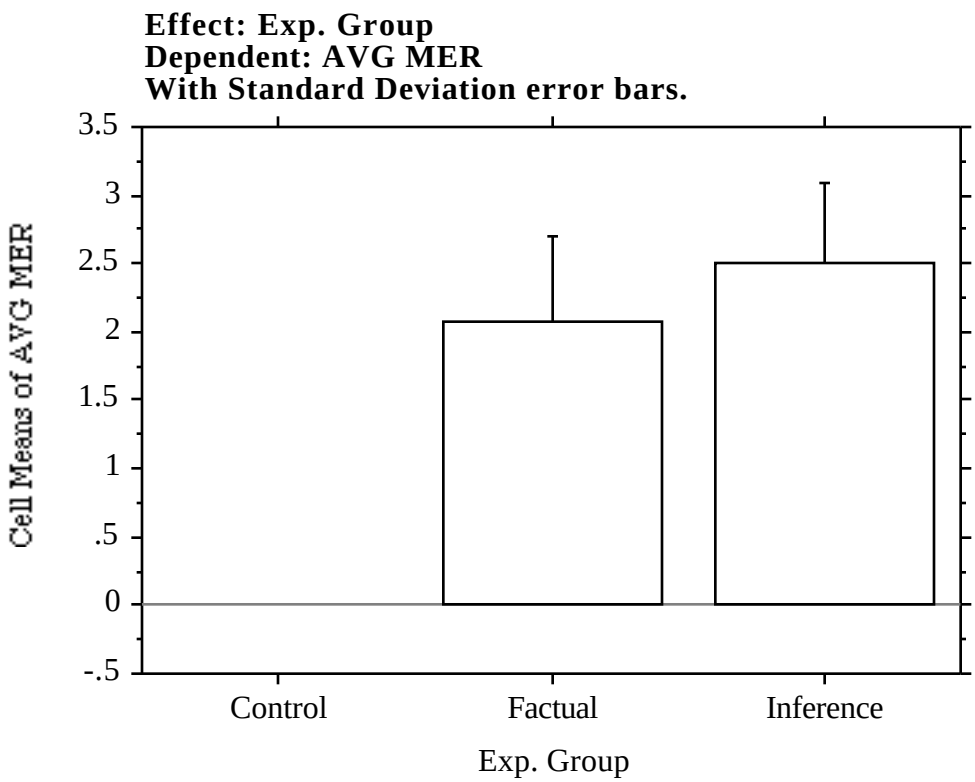

Figure 5.2. Average mental effort rating trend across experimental group.

In general, the lack of findings for differences in mental effort rating are at least partially due to the lack of a sufficiently difficult learning domain. As a result, the embedded questions this

learning domain could support were of limited difficulty, thereby narrowing the gap between the "easier" factual questions and the "more difficult" inference questions and creating a ceiling effect across experimental condition. The inference questions constructed for this study were as difficult as the instructional domain could support. The creation of more demanding inference questions would have to involve the selection of a more cognitively-challenging topic of instruction. Suggestions for potentially challenging topic areas will be presented later in this chapter under Suggestions for Further Research.

It is important to note that although the concepts involved with alcohol education are important and extremely difficult to communicate in terms of prompting a desired attitude change, they are not complex concepts to grasp when put in terms of mental effort. In fact, most adolescents are certainly aware that drinking is illegal and has negative consequences, the difficulty lies in diffusing the invulnerable attitudes and convincing adolescents of the likelihood of these negative consequences happening to them.

During question item development, the concern arose as to whether the factual and inference questions were as different in terms of perceived mental effort as originally envisioned. As such, an informal prestudy ($N = 2$) was planned and executed to ascertain whether inference questions elicited deeper processing than factual questions as determined by subjective mental effort rating scale data as an indicator of cognitive engagement. Results indicated an apparent difference on the measure of mental effort rating between the two question-types with inference questions generally being rated as requiring "a lot of thought" to answer, and factual questions consistently rated as requiring "no thought" or "very little thought" to answer. These results provided the necessary support to warrant full-scale data collection; however, the observed difference between question-types in the prestudy appeared to be somewhat of a fluke as such differences were not observed in the primary study.

In addition, it seems that the subjective mental effort rating scale may have been insensitive to the range and level of processing required in answering the embedded questions as it did not address the degree to which subjects called upon existing knowledge in answering the embedded question (e.g., to draw inferences or form conclusions regarding the inference questions). The subjective measure employed in the current study asked the subject to use a 5-point Likert-type rating scale to rate "…how much thought was needed to answer the preceding question". This probe may have been overly focused on the very general construct of mental effort, leading subjects to an understated assessment of processing activity. Recall that Craik and Lockhart's (1972) framework divided the rehearsal that takes place in working memory into two categories of processing: Type I processing (or maintenance rehearsal), which involves maintained processing at the same level of analysis, and Type II processing (or elaborative rehearsal), which involves deeper or more extensive processing of the stimulus. During Type II processing it is believed that incoming information is processed at a deeper level by comparing the information to and integrating it with existing knowledge. Thus, a more accurate measure of mental effort rating might have included a question that addressed the degree to which the subjects felt they had used existing knowledge from their previous experiences to answer the preceding question. Although not worded in the simplest form here, a probe such as this might better capture the true construct of interest -- deep processing in terms of the integration of new information with existing knowledge.

In retrospect, the study would have benefited greatly from a more challenging topic area as well as the inclusion of greater numbers of subjects in the primary study to boost power, and as part of the prestudy to help ensure that such a difference existed between embedded question-types before full-scale data collection began. In addition, a more comprehensive mental effort rating

scale could have been devised to better assess the true nature of the processing associated with answering the embedded questions.

5.2.2 Reaction-time. Inference questions were designed to relate the lesson content to subjects' existing knowledge. As such, it was expected that these questions would promote deeper processing and therefore elicit longer reaction-times than factual questions. It was further expected that when such inference questions were more individually relevant, even deeper processing would result, as manifested by longer reaction-times.

Like the subjective mental effort rating measure, the absence of significant findings on the reaction-time measure in the initial analyses can be at least partially attributed to the lack of a sufficiently difficult learning domain; however, other more significant problems existed for this quantitative index of processing depth. The lack of a sufficiently standard method of timing the auditory probe for the secondary-task, coupled with flaws in the method of responding to the auditory probe resulted in a general lack of utility for this measure.

It was crucial for the secondary-task probe to occur at a time shortly after the subject had finished reading the question to themselves and had begun processing the embedded question. However, as each embedded question varied in length, it was impossible to select a single set time for the probe to occur that would allow the subject to silently read any given question after it had appeared on screen. An attempt was made to determine the average reading time for each of the embedded questions. This was done by timing two female volunteers (12 and 16 years-old) while reading each question silently to determine approximately how much time would be required to read each of the embedded questions. It was determined that on average it took approximately one second to read three words (.33 seconds per word). Based on this admittedly rough formula and the number of words contained in a particular embedded question, the time-delay for each question to be displayed on the screen before the secondary-task probe sounded was determined and programmed into the test application.

After observing problems during data collection and speaking with each subject after completing the second session it became apparent that hand placement at the time of the auditory probe varied considerably. Several subjects reported that on some of the question trials the probe sounded just before they had finished reading the question, whereas on other trials the probe sounded when they were picking up their pencil to begin writing. Slower readers may have had their hands on the mouse when the probe sounded, thereby enabling them to elicit a very short reaction-time due to the proximity of their hand to the target button (i.e., the mouse button itself). The resultant reaction-time in this case would be a measure of effort related to physically reading the question rather than mental effort associated with actively processing the question en-route to an answer. Conversely, those who read faster may have already moved their hands away from the mouse to begin answering the question when the probe sounded. Such a reaction-time would represent a clouded mixture of lag-time due to psychomotor movement as well as the mid to late stages of processing on the embedded question.

An additional problem existed with the reaction-time measure that was related to the Authorware 3.0.1 authoring environment used to create the *IMPART 1.2*© program. Subjects were instructed to click the mouse button as quickly as possible when they heard the auditory probe. During the prestudy it was observed that a subject could depress and release the mouse button quickly enough that the Authorware program did not register the mouse-click, resulting in subject confusion as to why the program hadn't advanced to the next screen. Subjects either informed the experimenter that the program appeared stuck or clicked a second time, this time

slowly enough to register, moving them forward in the program. Either scenario resulted in reaction-times that were greatly inflated and in no way reflected the true response of the subject.

It was determined during the prestudy that the Authorware program checked only periodically for key-presses and mouse-clicks, such that it was possible for subjects to respond quickly enough that the program would miss the mouse-click. Before full-scale data collection began, the training program was altered to train subjects to click the mouse button as quickly as possible, but to hold the button down until they saw the phrase "OK!" flash briefly on the screen in 3" red letters. All of the test applications were altered in the same manner. This solution appeared adequate at the time, but proved to be far from perfect as it allowed the Authorware program to essentially "round" the actual reaction-times up to the nearest interval at which the program would probe for mouse-clicks and key-presses. Although this interval is relatively short (likely between 100 and 250 ms., depending on the speed of the computer), it undoubtedly led to inaccuracies in the reaction-time data. Smaller inaccuracies resulted when the subject responded and had to hold the mouse button down to register their response, and much larger inaccuracies resulted when subjects clicked and released too quickly, having to click a second time in order to register a response.

As mental effort rating and reaction-time were theoretically measuring the same construct of cognitive engagement, it was initially expected that the average reaction-time data would have shown a strong positive correlation to the average mental effort rating data. However, given the number and severity of problems associated with the reaction-time measure, it is little surprise that such a correlation was not observed. In addition, Wickens (1992) noted that high correlations between such measures of workload would generally only be found if the measures are assessed across tasks of similar structure and widely varying degrees of difficulty. As mentioned, the lack of a sufficiently challenging topic area in this study resulted in the two types of embedded questions being too similar to one another on the dimension of mental effort, further reducing the likelihood of finding a positive correlation between these two measures of mental effort.

5.2.3 Attitude constructs. The general lack of significance on the paired *t*-tests conducted on pre- and posttest attitude constructs would suggest that, regardless of experimental condition, the alcohol education program had no overall effect on changing alcohol-related attitudes. In examining the results across experimental condition, the exploratory analyses yielded a number of unexpected findings; however, a few expected results emerged that lend some limited support to the research hypotheses.

It was hypothesized (H1) that greater positive changes would be observed across all attitude constructs for subjects in the question conditions in comparison to the control group. This hypothesis received partial support as subjects in the inference question condition exhibited a significantly greater positive change in perceived benefit to avoiding alcohol in comparison to subjects in the control group, who unexpectedly exhibited a negative change on this attitude construct. Subjects in the factual question condition also exhibited a positive change on this construct; however, differential scores for factual condition subjects were not significantly different from the other conditions.

One possible reason for the question conditions showing positive change on this attitude construct relates to the content of the video segments and the embedded questions themselves. The interactive video focused on the consequences of action in typical scenarios where alcohol might be present. The branches of the story line were such that the subject first viewed what might happen if alcohol is included in the decision, followed by what might happen if alcohol is excluded from the decision. This is essentially an exercise in exposing the benefits of avoiding alcohol, both by

example and non-example, where the decision to use alcohol inevitably leads to a negative consequence and the decision not to use alcohol leads to comparatively more positive outcomes.

In addition to the interactive video's focus, every attempt was made to create factual and inference embedded questions which focused on alcohol or alcohol-related events and circumstances. The focus of the interactive story, coupled with the focus of the embedded questions may have provided enough exposure and prolonged thought to the consequences of accepting alcohol and the benefits of avoiding it that subjects in the question conditions were persuaded to re-evaluate and subsequently change their attitudes in a positive direction on this construct.

Of greater concern is an explanation for the observed negative change for control group subjects on this construct. Perhaps the circumstances portrayed in the scenarios were not realistic enough to convince control group adolescents of the benefits of avoiding alcohol. Such a lack of realism could be due to a number of factors, such as less than believable acting talent or scripts, or a lack of sufficient drama to convey the seriousness and relative likelihood of the consequences.

The primary function of questions in the learning process is to establish and maintain attention to provide for rehearsal and facilitate the encoding of information (Wager & Wager, 1985). The embedded questions may have drawn attention away from any shortcomings of the story or its production and redirected attention to the meaning of the events involved in the individual segments. Given that inference questions asked subjects to make inferences and draw conclusions regarding alcohol-related circumstances, this type of question could certainly have focused attention on the deeper meaning of the circumstances and events in the segments. Even the factual questions, which requested the recall of specific "surface detail" information from the segment, were at the very least focused on the alcohol-related circumstance or event whenever possible. Perhaps, in the absence of such questions, attention to the meaning of the interactive story's segments was lost to criticisms or other distractions.

Although gender effects were not included in the original hypotheses for this research, the results seem to indicate that these factors may play a significant role in the overall effectiveness of an alcohol education program. For example, males were observed to exhibit a positive change in perceived severity of alcohol-related consequences whereas females exhibited a negative change on the construct. A similar pattern was also observed in the interaction between experimental group and gender on the change in composite attitude score, such that male subjects in the embedded question conditions exhibited a positive change in overall alcohol-related attitudes whereas female subjects in the embedded question conditions exhibited a negative change in overall attitude score.

Analyses conducted on pretest measures of these constructs revealed that males began the study with significantly riskier attitudes (i.e., lower attitude scores) toward alcohol-related behavior than females on both perceived severity of alcohol-related consequences (F (1, 31) = 7.223, p = .0115) and composite attitude score (F (1, 31) = 7.284, p = .0112). The posttest scores across gender groups converged such that male attitudes became somewhat less risky than before the study (i.e., increasing in score), whereas female attitudes showed a trend in the riskier direction (i.e., decreasing in score).

Relatively consistent differences in risk perception across gender associate males with greater risk-taking behavior than females (Cherpitel, 1993; DeJoy, 1992; Irwin & Millstein, 1986). As such, the fact that males began the study with significantly riskier attitudes than females should not be surprising and it could logically be argued that males' attitudes improved as a result of using the alcohol education program. More difficult to explain is the observed negative change in attitude for

female subjects. It could be the case that females overestimated the severity of alcohol-related consequences in the pretest, and these attitudes normalized to roughly the same level as males after viewing the alcohol education program.

Another explanation for this unexpected negative attitude shift relates to the fact that pre- and posttest measures of the attitude and knowledge differed with respect to the settings in which they were administered. The pretest measures were administered in the subject's home whereas the posttest measures were administered in a laboratory setting immediately following the multimedia intervention. Subjects were strongly encouraged during pre- and posttest administrations to give honest answers and were assured that their responses would be considered strictly confidential and that they would remain completely anonymous. However, it is quite possible that some subjects felt compelled to respond differently during the pretest for a number of reasons.

As there were typically other family members at home when the subject was completing the pretest measures, subjects may have felt compelled to provide less risky responses to the attitude questions in case one of their family members inadvertently viewed their responses. In contrast, there was absolutely no risk of a family member seeing any of their responses in the posttest administration. Although highly speculative, it is possible that females were more sensitive to the risk of family members inadvertently viewing their responses than were male subjects, compelling them to make responses which were less risky. If this were the case, it could help to explain why female subjects exhibited a negative change on these attitude constructs.

The pretest measures were administered at home as a convenience to the subjects' families. Due to the unique constraints of this research project, the use of a standard location for subjects to administer both pre- and posttest measures would have required the majority of the subjects to travel 60 minutes round-trip to spend only 15 to 20 minutes completing questionnaires, and to make a second trip two weeks later for the second session. This seemed too much to ask of subjects and their families given that subjects could only be paid $15 for their participation.

5.2.4 Knowledge constructs. Although recognition, recall, and composite knowledge constructs each showed a significant positive pre- to posttest change in paired *t*-tests (see Appendix S), no significant main effects were observed across experimental group. This would suggest that interactive video may be appropriate for knowledge-based training; however, it is unclear whether the use of factual or inference embedded questions would increase the effectiveness of interactive video for learning. As mentioned previously, the instructional material used in the current study may not have been conceptually challenging enough to expose the benefits of the embedded questions. It is quite possible that the differential effectiveness of these embedded question types would be realized in a more demanding topic area.

The only expected results to emerge from the analyses involved internally-oriented subjects outscoring their external counterparts on the recall knowledge construct as well as the composite knowledge measure. These findings lend support to the hypothesis (H5) that individuals with an internal LOC orientation would show greater gains in knowledge, and is consistent with research conducted by Wolk and DuCette (1974) who found that internals recall more than externals on certain tasks requiring memory of relevant information. Based on some of the literature (Thal et al., 1983) we could speculate that this increased knowledge gain is due to internals processing the information at greater depth than externals; however, this study's reaction-time results do not support such an explanation. These results should be interpreted with caution due to the aforementioned limitations of the LOC group variable used in these analyses.

Finally, the significant positive correlation between age and the change in recall knowledge shows older subjects being associated with greater pre- to posttest gains on the recall component of the AKQ. This may simply mean that the older subjects were better able to learn from the program than younger ones, perhaps due to their increased experience with (a) computers and computer aided learning, (b) learning of instructional material, or (c) test-taking, especially when more difficult, short-answer recall questions were involved.

5.3 Limitations of This Study

5.3.1 Model association. One limitation of the current study involves the removal of a number of questions in the Youth Alcohol & Drug Survey (YADS) (Werch, 1995) during its modification for this study. The YADS is based on the Multi-Component Motivational Stages (McMOS) model (Werch & DiClemente, 1994), as is the content of the *IMPART 1.2*© alcohol education software. The purpose of the original YADS was to determine what youth are thinking (i.e., attitudes) and doing (i.e., behaviors) about alcohol and drugs. As drug use and underage drinking are illegal activities, the collection of information regarding such activities would place subjects at a certain degree of risk. Given that this study was concerned only with the effects of different training techniques on knowledge gain and attitude change, the degree of risk posed to subjects by asking questions regarding illegal behaviors was deemed unnecessary by the Virginia Tech Institutional Review Board. In an effort to reduce the level of risk posed to subjects, all questions asking subjects to reveal illegal activities were omitted from the YADS. As such, the modified version included only those constructs and related questions which assessed alcohol-related attitudes and beliefs -- all behaviorally-based constructs and their related questions were removed.

Unfortunately, a subset of these questions which comprised the constructs *Stage of Acquisition* for alcohol, and *Stage of Habit Change* for alcohol on the YADS, were among those questions removed from the modified version as they dealt with behavioral issues. As the McMOS model is based on stages of intentional behavior change, the missing constructs would have provided a crucial link to the model's continua of change and may have provided additional insight to the results of this study by directly relating the remaining attitude constructs to any movement along these continua of change.

5.3.2 Experimental design. Another limitation of this study involves its experimental design. The original design involved a 2 x 3 between-subjects pretest-posttest control-group design involving two levels of LOC orientation (internal and external) and three levels of question condition (control, factual, and inference). Subjects in this design would have been assigned to experimental condition based on the results of a screening for LOC orientation. This would have allowed for greater LOC score separation between LOC groups, and subsequently less problematic analyses of the interaction between LOC orientation and embedded question condition, providing greater power and yielding more robust results. The design was reduced to the present three group comparison by eliminating the LOC variable as a true factor due to limited resources and conflicts between existing time constraints and the additional time required to screen enough subjects to achieve a sufficient level of separation between LOC groups.

5.3.3 Methodology. This study was also limited by a number of aspects of its methodology. As mentioned previously, crucial flaws in the design of the reaction-time measure crippled its utility as an index of processing depth. Potential remedies for this problem are presented later in this chapter under Suggestions for Further Research.

Another limitation involved the lack of a control for previous exposure to alcohol education programs, as this information may have proven useful in gaining insight to otherwise unexplainable results. This omission is due to an oversight committed during the modification of the YADS for use in the current study. The original YADS included a question regarding previous alcohol and drug education programs; however, in the effort to reduce the YADS version to questions relating only to alcohol-related attitudes, this question was inadvertently removed.

Due in part to a limited subject pool and limited resources, the current study involved a relatively low number of subjects who do not seem to be representative of the general population of 12 to 15 year old adolescents. Although it is difficult to say whether similar interactions and main effects would have been observed had a larger and more representative sample been used for the study, such an increase in sample size would have certainly provided a much needed boost in power.

Another limitation involves the administration of the pre- and posttest measures of knowledge and attitude. The pretest knowledge and attitude measures were administered at the subject's home while the experimenter waited in another room with at least one of the subject's parents. In contrast, the posttest knowledge and attitude measures were administered immediately following the multimedia intervention while the experimenter waited in the hallway. This lack of consistency could have had an effect on how subjects answered the questions on each of these measures. Although it was stressed to the subject that their anonymity would be preserved, filling out a survey regarding alcohol-related attitudes while the subject's parents are in the next room may have inflated pretest subject attitude scores, such that they reflected "healthier" attitudes than would have normally been reported. Conversely, subjects may have been prone to respond more honestly in the posttest, knowing that there is no chance their parents would see the responses on the survey. If such an effect were present, it may help explain some of the puzzling negative changes in attitude observed in some of the attitude differential scores.

Finally, it is interesting to note that the paired *t*-tests revealed a significant overall positive change on each of the knowledge constructs; however, no such overall change was observed for any of the attitude constructs. This is perhaps due to the limited duration of the multimedia program used in this study, as it is unlikely that such a short intervention is sufficient to promote any reliable changes in alcohol-related attitudes.

5.4 Significance of Research

The results of this study lend support to the literature regarding the observed trend of subjects with internal LOC orientations outperforming those with external orientations in tasks requiring memory of relevant information. In the current study it was hoped that embedded questions might serve to narrow the gap between internals and externals for this type of learning such that externals might increase their potential for learning to roughly the same level as internals. Specifically, inference questions were expected to force external subjects to consider how the consequences of alcohol-related behavior might affect them, something that externals are not likely to do on their own volition. Although this expectation was not realized, it is apparent from the results of this study that the learner characteristic of LOC has significant bearing on the design of training systems and should be considered in the design and evaluation of such systems.

The significant overall changes in knowledge, coupled with the lack of significant overall changes in attitude in the current study lends support to the conclusion drawn by Clark and Sugrue (1989) that learning task type bears heavily on the efficacy of learning from media presentations. The results of this study raise question to the appropriateness of using interactive video in attitude-

type training; however, due to the number of limitations in the current study further research must be conducted to more effectively address this issue.

Embedded questions were expected to enhance knowledge gain and attitude change with inference questions proving more beneficial than factual questions; however, no reliable differences were observed across embedded question type for any of the dependent measures. Certain characteristics of the instructional domain of alcohol education may have limited the range of mental effort required by the questions making it difficult to identify differences in these measures. Although alcohol education is inarguably an important issue, the topic area's general lack of abstract concepts or complex problem-solving may have produced a constrained and conceptually "flat" arena in which to test these hypotheses. From this, it would seem that the decision to incorporate embedded questions must take into consideration the topic area and type of instructional material involved. Topics that involve some degree of complex problem-solving, such as statistics or computer programming, may be more appropriate for the inclusion of different types of embedded questions in the instructional material. Further research is needed to help establish guidelines to determine the characteristics of a given topic area that might make it a good candidate for using embedded questions or interactive video.

Much can also be learned from this research in terms of improved methodology. First, this research has illustrated the need for thorough prestudies and pilot-testing, as a more comprehensive prestudy would have helped to ensure that the embedded questions elicited the anticipated levels of mental effort from subjects, and could have helped identify the severity of the problems associated with the reaction-time measure. Second, this study has illustrated that the use of a more cognitively-challenging topic for the instructional domain is needed to ensure a sufficient difference between question types in terms of mental effort by supporting the creation of inference questions which are adequately demanding. Thirdly, this study has illustrated the need for substantially longer interventions in instructional domains where attitude changes are a factor. Finally, this study has illustrated the need for more standardized methods in timing auditory probes for secondary-task measures.

Regardless of the limited support shown for the use of embedded questions in this study, computer-based interactive video (CBIV) remains a potentially powerful tool for teaching higher order concepts, principles, procedures, and motor skills, as well as instruction dealing with attitudinal issues (Jost, 1992). Students using CBIV are able to take control of their own instruction by becoming actively involved in simulations which allow them to explore complex situations and receive immediate feedback (Farrell, 1991). The ability to simulate or role-play interpersonal interactions in vivo is especially important in areas such as adolescent alcohol education, which are difficult or otherwise impossible to teach.

5.5 Suggestions for Further Research

Considerable research needs to be conducted to identify the characteristics of a topic area that make it a good candidate for using interactive video, embedded questions, or any other training technology. For example, the use of a concept-rich instructional topic such as statistics, physics, chemistry, computer programming, literature, or biology would likely prove more challenging and better support the creation of more thought-provoking inference questions. It is believed that the general lack of abstract concepts in the alcohol education domain limited the ability to create embedded questions which were truly different in terms of the mental effort required to answer them. One line of research should investigate topics of varying difficulty to help establish guidelines to aid developers of training systems in selecting appropriate training technologies for specific training goals given the difficulty or abstract nature of the subject matter.

Future research should also strive to improve upon the methods used in the current study. For example, a number of changes could be made to rectify the variability problems associated with the reaction-time measure. The problem of hand placement could have been avoided by using an alternate response button, such as that on a second mouse or other constructed input device, connected to the computer and held stationary in a location equidistant from the subject's mouse and writing area to minimize variability of hand movement when responding to auditory probes.

The technique used to time the delay of auditory probe presentation could also be improved in a number of ways. For instance, if typing ability had not been an issue with the age group involved, subjects could have been instructed to read the question and then click a "Done" button as soon as they had finished reading. A subsequent screen might then appear for them to key in their answer to the question. On selected trials, the auditory probe would sound shortly after clicking the button or moving to the answer screen, thereby providing the ability to incorporate a standard time interval after the question has been completely read and before the auditory probe has been presented.

Cueing is a potential problem with this solution as subjects may be cued more easily due to a potentially more apparent pairing between switching screens and receiving an auditory probe. For the same reason, cueing was also an issue in the reaction-time trial method used for the current study; however, the cueing effect was not likely a factor since the majority of question trials had no reaction-time trial associated with them, and the four reaction-time trials were distributed on question trials when it was likely that they wouldn't be expected. Given a relatively small number of carefully distributed reaction-time trials, a cueing effect would not likely prove to be a factor for the alternative solution.

The reaction-time measure was not the only problematic measure of processing depth. The subjective mental effort rating scale may not have been sensitive to the amount of processing associated with answering the embedded questions as it did not address the degree to which subjects called upon existing knowledge in answering the embedded question (e.g., to draw inferences or form conclusions regarding the inference questions). Future research should use a more accurate measure of mental effort rating which might include questions that address the degree to which the subjects feel they have used existing knowledge from their previous experiences to answer a given question. A probe such as this might better capture the true construct of interest -- deep processing in terms of the integration of new information with existing knowledge.

Future research should also attempt to investigate the longer-term effects of interactive video training. Such research should assess not only long-term retention of learned materials and stability of self-reported attitude change, but attempt to determine the degree to which this training transfers into real-world experiences and social interactions with peers as well. Additional research is needed to determine the usefulness of interactive video, with and without embedded questions, in attitude-type training. Furthermore, future studies should attempt to explain how individual differences affect the learning process and investigate the impact that various types of interactions can have on different learners.

5.6 Summary and Conclusions

Plagued by a number of methodological shortcomings, the research hypotheses for this study received very limited support from the analyses. The most notable of these methodological problems involve a severely flawed reaction-time measure, a conceptually undemanding

instructional domain, and confounding settings for pre- and posttest administration of questionnaires.

The overall lack of significance on all of the paired *t*-tests conducted on the individual attitude constructs indicates that, regardless of experimental condition, no significant overall change in attitude occurred. Although contrary to contentions made in the literature (Jost, 1992), this seems to suggest that the use of interactive video may not be appropriate when a training program's goals include attitude change. To be fair, the intervention used in the current study was admittedly brief and it is quite possible that extended interventions would result in more favorable outcomes. Furthermore, the exploratory analyses yielded mixed findings that provide only limited support to the attitude-related hypotheses. Although the use of factual or inference embedded questions did little to increase the effectiveness of interactive video for changing alcohol-related attitudes, the lack of clear evidence suggests that more research be conducted in this area to determine appropriate durations for interventions across a number of topic areas to be effective at promoting attitude change.

Although recognition, recall, and composite knowledge constructs each showed a significant positive pre- to posttest change in the paired *t*-tests, no significant main effects were observed across experimental group. This would suggest that interactive video may be an appropriate choice for knowledge-based training applications, although it is unclear whether the use of factual or inference embedded questions would increase the effectiveness of interactive video for learning. It is likely that the lack of a concept-rich topic area did not provide enough challenge to expose the benefits of the embedded questions. As such, further research is needed in this area as it is quite possible that the differential effectiveness of these embedded question types would be realized in more cognitively-demanding topic areas with respect to knowledge gain.

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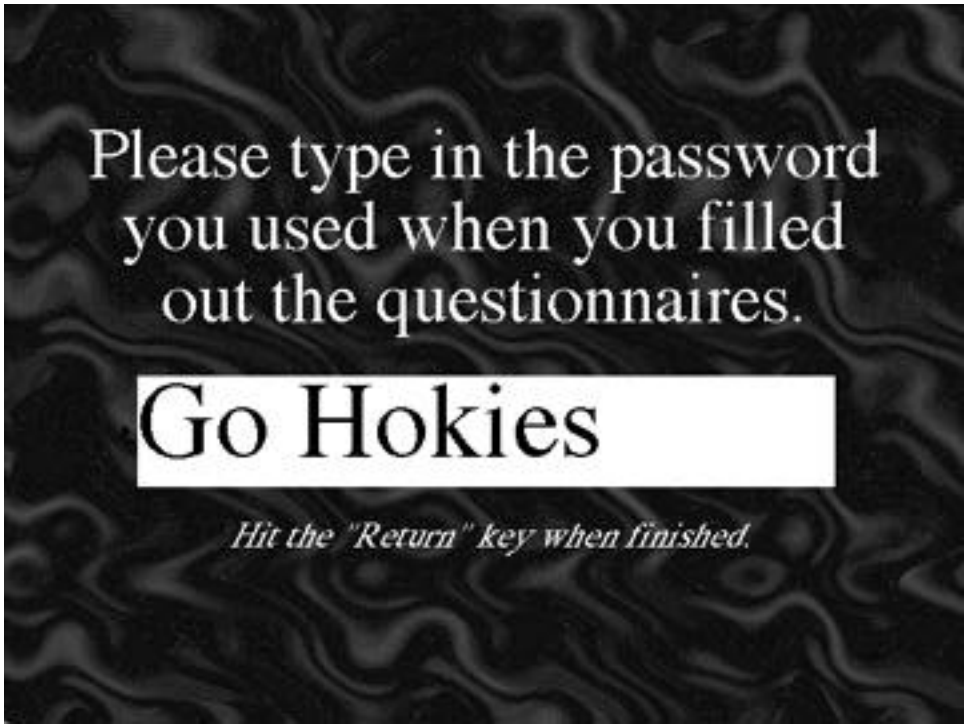
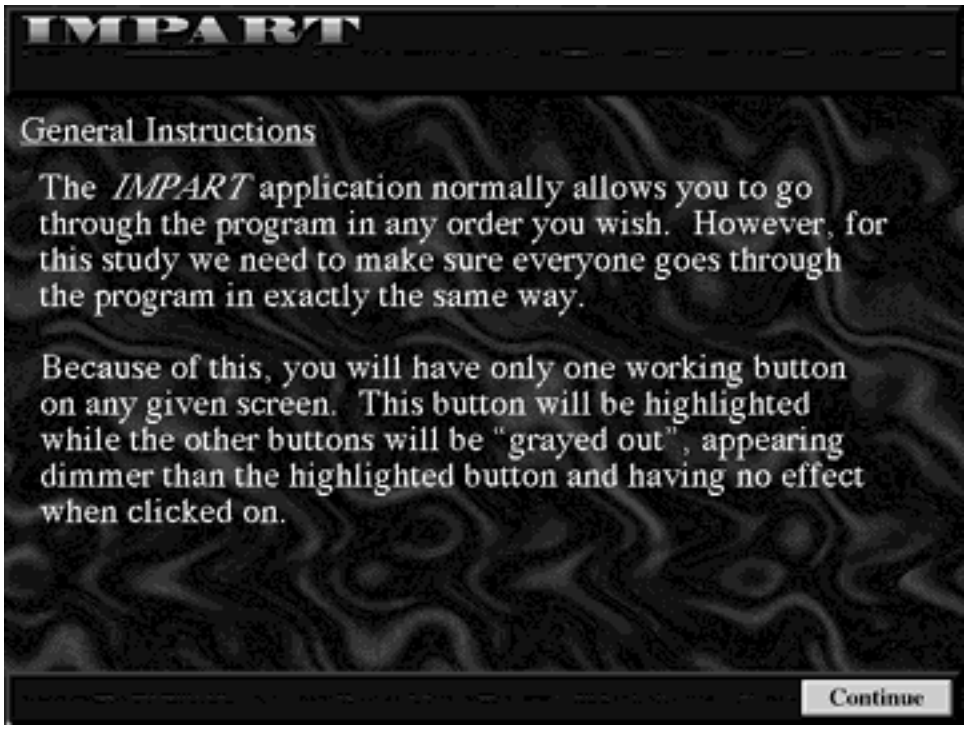
APPENDIX

A

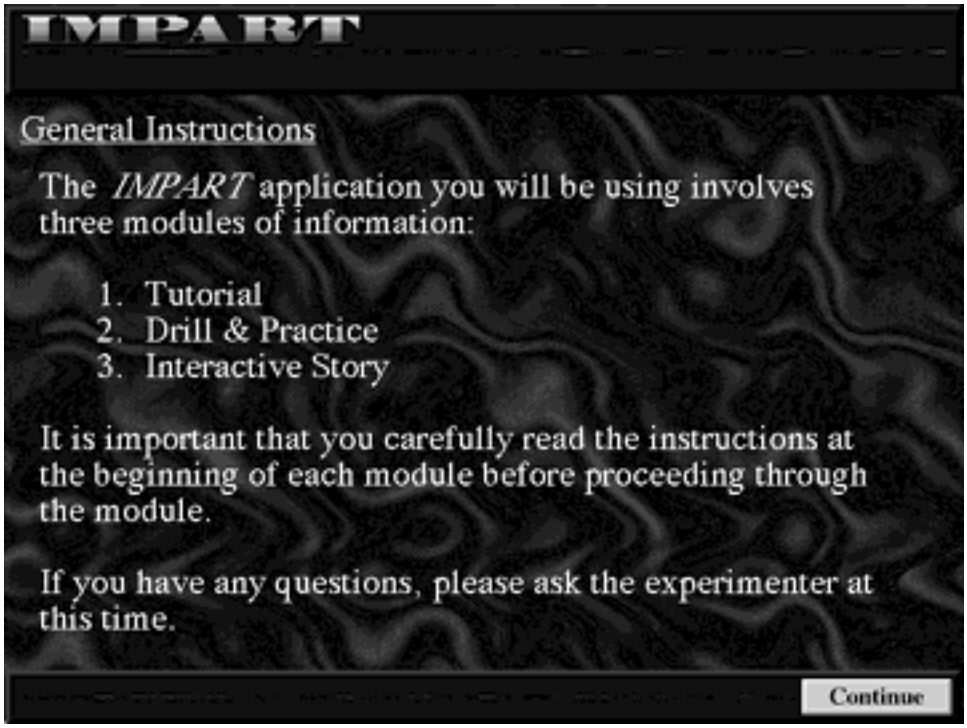
IMPART 1.2© OPENING SEQUENCE STORYBOARD



Password frame. *(© 1997 ARCOVA)*



General instructions frame 1. *(© 1997 ARCOVA)*

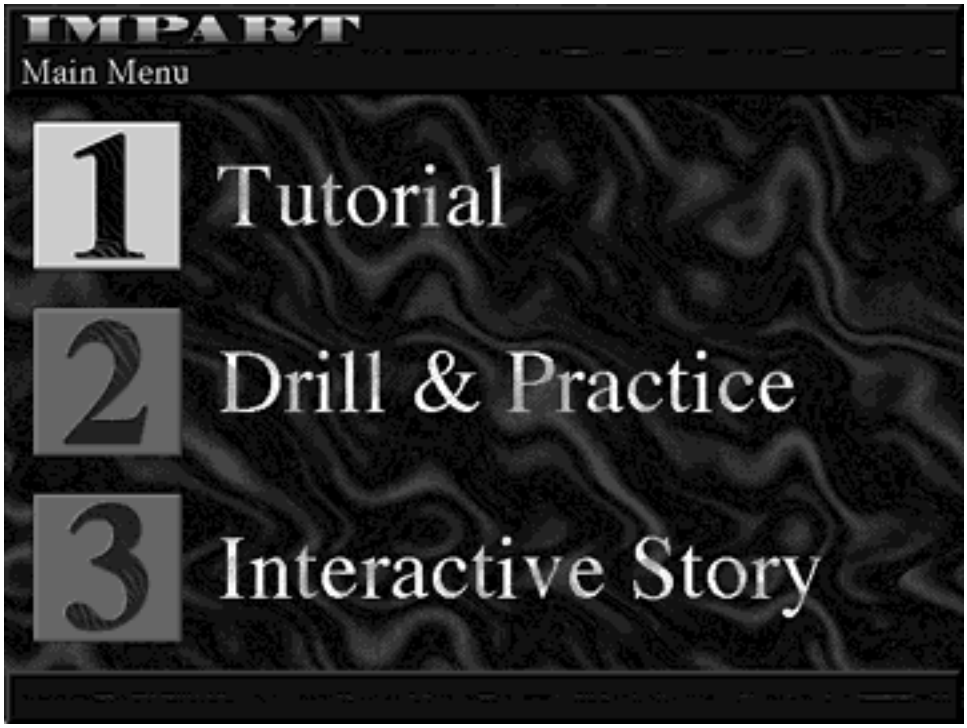


General instructions frame 2. *(© 1997 ARCOVA)*

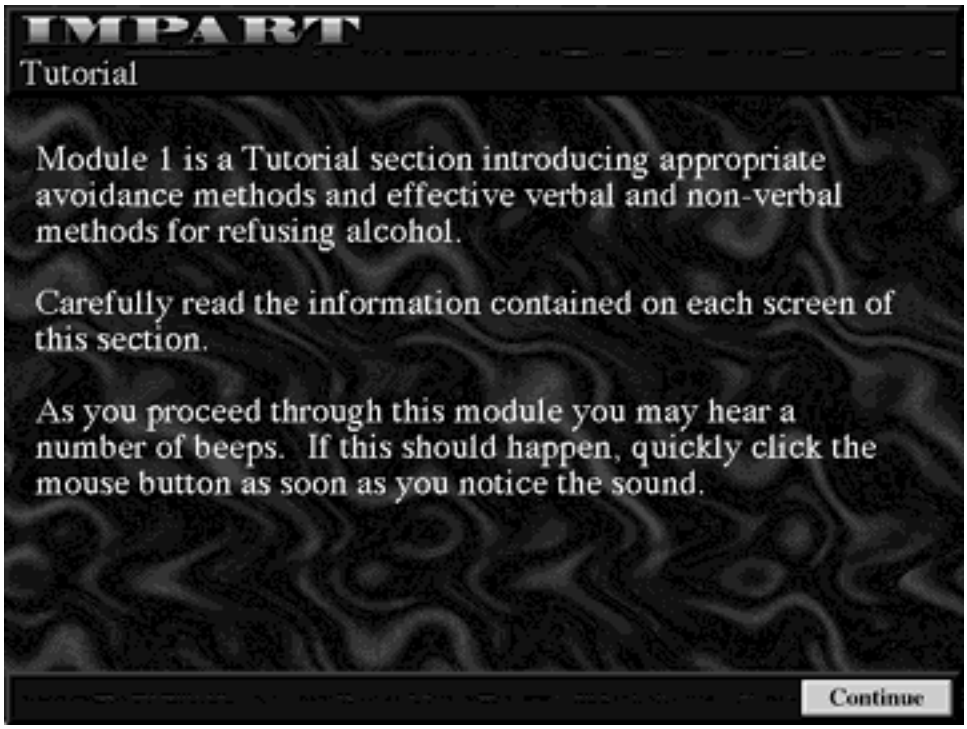
APPENDIX

B

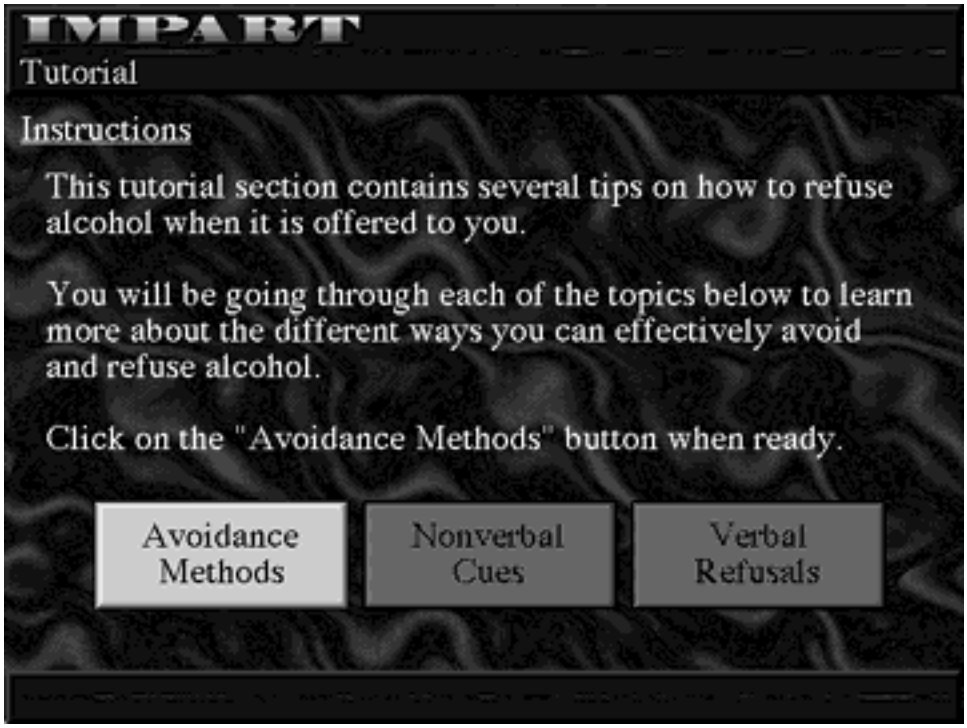
TUTORIAL MODULE STORYBOARD



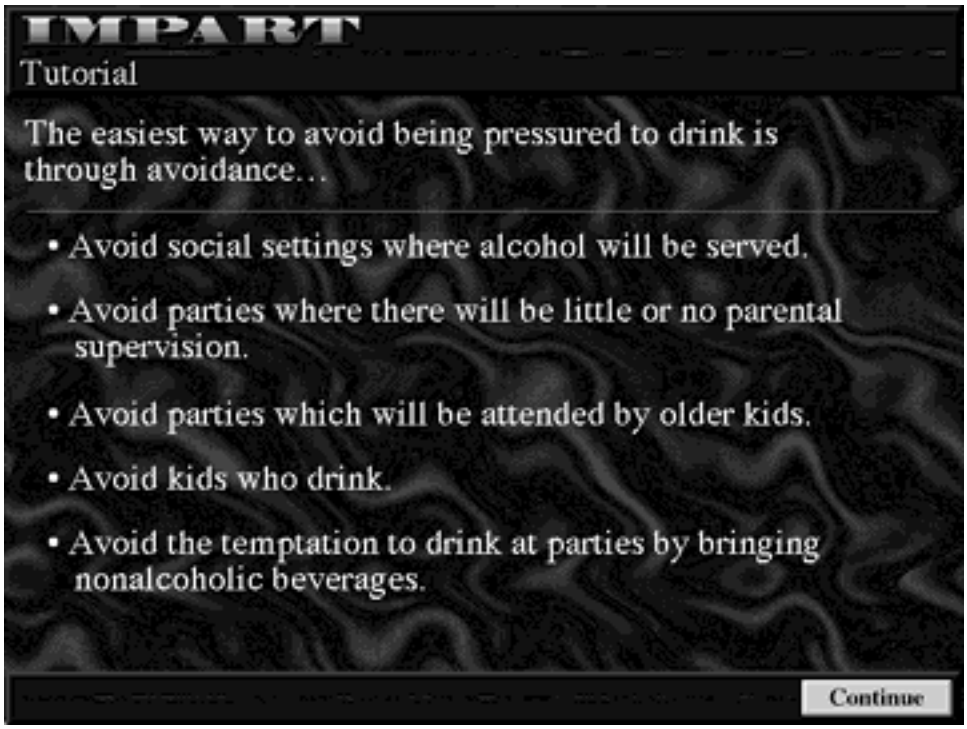
Main menu - *Tutorial* module enabled. *(© 1997 ARCOVA)*



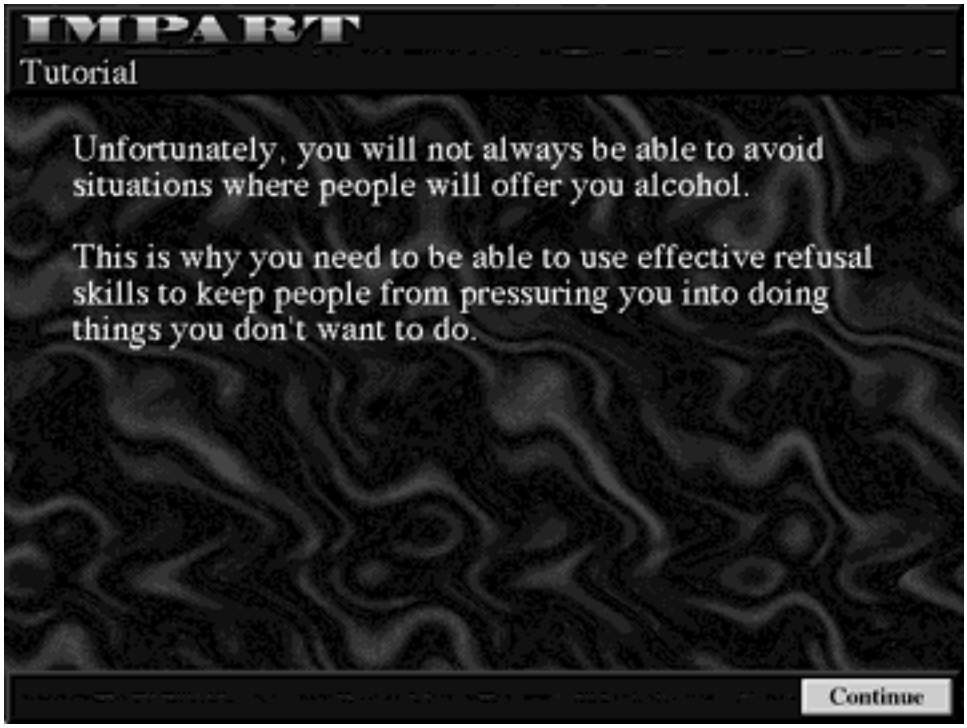
Tutorial: Module description frame. *(© 1997 ARCOVA)*



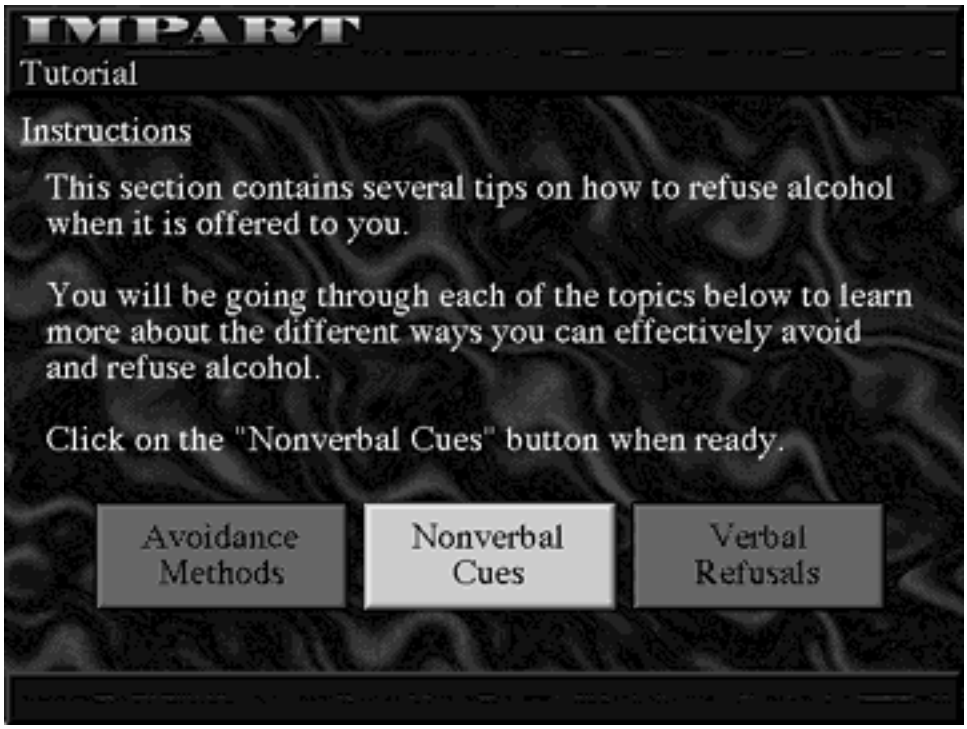
Tutorial: General instructions and submenu - Avoidance Methods enabled. *(© 1997 ARCOVA)*



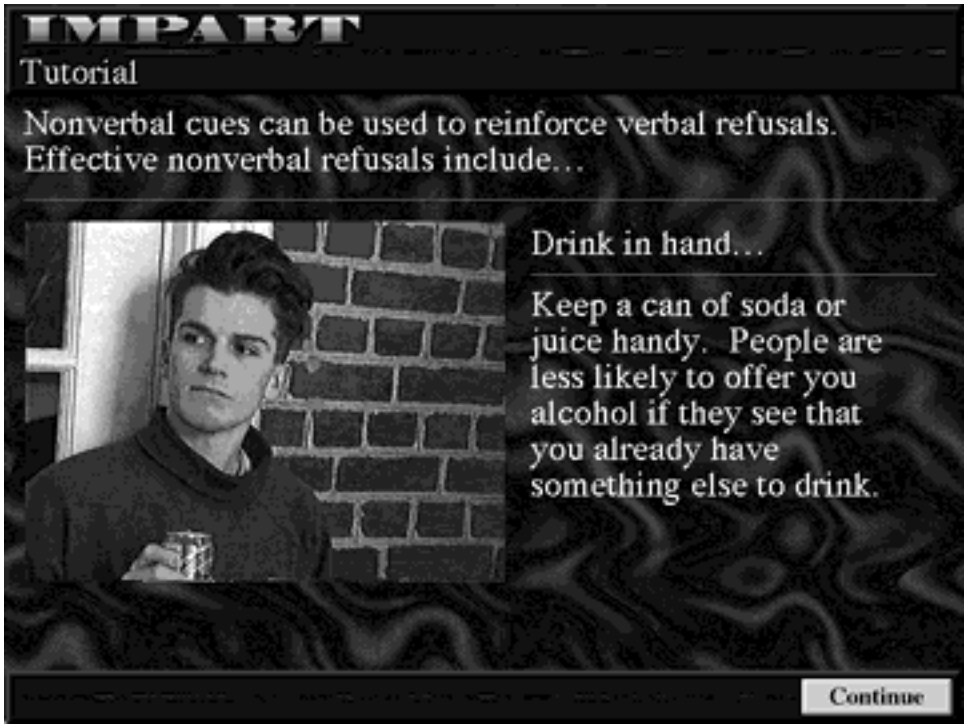
Tutorial: Avoidance frame 1. *(© 1997 ARCOVA)*



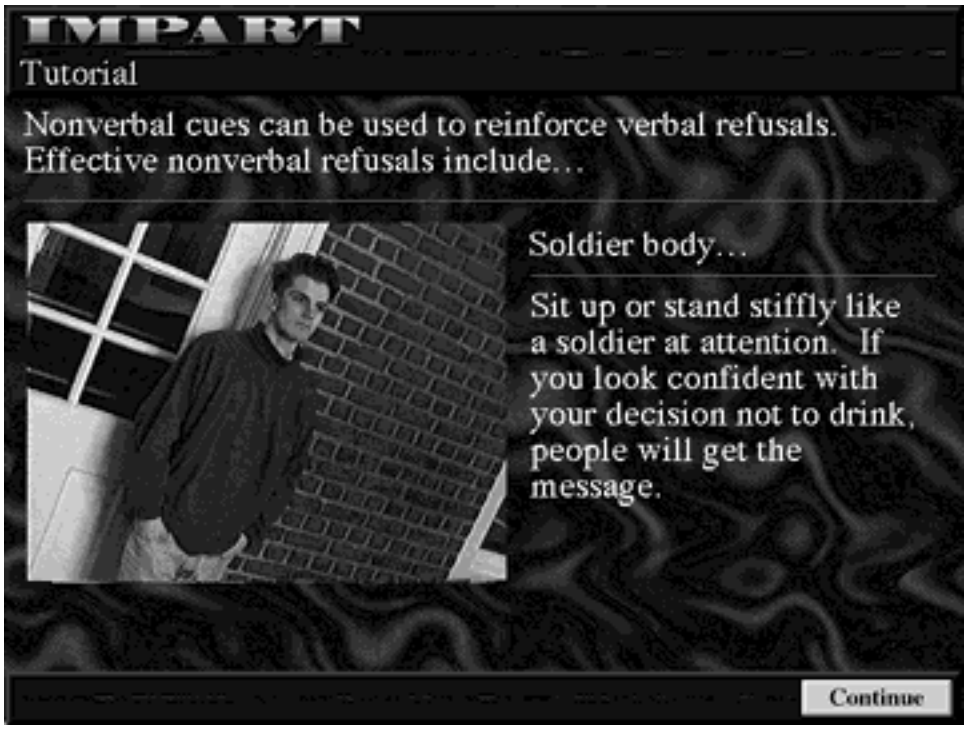
Tutorial: Avoidance frame 2. *(© 1997 ARCOVA)*



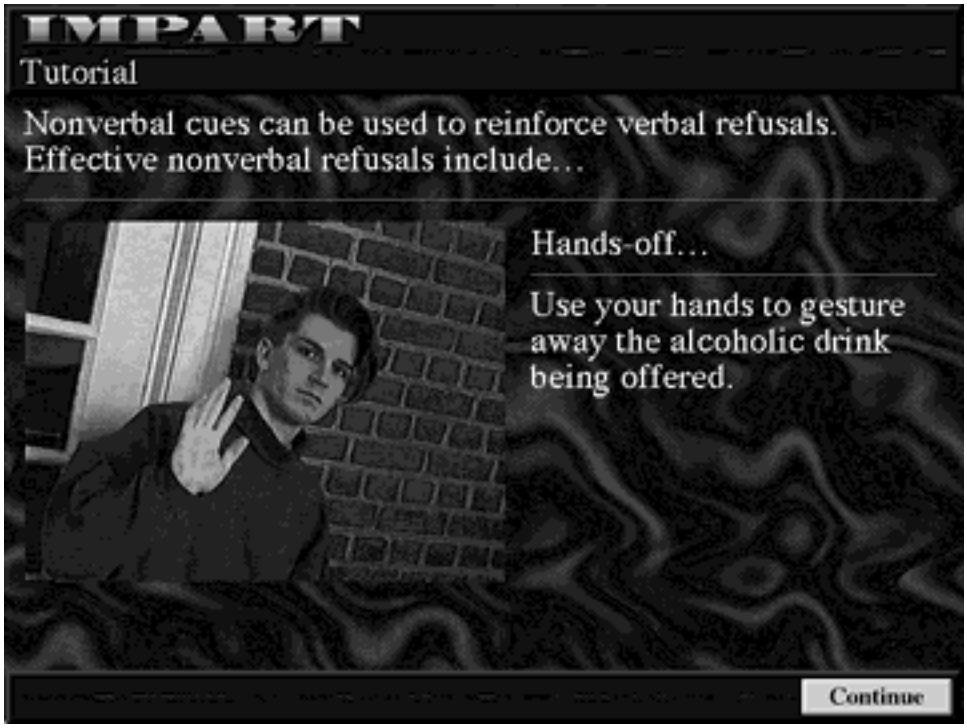
Tutorial: General instructions and submenu - Nonverbal Cues enabled. *(© 1997 ARCOVA)*



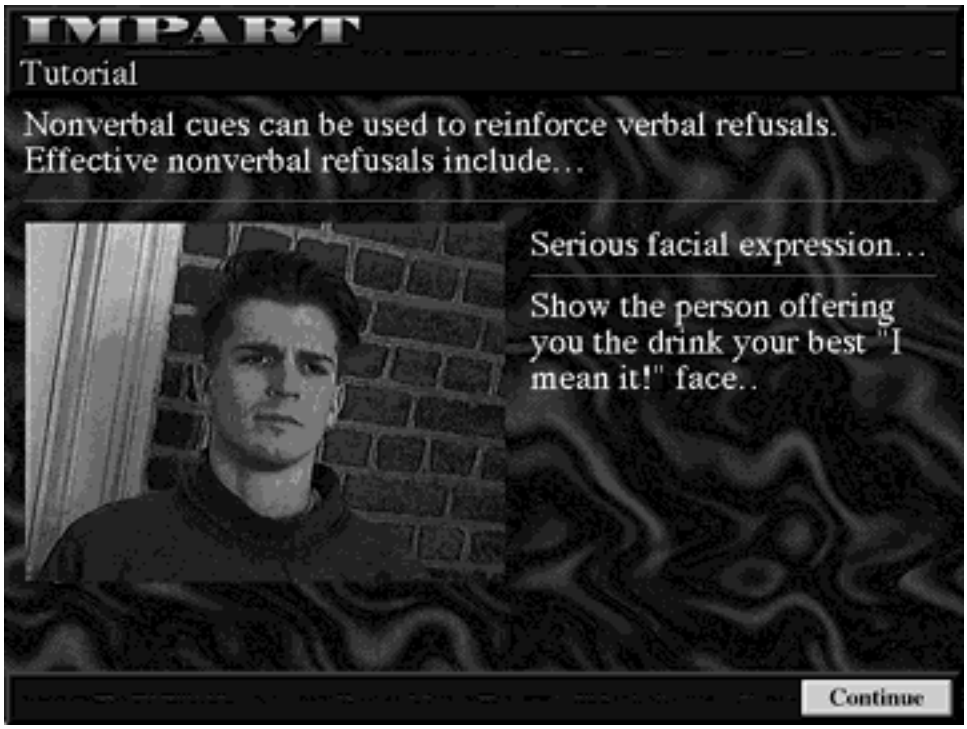
Tutorial: Nonverbal cues frame 1 - "Drink in Hand". *(© 1997 ARCOVA)*



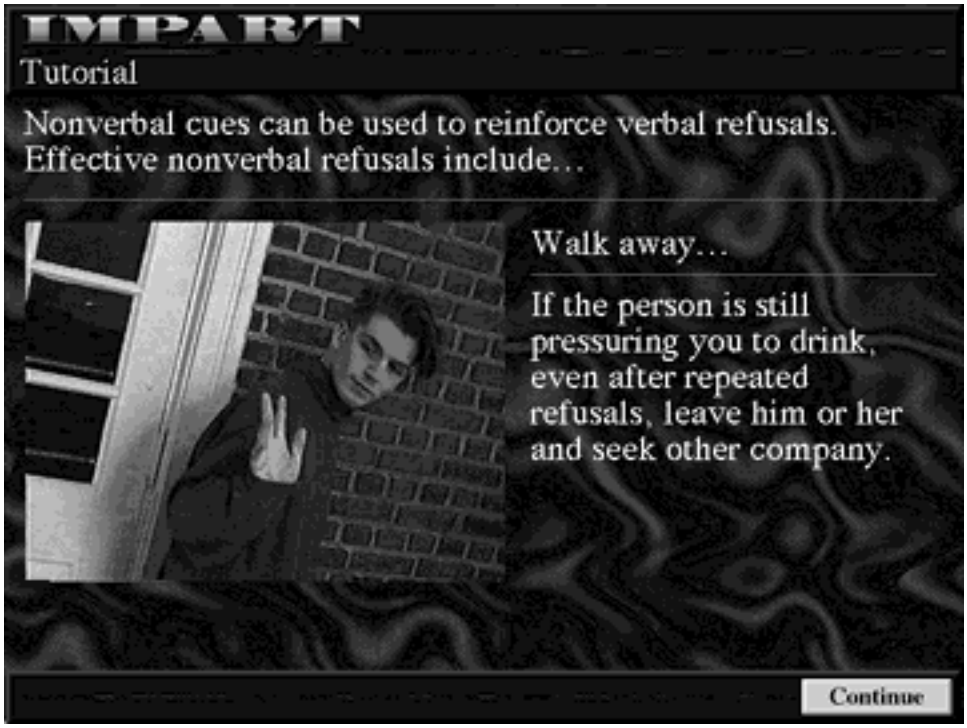
Tutorial: Nonverbal cues frame 2 - "Soldier Body". *(© 1997 ARCOVA)*



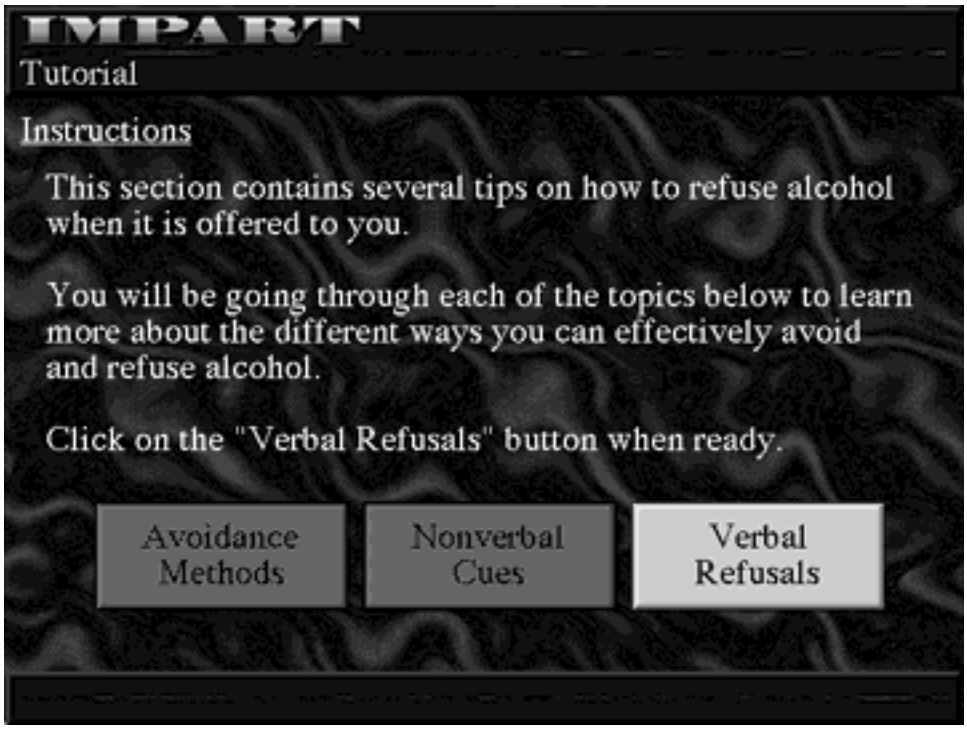
Tutorial: Nonverbal cues frame 3 - "Hands Off". *(© 1997 ARCOVA)*



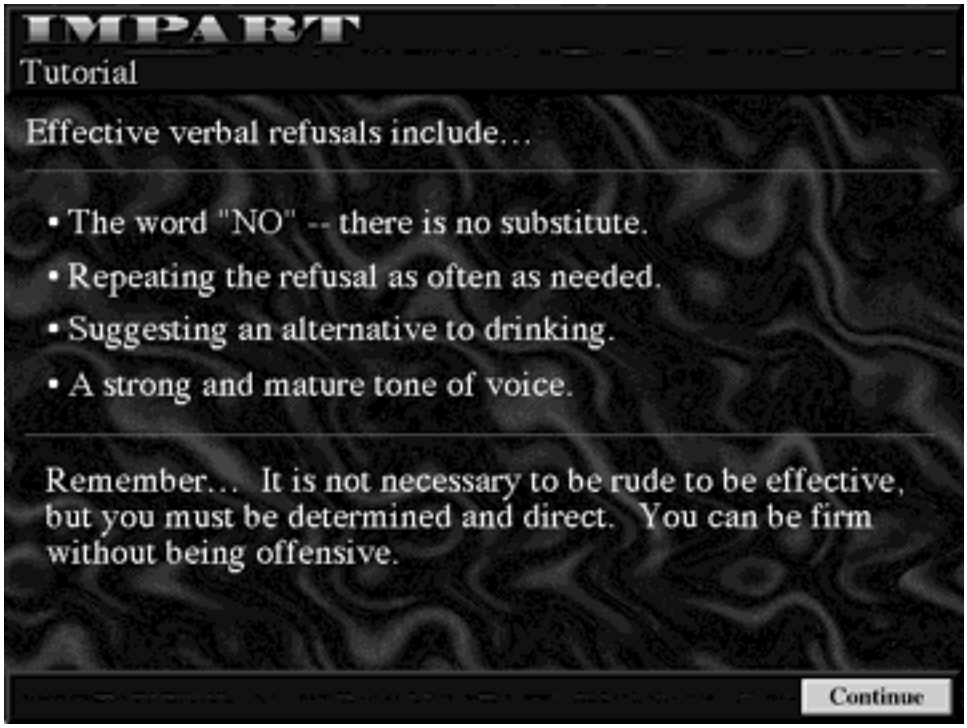
Tutorial: Nonverbal cues frame 4 - "Serious Facial Expression". *(© 1997 ARCOVA)*



Tutorial: Nonverbal cues frame 5 - "Walk Away". *(© 1997 ARCOVA)*



Tutorial: General instructions and submenu - Verbal Refusals enabled. *(© 1997 ARCOVA)*

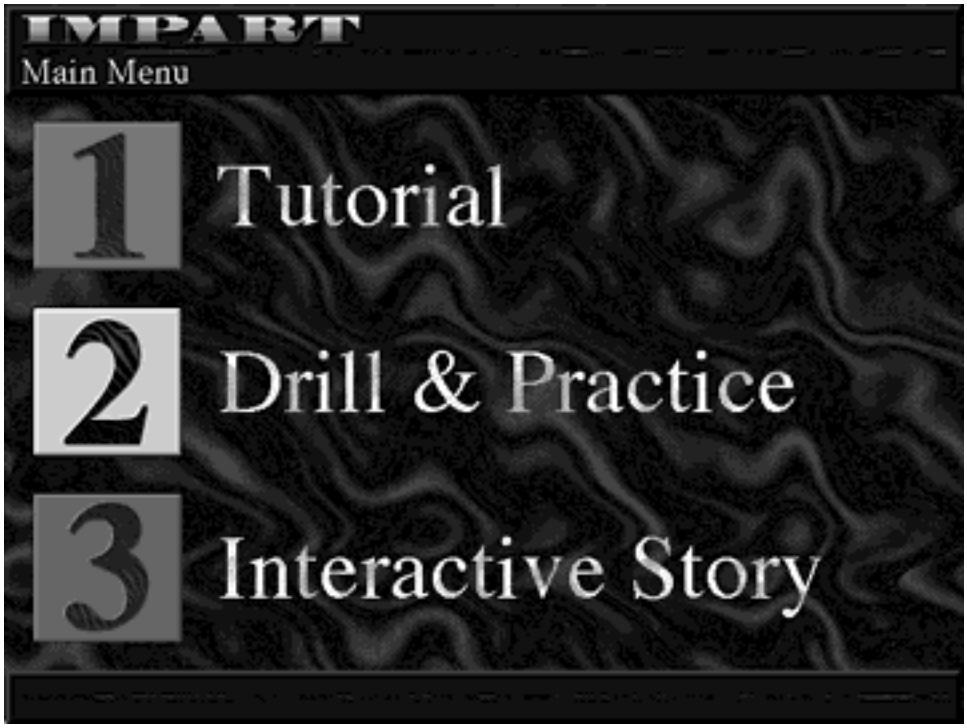


Tutorial: Verbal refusals frame. *(© 1997 ARCOVA)*

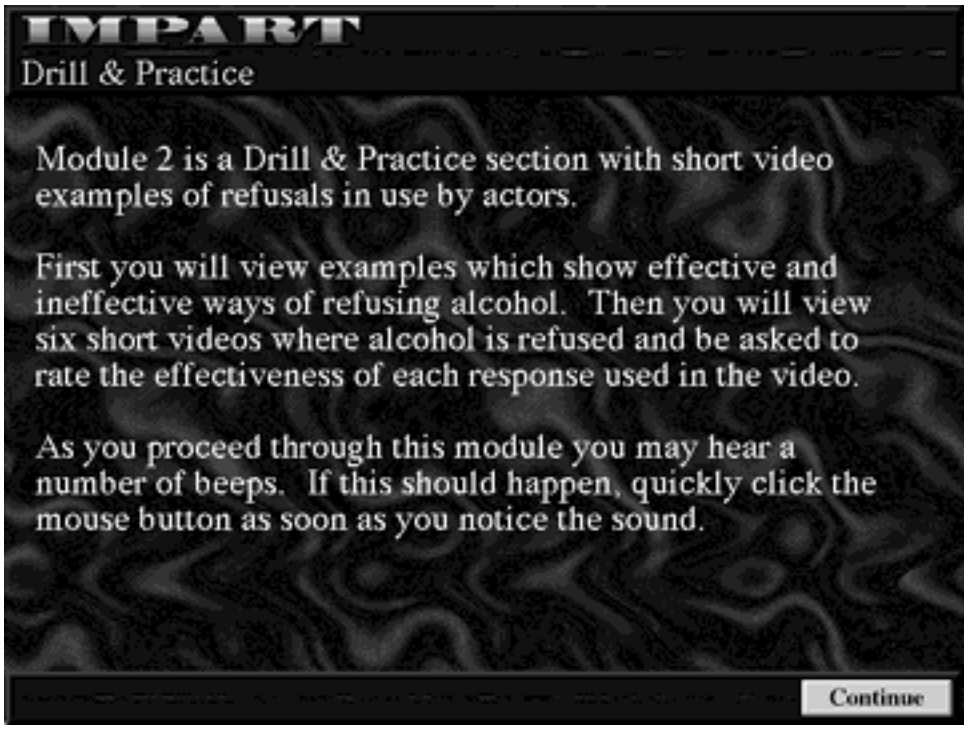
APPENDIX

C

DRILL & PRACTICE MODULE STORYBOARD



Main menu - *Drill & Practice* module enabled. *(© 1997 ARCOVA)*



Drill & Practice: Module description frame. *(© 1997 ARCOVA)*

Drill & Practice: Submenu - Rico & Steve Good Example enabled and playing. *(© 1997 ARCOVA)*

Drill & Practice: Rico & Steve Good Example. *(© 1997 ARCOVA)*

Rico & Steve Good Example Script *(© 1997 ARCOVA)*

Steve is in the kitchen opening a beer. Rico wanders in.

Steve: Hey, Rico. How's the game goin'? Have I missed anything?

Rico: *(heading for the refrigerator)* Naah, it's still the commercial break. Man, those nachos are great, but they sure are making me thirsty. Is it okay if I get something to drink?

Steve: Sure. *(holding out the beer he just opened)* Want a beer?

Rico waves the beer away.

Rico: *(firmly)* No, thanks. Do you have any soda?

Steve: *(persuasively)* Aw, c'mon, one beer won't hurt you. Besides, nothing goes better with nachos than a good beer. *(He holds the beer out to Rico again.)*

Rico: Thank-you, but no. *(He opens the refrigerator and looks in.)* Is it okay if I have some of this Pepsi?

Steve: *(reluctantly)* Sure, I guess so. *(Rico gets the Pepsi out and starts looking for a glass.)* But I think the rest of us are going to be drinking beer. C'mon, Rico, don't be the odd man out.

Rico starts pouring himself a glass of Pepsi, but he looks up at Steve with a serious expression on his face.

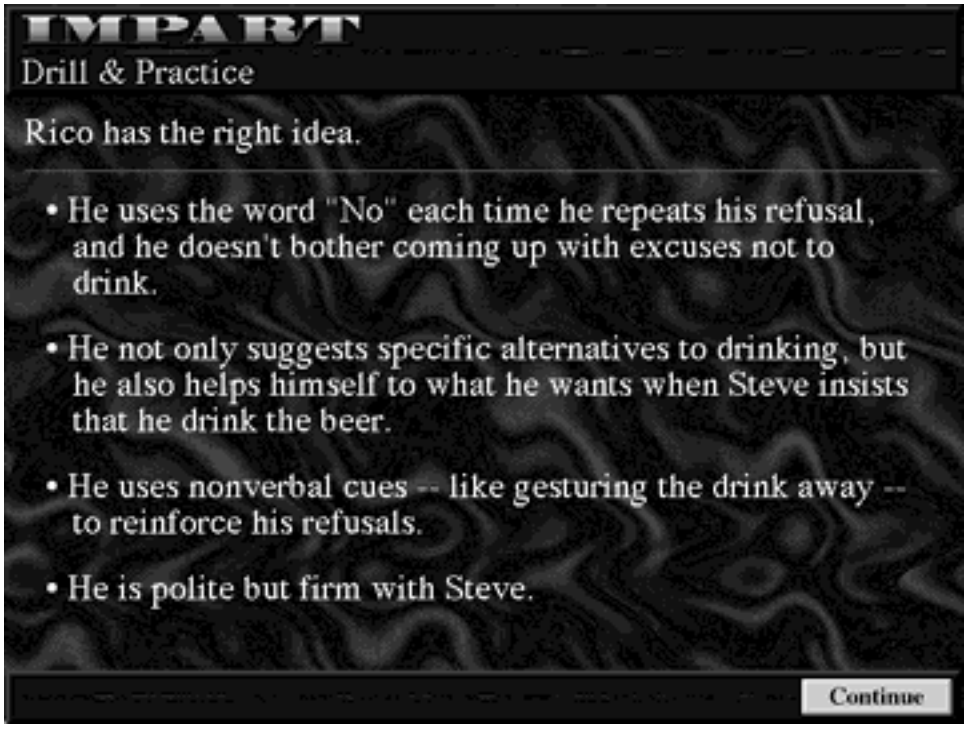
Rico: *No*, Steve. I don't want a beer. *(Rico puts the Pepsi back into the refrigerator.)*

Steve: *(warningly)* You don't want the other guys to think you're a geek, do you?

Rico: *(laughing)* Yeah, right!

Rico leaves the kitchen.

FADE TO BLACK



Drill & Practice: Rico & Steve Good Example - feedback. *(© 1997 ARCOVA)*

Drill & Practice: Rico & Steve Bad Example. *(© 1997 ARCOVA)*

Rico & Steve Bad Example Script *(© 1997 ARCOVA)*

Steve is in the kitchen opening a beer. Rico wanders in.

Steve: Hey, Rico. How's the game goin'? Have I missed anything?

Rico: *(heading for the refrigerator)* Naah, it's still the commercial break. Man, those nachos are great, but they sure are making me thirsty. Is it okay if I get something to drink?

Steve: Sure. *(holding out the beer he just opened)* Want a beer?

Rico looks at the beer with an apprehensive look on his face.

Rico: *(reluctantly)* That's okay…

Steve: *(persuasively)* Aw, c'mon, one beer won't hurt you. Besides, nothing goes better with nachos than a good beer. *(He holds the beer out to Rico again.)*

Rico: *(weakly, looking away from Steve)* Yeah, but you got that beer out for yourself. I can have something else…

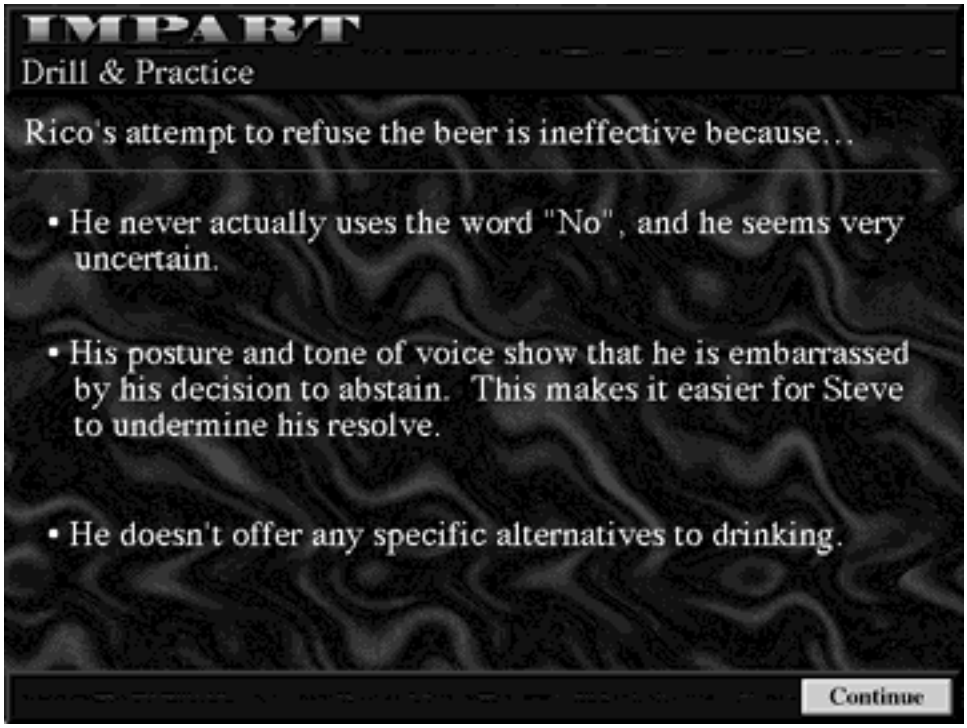
Steve: Oh, there's more in the fridge, so don't worry about it. In fact, I was just about to go see if any of the other guys want some. Go ahead, it's no big deal.

Rico: I think maybe I'd better not ...

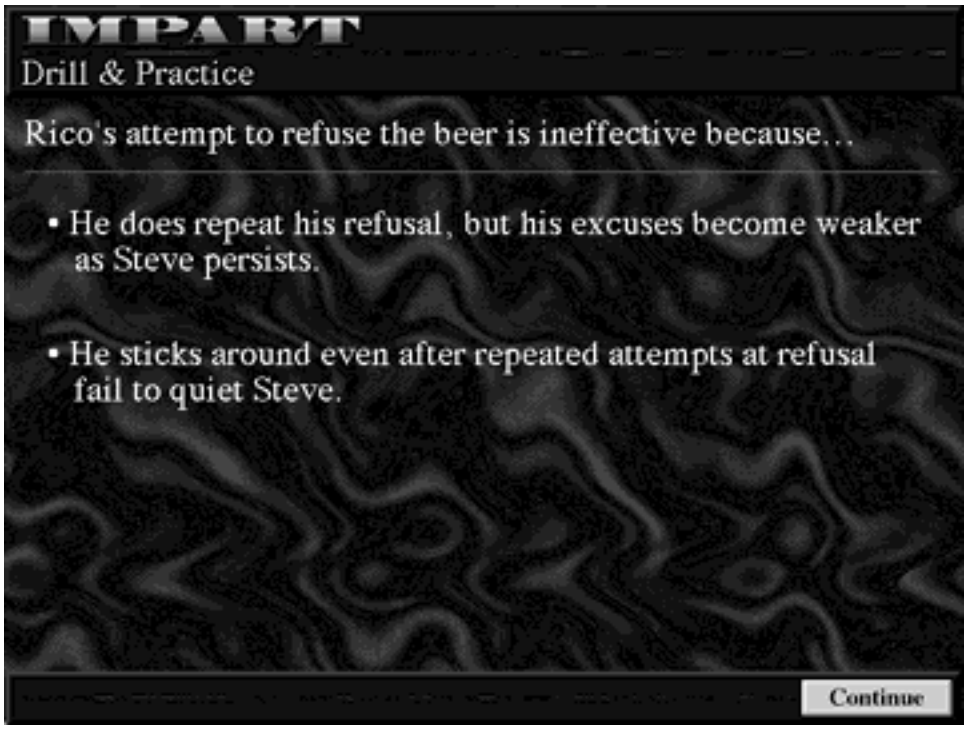
Steve: Why? *(in lower tones)* You don't want the other guys to think you're a geek, do you?

Rico: Well…

FADE TO BLACK

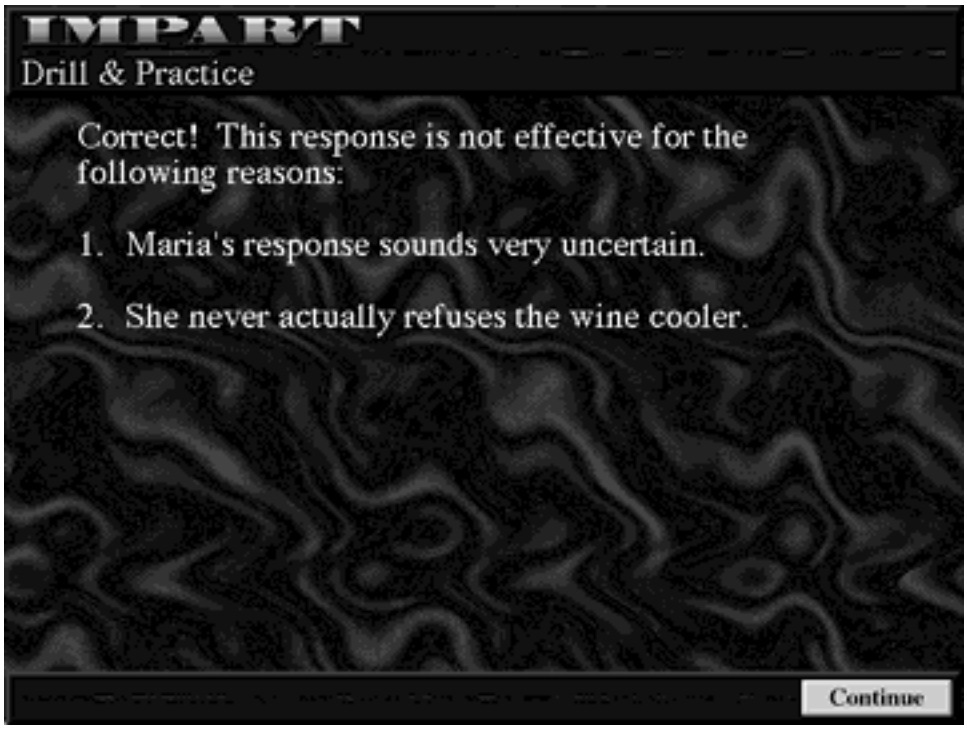


Drill & Practice: Rico & Steve Bad Example - feedback frame 1. *(© 1997 ARCOVA)*



Drill & Practice: Rico & Steve Bad Example - feedback frame 2. *(© 1997 ARCOVA)*

Drill & Practice: Response rating scenario example. *(© 1997 ARCOVA)*



Drill & Practice: Response rating feedback example. *(© 1997 ARCOVA)*

Drill & Practice: Brad and Catina response scenario. *(© 1997 ARCOVA)*

Brad and Catina Scenario Script *(© 1997 ARCOVA)*

Catina is at a party at Brad's house.

Catina: Hey, Brad, great party!

Brad: Thanks! Hey, would you like a beer?

Catina: *(reluctantly)* Well, I don't know… it's *probably* not a good idea right now.

Brad and Catina Scenario Feedback *(© 1997 ARCOVA)*

The response is mildly effective for the following reasons:

1. Her response is too wishy-washy and she sounds uncertain.
2. She does not suggest an alternative to drinking.

Drill & Practice: Tracy and Maria response scenario. *(© 1997 ARCOVA)*

Tracy and Maria Scenario Script *(© 1997 ARCOVA)*

Maria is sitting in front of the television, and Tracy comes in carrying two wine coolers.

Tracy: Want one?

Maria: *(looking at the wine cooler reluctantly)* I'm not sure…what if your parents come home?

Tracy and Maria Scenario Feedback *(© 1997 ARCOVA)*

The response is not effective for the following reasons:

1. She sounds very uncertain.
2. She has not actually refused the wine cooler.

Drill & Practice: Nick and Brian response scenario. *(© 1997 ARCOVA)*

Nick and Brian Scenario Script *(© 1997 ARCOVA)*

Nick and Brian have been playing football in Brian's backyard with some friends. Brian is pulling a beer out of a cooler as Nick jogs up.

Brian: *(holding a beer out to Nick)* Here Nick, have a beer.

Nick: *(reaching into the cooler and pulling out a Pepsi)* No thanks… I'd rather have a soda.

Nick and Brian Scenario Feedback *(© 1997 ARCOVA)*

The response is very effective for the following reasons:

1. He says "No."
2. He reinforces his refusal by getting himself a soda.

Drill & Practice: Kelly and Mr. Williams response scenario. *(© 1997 ARCOVA)*

Kelly and Mr. Williams Scenario Script *(© 1997 ARCOVA)*

Kelly is the one young person at a wedding reception. Mr. Williams offers her a cup with punch as she approaches the refreshment table.

Mr. Williams: Here, Kelly, have some punch.

Kelly: No, thank-you.

Mr. Williams: It's okay, there isn't very much vodka in it.

Kelly: *(with a polite but serious expression on her face.)* Thank-you for offering, but I really don't want any.

Kelly and Mr. Williams Scenario Feedback *(© 1997 ARCOVA)*

The response is very effective for the following reasons:

1. She says "No," and reinforces her refusal with a serious tone of voice and facial expression.

2. She repeats the refusal under repeated pressure to drink and is polite but firm.

Drill & Practice: Andre and Steve response scenario. *(© 1997 ARCOVA)*

Andre and Steve Scenario Script *(© 1997 ARCOVA)*

Andre and Steve have just come in from out of the cold. Steve pulls a thermos out of his backpack and takes a drink. He offers the thermos to Andre.

Steve: Here, this ought to warm you up.

Andre: *(eyeing the thermos longingly)* I'd like to, but… *(reluctantly shakes his head slightly)*

Andre and Steve Scenario Feedback *(© 1997 ARCOVA)*

The response is not effective for the following reasons:

1. He admits to wanting the drink.
2. His response is too wishy-washy and he sounds uncertain.

Drill & Practice: Beth and Kelly response scenario. *(© 1997 ARCOVA)*

Beth and Kelly Scenario Script *(© 1997 ARCOVA)*

Beth and Kelly are walking home from school after taking an exam; they both look a little depressed.

Kelly: Man, that test was a nightmare.

Beth: *(nodding in agreement)* I need a drink. *(eyes her persuasively)* Want to come over?

Kelly: *(reluctantly shaking her head)* Maybe it would be better if I didn't.

Beth and Kelly Scenario Feedback *(© 1997 ARCOVA)*

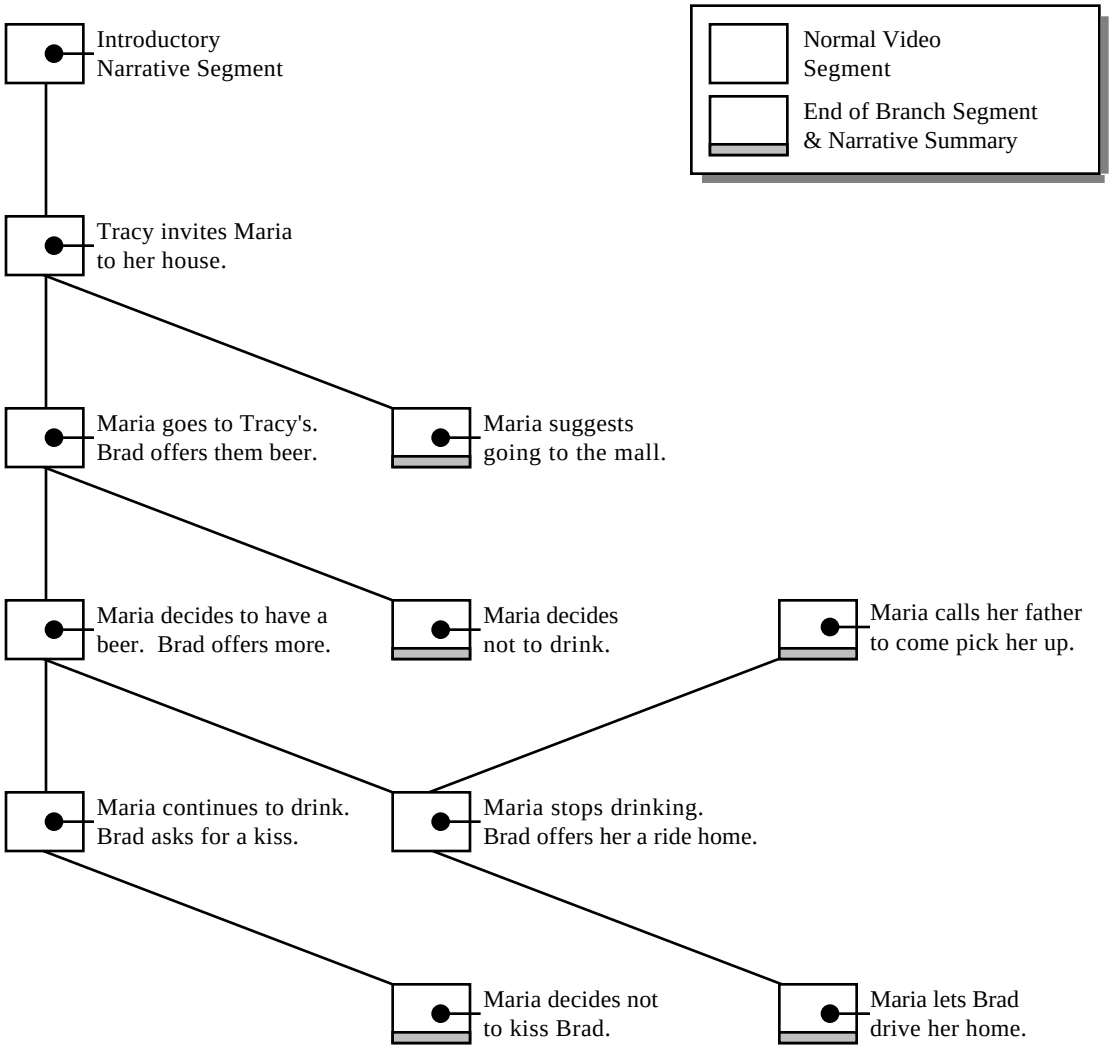
This response is mildly effective for the following reasons:

1. Her response is too wishy-washy and she sounds uncertain.
2. She doesn't offer an alternative to drinking.

APPENDIX

D

INTERACTIVE STORY MODULE STORYBOARD



Interactive Story: Story flowchart. *(© 1997 ARCOVA)*

Interactive Story: Introductory narrative segment. *(© 1997 ARCOVA)*

Introductory Narrative Segment Script *(© 1997 ARCOVA)*

Our narrator enters amidst several large white pillars in the front of a school.

Chris: *(entering frame from behind a pillar)* Hey, I'm Chris, you are about to take part in an interactive story in which you get to make several important decisions for Maria Hernandez, a typical girl, at the beginning of a very typical weekend.

Interactive Story: Segment 1 - Tracy invites Maria to her house. *(© 1997 ARCOVA)*

Segment 1 Script *(© 1997 ARCOVA)*

DAYTIME: HALLWAY AT GENERIC HIGH SCHOOL.

It is Friday afternoon, and the students are going through the usual end-of-the-day crush as they try to get their books together in time to make the bus. Maria is just leaving her last period class and is heading to her locker, when Tracy comes running around the corner and crashes into Steve, causing him to drop his notebook, which sprays loose sheets everywhere.

Tracy: Maria, hey Maria.

Steve: *(bending down angrily to pick up his notes)* Hey! Watch it!

Tracy crashes into Steve, causing him to drop his notebook.

Tracy: *(brushing him off)* Sorry. *(leaning against the locker, smiling cheerfully at Maria)* Hey, girl, you got any plans for tonight?

Maria: *(amused, but somewhat more reserved than Tracy)* Nothing much. What's up?

Tracy: Well, my folks are out of town tonight, so I thought maybe you could come over and we could watch a movie. You could even stay over, if you think your parents wouldn't want to pick you up so late.

Maria: *(interested, but with some trepidation)* Who else is coming? Your brother won't be there, will he?

Tracy: It should be just you and me. Brad got into so much trouble over the party he had last time my parents were gone that Mom said we have to keep things down and *definitely no alcohol* this time, though *(grinning mischievously)* she can't exactly enforce that from

Aunt Ginny's. But I doubt Brad will be there anyway. *(looking at her watch)* Hey, we better get moving if we don't want to miss the bus. You coming tonight or not?

Maria looks away from Tracy with an uneasy, thoughtful look on her face.

FREEZE-FRAME & FADE TO BLACK

Interactive Story: Segment 2 - Maria suggests going to the mall. *(© 1997 ARCOVA)*

Segment 2 Script *(© 1997 ARCOVA)*

DAYTIME: HALLWAY AT GENERIC HIGH SCHOOL.

Maria turns impulsively to Tracy.

Maria: I don't know, Tracy. It might be fun, but we haven't done anything with Kim and Sarah for awhile…

Tracy: *(dubiously)* Well, I guess we *could* invite them, too, but they might want to invite Jesse and Lee, and -

Maria: Why don't we go to the mall to see a movie, then? That way, we can also look around for clothes for the dance next weekend.

Maria closes her locker door and the two girls start heading for the exit.

Tracy: *(brightening)* That sounds good. I need a new dress anyway. So, what movie should we see?

Maria: Well, I hear the new Jean-Claude Van Damme movie is coming out sometime this weekend…

Tracy: *(disgustedly)* No way -- I am not in the mood for a bash-'em-up movie tonight. How about --

FADE TO BLACK AS CHARACTERS EXIT FRAME

FADE-IN NARRATIVE SUMMARY

Interactive Story: Segment 2 - Narrative summary. *(© 1997 ARCOVA)*

Segment 2 Narrative Script *(© 1997 ARCOVA)*

Our narrator is sitting on steps on the side of a school building.

Chris: While it is possible that alcohol would never have been a problem if Maria had gone to Tracy's house, the risk was still there. By going to the mall with some friends instead, Maria doesn't have to worry about being pressured to drink, getting into trouble, or any of the other risks associated with drinking.

Interactive Story: Segment 3 - Maria goes to Tracy's. Brad offers them beer. *(© 1997 ARCOVA)*

Segment 3 Script *(© 1997 ARCOVA)*

NIGHTTIME: TRACY'S FAMILY ROOM.

Tracy and Maria are sprawled out on the couch, the flickering blue of the TV screen reflecting off of their bored faces. Brad, Tracy's nice-looking older brother, walks into the room and looks at the TV screen. Maria's eyes follow his lithe form for a few seconds, then she rapidly returns her gaze to the screen before he has a chance to see that she is admiring him.

Brad: What're you guys watching?

Maria: *(dully, without looking up) Ishtar*. Tracy sure knows how to pick them.

Tracy: *(without rancor)* Oh, shut up. *(looking up at her brother)* What are you doing home? I thought you were going out with Jose tonight.

Brad: Aw, Walker called his dad and told him that Jose's failing her class again, so he's grounded, at least until his grades are up, which'll never happen.

Tracy: Bummer.

Brad plops down on the couch between the two girls and starts watching the movie with them.

Brad: *(to Maria)* Pass the popcorn.

Maria passes him the bowl, and a particularly lame line can be heard from the TV.

Brad: Man, this *is* bad.

Maria: You said it.

Brad hands the popcorn back to Maria, stands up, and grins mischievously.

Brad: Hey, I know how to make this movie a blast.

Tracy and Maria look up at him with interest.

Tracy: How?

Brad: *(heading out of the room with a big grin on his face)* You'll see. Wait here.

Tracy and Maria look at each other with amused excitement.

Maria: Your brother is crazy! What kind of trouble is he getting us into this time?

Tracy: *(giggling)* I don't know. *(yelling)* Brad! What's going on?

Brad: *(voice-over)* Back in a sec!

Brad reappears in the doorway, holding a six-pack of Coors over his head.

Brad: *(gaily)* I knew Dad wouldn't let us down!

Tracy: *(shocked but tempted)* Brad, we can't drink Dad's beer! He'll kill us!

Brad: Aah, he won't mind as long as Mom doesn't find out about it. Why else do you think he stocked up just before going out of town?

Tracy looks over at Maria uneasily, but obviously hoping that Maria will go along with this change in plan.

Tracy: Sounds good to me. What do you say, Maria?

Maria looks from Brad to Tracy, then back to Brad. Brad smiles encouragingly at her and waggles the beer.

Brad: Come on, Maria. It'll be fun!

Maria looks down, a little red in the face, a smile playing about her lips.

FREEZE-FRAME & FADE TO BLACK

Interactive Story: Segment 4 - Maria decides not to drink. *(© 1997 ARCOVA)*

Segment 4 Script *(© 1997 ARCOVA)*

NIGHTTIME: TRACY'S FAMILY ROOM.

Tracy and Brad are looking at Maria expectantly, Brad still holding the six-pack. Maria shakes her head.

Maria: I'm not in the mood. I think I'd rather have -- *(smiling mischievously)* Ice cream!

Brad looks a little disappointed, but Tracy lights up at this idea.

Tracy: Hey! I forgot -- we have some Rocky Road in the freezer. You want some?

Maria: Yeah!

Brad: *(reluctantly warming to this idea)* Well, I think there's some chocolate syrup in the pantry, and there should be some Cool Whip in the fridge.

Tracy: All right! We can make sundaes!

They scramble to their feet and head for the door.

FADE TO BLACK

FADE-IN NARRATIVE SUMMARY

Interactive Story: Segment 4 - Narrative summary. *(© 1997 ARCOVA)*

Segment 4 Narrative Script *(© 1997 ARCOVA)*

Our narrator is leaning against a short fence adjacent to a baseball backstop with the side of the school building in the background.

Chris: By suggesting an alternative activity to drinking, Maria was able to avoid being pressured to drink and probably saved herself a lot of trouble later on. Even though Brad seemed to think that they wouldn't get into trouble with his parents, Tracy said their mother specifically told them not to drink. And remember — the last time Tracy and Brad's parents went out of town, Brad's party got out of hand. Just because there are only three of them here this time doesn't mean that things still couldn't get out of control. This way, however, the three of them can still have a good time.

Interactive Story: Segment 5 - Maria decides to have a beer. Brad offers more. *(© 1997 ARCOVA)*

Segment 5 Script

NIGHTTIME: TRACY'S FAMILY ROOM.

Tracy and Maria and Brad are still sitting in front of the TV, but they are socializing instead of actively watching the movie. Tracy and Maria are still nursing their first beers, while Brad is popping the lid off of another bottle; it is unclear just how many beers he has had at this point. Brad is in midsentence as the scene opens.

Brad: ... so, anyway, then he banged his hands on the desk… *(he brings his hands down to illustrate his point, and a little beer sloshes out of the bottle)* Whoops! *(as he mops himself off with a nearby paper towel)* …anyway, then he told the teacher, "That ain't right!"

Maria's jaw drops in amused disbelief.

Maria: No way!

Brad: Way! The teacher was so blown away she about dropped her teeth!

Tracy yawns, then laughs at something she just saw on the movie. Maria and Brad look over at her.

Brad: What? What?

Tracy: You missed it? Oh, you have to see this part! It's wild!

Maria: *(giggling)* I don't even know what's going on in the movie anymore; I haven't been paying attention.

Brad: That's the secret to watching movies like this -

Tracy stops rewinding the tape and restarts the movie.

Tracy: Sssh! Sssh! Here it comes again!

Brad: *(to Maria)* You have to watch for the parts that aren't meant to be funny but are anyway just because the movie is so bad. Of course, the movies that are the best for this sort of thing are those -

Tracy screams with laughter. Brad and Maria stare at her blankly.

Tracy: Didn't you see it this time?

Maria: *(looking slightly puzzled)* I don't get it.

Tracy: *(incredulous)* You don't get it? Here, watch it again.

Brad: *(groaning)* Not again, Tracy. Face it, it just wasn't that funny.

Tracy makes a face at him, while, smiling, Maria finishes off the last of her beer.

Tracy: *(sullenly)* You guys just have no sense of humor.

Brad: *(teasingly)* Oh, give it up. *(to Maria, with a smile)* Hey! Can I get you another one?

Tracy: *(tossing off her drink)* Yo, *I'm* ready for a refill!

FREEZE-FRAME & FADE TO BLACK

Interactive Story: Segment 6 - Maria stops drinking. Brad offers her a ride. *(© 1997 ARCOVA)*

Video Segment 6 Script *(© 1997 ARCOVA)*

NIGHTTIME: TRACY'S FAMILY ROOM.

Brad tosses Tracy a beer, but Maria seems reluctant.

Maria: No, no ... I don't think so. I think maybe I've had enough.

Brad: *(shrugging)* If you say so.

Brad leans his head back and starts chugging the rest of his beer. SURREAL KIND OF SCENE-MORPH THING, AND SHIFT IN SCENE…

NIGHTTIME: TRACY'S FAMILY ROOM.

It is later in the evening. Brad is dozing in a chair while Tracy and Maria watch the end of Ishtar. Tracy is slouched back and is staring at the screen with her mouth half-open, an almost-empty beer dangling from her fingertips; Maria is seated on the floor, her knees drawn up to her chin, looking bored out of her mind. Finally the credits start rolling.

Maria: *(leaning back with a yawn)* I have to give you credit, Tracy. I didn't think you could pick a worse movie than the last one, but I was wrong.

Tracy: *(bopping the top of Maria's head with the bottom of her bottle)* Ha, ha, you're so funny.

Maria clutches the top of her head and whirls around to face Tracy.

Maria: Tracy! That hurt!

Tracy: *(trying to bop her again, giggling mischievously)* Sorry, I'll try to be more gentle this time.

Maria: *(vehemently waving the bottle away)* Tracy! Quit it!

Tracy: *(still trying to bop Maria)* Oh, don't be such a baby!

Maria manages to wrench the bottle away from Tracy, but spills part of the remaining beer on Tracy's shirt as she does so. Tracy leaps clumsily to her feet, suddenly in a rage.

Tracy: You idiot! Now look what you've done!

Maria: *(weakly)* Tracy, I told you to stop!

Tracy: *(as if she hadn't heard her)* This is my Mom's shirt! She's going to kill me!

Maria: You could wash it?

Tracy: *(starting to cry)* No, I can't! It's dry-clean only! When she finds out I've been drinking - *(running out of the room)* This is all your fault!

Maria stares at the doorway for a few seconds, then starts to stand up. Brad, evidently roused by the fight, looks up at Maria.

Brad: Where are you going?

Maria: *(exasperated)* Home, I guess.

Brad: What, this late? How are you going to get there?

Maria: I guess I'll have to call my parents.

Brad: I can give you a ride.

Maria surveys the beer bottles scattered around his chair with skepticism. He sees her look.

Brad: I'm okay to drive -- I haven't had that much. And you don't want to make your parents mad by getting them up this late, do you? Besides, *(lowering his voice)* you know you and Tracy are going to make up, but if your parents find out we were drinking, they'll never let you come over here again.

FREEZE-FRAME ON MARIA & FADE TO BLACK

Interactive Story: Segment 7 - Maria calls her father to come pick her up. *(© 1997 ARCOVA)*

Segment 7 Script *(© 1997 ARCOVA)*

NIGHTTIME: FRONT OF TRACY AND BRAD'S HOUSE.

Maria is waiting on the porch for her parents, while Brad swings lazily on the porch swing.

Brad: *(taunting)* Your parents were mad, weren't they? I told you so.

Maria: *(sarcastically)* Thanks for waiting out here with me.

Brad: No problem. So, I guess this is the end for you and Tracy, huh? Well, it's probably just as well, she has cooler friends than you.

Maria: *(casually)* Oh, I doubt it's the end of our friendship. Like you said, we fight all the time and we always make up.

Brad: *(sardonically)* I won't hold my breath -

Suddenly headlights appear as a car turns into the driveway. Maria picks up her bag.

Maria: There they are. Well, see you around, Brad.

Maria runs down the steps to meet the car.

Brad: *(rising unsteadily to his feet)* Not if I see you first.

Maria opens the passenger door and climbs in. As the door closes, we can still hear her as she greets her father.

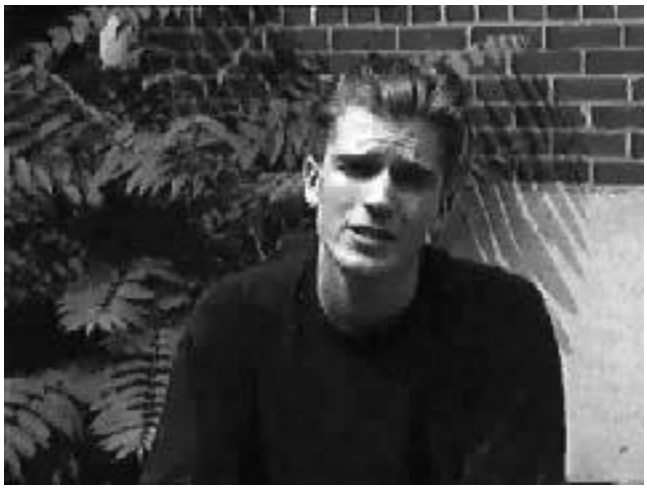
Maria: Thanks again for coming to get me, Dad.

Dad: Anytime. You okay?

Maria: *(warmly)* Yeah, I'm fine.

FADE TO BLACK AS CAR DRIVES AWAY

FADE-IN NARRATIVE SUMMARY



Interactive Story: Segment 7 - Narrative summary. *(© 1997 ARCOVA)*

Segment 7 Narrative Script *(© 1997 ARCOVA)*

Our narrator is sitting in the courtyard of a school building.

Chris: Even though most teenagers agree that you should never drink and drive, they are often afraid to call their parents for a ride. But your parents would want you to call — even if you wake them up — rather than have you drive while you're under the influence or ride with someone who is. Many families have an agreement that if the son or daughter calls and asks for a ride home, a parent will come and pick them up, no questions asked, no lectures given. You may not feel comfortable calling your parents, but the risks of drinking and driving are for too great.

Interactive Story: Segment 8 - Maria lets Brad drive her home. *(© 1997 ARCOVA)*

Segment 8 Script *(© 1997 ARCOVA)*

NIGHTTIME: OUTSIDE, NEXT TO BRAD'S CAR.

The scene opens on Brad's car, which is pretty old and beat-up. A door slams shut off-screen, and Brad and Maria step into view, Brad listing a little but not staggering, and Maria following rather timidly behind, clutching her jacket and backpack close to her body. Brad unlocks the passenger door and opens it, watching Maria expectantly. She looks at him and hesitates.

Brad: *(annoyed)* Well, what are you waiting for, hell to freeze over? Get in!

Maria slides into the passenger seat, shivering slightly as if chilled by the night air. As Brad closes the door, ZOOM-IN on Maria's face: she is clearly very nervous. Brad lopes around the car and hops into the driver's side. The car starts up and lurches forward, kicking up gravel, and, as Brad pulls out of the driveway, runs up onto the curb a little bit.

FADE TO BLACK AS CAR RACES OUT OF SIGHT.

FADE-IN NARRATIVE SUMMARY

Interactive Story: Segment 8 - Narrative summary. *(© 1997 ARCOVA)*

Segment 8 Narrative Script *(© 1997 ARCOVA)*

Our narrator is walking down some steps in front of a school building.

Chris: Although 92% of teenagers say a person should never drink and drive, 1/3 of them report that they've accepted rides from people who've been drinking. Even worse, alcohol is a factor in 45% of traffic accidents involving teenage drivers. Even if Brad doesn't get it an accident, there's always the chance that he will be pulled over by the police. In that case Maria's parents will surely be called to come pick her up. If you think Maria's parents would have been angry to find out that she had spent at someone's house where people were drinking, imagine how unhappy they will be when they find out she accepted a ride with a drunk driver?

Interactive Story: Segment 9 - Maria continues to drink. Brad asks for a kiss. *(© 1997 ARCOVA)*

Segment 9 Script *(© 1997 ARCOVA)*

NIGHTTIME: TRACY'S FAMILY ROOM.

It is much later. Tracy is asleep on the couch, and Maria and Brad are sitting on the floor together, watching MTV and laughing wildly at an amusing video. They are laughing so hard, in fact, that Brad throws his arm clumsily around Maria to give himself some additional support. Maria notices, but doesn't appear to mind, even when the song changes to some romantic ballad.

As their laughter subsides, Brad starts staring into Maria's face rather amorously, while Maria looks shyly away.

Brad: *(softly)* This is a beautiful song.

Maria: Yeah.

Brad staggers to his feet, while Maria looks on, giggling softly. He stretches out his hand toward her.

Brad: *(lowering his voice melodramatically)* C'mon, baby -- dance with me?

Maria timidly takes his hand, and he pulls her up with such energy that she flies into him, and for a moment their balance is uncertain. Then, as they steady themselves, Maria begins to laugh, and Brad pulls her against him.

Brad: *(whispering)* Ssssh, we don't want to wake up Tracy!

As Maria continues to giggle, they begin to rotate slowly, a little offbeat to the music. Gradually Maria's laughter subsides, and she looks up to see Brad smiling with amusement at her; his smile begins to fade as well as he gazes soulfully into her eyes.

Suddenly Brad steps on her foot and she trips, causing them both to tumble down to the floor into a heap. Maria begins to laugh again as Brad starts to disentangle himself from her, but she stops abruptly when he presses his lips against hers. Falling silent, she stares up at him with mingled desire and fear as he pulls back a little bit.

Brad: *(whispering)* Kiss me Maria…

Maria looks at Brad with a thoughtful look on her face.

FREEZE-FRAME & FADE TO BLACK

Interactive Story: Segment 10 - Maria decides not to kiss Brad. *(© 1997 ARCOVA)*

Segment 10 Script *(© 1997 ARCOVA)*

NIGHTTIME: TRACY'S FAMILY ROOM.

Maria smiles gently at Brad and rolls away from him. Brad looks surprised.

Brad: Won't you kiss me?

Maria begins to shake Tracy awake.

Maria: No, I'm too tired. Maybe some other time.

Brad: But all I asked for was -

Tracy moans sleepily and looks around, bleary-eyed.

Tracy: Wha -? What's going on?

Maria: C'mon, Trace, let's go to bed.

Tracy: *(dazedly, supporting herself on Maria's arm as she rises to her feet)* Well, okay. Night, Bratty Brad.

Brad flops down on the couch disgustedly.

Brad: Night, Twisted Tracy.

Maria: *(softly)* See you 'round, Brad.

Brad flips the channel to MTV, actively ignoring her. FADE OUT as the two girls leave the room.

FADE TO BLACK AS THE GIRLS LEAVE THE ROOM.

FADE-IN NARRATIVE SUMMARY

Interactive Story: Segment 10 - Narrative summary. *(© 1997 ARCOVA)*

Segment 10 Narrative Script *(© 1997 ARCOVA)*

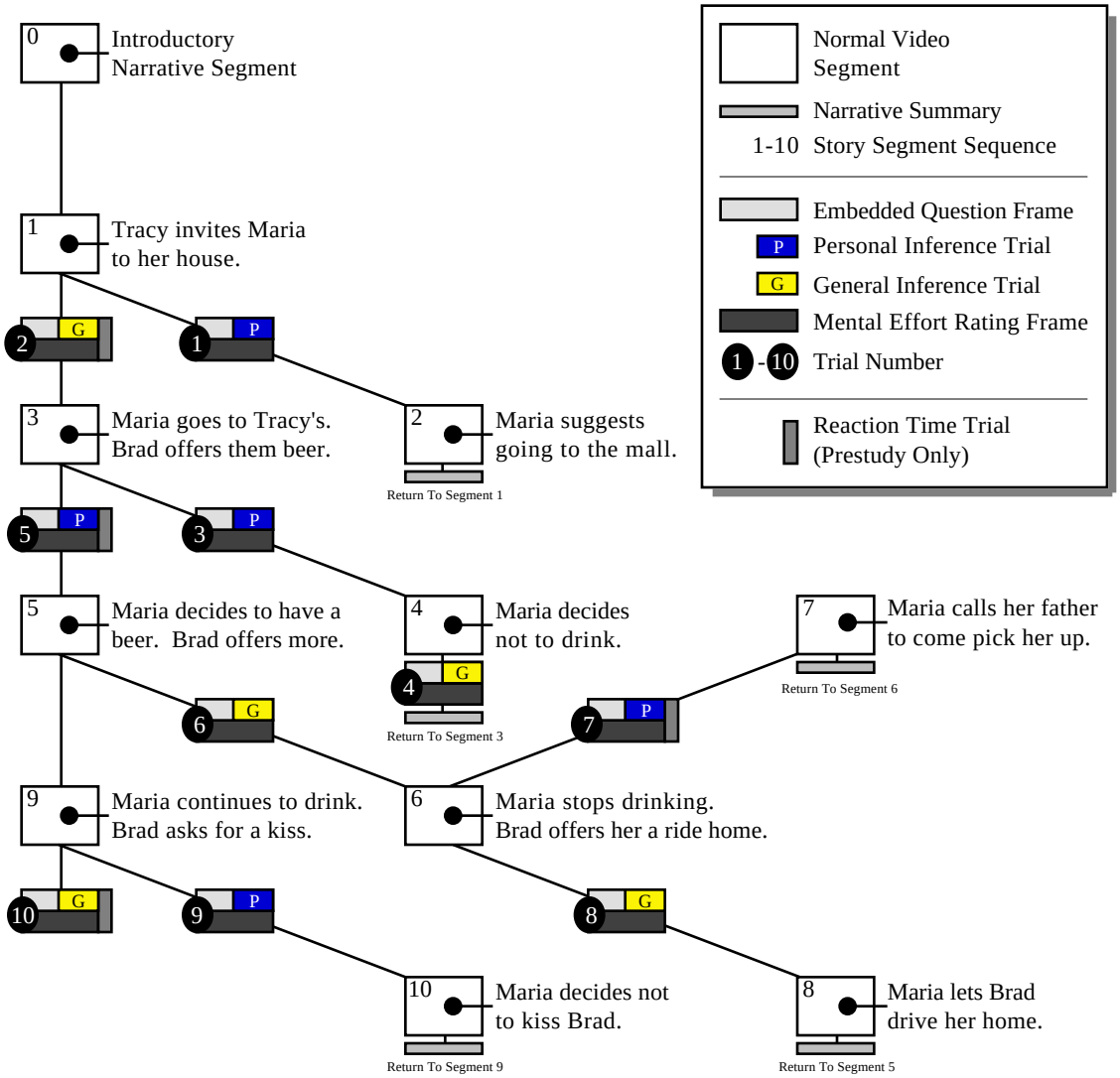
Our narrator is sitting on some steps outside of school.

Chris: On the surface, a kiss seems relatively harmless, but when you've been drinking, something as innocent as a kiss can easily lead to more than you bargained for. Since alcohol can lower a person's inhibitions and affect their judgment, it's best to just avoid situations that can quickly get out of control. Brad may be angry now, but he'll probably forget all about it when he sobers up.

APPENDIX

E

EXAMPLE QUESTION TRIAL SEQUENCE

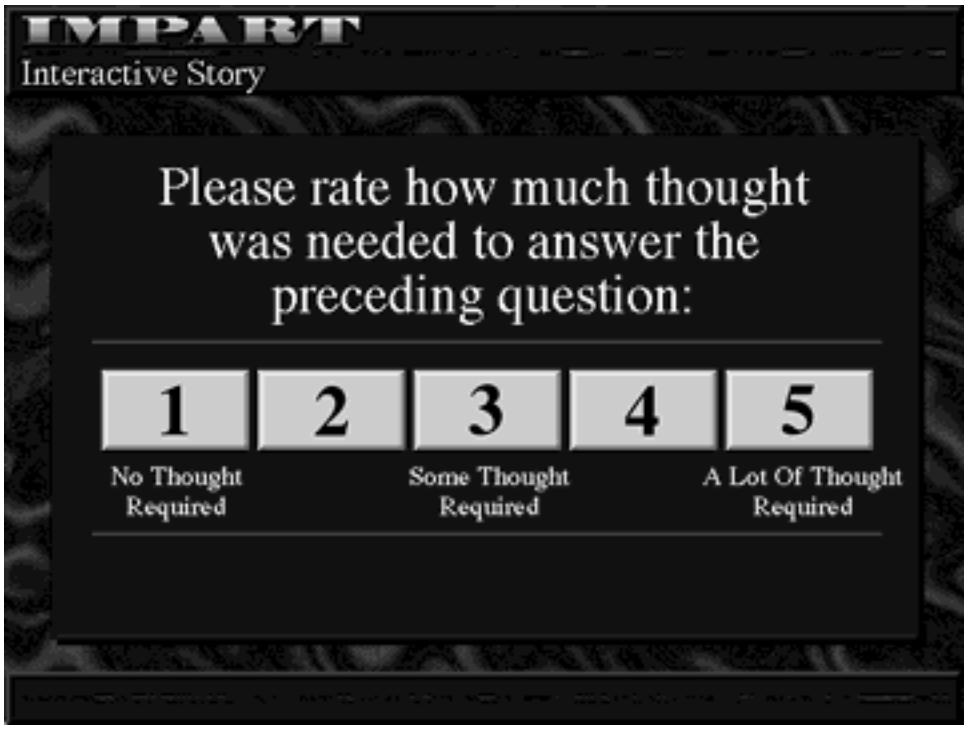


Interactive Story: Story flowchart indicating embedded question frame and mental effort rating frame location. *(© 1997 ARCOVA)*

Interactive Story: Viewing story segment 3. *(© 1997 ARCOVA)*

Interactive Story: Forced choice - "Don't Have A Beer". *(© 1997 ARCOVA)*

Interactive Story: Embedded question trial 3. *(© 1997 ARCOVA)*



Interactive Story: Mental effort rating trial 3. *(© 1997 ARCOVA)*

Interactive Story: Viewing story segment 4. *(© 1997 ARCOVA)*

Interactive Story: Embedded question trial 4. *(© 1997 ARCOVA)*

Interactive Story: Mental effort rating trial 4. *(© 1997 ARCOVA)*

Interactive Story: Viewing narrative summary. *(© 1997 ARCOVA)*

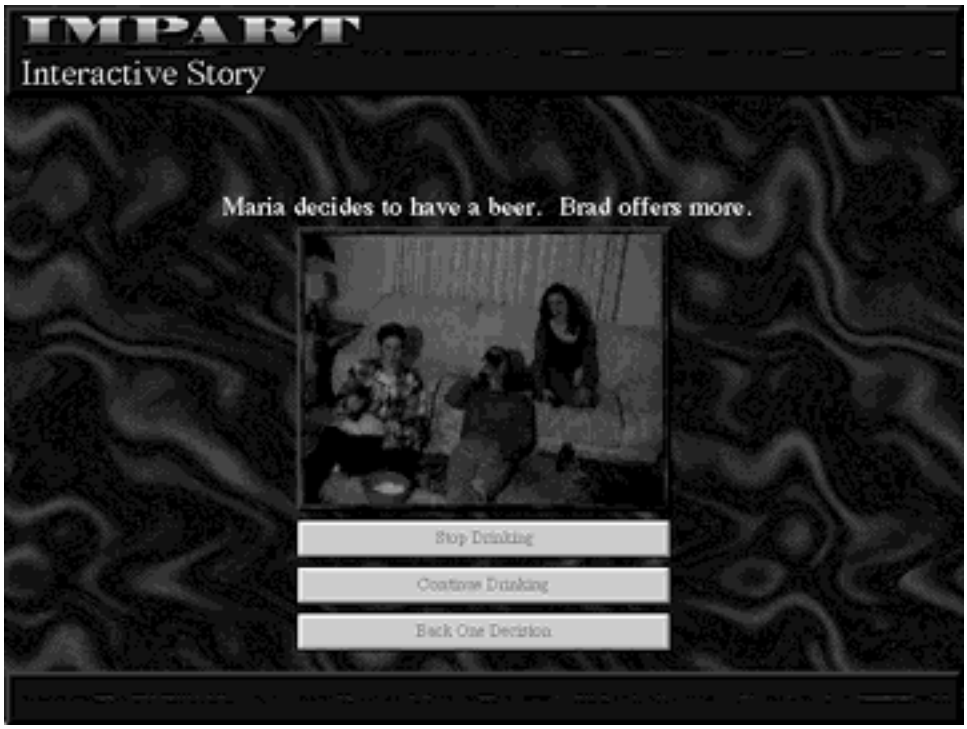
Interactive Story: Forced choice - "Back One Decision". *(© 1997 ARCOVA)*

Interactive Story: Viewing story segment 3. *(© 1997 ARCOVA)*

Interactive Story: Forced choice - "Have A Beer". *(© 1997 ARCOVA)*

Interactive Story: Embedded question trial 5. *(© 1997 ARCOVA)*

Interactive Story: Mental effort rating trial 5. *(© 1997 ARCOVA)*



Interactive Story: Viewing story segment 5. *(© 1997 ARCOVA)*

Interactive Story: Forced choice - “Stop Drinking”. *(© 1997 ARCOVA)*

APPENDIX F

FACTUAL EMBEDDED QUESTIONS AND KEY

FACTUAL EMBEDDED QUESTIONS

Trial 1. Tracy invites Maria to her house.
(Decision: Don't go to Tracy's has been pressed)

Q: What did Tracy's brother Brad get in trouble for?

A: A party he threw last time their parent's were gone.

Trial 2. Tracy invites Maria to her house.
(Decision: Go to Tracy's has been pressed)

Q: Because of the party Brad threw last time their parents were gone, what did Tracy's mom tell Tracy?

A: To keep things down and definitely no alcohol this time.

Trial 3. Maria goes to Tracy's. Brad offers them beer.
(Decision: Don't Have A Beer has been pressed)

Q: Why wasn't Brad out with his friend José that night?

A: One of their teachers [Mrs. Walker] called José's dad and told him José was failing his class. Now he's grounded until he can get his grades up.

Trial 4. Maria decides not to drink.
(Branch End: After Maria decides not to drink.)

Q: What does Maria suggest as an option to drinking?

A: Having ice cream/making sundaes.

Trial 5. Maria goes to Tracy's. Brad offers them beer.
(Decision: Have A Beer has been pressed)

Q: What does Brad say to encourage Maria to drink?

A: "…c'mon Maria, it'll be fun."

Trial 6. Maria decides to have a beer. Brad offers more.
(Decision: Stop Drinking has been pressed)

Q: Why does Tracy rewind the movie?

A: She wants the others to see a funny part.

Trial 7. Maria stops drinking. Brad offers her a ride home.
(Decision: Call Maria's Parents has been pressed)

Q: Why does an argument start between Maria and Tracy?

A: Tracy bonks Maria on the head with her beer bottle and beer gets spilled on Tracy's blouse.

Trial 8. Maria stops drinking. Brad offers her a ride home.
(Decision: Let Brad Drive has been pressed)

Q: What does Maria say to refuse the beer?

A: "No", and that she thought she'd had enough.

Trial 9. Maria continues to drink. Brad asks for a kiss.
(Decision: Don't Kiss Brad has been pressed)

Q: What was Tracy doing in this segment?

A: Passed-out/asleep on the couch.

Trial 10. Maria continues to drink. Brad asks for a kiss.
(Decision: Kiss Brad has been pressed)

Q: What were Brad and Maria doing in this segment before Brad asked for a kiss?

A: Watching TV, drinking.

APPENDIX G

INFERENCE EMBEDDED QUESTIONS AND KEY

INFERENCE EMBEDDED QUESTIONS

Trial 1. Tracy invites Maria to her house.
(Decision: Don't go to Tracy's has been pressed)

Personal Inference

Q: Why might your parents object to you going to someone's house if their parents were going out of town?

A: Because they would be unsupervised and could get into trouble.

Trial 2. Tracy invites Maria to her house.
(Decision: Go to Tracy's has been pressed)

General Inference

Q: Why would you think there might be alcohol at Tracy's?

A: Tracy mentions that their mom wanted them "to keep things down and definitely no alcohol this time" but then says "she can't enforce that from aunt Ginnies" -- showing that she doesn't take her mom's warning very seriously.

Trial 3. Maria goes to Tracy's. Brad offers them beer.
(Decision: Don't Have A Beer has been pressed)

Personal Inference

Q: How would you refuse this offer to drink alcohol if Brad were offering you the beer?

A: Any serious and effective response.

Trial 4. Maria decides not to drink.
(Branch End: After Maria decides not to drink.)

General Inference

Q: Why did Maria's refusal to drink alcohol work so well?

A: She suggests an alternative to drinking, and does so in a polite manner. She also sounds enthused about making ice cream sundaes.

Trial 5. Maria goes to Tracy's. Brad offers them beer.
(Decision: Have A Beer has been pressed)

Personal Inference

Q: What are some negative things that could happen to you as a result of drinking?

A: Any negative and realistic consequence (date rape, getting pregnant, getting in trouble, etc.).

Trial 6. Maria decides to have a beer. Brad offers more.
(Decision: Stop Drinking has been pressed)

General Inference

Q: Why didn't Maria think the movie was funny?

A: She had been listening to Brad's story and had not been paying attention to the movie.

Trial 7. Maria stops drinking. Brad offers her a ride home.
(Decision: Call Maria's Parents has been pressed)

Personal Inference

Q: What would you say to your parents if you needed to be picked up late at night?

A: Any serious and realistic response.

Trial 8. Maria stops drinking. Brad offers her a ride home.
(Decision: Let Brad Drive has been pressed)

General Inference

Q: Why does Maria seem unsure about letting Brad take her home?

A: Because he's been drinking all night and was passed-out until the argument between Maria and Tracy occurred.

Trial 9. Maria continues to drink. Brad asks for a kiss.
(Decision: Don't Kiss Brad has been pressed)

Personal Inference

Q: How would you let someone know you don't want to kiss them?

A: Any serious and effective response (say "no", give a reason, be polite but firm, leave, etc.).

Trial 10. Maria continues to drink. Brad asks for a kiss.
(Decision: Kiss Brad has been pressed)

General Inference

Q: What are some negative things that could happen if Maria were to kiss Brad?

A: Any serious and realistic response (unwanted sex, unprotected sex, fighting, etc.).

Question Relevance Trial Sequence

Trial #	*Question Relevance*
1	Personal
2	General
3	Personal
4	General
5	Personal
6	General
7	Personal
8	General
9	Personal
10	General

APPENDIX H

CNS-IE LOCUS OF CONTROL SCALE AND KEY

CNS-IE LOCUS OF CONTROL SCALE

The Nowicki-Strickland Personal Reaction Survey *Password:* _____

Circle your choice *(Key: Bold text indicates external responses)*

YES	NO	1.	Do you believe that most problems will solve themselves if you just don't fool with them?
YES	**NO**	2.	Do you believe that you can stop yourself from catching a cold?
YES	NO	3.	Are some kids just born lucky?
YES	**NO**	4.	Most of the time do you feel that getting good grades means a great deal to you?
YES	NO	5.	Are you often blamed for things that just aren't your fault?
YES	**NO**	6.	Do you believe that if somebody studies hard enough, he or she can pass any subject?
YES	NO	7.	Do you feel that most of the time it doesn't pay to try hard because things never turn out right anyway?
YES	NO	8.	Do you feel that if things start out well in the morning, that it is going to be a good day no matter what you do?
YES	**NO**	9.	Do you feel that most of the time parents listen to what their children have to say?
YES	NO	10.	Do you believe that wishing can make good things happen?
YES	NO	11.	When you get punished, does it usually seem it's for no good reason at all?
YES	NO	12.	Most of the time do you find it hard to change a friend's opinion?
YES	**NO**	13.	Do you think that cheering, more than luck, helps a team to win?
YES	NO	14.	Do you feel that it's nearly impossible to change your parent's mind about anything?
YES	**NO**	15.	Do you believe that your parents should allow you to make most of your own decisions?
YES	NO	16.	Do you feel that when you do something wrong, there's very little that you can do to make it right?
YES	NO	17.	Do you believe that most kids are just born good at sports?
YES	NO	18.	Are most of the other kids your age stronger than you are?

YES	NO	19.	Do you feel that one of the best ways to handle most problems is just to not think about them?
YES	**NO**	20.	Do you feel that you have a lot of choice in deciding who your friends are?
YES	NO	21.	If you find a four leaf clover, do you believe that it might bring you good luck?
YES	**NO**	22.	Do you often feel that whether you do your homework has much to do with what kind of grades you get?
YES	NO	23.	Do you feel that when a kid your age decides to hit you, there's little you can do to stop him or her?
YES	NO	24.	Have you ever had a good luck charm?
YES	**NO**	25.	Do you believe that whether or not people like you depends on how you act?
YES	**NO**	26.	Will your parents usually help if you ask them to?
YES	NO	27.	Have you felt that when people were mean to you, it was usually for no reason at all?
YES	**NO**	28.	Most of the time, do you feel that you can change what might happen tomorrow by what you do today?
YES	NO	29.	Do you believe that when bad things are going to happen, they just are going to happen, no matter what you do to try to stop them?
YES	**NO**	30.	Do you think that kids can get their own way if they just keep trying?
YES	NO	31.	Most of the time do you find it useless to try to get your own way at home?
YES	**NO**	32.	Do you feel that when good things happen, they happen because of hard work?
YES	NO	33.	Do you feel that when somebody your age wants to be your enemy, there's little you can do to change matters?
YES	**NO**	34.	Do you feel that it's easy to get friends to do what you want them to?
YES	NO	35.	Do you usually feel that you have little to say about what you get to eat at home?
YES	NO	36.	Do you feel that when someone doesn't like you, there's little you can do about it?

YES	NO	37.	Do you usually feel that it's almost useless to try in school because most other children are just plain smarter than you are?
YES	**NO**	38.	Are you the kind of person who believes that planning ahead makes things turn out better?
YES	NO	39.	Most of the time, do you feel that you have little to say about what your family decides to do?
YES	**NO**	40.	Do you think it's better to be smart than to be lucky?

APPENDIX

I

MODIFIED YOUTH ALCOHOL & DRUG SURVEY AND KEY

MODIFIED YOUTH ALCOHOL & DRUG SURVEY

The Modified Youth Alcohol & Drug Survey *Password:* _____

The purpose of this survey is to determine what youth are thinking about alcohol and drugs.
Your answers will be kept very secret. DO NOT PLACE YOUR NAME ON THIS FORM.
The password you create and place on the top of this page will allow us to keep you name secret.
We want to know what you really think, so please answer all questions honestly.
Thank you for your help.

PLEASE…

1. Circle the appropriate number or fill in the blank.
2. Answer each question carefully.
3. Erase completely to change an answer.
4. Use a pencil only.
5. Mark only one answer for each question.

SECTION A

Mark only ONE answer.

1. Are you…

    1. Male
    2. Female

2. How old are you?

    1. 11 years old or younger
    2. 12 years old
    3. 13 years old
    4. 14 years old
    5. 15 years old
    6. 16 years old or older

3. What grade in school will you be going into?

    1. 7th grade
    2. 8th grade
    3. 9th grade
    4. 10th grade
    5. Ungraded or other

SECTION B

4. I think using alcohol (answer each item):

a.	Makes people relax:	1. Yes	2. No
b.	Makes parties more fun:	1. Yes	2. No
c.	Makes a person lose control:	1. Yes	2. No
d.	Makes people more friendly:	1. Yes	2. No
e.	Makes people feel more alert:	1. Yes	2. No
f.	Makes the future seem brighter:	1. Yes	2. No
g.	Makes people feel more romantic:	1. Yes	2. No
h.	Helps people stand up to others:	1. Yes	2. No
i.	Makes a person feel good and happy:	1. Yes	2. No
j.	Makes people understand things better:	1. Yes	2. No
k.	Helps keep peoples' minds off their problems at home:	1. Yes	2. No

5. How sure are you that you can avoid using alcohol, even if asked to use it by friends?

   1. Very sure
   2. Somewhat sure
   3. A little sure
   4. Not sure

6. Could you resist an offer to drink alcohol at a party?

   1. Yes
   2. Probably yes
   3. Probably no
   4. No

7. Could you resist an offer to drink alcohol on a date?

   1. Yes
   2. Probably yes
   3. Probably no
   4. No

SECTION C

8. If you got drunk on alcohol, how likely is it that you would get sick?

    1. Very likely
    2. Somewhat likely
    3. A little likely
    4. Not likely

9. If you got drunk on alcohol, how likely is it that you would be injured in an accident?

    1. Very likely
    2. Somewhat likely
    3. A little likely
    4. Not likely

10. If you drank often, how likely is it that you would become addicted to alcohol?

    1. Very likely
    2. Somewhat likely
    3. A little likely
    4. Not likely

11. If you get sick from drinking alcohol, how bad would it be?

    1. Very bad
    2. Somewhat bad
    3. A little bad
    4. Not bad

12. If you were injured in an accident from drinking alcohol, how bad would it be?

    1. Very bad
    2. Somewhat bad
    3. A little bad
    4. Not bad

13. If you became addicted to alcohol, how bad would it be?

    1. Very bad
    2. Somewhat bad
    3. A little bad
    4. Not bad

14. How likely is it that you would stay healthy by not getting drunk?

    1. Very likely
    2. Somewhat likely
    3. A little likely
    4. Not likely

15. How likely is it that you would stay away from accidents by not getting drunk?

    1. Very likely
    2. Somewhat likely
    3. A little likely
    4. Not likely

16. How likely is it that you would stay out of trouble with the law by not getting drunk?

    1. Very likely
    2. Somewhat likely
    3. A little likely
    4. Not likely

The Modified Youth Alcohol & Drug Survey Scoring Guidelines

The scoring procedures are devised higher score is indicative of greater risk for alcohol and drug abuse.

Section A: Participant Demographics

Item 1 measures participant **gender**.

Item 2 measures participant **age**.

Item 3 measures participant **grade in school**.

Section B: Cognitive and Social Factors

Item 4 measures **expectancy beliefs** about the effects of alcohol (scored 1 = 2 and 2 = 1 except sub-item "C" scored as responded).

Varname 4 a-k = A', B', C'-EXPBEL

Items 5-7 measure **resistance self-efficacy** (scored as responded).

Varname 5 + 6 + 7 = A', B', C'-SELF_EFF

Section C: Alcohol-Related Health Benefits

Items 8-10 measure **perceived susceptibility** to alcohol-related health consequences (scored as responded).

Varname 8 + 9 + 10 = A', B', C'-PERCSUS

Items 11-13 measure **perceived severity** of alcohol-related health consequences (scored as responded).

Varname 11 + 12 + 13 = A', B', C'-PERCSEV

Items 14-16 measure **benefits** to avoiding alcohol (scored as responded).

Varname 14 + 15 + 16 = A', B', C'-BENEFIT

APPENDIX J

ALCOHOL KNOWLEDGE QUESTIONNAIRE AND KEY

ALCOHOL KNOWLEDGE QUESTIONNAIRE

The Alcohol Knowledge Questionnaire *Password:* _____

PLEASE…

1. Circle the letter by the most appropriate choice.
2. Answer each question carefully and completely.
3. Erase completely to change an answer.
4. Use a pencil only.

SECTION A
(Recognition Component)

Mark only ONE answer. *(Key: Bold text indicates correct response)*

1. What is the *easiest* way not to be pressured to drink?

   a. Carry a nonalcoholic drink
   b. Using strong nonverbal cues
   c. Using strong verbal refusals
   d. Using avoidance methods

2. Which of the following is an effective refusal for drinking alcohol?

   a. "No thanks, I'd rather have a coke."
   b. "It's probably not a good idea right now."
   c. "Let's wait until your parents leave."
   d. "I'm not sure."

3. It is not uncommon for boys who are drinking to:

   a. Become hostile
   b. Become aggressive
   c. Fall asleep
   d. All of the above

4. What percentage of teenagers say you shouldn't drink and drive?

   a. 45%
   b. 92%
   c. 66%
   d. 83%

5. If a person who has been drinking offers you a ride home, you should:

   a. Call your parents or a friend to pick you up
   b. Stay where you are
   c. Drive the car yourself although you do not have a license
   d. Accept the ride and take your chances

6. What percentage of teenagers say they've accepted a ride from someone who's been drinking?

   a. 12%
   b. 42%
   c. 33%
   d. 26%

7. Which of the following are characteristic of effective verbal refusals?

   a. Using the word "No"
   b. Repeating the refusal as often as needed
   c. Suggesting an alternative to drinking
   d. All of the above

8. Which of the following is a poor way to refuse alcohol at a party?

   a. Saying no thanks
   b. Asking what others are doing
   c. Leaving
   d. Asking for something nonalcoholic instead

9. Of all traffic accidents involving teenagers, what percentage is alcohol a factor in?

   a. 45%
   b. 25%
   c. 66%
   d. 30%

10. Holding a can of soda at a party where there is alcohol would be an example of:

    a. A verbal refusal of alcohol
    b. A nonverbal cue for avoiding alcohol
    c. An avoidance method
    d. All of the above

SECTION B
(Recall Component)

Answer each question in the space provided. *(Key: Bold text indicates correct responses)*

11. List as many ways of avoiding alcohol as you can. *(5 Points: +1 for each correct item)*

    - **Avoid social settings where alcohol will be served**
    - **Avoid parties with little or no parental supervision**
    - **Avoid parties which will be attended by older kids**
    - **Avoid kids who drink**
    - **Avoid the temptation to drink by bringing non-alcoholic beverages**

12. Why do you need to have effective refusal skills in addition to knowing effective avoidance techniques? *(2 Points: +1 for each correct item)*

- **You will not always be able to avoid situations where people will offer you alcohol**
- **Having effective refusal skills will keep people from pressuring you into doing things you don't want to do**

13. Explain the purpose of nonverbal cues in helping you refuse alcohol. *(1 Point)*

- **Nonverbal cues can be used to reinforce verbal refusals, making it easier to say "no"**

14. List as many effective nonverbal cues as you can. *(5 Points: +1 for each correct item)*

- **Drink in hand - have something else handy**
- **Soldier body - stand rigid and confident**
- **Hands-off - gesture the drink away with your hand**
- **Serious facial expression - show your best "I mean it!" expression**
- **Walk away - leave the person who is pressuring you to drink**

APPENDIX K

STUDY OVERVIEW

OVERVIEW: MULTIMEDIA & INTERACTIVE VIDEO STUDY

Thank you for your interest in our study. We are asking adolescents *between 12 and 15 years old* for their voluntary participation in a study designed to discover how to make interactive video more effective for learning.

We have developed a multimedia alcohol education computer program for adolescents and will be using the results of this study to help us determine the best way to design similar multimedia programs in the future.

Participants will receive $15 for completing the study.

Volunteers must have the following to participate in the study:

- PARENT/GUARDIAN INFORMED CONSENT FORM signed and dated by a parent or guardian
- PARTICIPANT'S INFORMED CONSENT FORM signed and dated by the participant

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The study will take place on *two separate days* - about *two weeks apart.*

Session one will take about *1 hour to complete*. During this time, participants will be asked to do the following:

1. Complete *confidential questionnaires* about their knowledge of the effects of alcohol and consequences of drinking, their attitudes toward drinking, and other general information.
2. Read specific instructions about the tasks they will perform in the study.
3. Complete a short training session to become familiar with the Macintosh computer system and multimedia educational software.
4. Use the *IMPART 1.2©* multimedia software, an experimental version of *Interactive Multimedia for the Promotion of Alcohol Awareness and Resistance Training - version 1.0©*, a program designed to delay the onset of drinking among adolescents. The *IMPART 1.0©* program was developed by ARCOVA under contract N43AA42010 from the National Institute on Alcohol Abuse and Alcoholism, Public Health Service, Department of Health and Human Services, Rockville, Maryland. ARCOVA has given permission to use material from the program for the purposes of this study.
5. Answer questions about the *IMPART 1.2©* content material while using the program.

Session two will take place about two weeks after the initial session and should take *about 15 minutes to complete*. During this time participants will be asked to complete additional questionnaires regarding the software used during session one.

For questions or to sign up: • ***Phone 552.7588 - ask for Mike***
• ***Leave name, age & phone number***

APPENDIX L

PARTICIPANT'S INFORMED CONSENT FORM

PARTICIPANT'S INFORMED CONSENT FORM

Note: *Sign and bring this set of Informed Consent Forms with you to the study.*

You are being asked to volunteer as a participant in a research project whose overall purpose is to find out how to make interactive video more effective for learning. Between 30 and 45 youths will participate in this study.

You will need to report to the American Research Corporation of Virginia (ARCOVA) in Radford, VA. It is the participant's responsibility to find transportation to and from ARCOVA for the study. The study will involve *two separate sessions* - occurring about *two weeks apart*. The *total amount of time* needed from you is about *two hours*.

Session one will take about *1 hour to complete*. During this time, you will be asked to do the following:

1. Complete *confidential questionnaires* about your knowledge of the effects of alcohol and consequences of drinking, your attitudes toward drinking, and other general information.

2. Read specific instructions about the tasks you will perform in the study.

3. Complete a short training session to become familiar with the Macintosh computer system and multimedia educational software.

4. Use the *IMPART 1.2*© multimedia software, an experimental version of *Interactive Multimedia for the Promotion of Alcohol Awareness and Resistance Training - version 1.0*©, a program designed to delay the onset of drinking among youths. The *IMPART 1.0*© program was developed by ARCOVA under contract N43AA42010 from the National Institute on Alcohol Abuse and Alcoholism, Public Health Service, Department of Health and Human Services, Rockville, Maryland. ARCOVA has given permission to use material from the program for the purposes of this study.

   The experimental version of this program includes three sections, and uses some of the material from the original program. In the study, you will be seeing 1) a tutorial section with text and graphics about how to avoid and refuse alcohol, 2) a drill and practice section involving short videos on how to refuse alcohol, and 3) an interactive video story section with middle-school and high-school aged actors involved in situations about the health and social consequences of drinking. **Please note** that while these situations touch on such topics as underage drinking, drinking and driving, and kissing, **nothing explicit is shown in any of the videos**.

5. Answer questions about the *IMPART 1.2*© content material while using the program.

Your parents or legal guardians have the option to view the program and study-related materials before giving approval for your participation in the study. If such a viewing is desired, please contact Mr. Michael Mitchell at 552-7588.

Session two will take place about two weeks after the first session and should take *about 15 minutes to complete*. During this time you will be asked to complete additional questionnaires about the software used during session one.

There are no known sources of discomfort or foreseeable risks in this study. This research project involves no tricks or deceptions. We are simply interested in how effectively people will be able to learn using this newly developed program.

While there are no major benefits to you from this research, you will earn up to $15 for participating in the study. In addition, you may learn more about the consequences of drinking alcohol and may find the experiment interesting.

You can be sure that we will not tell anyone about what you write down or tell us during this study. To make sure that you remain anonymous, you will only be identified by a password which you will create. You will enter a password of your choosing at the first session and use the same password for the second session. Only you will know your password, so you will remain anonymous. Data collected during this study will be considered strictly confidential.

All data collected in this study will be kept in a locked file cabinet. Dr. Robert C. Williges, the Principal Investigator for the study, will hold the only key to this file cabinet. All data collected during the study will be destroyed within 6 months of the study's completion.

You are free to withdraw from the study at any time without penalty. In such a case, you will be compensated for the portion of the study you have completed (payment will be prorated). You are free not to answer any questions you choose without penalty.

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University, and by the Department of Industrial and Systems Engineering.

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent to participate in this project.

If I participate, I may withdraw at anytime without penalty. I agree to abide by the rules of this project.

_____ _____

Signature *Date*

Should I have any questions about this research or its conduct, I may contact:

Michael W. Mitchell, Graduate Student (540) 552-7588

Dr. Robert C. Williges, Virginia Tech Faculty Member (540) 231-6270

Additional questions regarding your rights as a participant should be addressed to Dr. E. R. Stout, Chairman of the University's Institutional Review Board, at (540) 231-9359.

APPENDIX M

PARENT/GUARDIAN INFORMED CONSENT FORM

PARENT/GUARDIAN INFORMED CONSENT FORM

You are being asked to allow your child to volunteer as a participant in a research project whose overall purpose is to find out how to make interactive video more effective for learning. Between 30 and 45 adolescents will participate in this study.

Your child will need to report to the American Research Corporation of Virginia (ARCOVA) in Radford, VA. It is the participant's responsibility to find transportation to and from ARCOVA for the study. The study will involve *two separate sessions* - occurring about *two weeks apart.* The *total time requirement* from your child is approximately *two hours*.

Session one will take about *1 hour to complete*. During this time, your child will be asked to do the following:

1. Complete *confidential questionnaires* regarding their knowledge of the effects of alcohol and consequences of drinking, their attitudes toward drinking, and other general information.

2. Read specific instructions regarding the tasks they are to perform in the study.

3. Complete a brief training session to familiarize themselves with the Macintosh computer system and multimedia educational software.

4. Use the *IMPART 1.2©* multimedia software, an experimental version of *Interactive Multimedia for the Promotion of Alcohol Awareness and Resistance Training - version 1.0©*, a program designed to delay the onset of drinking among adolescents. The *IMPART 1.0©* program was developed by ARCOVA under contract N43AA42010 from the National Institute on Alcohol Abuse and Alcoholism, Public Health Service, Department of Health and Human Services, Rockville, Maryland. ARCOVA has given permission to use material from the program for the purposes of this study.

   The experimental version of this program includes three sections, and uses a portion of the material from the original program. In the study, your child will be seeing 1) a tutorial section with text and graphics about how to avoid and refuse alcohol, 2) a drill and practice section involving short videos on how to refuse alcohol, and 3) an interactive video story section with middle-school and high-school aged actors involved in situations about the health and social consequences of drinking. **Please note** that while these situations touch on such topics as underage drinking, drinking and driving, and kissing, **nothing explicit is shown in any of the videos**.

5. Answer questions regarding the *IMPART 1.2©* content material while using the program.

Parents and legal guardians have the option to view the program and study-related materials before giving approval for their child to participate. If such a viewing is desired, please contact Mr. Michael Mitchell at 552-7588.

Session two will take place about two weeks after the initial session and should take *about 15 minutes to complete*. During this time participants will be asked to complete additional questionnaires regarding the software used during session one.

There are no known sources of discomfort or foreseeable risks in this study. This research project involves no tricks or deceptions. We are simply interested in how effectively people will be able to learn using this newly developed program.

While there are no major benefits to you or your child from this research, your child will earn up to $15 for participating in the study. In addition, your child may learn more about the consequences of drinking alcohol and may find the experiment interesting.

To ensure anonymity and confidentiality, your child will only be identified by his or her own self-assigned password. Your child will enter a password of his/her choosing at the first session and use the same password for the second session. Only your child will know his or her password, therefore, anonymity is complete. Data collected during this study will be considered strictly confidential.

All data collected in this study will be kept in a locked file cabinet. Dr. Robert C. Williges, the Principal Investigator for the study, will hold the only key to this file cabinet. All data collected during the study will be destroyed within 6 months of the study's completion.

Your child is free to withdraw from the study at any time without penalty. In such a case, your child will be compensated for the portion of the study they have completed (payment will be prorated). Your child is free not to answer any questions they choose without penalty.

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University, and by the Department of Industrial and Systems Engineering.

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for my child to participate in this project if they so choose.

If my child participates, I or my child may withdraw at anytime without penalty. I agree to abide by the rules of this project.

_____ _____

Signature *Date*

Should I have any questions about this research or its conduct, I may contact:

Michael W. Mitchell, Graduate Student (540) 552-7588

Dr. Robert C. Williges, Virginia Tech Faculty Member (540) 231-6270

Additional questions regarding your child's rights as a participant should be addressed to Dr. E. R. Stout, Chairman of the University's Institutional Review Board, at (540) 231-9359.

APPENDIX
N
ONE-WAY ANOVA SUMMARY TABLES (A-M)

FACTOR: EXPERIMENTAL GROUP

MENTAL EFFORT RATING

Table A: One-way ANOVA Summary Table for the Dependent Variable AVG_MER.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	1	.962	.962	2.629	.1206
Residual	20	7.316	.366		

REACTION-TIME

Table B: One-way ANOVA Summary Table for the Dependent Variable AVG_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.222	.111	.234	.7925
Residual	30	14.187	.473		

Table C: One-way ANOVA Summary Table for the Dependent Variable AVG_BL_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.596	.298	2.262	.1216
Residual	30	3.953	.132		

Table D: One-way ANOVA Summary Table for the Dependent Variable EXP_BEL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.424	.212	.072	.9303
Residual	30	87.818	2.927		

Table E: One-way ANOVA Summary Table for the Dependent Variable SELF_EFF differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	1.697	.848	.517	.6018
Residual	30	49.273	1.642		

Table F: One-way ANOVA Summary Table for the Dependent Variable PERCSUS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	5.515	2.758	.894	.4197
Residual	30	92.545	3.085		

Table G: One-way ANOVA Summary Table for the Dependent Variable PERCSEV differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	5.515	2.758	1.580	.2227
Residual	30	52.364	1.745		

Table H: One-way ANOVA Summary Table for the Dependent Variable BENEFIT differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	13.879	6.939	2.313	.1163
Residual	30	90.000	3.000		

Table I: One-way ANOVA Summary Table for the Dependent Variable COMP_YADS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.970	.485	.021	.9788
Residual	30	677.273	22.576		

KNOWLEDGE CONSTRUCT DIFFERENTIALS

Table J: One-way ANOVA Summary Table for the Dependent Variable RECOG differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	6.727	3.364	1.086	.3504
Residual	30	92.909	3.097		

Table K: One-way ANOVA Summary Table for the Dependent Variable RECALL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.424	.212	.044	.9567
Residual	30	143.455	4.782		

Table L: One-way ANOVA Summary Table for the Dependent Variable COMP_AKQ differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	8.061	4.030	.446	.6442
Residual	30	270.909	9.030		

RESPONSE ACCURACY

Table M: One-way ANOVA Summary Table for the Dependent Variable RESP_ACC.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	1	8.754E-36	8.754E-36	7.186E-36	1.0000
Residual	20	24.364	1.218		

APPENDIX

O

ONE-WAY ANCOVA SUMMARY TABLES (N-Z)

FACTOR: EXPERIMENTAL GROUP
COVARIATE: LOC SCORE

MENTAL EFFORT RATING

Table N: One-way ANCOVA Summary Table for the Dependent Variable AVG_MER.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	1	.963	.963	2.500	.1303
LOC Score *(covariate)*	1	.002	.002	.000	.9485
Residual *(adjusted)*	19	7.315	.385		

REACTION-TIME

Table O: One-way ANCOVA Summary Table for the Dependent Variable AVG_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	.443	.222	.480	.6213
LOC Score *(covariate)*	1	.899	.899	1.960	.1717
Residual *(adjusted)*	29	13.287	.458		

Table P: One-way ANCOVA Summary Table for the Dependent Variable AVG_BL_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	.652	.326	2.430	.1053
LOC Score *(covariate)*	1	.071	.071	.530	.4719
Residual *(adjusted)*	29	3.882	.134		

Table Q: One-way ANCOVA Summary Table for the Dependent Variable EXP_BEL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	.448	.224	.070	.9287
LOC Score *(covariate)*	1	.320	.320	.110	.7469
Residual *(adjusted)*	29	87.498	3.017		

Table R: One-way ANCOVA Summary Table for the Dependent Variable SELF_EFF differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	1.734	.867	.530	.5962
LOC Score *(covariate)*	1	1.531	1.531	.930	.3428
Residual *(adjusted)*	29	47.741	1.646		

Table S: One-way ANCOVA Summary Table for the Dependent Variable PERCSUS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	6.430	3.215	1.030	.3692
LOC Score *(covariate)*	1	2.150	2.150	.690	.4131
Residual *(adjusted)*	29	90.396	3.117		

Table T: One-way ANCOVA Summary Table for the Dependent Variable PERCSEV differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	5.129	2.565	1.420	.2569
LOC Score *(covariate)*	1	.158	.158	.090	.7693
Residual *(adjusted)*	29	52.206	1.800		

Table U: One-way ANCOVA Summary Table for the Dependent Variable BENEFIT differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	13.344	6.672	2.150	.1347
LOC Score *(covariate)*	1	.006	.006	.000	.9654
Residual *(adjusted)*	29	89.994	3.103		

Table V: One-way ANCOVA Summary Table for the Dependent Variable COMP_YADS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	.507	.253	.010	.9891
LOC Score *(covariate)*	1	7.813	7.813	.340	.5652
Residual *(adjusted)*	29	669.460	23.0848		

KNOWLEDGE CONSTRUCT DIFFERENTIALS

Table W: One-way ANCOVA Summary Table for the Dependent Variable RECOG differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	8.416	4.208	1.360	.2735
LOC Score *(covariate)*	1	2.921	2.921	.940	.3400
Residual *(adjusted)*	29	89.988	3.103		

Table X: One-way ANCOVA Summary Table for the Dependent Variable RECALL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	1.563	.782	.180	.8395
LOC Score *(covariate)*	1	14.688	14.688	3.310	.0793
Residual *(adjusted)*	29	128.766	4.4402		

Table Y: One-way ANCOVA Summary Table for the Dependent Variable COMP_AKQ differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	15.815	7.908	.950	.3967
LOC Score *(covariate)*	1	30.709	30.709	3.710	.0640
Residual *(adjusted)*	29	240.199	8.283		

RESPONSE ACCURACY

Table Z: One-way ANCOVA Summary Table for the Dependent Variable RESP_ACC.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	1	.001	.001	.000	.9781
LOC Score *(covariate)*	1	.206	.206	.160	.6916
Residual *(adjusted)*	19	24.157	1.271		

APPENDIX
P
TWO-WAY ANOVA SUMMARY TABLES (AA-AM)

FACTORS: EXPERIMENTAL GROUP, GENDER

MENTAL EFFORT RATING

Table AA: Two-way ANOVA Summary Table for the Dependent Variable AVG_MER.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	1	1.105	1.105	3.139	.0934
Gender	1	.314	.314	.893	.3572
Exp. Group * Gender	1	.668	.668	1.899	.1851
Residual	18	6.334	.352		

REACTION-TIME

Table AB: Two-way ANOVA Summary Table for the Dependent Variable AVG_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.214	.107	.213	.8097
Gender	1	.177	.177	.351	.5583
Exp. Group * Gender	2	.441	.220	.438	.6497
Residual	27	13.570	.503		

Table AC: Two-way ANOVA Summary Table for the Dependent Variable AVG_BL_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.633	.316	2.228	.1272
Gender	1	.033	.033	.233	.6330
Exp. Group * Gender	2	.086	.043	.303	.7410
Residual	27	3.834	.142		

Table AD: Two-way ANOVA Summary Table for the Dependent Variable EXP_BEL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.341	.171	.054	.9472
Gender	1	.198	.198	.063	.8036
Exp. Group * Gender	2	2.887	1.443	.460	.6362
Residual	27	84.733	3.138		

Table AE: Two-way ANOVA Summary Table for the Dependent Variable SELF_EFF differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	1.651	.825	.497	.6138
Gender	1	3.759	3.759	2.264	.1441
Exp. Group * Gender	2	.681	.340	.205	.8159
Residual	27	44.833	1.660		

Table AF: Two-way ANOVA Summary Table for the Dependent Variable PERCSUS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	5.606	2.803	.822	.4502
Gender	1	.327	.327	.096	.7591
Exp. Group * Gender	2	.152	.076	.022	.9780
Residual	27	92.067	3.410		

Table AG: Two-way ANOVA Summary Table for the Dependent Variable PERCSEV differential.

Source	***df***	**SS**	**MS**	***F***	***p***	
Exp. Group	2	5.097	2.548	1.632	.2143	
Gender	1	7.645	7.645	4.896	.0356	*
Exp. Group * Gender	2	2.552	1.276	.817	.4524	
Residual	27	42.167	1.562			

Table AH: Two-way ANOVA Summary Table for the Dependent Variable BENEFIT differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	13.097	6.548	2.083	.1441
Gender	1	2.945	2.945	.937	.3416
Exp. Group * Gender	2	2.188	1.094	.348	.7092
Residual	27	84.867	3.143		

Table AI: Two-way ANOVA Summary Table for the Dependent Variable COMP_YADS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.624	.312	.014	.9862
Gender	1	55.309	55.309	2.464	.1281
Exp. Group * Gender	2	15.897	7.948	.354	.7050
Residual	27	606.067	22.447		

KNOWLEDGE CONSTRUCT DIFFERENTIALS

Table AJ: Two-way ANOVA Summary Table for the Dependent Variable RECOG differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	8.632	4.316	1.516	.2377
Gender	1	.259	.259	.091	.7654
Exp. Group * Gender	2	15.784	7.892	2.772	.0804
Residual	27	76.867	2.847		

Table AK: Two-way ANOVA Summary Table for the Dependent Variable RECALL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.523	.262	.050	.9511
Gender	1	1.868	1.868	.358	.5544
Exp. Group * Gender	2	.887	.443	.085	.9187
Residual	27	140.700	5.211		

Table AL: Two-way ANOVA Summary Table for the Dependent Variable COMP_AKQ differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	10.642	5.321	.581	.5660
Gender	1	.736	.736	.080	.7789
Exp. Group * Gender	2	23.006	11.503	1.257	.3007
Residual	27	247.167	9.154		

RESPONSE ACCURACY

Table AM: Two-way ANOVA Summary Table for the Dependent Variable RESP_ACC.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	1	.006	.006	.005	.9462
Gender	1	.297	.297	.229	.6380
Exp. Group * Gender	1	.733	.733	.566	.4617
Residual	18	23.333	1.296		

APPENDIX

Q

TWO-WAY ANCOVA SUMMARY TABLES (AN-AZ)

FACTORS: EXPERIMENTAL GROUP, GENDER
COVARIATE: LOC SCORE

MENTAL EFFORT RATING

Table AN: Two-way ANCOVA Summary Table for the Dependent Variable AVG_MER.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	1	1.082	1.082	2.930	.1052
Gender *(adjusted)*	1	.316	.316	.850	.3682
Exp. Group * Gender *(adjusted)*	1	.717	.717	1.940	.1816
LOC Score *(covariate)*	1	.050	.050	.140	.7165
Residual	17	6.284	.370		

REACTION TIME

Table AO: Two-way ANCOVA Summary Table for the Dependent Variable AVG_RT differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	.490	.245	.520	.6009
Gender *(adjusted)*	1	.202	.202	.430	.5184
Exp. Group * Gender *(adjusted)*	2	.832	.416	.880	.4256
LOC Score *(covariate)*	1	1.313	1.313	2.780	.1072
Residual	26	12.258	.472		

Table AP: Two-way ANCOVA Summary Table for the Dependent Variable AVG_BL_RT differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	.701	.350	2.430	.1076
Gender *(adjusted)*	1	.030	.030	.210	.6499
Exp. Group * Gender *(adjusted)*	2	.105	.044	.370	.6971
LOC Score *(covariate)*	1	.088	.088	.610	.4413
Residual	26	3.746	.144		

Table AQ: Two-way ANCOVA Summary Table for the Dependent Variable EXP_BEL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	.395	.198	.060	.9410
Gender *(adjusted)*	1	.214	.214	.070	.7992
Exp. Group * Gender *(adjusted)*	2	3.034	1.517	.470	.6313
LOC Score *(covariate)*	1	.480	.480	.150	.7034
Residual	26	84.253	3.241		

Table AR: Two-way ANCOVA Summary Table for the Dependent Variable SELF_EFF differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	1.787	.894	.540	.5913
Gender *(adjusted)*	1	3.879	3.879	2.330	.1391
Exp. Group * Gender *(adjusted)*	2	.533	.266	.160	.8531
LOC Score *(covariate)*	1	1.507	1.507	.900	.3504
Residual	26	43.327	1.666		

Table AS: Two-way ANCOVA Summary Table for the Dependent Variable PERCSUS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	6.444	3.222	.930	.4066
Gender *(adjusted)*	1	.371	.371	.110	.7457
Exp. Group * Gender *(adjusted)*	2	.114	.057	.020	.9837
LOC Score *(covariate)*	1	2.155	2.155	.620	.4370
Residual	26	89.911	3.458		

Table AT: Two-way ANCOVA Summary Table for the Dependent Variable PERCSEV differential.

Source	***df***	**SS**	**MS**	***F***	***p***	
Exp. Group *(adjusted)*	2	4.431	2.215	1.380	.2686	
Gender *(adjusted)*	1	7.537	7.537	4.710	.0394	*
Exp. Group * Gender *(adjusted)*	2	2.972	1.486	.930	.4081	
LOC Score *(covariate)*	1	.528	.528	.330	.5708	
Residual	26	41.639	1.602			

Table AU: Two-way ANCOVA Summary Table for the Dependent Variable BENEFIT differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	12.332	6.166	1.890	.1713
Gender *(adjusted)*	1	2.953	2.953	.900	.3502
Exp. Group * Gender *(adjusted)*	2	2.199	1.099	.340	.7171
LOC Score *(covariate)*	1	.012	.012	.000	.9519
Residual	26	84.855	3.264		

Table AV: Two-way ANCOVA Summary Table for the Dependent Variable COMP_YADS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	.692	.346	.020	.9851
Gender *(adjusted)*	1	56.338	56.338	2.450	.1298
Exp. Group * Gender *(adjusted)*	2	14.691	7.346	.320	.7296
LOC Score *(covariate)*	1	7.685	7.685	.330	.5683
Residual	26	598.381	23.015		

Table AW: Two-way ANCOVA Summary Table for the Dependent Variable RECOG differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	10.026	5.013	1.740	.1956
Gender *(adjusted)*	1	.224	.224	.080	.7828
Exp. Group * Gender *(adjusted)*	2	14.796	7.398	2.570	.0962
LOC Score *(covariate)*	1	1.891	1.891	.660	.4253
Residual	26	74.975	2.884		

Table AX: Two-way ANCOVA Summary Table for the Dependent Variable RECALL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	1.649	.825	.170	.8448
Gender *(adjusted)*	1	2.143	2.143	.440	.5124
Exp. Group * Gender *(adjusted)*	2	.325	.163	.030	.9671
LOC Score *(covariate)*	1	14.399	14.399	2.960	.0970
Residual	26	126.301	4.858		

Table AY: Two-way ANCOVA Summary Table for the Dependent Variable COMP_AKQ differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	2	18.457	9.228	1.090	.3516
Gender *(adjusted)*	1	.982	.982	.120	.7364
Exp. Group * Gender *(adjusted)*	2	18.767	9.383	1.110	.3457
LOC Score *(covariate)*	1	26.727	26.727	3.150	.0875
Residual	26	220.439	8.478		

RESPONSE ACCURACY

Table AZ: Two-way ANOVA Summary Table for the Dependent Variable RESP_ACC.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group *(adjusted)*	1	.002	.002	.000	.9693
Gender *(adjusted)*	1	.302	.302	.230	.6406
Exp. Group * Gender *(adjusted)*	1	1.097	1.097	.820	.3781
LOC Score *(covariate)*	1	.573	.573	.430	.5219
Residual	17	22.761	1.339		

APPENDIX
R
TWO-WAY ANOVA SUMMARY TABLES (BA-BM)

FACTORS: EXPERIMENTAL GROUP, LOC GROUP

MENTAL EFFORT RATING

Table BA: Two-way ANOVA Summary Table for the Dependent Variable AVG_MER.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	1	1.458	1.458	4.028	.0620
LOC Group	1	.242	.242	.669	.4256
Exp. Group * LOC Group	1	.098	.098	.271	.6100
Residual	16	5.792	.362		

REACTION-TIME

Table BB: Two-way ANOVA Summary Table for the Dependent Variable AVG_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.320	.160	.351	.7075
LOC Group	1	1.495	1.495	3.278	.0828
Exp. Group * LOC Group	2	.903	.452	.990	.3863
Residual	24	10.948	.456		

Table BC: Two-way ANOVA Summary Table for the Dependent Variable AVG_BL_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.763	.381	2.655	.0909
LOC Group	1	.027	.027	.190	.6672
Exp. Group * LOC Group	2	.047	.023	.162	.8510
Residual	24	3.449	.144		

Table BD: Two-way ANOVA Summary Table for the Dependent Variable EXP_BEL differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.467	.233	.084	.9194
LOC Group	1	.533	.533	.193	.6645
Exp. Group * LOC Group	2	5.267	2.633	.952	.4001
Residual	24	66.400	2.767		

Table BE: Two-way ANOVA Summary Table for the Dependent Variable SELF_EFF differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	1.867	.933	.544	.5876
LOC Group	1	.133	.133	.078	.7829
Exp. Group * LOC Group	2	7.467	3.733	2.175	.1355
Residual	24	41.200	1.717		

Table BF: Two-way ANOVA Summary Table for the Dependent Variable PERCSUS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	4.467	2.233	.626	.5431
LOC Group	1	.833	.833	.234	.6332
Exp. Group * LOC Group	2	4.067	2.033	.570	.5729
Residual	24	85.600	3.567		

Table BG: Two-way ANOVA Summary Table for the Dependent Variable PERCSEV differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	3.200	1.600	.780	.4695
LOC Group	1	.033	.033	.016	.8996
Exp. Group * LOC Group	2	.267	.133	.065	.9372
Residual	24	49.200	2.050		

Table BH: Two-way ANOVA Summary Table for the Dependent Variable BENEFIT differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	10.467	5.233	1.562	.2303
LOC Group	1	.300	.300	.090	.7673
Exp. Group * LOC Group	2	1.800	.900	.269	.7667
Residual	24	80.400	3.350		

Table BI: Two-way ANOVA Summary Table for the Dependent Variable COMP_YADS differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.067	.033	.001	.9987
LOC Group	1	1.633	1.633	.062	.8059
Exp. Group * LOC Group	2	34.867	17.433	.659	.5264
Residual	24	634.800	26.450		

KNOWLEDGE CONSTRUCT DIFFERENTIALS

Table BJ: Two-way ANOVA Summary Table for the Dependent Variable RECOG differential.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	9.867	4.933	1.783	.1897
LOC Group	1	4.800	4.800	1.735	.2002
Exp. Group * LOC Group	2	5.600	2.800	1.012	.3785
Residual	24	66.400	2.767		

Table BK: Two-way ANOVA Summary Table for the Dependent Variable RECALL differential.

Source	***df***	**SS**	**MS**	***F***	***p***	
Exp. Group	2	.800	.400	.090	.9140	
LOC Group	1	24.300	24.300	5.481	.0279	*
Exp. Group * LOC Group	2	3.200	1.600	.361	.7008	
Residual	24	106.400	4.433			

Table BL: Two-way ANOVA Summary Table for the Dependent Variable COMP_AKQ differential.

Source	***df***	**SS**	**MS**	***F***	***p***	
Exp. Group	2	13.067	6.533	.889	.4242	
LOC Group	1	50.700	50.700	6.898	.0148	*
Exp. Group * LOC Group	2	15.200	7.600	1.034	.3709	
Residual	24	176.400	7.350			

RESPONSE ACCURACY

Table BM: Two-way ANOVA Summary Table for the Dependent Variable RESP_ACC.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	1	0.000	0.000	0.000	1.0000
LOC Group	1	.200	.200	.267	.6126
Exp. Group * LOC Group	1	.800	.800	1.067	.3171
Residual	16	12.000	.750		

APPENDIX S

PAIRED COMPARISONS SUMMARY TABLES (BN-BX)

ATTITUDE CONSTRUCTS

Table BN: Paired *t*-test for EXP_BEL pretest vs. EXP_BEL posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
EXP_BEL post, EXP_BEL pre	-.515	32	-1.782	.9579

Table BO: Paired *t*-test for SELF_EFF pretest vs. SELF_EFF posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
SELF_EFF post, SELF_EFF pre	.303	32	1.379	.0887

Table BP: Paired *t*-test for PERCSUS pretest vs. PERCSUS posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
PERCSUS post, PERCSUS pre	-.424	32	-1.392	.9133

Table BQ: Paired *t*-test for PERCSEV pretest vs. PERCSEV posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
PERCSEV post, PERCSEV pre	.061	32	.259	.3987

Table BR: Paired *t*-test for BENEFIT pretest vs. BENEFIT posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
BENEFIT post, BENEFIT pre	.061	32	.193	.4240

Table BS: Paired *t*-test for COMP_YADS pretest vs. COMP_YADS posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
COMP_YADS post, COMP_YADS pre	-.515	32	-.643	.7375

KNOWLEDGE CONSTRUCTS

Table BT: Paired *t*-test for RECOG pretest vs. RECOG posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***	
RECOG post, RECOG pre	1.364	32	4.439	<.0001	*

Table BU: Paired *t*-test for RECALL pretest vs. RECALL posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***	
RECALL post, RECALL pre	1.939	32	5.254	<.0001	*

Table BV: Paired *t*-test for COMP_AKQ pretest vs. COMP_AKQ posttest.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***	
COMP_AKQ post, COMP_AKQ pre	3.303	32	6.426	<.0001	*

REACTION-TIME

Table BW: Paired *t*-test for Average Reaction-Time in the Question Relevance Comparison (Within-Subjects Design Extraction).

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
AVG_RT Personal, AVG_RT General	-.034	10	-.212	.5819

MENTAL EFFORT RATING

Table BX: Paired *t*-test for Average Mental Effort Rating in the Question Relevance Comparison (Within-Subjects Design Extraction).

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
AVG_MER Personal, AVG_MER General	.091	10	.485	.3192

APPENDIX T

UNPAIRED COMPARISONS SUMMARY TABLES (BY-CK)

MENTAL EFFORT RATING

Table BY: Unpaired *t*-tests across Experimental Group for the Dependent Variable AVG_MER.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.418	20	1.621	.0603
Inference Group, Control Group	•	•	•	•
Factual Group, Control Group	•	•	•	•

REACTION-TIME

Table BZ: Unpaired *t*-tests across Experimental Group for the Dependent Variable AVG_RT.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	-.064	20	-.313	.6213
Inference Group, Control Group	-.197	20	-.638	.7347
Factual Group, Control Group	-.133	20	-.382	.6466

Table CA: Unpaired *t*-tests across Experimental Group for the Dependent Variable AVG_BL_RT.

Hypothesized Difference (H_0) = 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.123	20	1.181	.2516
Inference Group, Control Group	-.203	20	-1.089	.2893
Factual Group, Control Group	-.326	20	-2.010	.0581

ATTITUDE CONSTRUCTS

Table CB: Unpaired *t*-tests across Experimental Group for the Dependent Variable EXP_BEL differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	-.273	20	-.372	.6431
Inference Group, Control Group	-.091	20	-.139	.5545
Factual Group, Control Group	.182	20	.229	.4106

Table CC: Unpaired *t*-tests across Experimental Group for the Dependent Variable SELF_EFF differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.545	20	.919	.1845
Inference Group, Control Group	.182	20	.321	.3757
Factual Group, Control Group	-.364	20	-.770	.7748

Table CD: Unpaired *t*-tests across Experimental Group for the Dependent Variable PERCSUS differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	-.909	20	-1.060	.8491
Inference Group, Control Group	-.818	20	-1.150	.8682
Factual Group, Control Group	.091	20	.137	.4463

Table CE: Unpaired *t*-tests across Experimental Group for the Dependent Variable PERCSEV differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.545	20	.847	.2036
Inference Group, Control Group	-.455	20	-.907	.8124
Factual Group, Control Group	-1.000	20	-1.870	.9619

Table CF: Unpaired *t*-tests across Experimental Group for the Dependent Variable BENEFIT differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***	
Inference Group, Factual Group	.455	20	.519	.3047	
Inference Group, Control Group	1.545	20	2.968	.0038	*
Factual Group, Control Group	1.091	20	1.410	.0869	

Table CG: Unpaired *t*-tests across Experimental Group for the Dependent Variable COMP_YADS differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.364	20	.155	.4391
Inference Group, Control Group	.364	20	.239	.4068
Factual Group, Control Group	0.000	20	0.000	•

KNOWLEDGE CONSTRUCTS

Table CH: Unpaired *t*-tests across Experimental Group for the Dependent Variable RECOG differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.091	20	.124	.4511
Inference Group, Control Group	1.000	20	1.350	.0961
Factual Group, Control Group	.909	20	1.167	.1284

Table CI: Unpaired *t*-tests across Experimental Group for the Dependent Variable RECALL differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.273	20	.261	.3986
Inference Group, Control Group	.182	20	.216	.4155
Factual Group, Control Group	-.091	20	-.101	.5398

Table CJ: Unpaired *t*-tests across Experimental Group for the Dependent Variable COMP_AKQ differential.

Hypothesized Difference (H_0) ≤ 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.364	20	.275	.3931
Inference Group, Control Group	1.182	20	.923	.1834
Factual Group, Control Group	.818	20	.660	.2585

RESPONSE ACCURACY

Table CK: Unpaired *t*-tests across Experimental Group for the Dependent Variable RESP_ACC.

Hypothesized Difference (H_0) = 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	0.000	20	0.000	•
Inference Group, Control Group	•	•	•	•
Factual Group, Control Group	•	•	•	•

APPENDIX U

ADDITIONAL STATISTICS TABLES (CL-CX)

Table CL: Selective Correlation Matrix (MER Trials Excluded)

	Correlation	*p*		95% Lower	95% Upper
LOC Score, Gender	.024	.8938		-.322	.365
LOC Score, Age	-.122	.5003		-.447	.231
LOC Score, EXP_BEL diff	.058	.7505		-.291	.394
LOC Score, SELF_EFF diff	.171	.3435		-.183	.486
LOC Score, PERCSUS diff	.112	.5371		-.240	.439
LOC Score, PERCSEV diff	-.097	.5944		-.426	.255
LOC Score, BENEFIT diff	.072	.6922		-.278	.405
LOC Score, COMP_YADS diff	.110	.5435		-.242	.437
LOC Score, RECOG diff	-.111	.5407		-.438	.241
LOC Score, RECALL diff	-.307	.0824		-.588	.041
LOC Score, COMP_AKQ diff	-.287	.1060		-.574	.063
LOC Score, AVG_BL_RT	.058	.7498		-.291	.394
LOC Score, AVG_RT	.217	.2272		-.137	.521
Gender, Age	.257	.1497		-.095	.552
Gender, EXP_BEL diff	-.047	.7951		-.384	.301
Gender, SELF_EFF diff	-.272	.1271		-.562	.079
Gender, PERCSUS diff	-.058	.7514		-.393	.291
Gender, PERCSEV diff	-.363	.0370	*	-.628	-.023
Gender, BENEFIT diff	-.168	.3518		-.484	.186
Gender, COMP_YADS diff	-.286	.1077		-.573	.064
Gender, RECOG diff	-.051	.7800		-.388	.298
Gender, RECALL diff	.114	.5308		-.239	.440
Gender, COMP_AKQ diff	.051	.7782		-.297	.388
Gender, AVG_BL_RT	.085	.6395		-.266	.416
Gender, AVG_RT	-.111	.5427		-.437	.242
Age, EXP_BEL diff	.026	.8863		-.320	.366
Age, SELF_EFF diff	.048	.7937		-.301	.385
Age, PERCSUS diff	.118	.5151		-.235	.444
Age, PERCSEV diff	.206	.2526		-.148	.513
Age, BENEFIT diff	-.082	.6545		-.413	.269
Age, COMP_YADS diff	.096	.5990		-.256	.425
Age, RECOG diff	-.049	.7877		-.386	.299
Age, RECALL diff	.456	.0069	*	.134	.691
Age, COMP_AKQ diff	.298	.0918		-.050	.582
Age, AVG_BL_RT	.101	.5789		-.251	.429
Age, AVG_RT	-.023	.9014		-.363	.323
EXP_BEL diff, SELF_EFF diff	.330	.0602		-.015	.605
EXP_BEL diff, PERCSUS diff	.062	.7329		-.287	.397
EXP_BEL diff, PERCSEV diff	-.195	.2781		-.505	.159
EXP_BEL diff, BENEFIT diff	.303	.0864		-.045	.586
EXP_BEL diff, COMP_YADS diff	.536	.0010		.237	.743
EXP_BEL diff, RECOG diff	.013	.9450		-.332	.354
EXP_BEL diff, RECALL diff	-.125	.4930		-.449	.229
EXP_BEL diff, COMP_AKQ diff	-.082	.6530		-.414	.269
EXP_BEL diff, AVG_BL_RT	-.187	.3004		-.498	.167
EXP_BEL diff, AVG_RT	.134	.4592		-.219	.457

Table CL: Selective Correlation Matrix (MER Trials Excluded) continued…

	Correlation	*p*	95% Lower	95% Upper
SELF_EFF diff, PERCSUS diff	-.053	.7708	-.389	.296
SELF_EFF diff, PERCSEV diff	-.011	.9513	-.353	.333
SELF_EFF diff, BENEFIT diff	.212	.2394	-.142	.517
SELF_EFF diff, COMP_YADS diff	.453	.0075	.129	.689
SELF_EFF diff, RECOG diff	-.065	.7212	-.399	.285
SELF_EFF diff, RECALL diff	.112	.5372	-.240	.439
SELF_EFF diff, COMP_AKQ diff	.042	.8193	-.306	.380
SELF_EFF diff, AVG_BL_RT	-1.230E-3	.9946	-.344	.342
SELF_EFF diff, AVG_RT	.068	.7086	-.282	.402
PERCSUS diff, PERCSEV diff	.463	.0061	.142	.695
PERCSUS diff, BENEFIT diff	.444	.0089	.119	.683
PERCSUS diff, COMP_YADS diff	.697	<.0001	.465	.840
PERCSUS diff, RECOG diff	-.131	.4719	-.454	.223
PERCSUS diff, RECALL diff	.035	.8481	-.312	.374
PERCSUS diff, COMP_AKQ diff	-.053	.7716	-.389	.296
PERCSUS diff, AVG_BL_RT	.110	.5457	-.243	.437
PERCSUS diff, AVG_RT	.161	.3751	-.193	.478
PERCSEV diff, BENEFIT diff	.076	.6774	-.275	.409
PERCSEV diff, COMP_YADS diff	.424	.0132	.095	.670
PERCSEV diff, RECOG diff	-.339	.0534	-.611	5.153E-3
PERCSEV diff, RECALL diff	.220	.2195	-.133	.524
PERCSEV diff, COMP_AKQ diff	-.044	.8089	-.382	.304
PERCSEV diff, AVG_BL_RT	.068	.7073	-.282	.402
PERCSEV diff, AVG_RT	-.082	.6545	-.413	.269
BENEFIT diff, COMP_YADS diff	.750	<.0001	.547	.869
BENEFIT diff, RECOG diff	.062	.7353	-.288	.397
BENEFIT diff, RECALL diff	.017	.9243	-.328	.359
BENEFIT diff, COMP_AKQ diff	.049	.7869	-.299	.386
BENEFIT diff, AVG_BL_RT	-.046	.8018	-.383	.302
BENEFIT diff, AVG_RT	.274	.1239	-.077	.564
COMP_YADS diff, RECOG diff	-.138	.4475	-.459	.216
COMP_YADS diff, RECALL diff	.070	.6996	-.280	.404
COMP_YADS diff, COMP_AKQ diff	-.032	.8615	-.371	.315
COMP_YADS diff, AVG_BL_RT	-.024	.8959	-.364	.322
COMP_YADS diff, AVG_RT	.211	.2396	-.142	.517
RECOG diff, RECALL diff	.148	.4140	-.206	.468
RECOG diff, COMP_AKQ diff	.704	<.0001	.476	.843
RECOG diff, AVG_BL_RT	.135	.4576	-.219	.457
RECOG diff, AVG_RT	-.105	.5639	-.433	.247
RECALL diff, COMP_AKQ diff	.807	<.0001	.641	.901
RECALL diff, AVG_BL_RT	.268	.1321	-.083	.560
RECALL diff, AVG_RT	-.082	.6529	-.414	.269
COMP_AKQ diff, AVG_BL_RT	.273	.1248	-.077	.564
COMP_AKQ diff, AVG_RT	-.122	.5034	-.446	.231
AVG_BL_RT, AVG_RT	.115	.5259	-.237	.441

33 observations were used in this computation.

Table CM: Descriptive Statistics

	Age	Gender	LOC Score
Mean	13.273	1.455	11.515
Std. Dev.	1.180	.506	5.762
Std. Error	.205	.088	1.003
Count	33	33	33
Minimum	12.000	1.000	4.000
Maximum	15.000	2.000	25.000
# Missing	0	0	0
Variance	1.392	.256	33.195
Coef. Var.	.089	.348	.500
Range	3.000	1.000	21.000
Sum	438.000	48.000	380.000
Sum Squares	5858.000	78.000	5438.000
Geom. Mean	13.222	1.370	10.261
Harm. Mean	13.173	1.294	9.160
Skewness	.268	.183	.941
Kurtosis	-1.407	-1.967	5.899E-3
Median	13.000	1.000	10.000
IQR	2.000	1.000	8.000
Mode	12.000	1.000	10.000
10% Tr. Mean	13.222	1.444	10.889
MAD	1.000	0.000	3.000

Table CN: Descriptive Statistics for Age Split Across Experimental Group

	(Age) Total	(Age) Control	(Age) Factual	(Age) Inference
Mean	13.273	13.273	13.273	13.273
Std. Dev.	1.180	1.191	1.191	1.272
Std. Error	.205	.359	.359	.384
Count	33	11	11	11
Minimum	12.000	12.000	12.000	12.000
Maximum	15.000	15.000	15.000	15.000
# Missing	0	0	0	0
Variance	1.392	1.418	1.418	1.618
Coef. Var.	.089	.090	.090	.096
Range	3.000	3.000	3.000	3.000
Sum	438.000	146.000	146.000	146.000
Sum Squares	5858.000	1952.000	1952.000	1954.000
Geom. Mean	13.222	13.225	13.225	13.218
Harm. Mean	13.173	13.177	13.177	13.165
Skewness	.268	.197	.197	.384
Kurtosis	-1.407	-1.406	-1.406	-1.425
Median	13.000	13.000	13.000	13.000
IQR	2.000	2.000	2.000	2.750
Mode	12.000	12.000	12.000	12.000
10% Tr. Mean	13.222	13.222	13.222	13.222
MAD	1.000	1.000	1.000	1.000

Table CO: Descriptive Statistics for Gender Split Across Experimental Group

	(Gender) **Total**	(Gender) **Control**	(Gender) **Factual**	(Gender) **Inference**
Mean	1.455	1.455	1.455	1.455
Std. Dev.	.506	.522	.522	.522
Std. Error	.088	.157	.157	.157
Count	33	11	11	11
Minimum	1.000	1.000	1.000	1.000
Maximum	2.000	2.000	2.000	2.000
# Missing	0	0	0	0
Variance	.256	.273	.273	.273
Coef. Var.	.348	.359	.359	.359
Range	1.000	1.000	1.000	1.000
Sum	48.000	16.000	16.000	16.000
Sum Squares	78.000	26.000	26.000	26.000
Geom. Mean	1.370	1.370	1.370	1.370
Harm. Mean	1.294	1.294	1.294	1.294
Skewness	.183	.183	.183	.183
Kurtosis	-1.967	-1.967	-1.967	-1.967
Median	1.000	1.000	1.000	1.000
IQR	1.000	1.000	1.000	1.000
Mode	1.000	1.000	1.000	1.000
10% Tr. Mean	1.444	1.444	1.444	1.444
MAD	0.000	0.000	0.000	0.000

Table CP: Descriptive Statistics for Locus of Control Score Split Across Experimental Group

	(LOC) **Total**	(LOC) **Control**	(LOC) **Factual**	(LOC) **Inference**
Mean	11.515	9.818	12.000	12.727
Std. Dev.	5.762	6.369	5.675	5.331
Std. Error	1.003	1.920	1.711	1.607
Count	33	11	11	11
Minimum	4.000	4.000	6.000	7.000
Maximum	25.000	25.000	24.000	24.000
# Missing	0	0	0	0
Variance	33.195	40.564	32.200	28.418
Coef. Var.	.500	.649	.473	.419
Range	21.000	21.000	18.000	17.000
Sum	380.000	108.000	132.000	140.000
Sum Squares	5438.000	1466.000	1906.000	2066.000
Geom. Mean	10.261	8.320	10.994	11.809
Harm. Mean	9.160	7.210	10.208	11.007
Skewness	.941	1.287	1.081	.840
Kurtosis	5.899E-3	.860	-.201	-.199
Median	10.000	7.000	10.000	11.000
IQR	8.000	8.500	7.750	7.250
Mode	10.000	•	10.000	•
10% Tr. Mean	10.889	8.778	11.333	12.111
MAD	3.000	3.000	2.000	4.000

LOCUS OF CONTROL SCORE

Table CQ: One-way ANOVA Summary Table for the Dependent Variable LOC Score.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	50.424	25.212	.748	.4822
Residual	30	1011.818	33.727		

Table CR: Two-way ANOVA Summary Table for the Dependent Variable LOC Score.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	47.087	23.543	.667	.5216
Gender	1	.631	.631	.018	.8946
Exp. Group * Gender	2	57.754	28.877	.818	.4521
Residual	27	953.433	35.312		

Table CS: Unpaired *t*-tests across Experimental Group for the Dependent Variable LOC Score.

Hypothesized Difference (H_0) = 0	**Mean Diff.**	***df***	***t***	***p***
Inference Group, Factual Group	.727	20	.310	.7599
Inference Group, Control Group	2.909	20	1.162	.2590
Factual Group, Control Group	2.182	20	.848	.4063

REACTION-TIME

Table CT: One-way ANCOVA Summary Table for the Dependent Variable AVG_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.013	.006	.013	.9876
AVG_BL_RT *(covariate)*	1	.013	.013	.026	.8740
Exp. Group * AVG_BL_RT	2	.063	.032	.061	.9408
Residual	27	14.014	.519		

Table CU: Two-way ANCOVA Summary Table for the Dependent Variable AVG_RT.

Source	***df***	**SS**	**MS**	***F***	***p***
Exp. Group	2	.095	.047	.078	.9252
Gender	1	.001	.001	.001	.9745
AVG_BL_RT *(covariate)*	1	.006	.006	.010	.9220
Exp. Group * Gender	2	.431	.215	.355	.7055
Exp. Group * AVG_BL_RT	2	.079	.039	.065	.9376
Gender * AVG_BL_RT	1	3.381E-5	3.381E-5	5.567E-5	.9941
Exp. Group * Gender * AVG_BL_RT	2	.309	.154	.254	.7777
Residual	21	12.752	.607		

PRETEST ATTITUDE CONSTRUCTS

Table CV: One-way ANOVA Summary Table for the Dependent Variable PERCSEV pretest.

Source	***df***	**SS**	**MS**	***F***	***p***
Gender	1	11.349	11.349	7.223	.0115
Residual	31	48.711	1.571		

Table CW: One-way ANOVA Summary Table for the Dependent Variable COMP_YADS pretest.

Source	***df***	**SS**	**MS**	***F***	***p***
Gender	1	185.034	185.034	7.284	.0112
Residual	31	787.511	25.404		

CORRELATIONS

Table CX: Mental Effort Rating and Reaction-Time Correlation.

	Correlation	***p***	**95% Lower**	**95% Upper**
Mental Effort Rating, Reaction-Time	.182	.4216	-.259	.561

22 observations were used in this computation.
11 cases were omitted due to missing values.

APPENDIX V

VITA

MICHAEL W. MITCHELL

D.O.B. August 28, 1967

EDUCATION

Doctorate of Philosophy, Industrial and Systems Engineering - (Human Factors Option)
Virginia Tech • GPA 3.57/4.00 • Expected May 1997
Dissertation Research: *The effects of embedded question type and locus of control on processing depth, knowledge gain, and attitude change in a computer-based interactive video environment.*

Master of Science, Psychology - (Human Factors Option)
University of Idaho • GPA 3.71/4.00 • May 1993
Thesis Research: *Determining effective display format and content options for in-car moving-map navigation and information systems.* (Sponsored by General Motors Research Laboratories)

Bachelor of Science, Psychology - (Minor: Music)
University of Idaho • GPA 3.01/4.00 • May 1989

PROFESSIONAL EXPERIENCE

Industry

Human Factors Engineer Co-op (2/97-5/97)
IBM Corporation, Web Externals Design and Development, Research Triangle Park, North Carolina.

- Designed and rapid prototyped user-interfaces for web server software using HTML
- Aided in the creation of requirements for Java-based GUI widgets
- Served as liaison to programmers to communicate and implement human factors design considerations
- Recruited users for usability testing
- Designed and conducted usability evaluations of software products

Research

Staff Scientist (7/94-9/96)
American Research Corporation of Virginia, Radford, Virginia.

- Managed the development of interactive multimedia and computer graphics software for medical and behavioral applications sponsored by the federal government
- Lead designer/developer of graphical user-interfaces for multimedia software applications
- Served as liaison to management, programmers, and video/graphic artists to communicate and implement human factors design considerations
- Designed and conducted usability and efficacy evaluations of software products

Staff Scientist (7/94-9/96) continued...
- Programmed Macintosh and Windows software using Authorware v. 3.0.1
- Organized content and edited scripts for multimedia productions
- Managed the filming and editing of video and creation of art/animation for software products
- Recruited and supervised personnel, including actors for multimedia productions
- Co-authored 1 conference paper

Research Assistant (1/93-5/94)
Department of Music, Virginia Tech.
- Managed groundwork development for multimedia music courseware for the Macintosh
- Managed integration of MIDI (Musical Instrument Digital Interface) data into Macromedia Authorware Professional v. 2.0
- Investigated pitch-recognition algorithm alternatives for use within Authorware Professional v. 2.0

Research Assistant (1/92-7/92)
Vehicle Analysis and Simulation Laboratory, Virginia Tech.
"Research on vehicle-based driver status/performance monitoring." National Highway Traffic Safety Administration (NHTSA)
- Involved in algorithm development for driver fatigue and drowsiness detection for NHTSA
- Conducted research and technological review of drowsiness detection
- Contributed to the design of the data acquisition and control system
- Aided in the creation of PASCAL data acquisition and manipulation programs
- Authored sections of the semiannual research report

Research Assistant (9/91-12/91)
Vehicle Analysis and Simulation Laboratory, Virginia Tech.
"Comparison of driver performance and behavior using a high content head up display and using a conventional head down display." General Motors Research Laboratories
- Reduced data of videotaped driver manual tasks from an on-road driving experiment

Research Assistant (4/90-8/91)
Human Factors Group, University of Idaho.
"Human factors test and evaluation of TravTek™ route guidance screens and planning."
General Motors Research Laboratories
- Managed the conduct of the human factors evaluation of the TravTek™ in-vehicle moving-map navigation system
- Created the experimental design for the study
- Constructed visual navigation map stimuli
- Collected and analyzed dual and single task data
- Aided in the design of the data acquisition and control system
- Authored the documentation of findings

Research Assistant (5/90-9/90)
Human Factors Group, University of Idaho.
"Human factors test and evaluation of TravTek™ nomenclature, labeling, and voice message content." General Motors Research Laboratories
- Collected and reduced data in the human factors evaluation of nomenclature and labeling of the TravTek™ in-vehicle moving-map navigation system

Research Assistant (1/89-8/89 and 1/90-5/90)
Human Factors Group, University of Idaho.
"Modeling of problem solving and spatial reasoning." U.S. Air Force and the Idaho State Board of Education
- Developed software and materials for a spatial reasoning study
- Collected and reduced data for coding and cognitive mapping in a verbal protocol experiment

Teaching

Teaching Assistant (4/90-8/91)
Physiological Psychology - Department of Psychology, University of Idaho.
- Helped undergraduate students understand basic physiological structures of the brain
- Provided guidance on student research projects
- Graded quizzes, assignments and research project reports

Lab Instructor/Teaching Assistant (8/89-12/89 and 8/90-12/90)
Research Methods for the Behavioral Sciences - Department of Psychology, University of Idaho.
- Taught undergraduate psychology majors basic principles of research methods
- Provided guidance on student experiments and research projects
- Graded quizzes, lab assignments and research project reports

CONTRACTS AND GRANTS

Staff Scientist, Lead Developer (8/94-2/95)
"A comprehensive alcohol education program for pre-adolescents using interactive multimedia." Department of Health and Human Services, National Institute on Alcohol Abuse and Alcoholism, $683,404, Contracts N43 AA42010 and N44 AA52010

Staff Scientist, Associate Investigator (7/94-1/95)
"Hypermedia for alcoholism management training." Department of Health and Human Services, National Institute on Alcohol Abuse and Alcoholism, $633,469, Grants 1 R43 AA09572-01A1 and 2 R44 AA/DA09572-02

Staff Scientist, Interface Designer (7/94-1/95)
"Video compression using neural networks." Space and Naval Warfare Systems Command, Department of the Navy, $618,021, Contracts N00039-93-C-0046 and N00039-95-C-0006

Staff Scientist (9/95-6/96)
"An interactive multimedia program for teaching intensive insulin therapy self-management techniques to adolescents with diabetes." Department of Health and Human Services, National Institute on Diabetes and Digestive and Kidney Diseases, $99,981, Contract N43-DK-5-2226

Staff Scientist (7/94-3/95)
"Interactive multimedia to teach asthma self-management." Department of Health and Human Services, National Heart Lung, and Blood Institute, $78,754, Grant 1 R43 HL52363-01

RELATED EXPERIENCE

***Compudex* • Interface Design and Usability Project (1/93-5/93)**
Human-Computer Interaction • Department of Computer Science, Virginia Tech.
This HyperCard based prototype of a personal information management (PIM) utility software program was designed to facilitate increased organization and access to phone data and allow for easier tracking and follow-up on phone calling tasks.

- Co-developed a PIM utility prototype using a user-centered approach
- Developed usability specifications for formative evaluation of system
- Designed and rapid prototyped the system's user-interface using HyperCard
- Collected and analyzed usability test data
- Co-authored final report documenting the system development, testing, and modification

***MIDI Trumpet* • Multimedia Design Project (1/93-5/93)**
Microcomputer Applications in Music • Department of Music, Virginia Tech.
This computer simulation animates as scales are "played" on a virtual trumpet, showing the path air is taking through the instrument's tubing and valves, as well as sounding each corresponding note via standard MIDI (Musical Instrument Digital Interface) file data while displaying the pitch in standard musical notation on the screen.

- Conceptualized and developed a full-color computer animation which demonstrates the mechanics of a piston valve trumpet and the flow of air as notes are played
- Designed and rapid prototyped the system's user-interface using Macromedia Director
- Integrated Macromedia Director animations into HyperMIDI software shell using HyperTalk and specialized HyperCard XCMDs

***Individual Improvement Sports Series* • Multimedia Design Project (8/92-12/92)**
Educational Hypermedia • Department of Education: Curriculum and Instruction, Virginia Tech.
This application provides textual information and digital audio for verbal skill descriptions, and stills, animation, and full-motion QuickTime video for visual examples of skills in proper form and use.

- Conceptualized and developed a multimedia individual improvement sports series to aid in the development of rudimentary sport-related skills
- Created all video footage content
- Designed and rapid prototyped the system's user-interface using HyperCard

***HomeFinder* • Multimedia Design Project (1/92-5/92)**
Human Factors System Design II • Department of Industrial and Systems Engineering, Virginia Tech.
This HyperCard based system was designed to aid users in finding homes in Virginia's New River Valley and incorporates textual information, animation, digital audio, still photography, and full-motion QuickTime video to allow for video "drive-bys" and "walk-throughs" of prospective homes.

- Co-developed a hypermedia home-locating system using a human factors systems approach
- Conducted needs analysis and task analysis to create system requirements and specifications
- Designed and rapid prototyped the system's user-interface using HyperCard
- Collected and analyzed usability test data
- Co-authored conference paper documenting the system development, testing, and modification

SOFTWARE PRODUCTS

1996 *Interactive Multimedia for the Promotion of Alcohol Awareness and Resistance Training (IMPART),* version 1.5
1995 *Promotion of Responsible Sexuality with Multimedia (PRISM),* version 1.5
1995 *Asthma Busters!*, version 1.0
1995 *IMPART*, versions 1.0 and 1.1
1994 *Interactive Multimedia Program for Alcoholism Assessment and Counseling Training (IMPACT),* version 1.0

PUBLICATIONS AND REPORTS

Mullis, J. W., Avent, R. R., Mullis, H. T., Wilson, A. L. and Mitchell M. W. (1995). IMPACT: An interactive multimedia program for alcoholism assessment and counseling training. In *Proceedings of the IEEE International Conference on Multimedia Computing and Systems* (pp. 318-322). Piscataway, NJ: Institute of Electrical and Electronics Engineers.

† Neale, W. and Mitchell, M. W. (1993). A human factors systems approach to the design of a hypermedia home locating system. In *Interface '93 Proceedings* (pp. 66-71). Santa Monica, CA: Human Factors and Ergonomics Society.

Wierwille, W. W., Wreggit, S. S. and Mitchell, M. W. (1992). *Research on vehicle-based driver status/performance monitoring*. Unpublished Semiannual Research Report to NHTSA. Virginia Tech ISE Report No. 92-01.

Dingus, T. A., Mitchell, M. W. and Hulse, M. C. (1992). *Human Factors Test and Evaluation of TravTek™ Route Guidance Screens and Planning.* General Motors Research Laboratories Technical Report.

RESEARCH INTERESTS

- Application of telecommunications technologies to distance learning and remote training
- Navigation and spatial awareness in virtual and actual interactive environments
- Training applications for virtual environments and related technologies
- Sensation, perception and display design applications
- Human-computer interaction and user-interface design
- Intelligent Transportation Systems (ITS) applications
- Computer-Assisted Instruction (CAI) applications

† Publication judged "*Best Student Paper*" (tie) Interface '93 Conference • May 5-8,1993 • Raleigh, NC

TEACHING INTERESTS

Human Factors and General Psychology

- Sensation and perception
- Research methods
- Information processing
- Training fundamentals

HCI and Interface Design

- Interface design and usability
- Training system design

HONORS AND AFFILIATIONS

Human Factors and Ergonomics Society • Member: 1997
Human Factors and Ergonomics Society Carolina Chapter • Member: 1997
Alpha Pi Mu Industrial Engineering Honor Society • Member: 1992-Present
Virginia Tech Human Factors and Ergonomics Society Student Chapter • Member: 1991-1996
University of Idaho Human Factors Society Student Chapter • Chartering President: 1990-1991
Human Factors and Ergonomics Society • Student Member: 1989-1996
Psi Chi National Honor Society in Psychology • Student Member: 1989-Present
Psi Chi Honor Graduate: 1989

SPECIAL SKILLS

Usability testing
Rapid prototyping
HTML 3.2 programming
Project and personnel management
Videography and video editing
Web server administration

Software Skills

‡ Macromedia Authorware
‡ Macromedia Director
Macromedia SoundEdit 16
HyperCard & HyperTalk
Strata MediaPaint
‡ CD-ROM authoring/pre-mastering
‡ Microsoft Office
‡ Adobe Photoshop
‡ Adobe Premiere
Adobe After Effects
Adobe Illustrator
Adobe Pagemaker
‡ Most Internet tools
‡ Most MIDI sequencing applications

‡ Indicates cross-platform experience