# Minimalist and Traditional Training Methods for Older Adults: A Comparative Study in a Software Environment

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**ABSTRACT**

It is important to utilize training that facilitates the best learning and performance on real tasks. Much research has been conducted to develop theories of learning and determine beneficial training characteristics. Still, this research often remains as separated characteristic recommendations and is not used to ascertain the best training method. This occurs even though most individuals simply use a training method and do not bother to go into the literature for recommendations each time they are looking to train or teach something. Generalizability is also often a factor lacking in research on training methods. This lack of research performed includes those that could determine whether or not a specific training method is generalizable to older adults.

Minimalism is a training method that could potentially alleviate some of the problems older adults experience when training. Yet, up to the time of this study, no empirical evidence had been gathered to compare minimalism to traditional training methods for older adults. This study attempted to gain empirical data to test the hypothesis that minimalism is more beneficial as well as to gain initial subjective data from participants. This study also endeavored to conduct a preliminary examination of individual difference factors and their affects on performance and subjective reports in a training environment.

Results indicated that, although significant results were not obtained, minimalism may still be an area worth pursuing for training older adults. Effects of interactions, which included gender and learning style, are discussed. Implications, as well as recommendations and conclusions, of the study are presented.

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*I've learned...that the best classroom in the world*
*is at the feet of an elderly person.*
*--Andy Rooney*

# 1. INTRODUCTION

## 1.1. Project Background

Currently, a project is being conducted in the Computer Science Department's Center for human-computer interaction (HCI) at Virginia Tech about the potential use of simulations as an avenue for a community outreach program. The potential for simulations in this role is currently being investigated using the visual programming environment of Stagecast Creator, developed by Allen Cypher and David Canfield Smith (1997), where individuals learn to use a high level programming language. In this Community Simulations Project, the HCI research team is creating various simulations with Stagecast Creator and making them available to the public via the Blacksburg Electronic Village, BEV, website. Community members are invited to learn Stagecast Creator so that they may alter the simulations and contribute to a discussion of these simulations, which are based on current community issues.

The community issues that are the focus of these simulations are those that are thought to be of most interest to teenagers. The vision of this environment is to provide a forum that brings together the eldest population group, who often have more free time and who bring with them a vast amount of experience in "real world" problems, together with a segment of the population that would greatly benefit from this knowledge—children. Through this medium, the elderly may take on the role of helping to educate our country's youth with their experience. In school, children obtain the benefits of receiving a great deal of knowledge, but practical knowledge about real world problems is generally not the focus of textbooks or classes. Normally, these problems are not discussed. The Community Simulations Project will help fill this knowledge gap. And, as White and Weatherall (2000) suggest, the effect of computer-mediated communication on intergenerational communication is an area worth pursuing.

**1.2. Problem Statement**

With this forum available for the two age groups, the question arises of how to best train people so that they will know enough to effectively use this environment. Upon reviewing the literature, it can be noted that the age group that appears to have had the least research performed is the eldest age group, the group that will heretofore be referred to as "older adults." Especially lacking in the literature is research that ascertains the best way to teach computer-related information to older adults. Training that facilitates the highest learning and motivation for continuing use is the goal.

The benefits of effective training techniques are numerous, but most research in this area focuses exclusively on children or young adults. Due to this fact, a literature search was begun in many research areas. Areas of literature included learning, training, and technology, in general, and specifically with older adults. This literature search was instigated to bring together all research-based recommendations on how to design training materials for older adults. It was upon examining the available literature that the benefits of a *minimalist* approach in training older adults began to emerge.

The minimalist approach to training allows the learner to quickly begin real tasks and avoids extraneous information (Carroll, 1990). It appears that the characteristics of this approach are likely to give the greatest learning advantage to older adults. Even though prior researchers had suggested that minimalism may be the most advantageous approach to training older adults on technology (Kelley & Charness, 1995), no empirical data have been produced. Therefore, this research will contribute to the current body of literature by conducting an empirical study for the potential of an approach that has never been applied to the training of older adults in past studies—that is, minimalism. Additionally, in order to improve future minimalist training designs for older adults, a list of recommendations will be created on how to better design minimalist training materials for older adults.

## 1.3. Research Justification

By the year 2030, people age 65 or older will comprise 22% of the population in the United States. This proportional change represents a 10% increase since 1990 (Czaja, 1997). As the population shifts so that a greater percentage are middle-aged and older adults, and as dependence on computer technology increases, it becomes more crucial to understand how to design computer training for these older age groups (Czaja, Hammond, Blascovich, & Swede, 1989; Kelley & Charness, 1995). In addition, like many previous researchers have similarly noted, Charness, Kelley, Bosman, and Mottram (2001) observed that because technology is becoming so ingrained in our everyday living, if older adults are to continue functioning independently, our society will need to find effective computer interfaces and training techniques. Although the necessity for this research is commonly noted, the gap in the research and empirical data in the area is also frequently noted.

### *1.3.1. Empirical Absence*

White and Weatherall (2000) note that the research examining older adults and Information Technology is limited, and Morrell and Echt (1997) state that there is a definite need for the development of training, or instructional, materials for computer use that are "elderly friendly." More specifically, Mead and Fisk (1998) discuss that previous research does clearly suggest that the type of training provided to older adults when they are learning to use new technology is important. Further, they state that research is needed that specifically evaluates the type of training independent of the mode of training delivery. Somewhat similarly, Sharit and Czaja (1994) note that the development of training strategies that are effective in teaching older adults computer skills is an essential area of ergonomic intervention. Although earlier work has shown appropriate training strategies, such as the discovery method, to help in the development of new skills in older adults, very little attention has been given to training the older worker. Despite the literature available that examines individual strategies and suggestions from researchers in the areas of learning, training, and technology for older adults, there has not been an attempt to utilize all of this literature for a common purpose. Integration of the current literature is required in order to identify training methods that are likely to be the most beneficial for older adults.

### *1.3.2. Research Support*

As is noted later in the literature review section of this paper, research indicates that minimalist training may be of greatest advantage for older adults, but there have been no studies conducted to bring any validation to this claim. Researchers have noted the irony of this situation. Although many authors have pointed out that older adults may have some special needs and concerns when learning to use computers, very little in the way of empirically-tested recommendations exists for those who intend to train older adults to use computers (Kelley & Charness, 1995).

*1.3.3. A Win-Win Situation*

Upon evaluation of prior research, it became apparent that regardless of individual motives, whether in money or in something like improving another person's quality of life, finding a training method that is beneficial for older adults can only be considered a positive goal.

1.3.3.1. Financial Benefits

If money is an individual's deciding factor as to where research should stop, as is often the case in business, the evidence still points to the decision that studies should be conducted in this area of training. The evidence is still there because researchers realize that older adults in the workforce are not able to reach their full potential if the training materials are poorly designed for that age group's characteristics.

Hawthorn (2000) stated that because it has been noted that the effects of age become noticeable from the mid-forties onward, if designs are only tested on younger users, there is a risk of misjudging the capability of nearly half of future users. Charness et al. (2001) conclude that societies hoping to gain workforce participation beyond the standard retirement age may find that they are gaining a less efficient workforce in the areas that involve much technology use, including computers, unless better training techniques are developed. Also, Carter and Honeywell (1991) note that many companies actually prefer to have older adults working for them because companies have found that older adults appear more likely to possess characteristics like responsibility, honesty, and wisdom.

In addition, of importance to businesses that sell training manuals, much research supports the conclusion that most computer users are individuals without much expertise. The documentation needs of this audience differ from that of experts, and it has been found that a good manual can clinch a sale (Lazonder & van der Meij, 1993).

1.3.3.2. Optimal Situation

As well as the support strictly for individuals who have money as their sole driving force, research is available for those who are looking to improve individuals' quality of life.

It has been noted that Walker, Philbin, & Fisk (1997) successfully undertook a theory-driven design of interfaces for older adults that greatly improved older adults' performance and simultaneously benefited younger adults' performance. This came years after Czaja et al. (1989) hypothesized that older adults do not need specialized systems in training, because, typically, changes in system design improve the performance of all age groups. Since 1997, others have supported this same hypothesis. This includes Morrell and Echt (1997), who state that although they focus specifically on older adults, it is likely that elderly friendly guidelines will extend to computer users of other ages. Czaja, in more recent years, has continued to advocate this idea and says that in order to maximize the benefits of computer technology for older adults and optimize their interactions, older adults must be included in system design and evaluation efforts. This participatory approach will not only serve to benefit older adults, but all potential users of computer systems (Czaja, 1997). Logic suggests that the success of using the approach of designing with older adults in mind for interfaces may be usefully extended to the design of training manuals.

The essence of the current philosophy to those using a business-oriented perspective is that this research would allow businesses to increase their consumer target market. This would be done while continuing to satisfy current consumers, and therefore, increase profits. On the other hand, for those who are more interested in equality and improving individuals' quality of life, they may already see the benefits of this research as helping to "level the playing field for older adults" in the numerous places where technology is involved.

1.3.3.3. Quality of Life Benefits

If improving quality of life is a person's only interest, there are still further things to note. As Mead, Batsakes, Fisk, and Mykityshyn (1999) state, "although it is important to note that computerized systems are so common that older adults may not be able to avoid them, it is more important to note that computer use has the potential to significantly improve the quality of life of older adults (p. 554)." For instance, via computers and the Internet, older adults have gained easy access to health information and further outside contacts that have previously been limited or difficult to find.

In addition, many benefits are gained simply as a result of older adults interacting with computers (Hendrix, 2000; Morrell & Echt, 1997). It has been recognized that computer use appears to promote positive interactions with family and friends (White & Weatherall, 2000), to increase self-esteem in older adults (Hendrix, 2000), and is linked to a positive shift in computer attitudes, while decreasing feelings of depression and isolation (Kelley, Morrell, Park, & Mayhorn, 1999).

## 1.4. Document Overview

The remaining body of this paper is divided into five main sections—the literature review, research overview, methodology, results, and discussion, respectively. A brief overview of each section follows.

*1.4.1. Literature Review*

The literature review section, which follows next, examines the current literature for information relevant to this study. It begins by examining minimalism, learning theories, and further pertinent research theories, and it ends with a discussion of individual differences.

*1.4.2. Research Overview*

The research overview section includes concrete statements summarizing important aspects of the study. This section states the research purpose, questions, and hypotheses of the study.

*1.4.3. Methodology*

The methodology section first describes the experimental design followed by a description of the variables and measures involved. Then, there is an overview of the participants in this study. This is followed by an examination of all of the materials and equipment in the study, and subsequently, the exact procedure is described in detail.

*1.4.4. Results*

The results section gives an overview of the data analyses, including a detailed view of the dependent measures used. Significant results are then given.

*1.4.5. Discussion*

The discussion section is the final section of this paper. It first includes a section that answers the research questions. Then reseach implications and conclusions are discussed.

## 2. Literature Review

### 2.1. Introduction to Minimalism

John Carroll (1990) stated that, "The essence of the minimalist approach is to obstruct as little as possible the learner's self-initiated efforts to find meaning in the activities of learning (p. xvii)." This is in contrast to a traditional approach, which Manning (1998) explains as being an approach that attempts to describe schemas directly, even though they come out as abstract by virtue of the nature of schematic models. The problem is that learners cannot generally absorb new schemas directly from outside sources; rather, these new schemas have to be constructed by the readers themselves. As Manning (1998) notes, this is why minimalist manuals do not spend so much time trying to describe the inner workings of the system, but rather spend more time guiding the reader from naive hypotheses to better ones through exemplary tasks.

Minimalism, an approach first defined by John Carroll and associates in the 1980s, and later discussed in his book *The Nurnberg Funnel* (1990) is supported by numerous studies. Carroll writes that three commitments needed in minimalist instruction are: 1) writing the materials with minimal wording, while not eliminating vital task information, 2) giving error recovery strategies, and 3) giving meaningful tasks early in the training.

Researchers have attempted to replicate studies comparing conventional manuals to minimalist manuals under more stringent conditions than used in Carroll's initial studies. These studies too, have shown positive support for the minimalist manual (Lazonder & van der Meij, 1993; Ramsey & Oatley, 1992; Van der Meij & Lazonder, 1993).

Often, research that ascertains successful training strategies for the average adult has the potential to be generalizable to older adults and should be tested. For instance, Dyck and

Smither (1996) noted that, like younger participants, older adults who were less anxious at the onset of a word-processing course demonstrated more knowledge at the end of the course than those who were more anxious. Generalizability from younger adults to older adults is not always a logical thing to do, depending on the characteristics of each case. However, the subsequent discussion of the literature will demonstrate that minimalism does, in fact, seem to be a promising method for older adults.

### 2.2. Roots and Support of Minimalism

Upon reviewing literature on training older adults to use computers, Kelley and Charness (1995) state a conclusion gained through a review of Carter and Honeywell's (1991) work on training older adults to use computers: "Self-training using a 'minimal manual' should be an especially effective method for training older adults, because older adults may prefer to work at their own pace, and extraneous material may not be attended and thus not remembered (p.115)." Unfortunately, as noted in the Introduction, few other researchers have taken recommendations from prior research to develop an entire method or approach that individuals may be able to use to design their instruction. As Morrell and Echt (1997) note, there has been little in the way of systematically applied research on how to design instructional materials for older adults. More specifically, no research has focused on types of computer tasks that may be affected by the age-related changes in cognition, which, in turn, might affect the acquisition of skills required for older adults. This research will begin to contribute to this portion of the knowledge base.

A number of researchers have examined the cognitive changes that occur as adults age and some have made recommendations based on these changes. These recommendations have been supported by empirical research. Many researchers believe that research aimed at designing training interfaces to enhance the performance of older adults can and should be driven by cognitive or psychological theory. Often stated is that the successful development of age-appropriate training and design systems requires an understanding of the age-related declines in cognitive abilities and performance differences (Birdi & Zapf, 1997; Czaja, 1997; Mead et al., 1999). Hendrix (2000) similarly notes that in teaching older adults to use computers, teaching and learning strategies that aid the learning process in older adults need to be applied.

### *2.2.1. Cognitive Aging Theories and Characteristics*

Age-related cognitive declines are often characterized in the literature by: 1) a decreased ability to inhibit task-irrelevant information, 2) decreases in processing speed, and 3) decreases in working memory capacity.

<u>Decreased Ability to Inhibit Task-Irrelevant Information</u>: As Morrell, Park, Mayhorn, and Kelley (2000) conclude, due to older adults' lessened ability to disregard irrelevant information as compared to this ability in younger adults, if extraneous information is added to a set of instructions, it is possible that older adults might not be able to understand them as well as younger adults. Further, Morrell et al. (2000) obtained supporting data that simple, rather than expanded, instructions facilitated retention of computer procedures for older adults. The authors also recognized that underlying cognitive mechanisms are related to how well older adults retain computer skills. One can glean from this, as noted by Jones and Bayen (1998), that when teaching older adults to use computers, one should eliminate distractions and irrelevant information.

<u>Decrease in Processing Speed</u>: Although Zacks and Hasher (1994) tentatively hypothesized that the decreased ability to inhibit task-irrelevant information might be the cause of the apparent decrease in processing speed and decreased working memory capacity, the more accepted theory in the literature is by Salthouse. Salthouse (1996) does not speculate that the

decreased ability to inhibit task-irrelevant information causes this decrease in processing speed, but rather, that this decrease in processing speed is the major factor in the age-related differences in cognitive functioning. However, regardless of what causes these changes that become evident in older adults, the same issue is at hand. If these declines are occurring, then the concern for designers is to design materials and interfaces that maximize all learning and performance factors for the old, as well as the young.

Decreased Working-Memory Capacity or Cognitive Slowing: In general the literature suggests that cognitive systems that place minimal demands on working memory are more suitable for older adults and beneficial for all ages (Czaja, 1996). Results from studies also suggest that training methods that reduce cognitive demands are likely to enhance the acquisition of computer skills in both young and old adults (Echt, Morrell, & Park, 1998), with special payoffs for older people (Hawthorn, 2000).

The main idea of cognitive load theory is that working memory capacity is limited and must therefore be carefully managed. Using this theory to guide their experimental designs, Chandler and Sweller (1991) received supporting evidence to their hypothesis that redundant information could impede learning. They found that the removal of this superfluous information was necessary to improve instructional materials, which thereby challenged the design of conventionally used instructional designs. In light of the fact that many researchers believe that it is demands on working memory that cause many difficulties experienced by older adults, this piece of information is especially pertinent to the design of materials for older adults. One may note already that the recommendations are still similar to those related to decreased ability to inhibit task-irrelevant information. As noted in the processing speed section, the bottom line is really the same; eliminating excess information that will put extra demands on the working memory is desirable.

Carroll (1990) notes that the factor of being overwhelmed often comes into play when learning something both novel and complex and this idea is reflected in his writing in one of the three commitments: the training materials should be written so that the wording is as minimal as possible while still getting the points across. Therefore, designed into minimalist instruction is that excess must be eliminated, which can then alleviate demands on the working memory. More generally, minimalism reduces the demands on working memory because it takes a training approach that is constructive. This is an approach based on a theory of learning that is further explained in the next section.

### *2.2.2. Theories of Learning*

There are three primary theories of human learning and cognition—behaviorist, cognitivist, and constructivist. Each of these theories puts a different emphasis on how to design instructional systems. Hannafin and Rieber (1989) observe that instructional research has evolved from being predominantly behaviorally oriented to being cognitively oriented. More recently, instructional research has turned its focus toward cognitive constructivism. As Manning (1998) summarizes, minimalism synthesizes the action-oriented pragmatic theories of John Dewey, Piaget, and the more recent work of Jerome Bruner in constructivism. Carter and Honeywell (1991) note the importance of understanding theories of learning when they observe that in order to most efficiently use human resources, organizations will have to understand how older adults learn.

2.2.2.1. Behaviorism

The principles of training through programmed learning proposed by Skinner were based on this first instructional theory—the behaviorist theory, the roots of which date back to around the 1940s. According to the behaviorist view, learning is shaped by selective reinforcement in the form of motivational and/or correctional feedback to increase the likelihood of target behaviors (Kettanurak, Ramamurthy, & Haseman, 2001). Seels (1989) argues that programmed instruction was the first instructional technology because it was the first system for teaching that was based on a theory of learning. Essentially, this earliest learning theory supports early ideas about instructional design, which is why much training has used this systematic approach to develop training materials.

2.2.2.2. Cognitivism

By the late 1960s, cognitive psychologists, including Jerome Bruner, began challenging Skinner's programmed instructional approach. Cognitivists took the view that learning was concerned with what learners know and how they acquire it, as opposed to behaviorists' concern of what learners do. The primary goal from the cognitivist perspective is to transfer knowledge to learners in the most efficient and effective manner (Kettanurak et al., 2001).

2.2.2.3. Constructivism

A more recent theory of learning is known as the constructivist theory. As Seels (1989) states, "The constructivist paradigm proposes that learning occurs because personal knowledge is constructed by an active and self-regulated learner who resolves conflicts between ideas and reflects on theoretical explanations (p. 13)." Spigner-Littles and Anderson (1999) describe the theory of constructivism as the acquisition of knowledge through an active process wherein the individual continuously structures and restructures experience through self-regulated mental activity. From this view, errors are valued and a learning environment is sought that allows for play and discovery and is responsive to learner explorations by providing immediate feedback (Seels 1989).

Aligned with this view of errors is another of Carroll's (1990) three commitments. Carroll believes that errors are going to happen, and so minor errors should be expected. He continues by saying that ways to recover should be given, and that using errors this way should actually serve as motivation for learners.

It is through this latest theory that one may begin to understand where the empirically documented beneficial characteristics of minimalism are first noted. As van der Meij and Lazonder (1993) note, many of the minimalist design principles can also be found in the constructivist approach to instruction. Van der Meij and Lazonder (1993) observe that constructivism and minimalism share important fundamental principles, such as placing a high value on experience-based learning in context-rich environments and being problem oriented. These principles stimulate students to apply their knowledge and skills almost immediately. But, both methods leave out advanced explanations so that students have to discover major ideas themselves. It capitalizes on the learner's prior knowledge and ability to make inferences.

Supporting this theory, Spigner-Littles and Anderson (1999) have observed that, for people of all ages, learning is most effectively accomplished when new information is connected to and built upon a person's prior knowledge and real-life experiences. The authors went on to remark that this appears to be especially relevant when applied to older learners. Also, as Boud (1986) observes, with reference to higher education institutions, even the least experienced learners have significant experience that should be drawn upon in courses. Knowles (1980) even states that teaching and learning strategies for adults should be developed with great respect for their experiences. Carroll's (1990) minimalist thoughts correspond to those of other researchers when he notes that adult learners are not blank slates and that they are experts in many areas of knowledge and skill.

Carter and Honeywell (1991) noted that older adults place information into memory more consciously after judging its usefulness. These authors suppose that, because these processes are carried out less spontaneously than they were earlier, gaps in learning and retention may occur. These gaps may then be interpreted as poor memory when, in fact, the information has never been stored into memory in the first place. Therefore, Carter and Honeywell (1991) state that instructional design must support the conscious input of learned material into memory for effective learning to take place. The authors further hypothesize that the apparent lack of memory of a learned event for an older adult may be due to ineffective search and retrieval processes. Thus, given older adults, the idea of making use of learners' prior knowledge may be especially important due to their learning characteristics. Many of these ideas are also supported in the following theories of activity and assimilation.

### *2.2.3. Further Theories*

#### 2.2.3.1. Activity Theory

Like minimalism, the activity theory, which is derived from the work of Vygotsky, (Nardi, 1996) can also be linked to the constructivist approach in their similarity of ideas. Nardi (1996) even suggests that HCI research should move to focus on activity theory as its basis. As Jonassen and Rahrer-Murphy (1999) discuss, activity theory proposes that conscious learning emerges from activity and notes the importance of consciousness during an activity. Jonassen and Rahrer-Murphy (1999) clearly explain that, "…the richer the context, the more meaning learners will construct both for the activities and the thought processes (p. 68)." Spasser (1999) goes further to say that, due to the fact that activities are always in a given context, and so are impossible to understand alone, individual actions should include some minimal meaningful context.

Again complementing these researchers' ideas is the last of the three commitments that Carroll (1990) writes of minimalist instruction. This commitment is that learners should be working on meaningful tasks as soon as possible, which means not making the learner go through a lot of conceptual discussions of the system, and instead allowing him or her to pursue significant activities shortly after beginning training.

#### 2.2.3.2. Assimilation Theory

Assimilation theory, as it is applied to learning, was first defined by Ausubel (1963; 1968) as a theory that suggests learners must actively work with both their prior knowledge and the new information in order to learn new information. The main role of a training method is to facilitate assimilation (Davis and Bostrom, 1993). Davis and Wiedenbeck (1998) state that the integration of new and old information is critical and leads to success in problem solving. Again, the same underlying themes between the assimilation theory and constructivism, and between the assimilation theory and minimalism, are easily noticed.

Carroll (1997) notes that individuals should understand several things with reference to learners, including that individuals rely on their prior knowledge when trying to understand and assimilate a new experience. Therefore, a minimalist principle is to take advantage of what people already know.

*2.2.4. Applying the Theories*

Through the use of aging and training literature, a few researchers have developed recommendations for characteristics of training methods to help individuals, and especially older adults, learn. Hollis-Sawyer and Sterns (1999) concluded that research in aging and training suggests that the majority of older adults, as well as younger adults, benefit from participation in a training program that provides the following characteristics:

1) Heightens feelings of task motivation
2) Allows exploratory learning of task
3) Involves training on an intrinsically interesting task
4) Provides structure in learning the task
5) Organizes the presentation of material
6) Permits active participation in the learning process
7) Provides rapid feedback regarding progress
8) Is sensitive to the pacing preferences of older trainees

Czaja (1997) notes that although none of the studies to date examining training techniques have identified a training method that is especially beneficial to older adults, the results do suggest ways in which the learning of older adults may be improved for computer tasks. Morrell and Echt (1997) also made a similar note earlier when focusing on age-related changes. The hypothesis of this study is that minimalism is likely to fill this literature gap. Many others in the fields of training, learning, and aging have made similar recommendations as those recommendations of Hollis-Sawyer and Sterns (1999). The rest of this section has been divided into focus areas where the literature by these researchers generally converge. These areas are as follows:

1) Active, discovery, and exploration learning
2) Hands on and concrete learning
3) Self-pacing
4) Motivation and content
5) Early success
6) Immediate error correction

What will be noted is that these frequently researched areas of positive characteristics of learning are also characteristics of minimalism, as is briefly indicated in Table 1. Further, the areas described are not only areas supported by general learning data, as previously noted, but are those that researchers of training, technology, and older adults believe to be the characteristics that are likely to be the most helpful in training older adults. Also provided in Table 1 is a third column that gives a first look at how these characteristics associate with the existing control condition that was used in this study. A closer look at the control condition, which is based on more traditional design principles, and overall design rationale is given later in the methodology section of this paper.

**Table 1: Research Characteristics and Conditions**

| Characteristics suggested by literature | Associated minimalist principles | Control condition in Stagecast Creator |
|---|---|---|
| Active, discovery, and exploration learning | Take advantage of what people already know; rely on people to think and improvise | Does not encourage active exploration or improvisation |
| Hands on and concrete learning | Embed information in real tasks | Things are taught as separate small pieces of what an individual may do |
| Self-pacing | Rely on people to think and improvise; (minimalist tutorials are self-paced) | Does allow for self-pacing |
| Motivation and content | Allow learners to get started fast; embed information in real tasks | Does not utilize individuals' motivation to the greatest extent |
| Early success | Allow learners to get started fast | Does allow for small early successes |
| Immediate error correction | Support error recognition and recovery | Not supported immediately |

Active, Discovery, and Exploration Learning: Naylor (1996) states that adults, by far, learn the best when they do something—by practicing skills on realistic problems where they have a sense that they are making progress. This idea of learning by doing is, of course, a key aspect of minimalism, as it is part of the constructivist and active learning theories.

With reference to active versus passive learning, Atlas, Cornett, Lane, and Napier (1997) note that the active learning ideas, under the names of discovery and exploration learning, have good backing in theory and research. This active learning is known as beginning with Bruner advocating discovery learning in 1961 to Carroll's research, which led to the minimalist approach and the *Nurnberg Funnel*. This latter approach is sometimes known as guided exploration.

It was also noted by Czaja, Hammond, Blascovich, and Swede (1986) that large manuals encourage a passive learning experience where individuals are not as likely to develop a deep understanding. Due to this, it was recommended that training designs should include more active participation on the part of the learner through more problem-solving exercises. At the same time, Charney and Reder (1986) found, while designing interactive tutorials for computer users, that problem solving resulted in better performance when worked-out examples were given.

Carter and Honeywell (1991) note that the discovery method is particularly useful in training older adults, wherein the learner is given initial instructions and ongoing support and is allowed to discover how a task should be done. The task is usually divided into small meaningful problems, and rote memorization of abstract terminology is avoided. Meaningfulness is another key to deep learning, as noted in the earlier learning literature. As Boud (1986) states, with reference to higher education institutions, learning should always be meaningful. Hendrix (2000) also notes that meaningfulness is important and that computer use that is both interesting and personally relevant to older adults has been connected with positive attitude change.

Minimalism is an approach that has theoretical foundations in the research that supports active, exploration, and discovery learning, but it also has the added advantage of supporting the learner in aspects of these approaches about which researchers have expressed concern. Kelley and Charness (1995) state that, “The main challenge in designing an active training program for older learners is to provide enough structure that the trainee is not completely lost, while allowing him to engage in as much active exploration as possible (p. 115).” Minimalism attempts to supply this structure by giving some guidance and by providing error support and recovery information—giving this structure should also lend to user confidence and greater motivation due to the active nature.

Hands On and Concrete Learning: In the 1980s, discovery learning and learning from examples were already being noted as two powerful learning strategies (Charney & Reder, 1986). As White and Weatherall (2000) state, along with guided experience, technology is best learned when associating it with today's world for older adults. These two citations already begin to illustrate the importance of real world tasks. In addition, Mead and Fisk (1998) found that action training, as opposed to training emphasizing concepts, was associated with faster and more accurate performance immediately after training, as well as better retention, one month later, for older adults.

Generally, training methods that include hands-on and on-the-job methods, as well as concrete language are imperative since concrete practice and immediate application to job tasks increase what the individuals see as being relevant and therefore retain (Carter & Honeywell, 1991). General or abstract information may be difficult for them to learn (Hendrix, 2000). Hawthorn (2000) even notes that older computer users also appear to prefer learning in the context of concrete tasks.

As Manning (1998) states, a generalized minimalist model notes the critical importance of concrete examples, especially those which illustrate a problem not easily explained by what a reader already knows. As noted in Table 1, embedding information in real tasks is one of Carroll's (1997) stated minimalist principles.

Self-pacing: Mead and Fisk (1998) also cite that a number of other studies have demonstrated the superiority of active, self-paced learning conditions, over passive, fixed-paced learning conditions for older adults.

As many researchers, such as Dyck and Smither (1996) and Mead and Fisk (1998) note, older adults often need more time to complete training. Also more specifically noted, was that older adults learn computer tasks at a slower pace, and therefore require longer to train (Charness et al., 2001; Kelley & Charness, 1995). The answer to providing a different or slower pace appears to be solved by the option of self-pacing.

Carter and Honeywell (1991) state that self-paced learning materials are an especially effective method in teaching technical skills to older adults, and note that allowing sufficient time to practice is important for retention and self-esteem. In addition, many other researchers agree that self-paced learning is an important and beneficial method for older adults (Czaja, 1996; Hendrix, 2000; Zandri & Charness, 1989). Self-pacing is also a part of those training approaches that allow for active discovery and exploration, which, again, includes minimalism.

Motivation and Content: Carroll (1990) notes that the most important factor in learning is the learner's motivation. As Venkatesh and Smith (1999) note, research has indicated that intrinsic motivation in training leads to more positive outcomes, including a greater willingness to spend time on a task, a positive mood, less anxiety, and greater learning. By accepting the constructivist learning theory, one can understand the need for motivation through a statement by Manning. Manning (1998) discusses how learners discard old mental models for new ones—the definition of learning—but only if they are stimulated to build new schemas for themselves, stimulated by concrete hypotheses and tasks. Therefore, without the learner being motivated enough to build new schemas, learning cannot occur.

Like minimalist principles state, Czaja (1996) also notes that training materials for teaching computer skills to older adults should be well organized and streamlined. Oatey and Cawood (1997) note that since no procedure can cover all possible sequences of actions, it would seem to be a better teaching method to simply give users several fully developed examples that use as many options as possible. These statements are also in alignment with minimalist principles. As Manning (1998) notes, minimalist documentation generally means that computer functions are not described beyond real tasks.

As Carroll (1990) notes, individuals who are using computer equipment and software are already motivated to accomplish real tasks. By virtue of the fact that they want to learn to use something, they are motivated to learn how to do those things. So, why not take advantage of this fact and get people started on real tasks? The minimalist approach basically suggests that trainers need to get out of the learner's way.

Early Success: Carter and Honeywell (1991) suggest that an older learner's fear of technology can partly be addressed by building early success into the course design. They suggest that early exercises should be simple and relevant to the learner's job, while giving an immediate response that will reassure the learner. Czaja and Sharit (1998) also conclude that given that older people often have less experience with technology, it is critical that they are introduced to computers in a manner that is comfortable to them and that they experience some success in the performance of tasks.

Lazonder and van der Meij (1993) note that the task-oriented nature of the minimal manual is such that it allows users to get started fast. This is also one of Carroll's (1997) main minimalist principles, which in combination with the minimalist's guided exploration approach that includes built-in recovery for errors, should make it likely that a user will experience early success.

Immediate Error Correction: Carter and Honeywell (1991) and Hendrix (2000) similarly note that older adults must be assured that striking a wrong key will not impair computer function, and that instructions for immediately correcting errors, as well as frequent positive feedback, must be included in training materials for older adults. This is essential because many have developed a fear that doing something like striking the wrong key can cause great irrevocable damage.

Birdi and Zapf (1997) also advise that since older workers appear to react more negatively to errors in computer work, it may be very advisable to develop modules to assist people to see the positive value of their errors. Czaja (1996) also notes the value of training older adults how to correct computer errors immediately so that they do not become learned.

Here again, one sees that one of Carroll's minimalist principles provides for this issue as well. A minimalist principle includes supporting quick error recognition and recovery.

### 2.3. Satisfaction

Minimalism has not only shown better results in performance, but there is also evidence supporting the idea that it is preferred (Carroll, 1990; Ramsey & Oatley, 1992). As Ramsey and Oatley (1992) note, not only were minimalist users less likely to lose sight of their goals, but they also appeared to enjoy achieving them more than the traditional approach users.

Measures of satisfaction were taken in the study in addition to the more objective measures like performance. Subjective data are always important because whether or not someone likes a new method is a good indication of whether it may be successfully implemented in the future.

### 2.4. Interactivity

As mentioned earlier, Mead and Fisk (1998) have stated the need for research that specifically evaluates the type of training independent of the mode of training delivery. Upon evaluation of the existing tutorial on the Stagecast Creator software, which was used in this study, it was realized that the comparison between the recently created paper-based minimalist tutorial and the existing interactive multimedia tutorial would not be a fair comparison.

The first problem is the fact that the minimalist tutorial that is being created must be paper-based because the team does not have access to the underlying software code. This gives the existing tutorial the added advantage of being given in an interactive multimedia format. Research suggests that interactive multimedia may increase motivation (Kinzie, 1990) and, like active learning, is likely to promote deeper learning by actively engaging the learner (Cairncross & Mannion, 2001; Kettanurak et al., 2001). Further research also notes that introducing technology using a highly interactive and understandable approach was a factor that influenced older adults' openness toward computers (Edwards & Engelhardt, 1989). Kettanurak et al. (2001) later provided further support to this when they confirmed their hypothesis that modes of interaction have a very strong effect on attitude measurements regardless of learning style.

A second problem with comparing these two tutorials, as they exist, is that through multimedia, the existing Stagecast Creator tutorial also sometimes illustrates what is to be done next. Research shows that, when behavioral modeling is shown before the task is to be performed by older adults, the individuals consistently perform better on computer software, even when compared to an interactive approach (Carter & Honeywell, 1991; Gist, Rosen, & Schwoerer, 1988). In the case of the existing tutorial, there would be some of both interactivity and a sort of behavioral modeling. Also, as Atlas et al. (1997) conclude, animation alone promises to be an effective tool in training to use computer software, and due to its enjoyable nature, may motivate individuals to learn more.

The third problem with using the existing Stagecast Creator tutorial is that it controls for errors. Controlling for errors so that individuals can recover is characteristic of minimalism, but is not characteristic of a traditional training approach, and being paper-based, the minimalist approach would still never be able to control for errors as well as is the case for the existing tutorial, which involved changing the software code. It is for these reasons that the existing Stagecast Creator tutorial was made into a paper-based format, which allowed for a better controlled comparison.

## 2.5. Individual Differences

Hollis-Sawyer and Sterns (1999) found, when researching goal-oriented training with older learners, that individual differences in intellectual ability and personality dimensions did not account for a significant amount of variance in predicting training outcomes. In general, it is believed that regardless of individual differences, those receiving minimalist instruction will outperform those in the control condition. Nonetheless, learning style did emerge as a factor that may have a significant effect due to the nature of the software environment, Stagecast Creator.

### *2.5.1. Learning Style Factor*

Charness, Schumann, and Boritz (1992) concluded that an older adult's success in learning a computer training program is primarily influenced by the quality of the training program design, rather than individual difference factors. However, due to the rather abstract nature of the visual programming software that was used in this study, it was hypothesized that those individuals with an abstract learning style would perform better than those with a concrete learning style.

The initial design of the present work included a collaborative learning environment where pairs of adults would learn together. As Spigner-Littles and Anderson (1999) note from their own experiences, which other literature also supports (Naylor, 1996) (Carter & Honeywell, 1991), older learners respond best to collaborative learning environments. This type of environment is the best at facilitating learners to connect new information to their existing knowledge base and real-life experiences, and to reconstruct their prior knowledge. However, in pilot testing, it became apparent that the abstract nature of the software was bringing about an unexpected effect that was thought should best be contained.

In addition, there does appear to be literature that supports the idea that the given software environment is likely to give an advantage to individuals with certain learning styles. Bostrom Olfman, and Sein (1990) stated that there are very consistent findings suggesting that the learning style construct is a significant factor in determining the learning of an end-user. These authors later state that, in general, it can be expected that abstract learners (i.e., individuals who learn by thinking or analyzing) will perform better than concrete learners (i.e., individuals who learn by experiencing) when studying a new software package; their study provided further support to this hypothesis.

For the purposes of this study, Kolb's Learning Style Inventory (LSI) was selected. In determining which test to use to measure learning style, the literature was first reviewed to determine what learning style tests included the abstract to concrete construct. Upon review, it was determined that Kolb's LSI was the most frequently used in research (Bostrom et al., 1990) and appeared to have had the most acceptable reliability and validity (Katz, 1988; Yahya, 1998) studies performed on its design (Willcoxson & Prosser, 1996).

#### *2.5.2. Personality Factor*

Driskell, Hogan, Salas, and Hoskin (1994), upon researching predictors of training performance, determined that the results of their study indicated that even though learning style tests are reliably associated with learning ability and performance, personality measures can predict the factors of motivation and attitude that also affect training success. It is commonly accepted that individuals who are highly motivated in a learning situation learn better than those who have a lesser motivation level. Some individuals have a personality such that they are often highly motivated to learn or to help others, which would be an advantage for participants in this study. Individuals with this personality are then likely to perform better than those with other personalities. People with a Type A personality tend to be impatient and are motivated by the feeling that they are constantly under time pressure. It is believed that this type of individual may be less likely to spend adequate time learning with the tutorials than individuals with the opposite Type B behavior, who are less likely to be impatient during a learning event. It is assumed that decreased time with the tutorial is likely to be associated with inadequate performance. It was not thought that this trait would be a main factor, but along with several other factors that will be mentioned in the next subsections, multiple regression analysis was performed on several selected traits after the study was completed.

There has been a lull in new literature in the area of validating Type A personality measures for the last several years. However, Edwards (1991) assessed the validities of what he noted to be the most widely used scales to test for Type A behavior, which included the Jenkins Activity Survey, the Framingham scale, and the Bortner scale. Upon examining the literature, these do in fact appear to be the most commonly cited measures. By far the most common of the three is the Jenkin's Activity Survey, which is still cited frequently in the literature. Test-retest reliability over the duration of a four to six month interval determined coefficients ranging from .65 to .82 for the survey (Jenkins, Zyzanski, & Rosenman, 1979). Data supporting the survey's validity were gathered through structured interviews and prevalence of coronary heart disease, which is directly correlated with Type A behavior (Jenkins, Zyzanski, & Rosenman, 1979).

*2.5.3. Attitudes and Anxiety Factor*

Chou (2001) stated that prior research shows that computer anxiety and attitudes are two critical factors that influence computer learning and performance. Computer anxiety has been shown to be significantly related to more general computer attitudes (Czaja & Sharit, 1998; Henderson, Deane, & Ward, 1995). Schuh (1996) noted that previous research has supported the finding that anxiety interferes with individuals' achievements from a variety of instructional methods. It has also been suggested that attitudes are a critical component of usability and that the system must provoke positive attitudes from the user (Czaja & Sharit, 1998).

Upon reviewing the literature, Kelley and Charness (1995) note that the effect of anxiety and attitudes on an individual's ability to learn computers is unclear, as there have been mixed results. However, many researchers suggest that positive attitudes and low anxiety may be beneficial when learning to use things as complex as what is often taught on a computer. Since attitudes and anxiety have the potential of being a mediating factor, it was determined that measures of computer attitudes and anxiety should be taken.

Upon evaluation of the literature, the Computer Attitude Scale, or C.A.S., by Loyd and Gressard (1984) was selected to evaluate individuals because prior research has shown that the C.A.S. is appropriate to use with older adults (Dyck & Smither, 1994). It is also a single scale that evaluates four different subtypes of computer attitudes, including anxiety, confidence, liking, and usefulness, which were of interest in this study. In addition, there have been reliability and validity studies conducted that provide supporting evidence for the scale's use (Gardner, Discenza, & Dukes, 1993; Harrison & Rainer, 1992; Loyd & Loyd, 1985). Estimates of reliability coefficients for the C.A.S. subscales range from .82 to .93 (Gardner, Discenza, & Dukes, 1993; Loyd & Loyd, 1985). Harrison and Rainer (1992) examined validity by comparing the C.A.S. with similar scales and determined that all correlations were significant at the .001 level.

*2.5.4. Computer Understanding and Experience Scale*

As has been found with younger adults, Dyck and Smither (1996) and Czaja and Sharit (1998) found that greater computer experience is associated with a more positive attitude toward computers and with learning more during their controlled experience in the study. On the other hand, Czaja and Sharit (1993) researched age and computer experience together and found that when controlling for the factor of computer experience, the effect of age on performance is drastically reduced. Kelley and Charness (1995) concluded that prior computer experience may be an important factor in understanding the differences between older and younger adults trying to learn new software.

Experience was not thought to be a large determining factor in this study because of the unique nature of the software environment that was used and due to the data gained about kids' computer experience and their resulting performance in this software environment through other studies conducted by Virginia Tech's Computer Simulation Project Team. Nonetheless, it was determined that it would still be advantageous to collect this information. A review of the literature disclosed that few computer experience scales exist, and upon checking for a questionnaire that refers to computer experience on the test collection available on the Educational Testing Service Database, it was found that only one scale was relevant to this study. The scale obtained is called the Computer Understanding and Experience Scale by Potosky and Bobko (1998). Since validity and reliability were tested on this scale, it was determined that it would be advantageous to gather some computer experience data in this form. The scale's internal reliability estimate was alpha equals .93, and support of construct validity included significantly and positively correlated data from the scale with individuals' self ratings and experience (Potosky & Bobko, 1998).

### *2.5.5. Age*

Charness et al. (2001) found that older adults did not deploy their knowledge as effectively or attain the same levels of performance as middle-aged adults. Lesser performance in those who are older has been a common finding in the literature for many years. As Ralls (1998) observed in his study, computer experience and age were significant factors in the variance in computer training among older adults. However, more recently, there have even been a few researchers who have focused on determining whether this effect remains within different age segments of older adults.

More specifically, Echt et al. (1998), upon comparing computer performances of individuals defined by age as young-old (ages 60-74 years) and old-old (ages 75-89 years) found that the young-old adults consistently outperformed old-old adults across all dependent measures, which suggests that the oldest of the olds may have more problems learning. Morrell et al. (2000) also found, when comparing performances of individuals defined by age as young-old (ages 60-74 years) and old-old (ages 75-89 years), that the young-old adults appeared better able to perform computer tasks.

#### 2.5.5.1. Intelligence

Fluid intelligence has been defined as our "on-the-spot reasoning ability, a skill not basically dependent upon our experience" (Belsky, 1990, p. 125). Crystallized intelligence, on the other hand, can be defined as "the extent to which a person has absorbed the content of culture" (Belsky, 1990, p. 125). Something like learning a new software program, as in this study, is likely to be mainly utilizing fluid intelligence.

Research suggests that although education slows the rate of crystallized intelligence, this does not appear to be the case for other cognitive abilities, which include fluid intelligence (Christensen, Korten, Jorm, Henderson, Jacombs, Rodgers, & MacKinnon, 1997). From this, one can conclude that it is not apparent that education correlates with fluid intelligence. However, research does support the idea that age and fluid intelligence tend to move together in an inverse relationship. Ralls (1998) states that previous research indicates that older adults have significantly more difficulty learning computer-based applications as compared to younger adults. Also noted is that fluid intelligences, including logical reasoning ability and spatial orientation, predict computer training and computer-based performance. The author states that these two specific cognitive abilities decline with age. Christensen, Mackinnon, Jorm, Henderson, Scott, and Korten (1994) note that even when studying older adults who are 70 years of age or older, crystallized and fluid intelligence both decrease, with the greatest decrease being in fluid intelligence. This is further evidence of prior studies, which found the same trend when looking at a wider spectrum of ages.

Stankov (1994) even suggests that the often noted tendency for the magnitude of age differences in performance to increase as the task becomes more complex may be a result of the fact that fluid intelligence negatively correlates with age.

#### 2.5.5.2. Spatial Ability

Many researchers have specifically examined the spatial ability aspect of fluid intelligence as potentially being the important factor that should be examined in researching performance differences. Researchers have found that regardless of gender, there is often an age-related decline in spatial ability, (Willis & Schaie, 1988) and that older adults are generally outperformed by younger adults (Robert & Tanguay, 1991).

It has been suggested that age differences in computer learning efficiency and performance may be due in part to age-related differences in spatial memory (Czaja et al., 1989; Kelly & Charness, 1995). Older adults appear to perform worse on spatial memory tasks than younger adults (Hawthorn 2000). However, Charness et al. (2001) state that measures such as spatial ability do not play as strong of a predictive role for software training outcomes as do age and experience.

What one can gather from this information is that age may be an even better factor to measure than any other fluid intelligence measures. Therefore, data on participants' ages were collected and examined in this study.

### *2.5.6. Gender Factor*

As Chou (2001) notes, gender has been proposed as a variable that moderates the effects of training method and computer attitudes and anxiety on computer performance. As a result of Chou's research on gender effects, he hypothesizes that males will generally score higher on computer learning performance measures and score lower on computer anxiety measures. This indicated that it might be advantageous to collect gender information. In addition to this, it was noted by some of the Community Simulation Project researchers, in a preliminary meeting of adults that were helping to work on a part of the Community Simulation Project, that women appeared more receptive than males to the ideas being proposed. The project and ideas utilized the same software environment that was used in this study. Therefore, it was determined that there might be a difference between the genders that may translate to the performance and level of satisfaction of participants.

Having discussed the pertinent points of prior research for this study, the next section will include an overview of the important aspects of the study.

# 3. RESEARCH OVERVIEW

## 3.1. Research Purpose

### *3.1.1. Primary*

The primary purposes of this research were to:

1) Determine the effectiveness of a minimalist approach as compared to a more traditional control condition in facilitating learning in older adults.
2) Compare the subjective data of individuals using a minimalist approach to those using a control condition based on a more traditional approach.

### *3.1.2. Secondary*

The secondary purpose was to examine individual differences, especially learning style and gender, to determine if they have an effect on either subjective data or performance.

## 3.2. Research Questions and Hypotheses

The study was designed to answer the following research questions:

1) What are the differences in the effectiveness of two different training types, minimalist training and the control condition, for older adults within a software environment?
2) What are the subjective differences among older adults for two different training types, minimalist training and the control condition, when learning in a software environment?

To answer these questions, the following two hypotheses were tested. The minimalist training approach, when compared to the control condition, will be a more effective training tool, as measured by performance, for older adults within the given software environment. Results supporting this hypothesis would indicate that minimalist training approach would be more suitable in training older adults to use computer software. The other hypothesis was that older adults will be more satisfied with the minimalist training approach when compared to the control condition within the given software environment. Support for this hypothesis would indicate that older adults prefer to be trained through minimalist training when given a computer software environment.

3) To what extent does learning style predict performance or knowledge, regardless of training type, in learning a high level programming language?

To answer this question, the hypothesis was tested that those with an abstract learning style will perform better than those with a concrete learning style within the given software environment. This would support the previously mentioned research, which has given the preliminary indication that those individuals who tend to think more abstractly are better at learning new computer software.

4) To what extent does gender predict performance or knowledge, regardless of training type, in learning a high level programming language?

To answer this question, the hypothesis was tested that females will perform better than males in the given software environment. Support for this would imply that females are generally better at learning new software.

5) To what extent does gender predict training satisfaction, with the two types being minimalist training and the control condition following a more traditional approach?

To answer this question, the hypothesis was tested that females will be more satisfied with the minimalist training approach when compared to the control condition within the given software environment.

# 4. Methodology

## 4.1. Primary Experimental Design

A one-factor between subjects design, with the main factor being training type, was used in this study, further information is provided in Table 2.

**Table 2: Factor Levels and Types**

| Factor Name | Levels | Type |
|---|---|---|
| Training Type | Minimalist Tutorial<br>Existing Tutorial | Between-Subject,<br>Fixed Effects |
| Subjects | $S_1 \ldots S_{30}$ | Between-Subject,<br>Random Effects |

## 4.2. Secondary Analyses

There were no main factors in the design of this study other than training type. However, research questions and hypotheses also covered learning style, in the abstract to concrete construct, and gender. Therefore, further analyses were conducted using these data. The data matrix given in Table 3 illustrates participants' characteristics of gender and learning style as well as what training condition to which they were exposed.

**Table 3: Data Matrix**

| | Type of Training | |
|---|---|---|
| **Learning Style** | *Minimalist Tutorial* | *Control Tutorial* |
| *Abstract* | 5 Females<br>4 Males | 6 Females<br>3 Males |
| *Concrete* | 3 Females<br>3 Males | 3 Females<br>3 Males |

## 4.3. Dependent Measures

Three dependent measures were taken to assess an individual's tutorial experience. These measures included a performance test, a knowledge test, and a subjective questionnaire. The performance test was created to assess how well the individual could perform tasks that were designed to have been learned while working with the tutorial. The knowledge test was created to evaluate how well individuals learned the programming concepts included in the tutorial. The subjective questionnaire was designed to determine how much the participants enjoyed their tutorial experience.

## 4.4. Participants

Thirty participants were recruited for this study, consisting of 17 females and 13 males. Using the same age to define older adults as Echt et al. (1998) and Morrell et al. (2000), individuals were recruited who were at least 60 years of age. The mean age of the participants was 69.53 (*SD* = 6.36). Participants were obtained through a newspaper advertisement and through advertisements e-mailed out by other participants. The author conducted all aspects of the study.

## 4.5. Materials and Equipment

### *4.5.1. Stagecast Creator*

The tutorials being used in this study to compare the training types were created to teach an individual some basic, high-level programming concepts on the software Stagecast Creator (Version 1.0). Stagecast Creator is a game-like programming environment that teaches individuals programming concepts using a very visual format. Given enough experience with the software, an individual could learn how to create a game, such as Pac-man, without ever needing to learn the code of a traditional programming language.

*4.5.2. Training Type*

Since meaningful tasks are a requirement for any minimalist tutorial, the tutorials were created by first identifying the meaningful tasks. The determination of these meaningful tasks was constrained by the Community Simulations Project context and by the modules available in the existing Stagecast Creator tutorial. Using these constraints, the tutorials were equated so that the same concepts and skills were taught in each. Since the minimalist tutorial was completely created by the team, no changes were made to an established, or previously published, form. However, the existing tutorial created by Stagecast Creator was altered so that only the pieces equivalent to the information in the minimalist tutorial were used. The long length of the existing Stagecast Creator tutorial made using only part of it a logical alternative, and it was also changed to a paper-based form, so that it would be in the same form as the minimalist tutorial. The minimalist and existing control tutorials may be found in Appendices A and B, respectively.

*4.5.3. Tutorial Design*

Five of the potential 18 segments given in the Stagecast Creator tutorial were given to participants in the control condition of this study. Table 4 gives a detailed comparison of the characteristics of the Stagecast Creator tutorial and of the minimalist tutorial.

**Table 4: Comparison of Characteristics of the Tutorials**

| Concepts and skills taught in Stagecast Creator Tutorial | Characteristics of approach taken to teach the concept or skill in the Stagecast Creator tutorial | Characteristics of approach taken to teach the concept or skill in the minimalist tutorial |
|---|---|---|
| Segment 1: Familiarize individual with the Stagecast Creator environment | This segment asks the user to move and click on objects and shows the user how to use delete and copy buttons.<br>This segment is characteristic of more traditional approaches to training, where the individual is taught to do things in separate small steps that will be used together with other small steps in common tasks. And so, small early successes are included. | This segment information does not occur in the minimalist tutorial. This tutorial does not step individuals through to familiarize them with the environment. It advocates allowing the user to get started on real tasks as soon as possible and encourages active exploration throughout. It takes an approach of discovery learning. |
| Segment 2: Learn to make simple rules | This segment introduces the four steps needed to create a rule. It consistently previews what will be done, then goes through each step one at a time, and then reviews what has just been done. There is constant reassurance by giving the user pictures of how their screen may look and then showing which pictures are right and wrong. And thereby, small early successes are included | This segment information is taught fairly quickly by placing the individual in what is potentially a real task and providing error recovery. It takes an approach of active learning. |
| Segment 3: Learn to make more complex rules | This segment introduces a bit more complex rules by teaching the character how to negotiate objects. These rules are taught in essentially the same manner as Segment 2, but there is slightly less reassurance information given. | This segment is taught with the same minimalist principles as given in Segment 2 above. |
| Segment 4: Learn how to change appearances | This segment first introduces the user to changing appearances in general and then how to make rules that involve appearance changes. This contains the same basic format as in Segment 2, but the initial steps needed to guide an individual through creating a rule are now combined so that they are not stepped through each individually. | This segment is also taught with the same minimalist principles as given in Segment 2. |
| Segment 5: Learn to create and use variables | This segment teaches users how to first create a variable, then how to give it a value, followed by how to use it in rules, and then how changing values have an effect. This contains the same basic format as in Segment 2. | This segment is also taught with the same minimalist principles as given in Segment 2. |

Like many studies, the design of the two training conditions could not be created in a way that did not have the potential to introduce some problems to the comparison. In the case of this study, the issues mainly have to do with the existing Stagecast tutorial, or the control condition. They are as follows:

1) Although there is no consistent immediate error recovery, error recovery information does appear off and on throughout the existing Stagecast tutorial. Also, consistently there are questions and answers to make sure the person does not get off track. Essentially, the user is not given a lot of error recovery information or the opportunity for active exploration, but instead is given training wheels, constant guidance and reassurance, to keep the user headed in the right direction. This means that there is a level of the minimalist principle of providing immediate error recovery that occurs in the tutorial, which could prove to a small confounding factor.
2) The Stagecast tutorial allows for small early successes. Although not provided in the same exact way as in the minimalist condition, this aspect of minimalism also exists in the control condition.
3) Although not embedded in complete real tasks, as in the minimalist condition, smaller pieces of real tasks are given in the existing tutorial.

### *4.5.4. Computer Hardware and Software*

In order to allow participants to learn and perform in a familiar context, data collection occurred mainly at a town library and secondarily at participants' homes, depending upon the preference of the participant. All computer interaction took place on a Dell Inspiron 8000 notebook computer. The Stagecast Creator software ran solely from that computer, and a desktop mouse was attached for participants to use.

### *4.5.5. Observation and Data Recording*

TechSmith's Camtasia software was used to record performance data during testing. Camtasia, once set to record, took frequent screenshots of the of the Dell Inspiron's computer screen, which created a movie that the evaluator later watched to determine how well tasks were performed. All other data gathered were obtained via paper and pencil. Measures taken included a performance test, a knowledge test, a subjective questionnaire, a background questionnaire, the Learning Style Inventory, the Jenkins Activity Survey, the Computer Understanding and Experience Scale, and the Computer Attitude Scale.

#### 4.5.5.1. Performance Test

A performance measure was created to examine the performance effects of the variables of interest. The performance test assessed the concepts and skills used in creating the two tutorials. The performance test may be found in Appendix C. To evaluate performance, each task was divided into the subtask elements required to accomplish each task. This list was used so that the number of correct subtasks and the number of errors for individuals could be noted during evaluation. In addition, the length of time needed to accomplish each task was recorded. The form used to document these dependent measures is in Appendix D. A screenshot of the Stagecast Creator environment, or world, that was used is given in Figure 1. To obtain another dependent measure for greater support of inferences about learning, a knowledge test was also given to participants.


**Figure 1: Screenshot of Performance Test Environment**

4.5.5.2. Knowledge Test

A knowledge test was created that measures understanding of the concepts found in the tutorial tasks. This test may be found in Appendix E. The knowledge test consisted of open-ended questions. The test was scored based on accuracy. A knowledge score was calculated by dividing the number correct by the total score possible. The knowledge test key can be found in Appendix F.

4.5.5.3. Subjective Questionnaire

Beyond performance and knowledge tests, it is important to know whether or not individuals enjoy and accept a training method. This is why subjective data were collected. The subjective questionnaire is located in Appendix G. The questionnaire used a Likert scale, as well as some open-ended questions that were used to help determine recommendations for future tutorial designs. Also added to the subjective questionnaire were measures of the five minimalist principles:

1) Allow learner to get started fast
2) Embed information in real tasks
3) Take advantage of what the user knows
4) Rely on user to think and improvise
5) Support error recognition and recovery

These measures were taken to see if there was a difference in how individuals felt about these aspects in the two training conditions.

4.5.5.4. Background Questionnaire

The background questionnaire included a myriad of experience-based questions as well as information about each participant's age and gender. The questionnaire may be found in Appendix H.

4.5.5.5. Learning Style Inventory

The Learning Style Inventory (Version 3) by Kolb was used to determine whether individuals had an abstract or concrete learning style. The abstract to concrete construct is one of Kolb's primary measures, so an individual's style was labeled according to Kolb's evaluation criteria. The verbal content of the inventory was not altered and may be found in Appendix I.

4.5.5.6. Jenkins Activity Survey

The Jenkins Activity Survey was included to determine whether a participant's personality tended towards a Type A or Type B personality. See Appendix J for the complete survey.

4.5.5.7. The Computer Understanding and Experience Scale

The Computer Understanding and Experience Scale by Potosky and Bobko (1998) was administered to examine the effect of computer knowledge and experience on performance and reactions. The scale can be found in its entirety in Appendix K.

4.5.5.8. Computer Attitude Scale

The Computer Attitude Scale (C.A.S.) by Loyd and Gressard (1984) was included to test the possible role of computer attitudes, including an anxiety measure. The scale may be found in Appendix L.

**4.6. Procedure**

Data collection occurred at two separate times. On the first day individuals were given a brief introduction and were asked to read and sign an informed consent form. The informed consent form is in Appendix M. After obtaining their signature, the participants were asked to complete the background questionnaire, the Learning Style Inventory, the Jenkins Activity Survey, and the Computer Understanding and Experience Scale, which were described in Section 4.3.

Upon completing the questionnaires, the participants were asked to schedule a second session time for the study. The entire first meeting lasted between 20 and 45 minutes. At the second meeting, individuals were given a brief reintroduction, which included the reading of the cover letter in Appendix N. The cover letter included background information about the purpose of learning Stagecast Creator and further information about how the study would be conducted. The participants were then asked if they had any questions, and when ready to begin, they were given one of the two tutorials. Upon completing the tutorial, individuals were given a performance test. Then they were asked to complete a knowledge test, a subjective questionnaire, and the Computer Attitude Scale, which was given after everything else had been completed in order to avoid carryover effects. A debriefing of the study followed. The testing during the second day lasted between one-and-a-half and three hours.

The training condition factor was manipulated through the use of two different tutorial designs. Each participant was exposed to only one of the tutorials, either the paper-based minimalist tutorial created by the Community Simulations Team, or the paper-based tutorial based on the existing Stagecast Creator tutorial, also known as the control condition.

# 5. RESULTS

## 5.1. Data Analyses

Statistical Analysis System (SAS) was used to conduct all analyses. All Analyses of Variance (ANOVAs) and Analyses of Covariance (ANCOVAs) used the General Linear Model (GLM) procedure. All post hoc analyses used Least Squares Means (LSMeans). Alpha was set at a level of .05. Dependent measures used to analyze a participant's tutorial experience were taken from the performance test, the knowledge test, and the subjective questionnaire. The dependent measures tested for significance are given in Table 5. Further details of the following data analyses may be found in Appendix O.

**Table 5: Dependent Measures and Descriptions**

| Dependent Variable | Description |
|---|---|
| Performance | Determined by evaluating a participant's performance via Camtasia and the correct subtasks as defined on the performance test key to determine the number of subtasks performed correctly on the performance test |
| Performance errors | Determined by evaluating a participant's performance via Camtasia and the correct subtasks as defined on the performance test key to determine the number of errors occurring during the performance test |
| Performance time | The length of time taken on the performance test measured from the first button pressed in Stagecast until Stagecast was exited as captured by Camtasia |
| Knowledge | Determined as the number of subtasks answered correctly as defined by the knowledge test key |
| Subjective response referring to the principle of allowing learners to get started fast | Sum of the Likert scale responses to the three questions on the subjective questionnaire referring to the principle of allowing learners to get started fast |
| Subjective response referring to the principle of embedding information in real tasks | Sum of the Likert scale responses to the three questions on the subjective questionnaire referring to the principle of embedding information in real tasks |
| Subjective response referring to the principle of taking advantage of what the user already knows | Sum of the Likert scale responses to the three questions on the subjective questionnaire referring to the principle of taking advantage of what the user already knows |
| Subjective response referring to the principle of relying on user to think and improvise | Sum of the Likert scale responses to the three questions on the subjective questionnaire referring to the principle of relying on user to think and improvise |
| Subjective response referring to the principle of supporting error recognition and recovery | Sum of the Likert scale responses to the three questions on the subjective questionnaire referring to the principle of supporting error recognition and recovery |
| Subjective response referring to satisfaction-related questions designed to take note of reactions unrelated to the minimalist principles | Sum of the Likert scale responses to the 20 questions on the subjective questionnaire referring to general satisfaction |

### *5.1.1. One-Way and Three-Way ANOVA*

#### 5.1.1.1. Main Effects

A One-Way ANOVA was used to examine training type. The dependent measures tested were the number of subtasks performed correctly on the performance test and the number of subtasks answered correctly on the knowledge test. A third dependent measure included the sums of the Likert scale responses on the subjective questions designed to measure general reactions relating to satisfaction, which did not include those questions related to minimalist principles. Only training type for the subjective measure using the 20 satisfaction-related questions was found to be significant, $F\,(1, 28) = 4.69$, $p < .05$. Participants in the control group ($M = 67.00$, $SD = 12.97$) gave significantly higher satisfaction ratings of their training type than those in the minimalist group ($M = 56.60$, $SD = 13.33$).

A Three-Way ANOVA was also conducted using the primary variables of interest, which included training type, learning style, and gender. One further main effect was found when examining participants' ratings given to the question of whether the tutorial embedded information in real tasks. With this question, training type was significant, $F\,(1, 22) = 5.52$, $p < .05$, with participants in the control condition ($M = 9.73$, $SD = 2.12$) reporting significantly higher levels than those in the minimalist condition ($M = 8.67$, $SD = 1.50$).

#### 5.1.1.2. Two-Way Interaction

In examining the responses of individuals to subjective questions relating to satisfaction, and unrelated to minimalist principles, one also finds, by way of the Three-Way ANOVA, that the interaction of gender and condition was significant with $F\,(1, 22) = 7.48$, $p < .01$. Post hoc results indicated that males in the control condition ($M = 75.17$, $SD = 6.27$) reported significantly higher totals than males in the minimalist condition (*M* = 49.86, *SD* = 14.45). Figure 2 illustrates the difference between the ratings given by females and males.

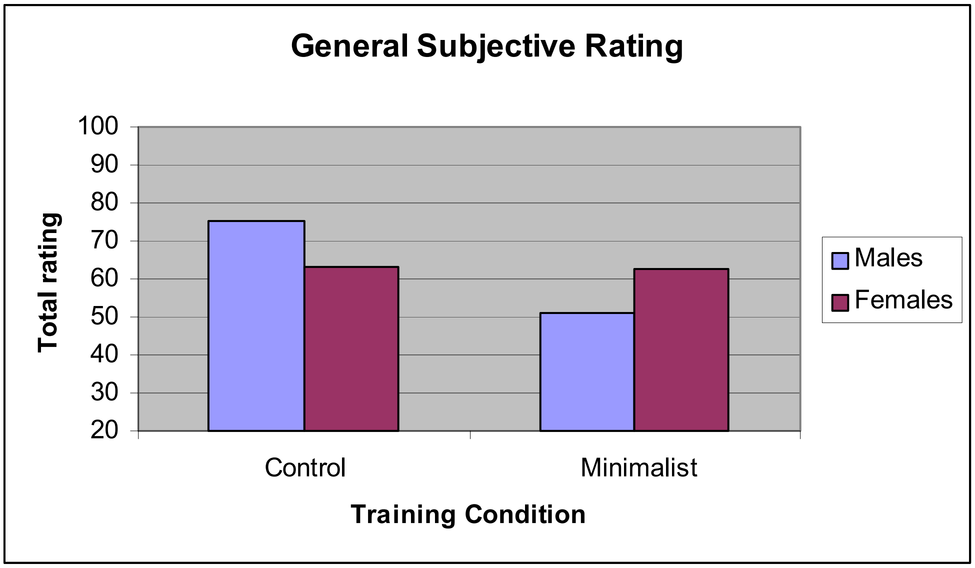


**Figure 2: Results of General Subjective Rating**

Post hoc analyses of subjective questions relating to satisfaction also revealed that individuals in the control condition with the abstract learning style (*M* = 65.22, *SD* = 14.55) and with the concrete learning style (*M* = 69.67, *SD* = 10.88) reported significantly higher satisfaction ratings than individuals in the minimalist condition with an abstract learning style (*M* = 53.56, *SD* = 14.51).

Post hoc results showed that, when participants' gave ratings answering the question of whether the tutorial embedded information in real tasks, males in the control condition (*M* = 10.00, *SD* = 1.90) and females in both the control (*M* = 9.56, *SD* = 2.35) and minimalist conditions (*M* = 9.75, *SD* = 1.04) reported significantly higher ratings than males in the minimalist condition (*M* = 7.43, *SD* = .79) with $p < .05$. Figure 3 charts the ratings given by these four groups.

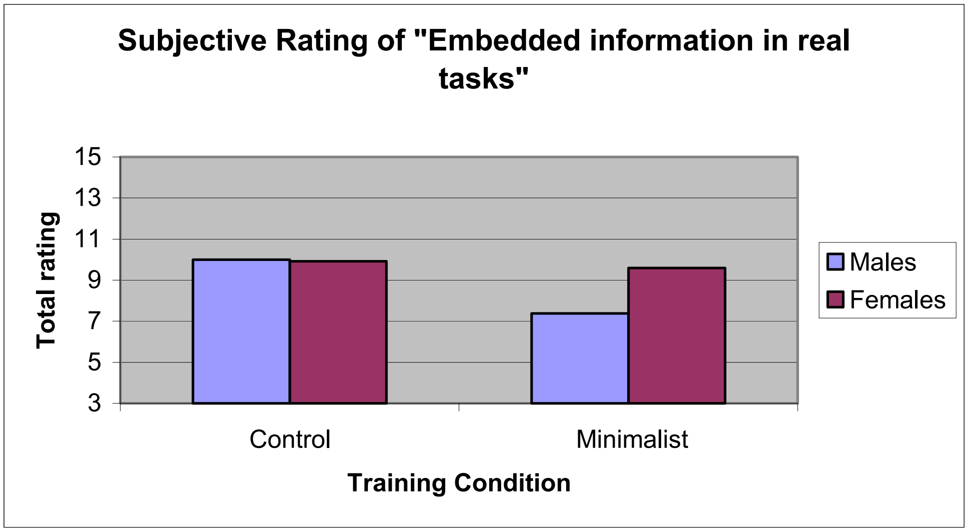


**Figure 3: "Embedded Information in Real Tasks" Rating**

In addition, individuals with a concrete learning style in the control condition (*M* = 10.50, *SD* = 2.07) gave significantly higher ratings to whether information was embedded in real tasks than individuals with a concrete learning style in the minimalist condition (*M* = 8.00, *SD* = 1.41) with $p < .05$.

5.1.1.3. Three-Way Interaction

Post hoc examination revealed some interesting trends to performance involving all three factors. Females with an abstract learning style in the minimalist condition (*M* = 12.40, *SD* = 10.78) obtained scores higher than females with an abstract learning style in the control condition (*M* = 3.83, *SD* = 2.32), and this result approached significance with $p = .07$.

Significant results were found through the use of post hoc analyses when examining knowledge scores. Results indicated that males with an abstract learning style in the control condition (*M* = 5.33, *SD* = 2.08) obtained a knowledge score that was significantly higher than females with an abstract learning style in the control condition (*M* = 1.83, *SD* = .41).

*5.1.2. ANCOVA*

ANCOVAs were carried out to test for the possible effects of gender and learning style on results. After conducting ANCOVAs on the numerous, aforementioned, measures, it was determined that age and experience were the best predictors of performance and that those should be included as part of the data analyses of this study. A One-Way ANCOVA with age and experience as the covariates, determined age to be significant $F$ (1, 26) = -2.42, $p < .05$, and experience to be significant $F$ (1, 26) = 3.43, $p < .01$. Although the results of these analyses when accounting for the covariates were somewhat different than with the ANOVAs mentioned earlier, nothing moved past the .05 set threshold statistical significance.

*5.1.3. Additional Analyses*

A few further analyses were conducted on the study's data and with these came a further significant result. The amount of time spent on the tutorial was significantly different between participants depending upon the training condition, $F$ (1, 28) = 6.66, $p < .05$. Participants in the minimalist group ($M$ = 99.67, $SD$ = 18.37) spent significantly less time on the tutorial than those in the control group ($M$ = 81.33, $SD$ = 20.48). Figure 4 illustrates the difference found.

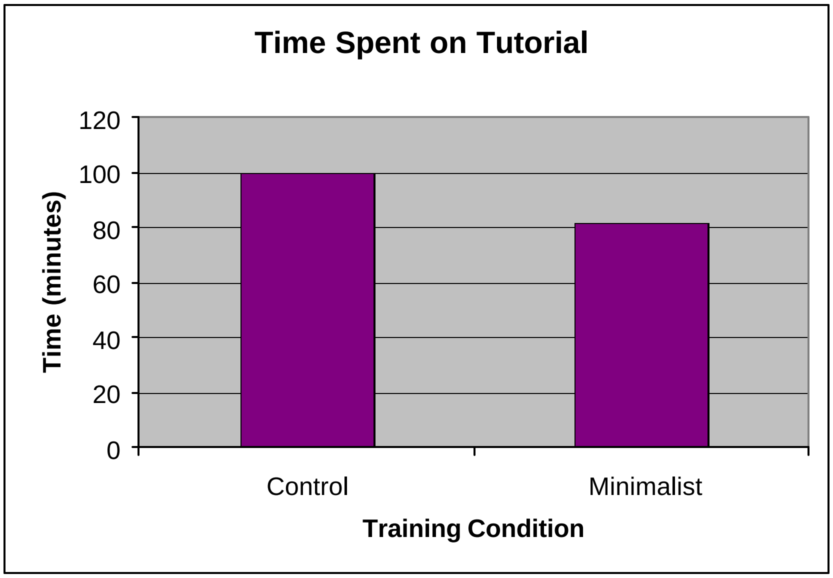


**Figure 4: Difference in Amount of Time Spent on the Tutorial**

# 6. Discussion

## 6.1. Answering the Research Questions

### *6.1.1. Research Question 1*

The first research question asked whether there was a difference in the effectiveness of two different training types, minimalist training and the control condition, for older adults within a software environment?

The hypothesis for this research question was that the minimalist training approach, when compared to the control condition, would be a more effective training tool, as measured by performance, for older adults within the given software environment.

A significance level of .05 was not obtained for this hypothesis. Therefore, the hypothesis was not supported.

### *6.1.2. Research Question 2*

The second research question asked what the subjective, or satisfaction, rating differences are among older adults for two different training types, minimalist training and the control condition, when learning in a software environment?

The hypothesis for this question was that older adults would be more satisfied with the minimalist training approach when compared to the control condition within the given software environment.

The results indicated that individuals in the control condition were more satisfied than those in the minimalist condition. Although females gave almost identical subjective ratings regardless of the training condition in which they were placed, males in the minimalist condition expressed lower satisfaction than females and males in the control condition. Overall, results provided evidence opposing the hypothesis.

*6.1.3. Research Question 3*

The third research question asked to what extent does learning style predict performance or knowledge, regardless of training type, in learning a high level programming language?

The hypothesis for this question was that those with an abstract learning style would perform better than those with a concrete learning style within the given software environment.

The results showed that although it may have been approaching significance, individuals with an abstract learning style did not perform significantly better than individuals with a concrete learning style at a .05 level. Therefore, the hypothesis was not supported.

*6.1.4. Research Question 4*

The fourth research question asked to what extent does gender predict performance or knowledge, regardless of training type, in learning a high level programming language?

The hypothesis was that females would perform better than males in the given software environment.

The results indicated that gender alone does not predict how well individuals will perform in a newly learned software environment. The hypothesis was not supported.

*6.1.5. Research Question 5*

The fifth research question asked to what extent does gender predict training satisfaction, with the two types being minimalist training and the control condition following a more traditional approach?

The hypothesis was that females would be more satisfied with the minimalist training approach when compared to the control condition within the given software environment.

The results indicated that gender alone was not a strong predictor for level of satisfaction. Although the satisfaction level of females in both training groups was found to be significantly higher than the males in one of the training conditions, the minimalism condition, the hypothesis for gender was not supported.

**6.2. Implications of this Research**

To summarize, significant results were found relating the ideas that participants in the control condition indicated a greater amount of satisfaction and that they had a stronger belief that their tutorial was embedded in real tasks than those in the minimalist condition. Upon further examination, one sees that gender had a significant interaction with training type, wherein the male gender appears to have been the main influencing factor in obtaining the significant difference in satisfaction between the two training groups. Also, age and computer experience were found to be significant indicators of performance, with decreasing age and increasing experience both being associated with increased performance. Lastly, a significant difference was found in the amount of time spent on the tutorial, with individuals in the minimalist group spending significantly less time on the tutorial than those in the control group.

Although most of the initial data about the effectiveness of minimalist training for older adults, when compared to a control condition within a software environment, did not obtain statistical significance, interactions indicate that further investigation may be warranted. Although individuals in the minimalist condition did not perform significantly better than those in the control condition, they spent significantly less time training on the tutorial, which may indicate that minimalism has the potential to be a more efficient method of training for older adults in this environment. Results supporting this hypothesis would provide some backing to the idea that a minimalist training approach may be more suitable in training older adults when time is a notable factor, but subjective ratings provided another side to the story.

Significant results were obtained for training type in general subjective ratings of satisfaction, but these were not in the hypothesized direction. This opposing trend could indicate that older adults may prefer a more structured environment when learning to use a new piece of software. However, one should perhaps hesitate to settle upon this conclusion, due to the influence gender seemed to have on individuals' opinions.

The idea that gender played a role in the results of this study became apparent when examining the general subjective data. Females' subjective ratings appeared to be the same regardless of training type. However, males in the minimalist group expressed significantly lower amount of satisfaction than males in the control group. It was noted by the author, that while females' reactions did not appear to vary according to their performance, it seems plausible that this may have been at least a partial cause for the definite shift in males' reactions. It seems possible that males based their subjective ratings to a greater extent on their performance than females did. Males in the minimalist condition obtained lower scores than those in the control condition, although not significantly, which may explain part of the difference. The generation of adults tested in this study grew up in a time when almost all ethnic majority males went to work outside of the home and nearly all females stayed almost exclusively inside the home. It is believed, by the author, that it is possible that because of having a career outside of the home, males may have learned to base their opinions more so on career success than females may have learned to do. And, in general, it should be said that the idea that males are just generally more instrumental, or task oriented, while females may be more process oriented is not a new thought.

Some individuals, including several males, did make comments that they thought they had learned a lot from the tutorial until they took the performance test. In addition, the author believes another effect may have been that females, having generally been the primary caregiver to their families, may also find more value in play, which is part of active exploration and a foundation of minimalism, than males who have spent more time in the workforce. (The reader may wish to note that only 2 of the 15 females in this study could be considered career women.) However, all of this should be considered fairly speculative and a very tentative hypothesis.

Another interesting result that had to do with subjective ratings was that which referred to the minimalist principle of embedding information in real tasks. It is believed, by the author, that individuals in the control condition gave ratings significantly higher than those in the minimalist condition simply because they had no real frame of reference as to what a real task would be. Then, with the minimalist tasks being more complex, individuals in the minimalist group may have thought that the tasks they were given were likely to be more complicated than a real task that they could see themselves doing. This would certainly be possible since the environment was completely new and unique to participants, and given that few individuals could perform most of the tasks that they were asked to complete in the performance test. It is possible that this lack of any sort of frame of reference was the reason for the general absence of significant results for most of the subjective ratings relating to minimalist conditions. Several participants commented, when reading the subjective question referring to whether it took advantage of what the participant knew, that they didn't know anything, and so, how could something take advantage of it. It seems that the environment might have been so new that in the given amount of time, some individuals were not able to make a firm connection to past experiences to create a strong new frame of reference.

A new pattern also seemed to emerge when gender entered into the performance data analyses. Results indicated that females with an abstract learning style may have had a very difficult time in the control condition when compared to females with an abstract learning style in the minimalist condition. Males with an abstract learning style, however, appeared to do quite well in the control condition, whereas males with an abstract learning style in the minimalist condition did not appear to do as well. Again, this was not at a significant level. Perhaps this finding goes back to the life experiences of the generation of the participants at hand. In the workforce, males may have learned to thrive on the typical training conditions. In the author's experience with the participants, males did not appear to appreciate or feel as comfortable with the minimalist condition as the females. So this possible cohort effect may help to explain the difference. Overall, results indicated that gender alone did not predict how well individuals performed in a newly learned software environment, but intriguing results about the interaction of gender and training type emerged for performance, as it had for satisfaction.

Although learning style never reached a significant level in predicting performance, ANCOVA results indicated that a learning style effect may have emerged if the study had possessed a little more power. There is another point of interest, although unrelated to quantitative data, which refers to learning style. The author noted that two of the three males with a concrete learning style that were given the minimalist tutorial made the verbal comment that they wanted to see everything they were asked to do in the tutorial written down step-by-step. They did not want to have to go back through the tutorial and make any small mental adjustments to the material. This would appear to be a logical complaint for a concrete learner, who would seem to be more likely to prefer rote memorization.

There are a few things of interest to be noted with reference to the results pertaining to the training condition. First it should be reiterated that although there were no significant findings in performance, the amount of time spent on the tutorial was significantly less for individuals in the minimalist group than for the control group. Another point is that the tutorials in this study were attempting to teach basic programming concepts, which may be too complicated to really take advantage of minimalist principles when the training only lasted such a short period of time. In addition, although a cover letter was included to improve motivation, it may not have been enough for individuals to really feel motivated to learn and for them to know that they were doing a real task in the minimalist condition.

A further area to reiterate with particular reference to the results of the training condition is that, as was mentioned earlier, there may have been a sort of cohort effect on some of the results. Another sort of generational effect, which the researcher observed, was that most participants did not appear to see the value in just playing with a computer to learn it. There were only a couple of participants who gave the impression that they learned technology by playing with it, and the age of both was in their early 60s. Several individuals, while in testing sessions, made comments that their grandchildren had told them that they just "have to play" with software to really learn it, but the participants said that they did not really do that. It seems that the younger generations, who grew up when computers became fairly commonplace, will express the notion that frequently, to learn new technology, you just have to spend time playing with it. However, most of the individuals tested here grew up in era where rules and discipline were very valued and play was not very valued. Many of the participants even expressed fears to the researcher about pressing the wrong key because they remembered losing a great deal of work that way in the 1980's. So, perhaps beyond just females valuing play more than males, younger generations may value it more than older generations. In the author's experience, today, young adults frequently speak about looking for a job that they very much enjoy, but when the current generation of older adults were that age, individuals were just worried about getting a steady job that would enable them to support their families. In fact, several older adults exemplified this attitude about past jobs at some point during the study. Whether or not this attitudinal shift was a factor that truly had an effect on these results, only time and further research will tell.

One last and important point to understand about this research is that is only measured original learning. There was no testing for transfer of training or retention of that training over a period of time. One might hypothesize that, if minimalism does in fact facilitate a deeper depth of processing than a more rote approach, as it is theorized to do, then a significant difference may be obtained when testing in conditions similar to this study that measure transfer of training and/or retention. Of course, future research would have to be conducted supporting this idea for it to obtain substantiation.

#### *6.2.1. Recommendations*

Aspects of the minimalist principles that the author would recommend changing mainly have to do with giving the user more scaffolding or training wheels to reassure the user than is normally recommended. Some studies have indicated that today's older adults appear to have higher levels of computer anxiety than younger adults (Languna and Babcock, 1997). This idea is also supported by the author's experience. Therefore, the design changes suggested involve giving them extra reassurance so that they are less likely to experience an overabundance of stress, which could result in either not finding the experience as enjoyable or not remembering as much of what they have finished. If an individual wishes to utilize minimalist training principles with older adults in the future, the following changes are recommended:

1) Provide frequent feedback illustrating whether or not the individual is exactly where he or she should be. Pictures seem to do well for this if there is not an instructor available to give one-on-one attention.
2) Allow for smaller and more frequent successes than may ordinarily be used in minimalism. This may involve giving feedback at intervals while working on real tasks rather than waiting until the individual has completed a task in its totality.
3) Offer more frequent opportunities for repetition than you would generally design into a minimalist tutorial.

There are also two general things to note that the author has not seen in previous literature. The following are general points for all individuals who wish to train older adults:

1) Quick reference and overview sheets are not likely to help older adults to supplement their working memory because, once immersed in the new software environment, they are likely to have forgotten about them.
2) Do <u>not</u> begin adding preview and review information to the concepts being taught, like many traditional training designs advocate, as this seems to consistently cause much confusion and frustration.

## 6.3. Conclusions

### *6.3.1. Relationship to Existing Literature*

Supporting the statement of Charness et al. (2001) that the truly strong predictive role for software training outcomes are age and experience, this study found that the predictors with the strongest relationship were age and computer experience. Indeed, in this study, these were the two measures that required covariate analyses to obtain the most accurate performance results.

It should not be considered that this study either confirmed or disconfirmed Bostrom et al.'s (1990) hypothesis that abstract learners will perform better than concrete learners when studying a new software package. The trends in the current study indicated that a relationship may exist.

There were not enough data to merit drawing compelling conclusions about minimalism. Charness et al. (1992) stated that older adults' ultimate success in learning through computer training is primarily influenced by the quality of the training program design, rather than individual difference factors. However, the post hoc results of this study indicate that gender and learning style may have had an influence on individuals' performances and reactions with minimalist training materials.

Several of the suggested characteristics of training that would benefit older adults by Hollis-Sawyer and Sterns (1999) include the characteristics of providing structure in learning the task and providing rapid feedback regarding progress, as well as including the characteristics of allowing exploratory learning of the task, permitting active participation in the learning process, involving training on an intrinsically interesting task, and heightening the feeling of task motivation. The results of this study suppose that emphasis may be best placed on certain characteristics. The ideal training design may be a minimalist approach that provides more frequent feedback and a greater amount of structure, or guidance, than ordinarily found in a minimalist tutorial. This design would hope to retain and/or enhance the performance benefits of minimalism while additionally capturing higher subjective ratings by older adults.

*6.3.2. Limitations and Future Research*

None of the results referring to age, experience, learning style, and gender were accounted for in a pre-planned way. Therefore the generalization of the results regarding these factors is limited. Pre-planned comparisons that examine gender, learning style, and training type should be conducted using a greater sample size and more equivalent numbers in each group to obtain more reliable results. Future research should also limit or account for age and computer experience differences, perhaps by designing levels of these into their experimental design.

Another interesting way for future studies to build on this research would be to compare a minimalist approach, a more traditional approach, and an approach that uses a minimalist approach that was altered based on the recommendations given in this paper. Ideally, this would include the above factors (gender, learning style, etc.) to get a better idea about interactions with this new approach, and it would also look at both performance and subjective data.

The possible lack of sufficient motivation may also have had an unwanted effect, and future studies should be designed so that motivation is ensured and payoffs of the goals are evident. In addition, the deep and abstract nature of the learning environment, or software, may have caused some unanticipated effects. Future research would do well even to simply replicate this study using a less abstract and complex topic, or environment.

One last point for future research is that it would be useful to examine minimalism in the context of transfer of training and retention over a substantial length of time. Although this research might be more difficult and time consuming to conduct, it is believed that results of a study that examine this idea would be a great contribution, since trainees are generally interested in what they will be able to do on their own at some later time.

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# APPENDIX A: MINIMALIST TUTORIAL

# Exploring Stagecast Creator

## Stagecast Creator Tutorial:
## Kids Smoking on the Playground

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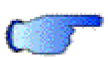
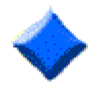
This tutorial is a draft of materials being developed as part of research underway in the Computer Science Department at Virginia Tech.

# Introduction

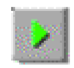
- Stagecast Creator is used to build visual simulations, or animated worlds. You will learn to use and change these worlds.
- We are interested in how Creator might be used to build simulations of interest to the Blacksburg community.
- We are currently working with students on these simulations and teaching older adults to use them for the purpose of mentoring kids. As a mentor, adults would use their life experience to help in simulation discussions.
- No programming experience is required to use Creator.
- A Quick Reference Sheet and a Layout Overview are provided as help aids.
- ***IF you have any problems***, please see the information denoted with a , this will give you error recovery information.
- The  is used to show which bulleted segment is exactly associated with the pictures given on the left side of the page.

# Explore the Smoking Kids

- Open the Stagecast Creator program.
  - ***Double click*** on the **Creator icon**  on the screen.

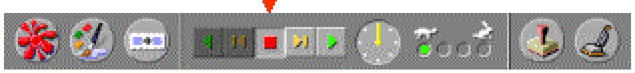
- Open a 'World.'
  - ***Click*** on the **blue tab** 
  - Browse the list of worlds and ***click*** on '**For Smoking Kids'**.
  - ***Click*** **Open**.

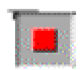
Play button

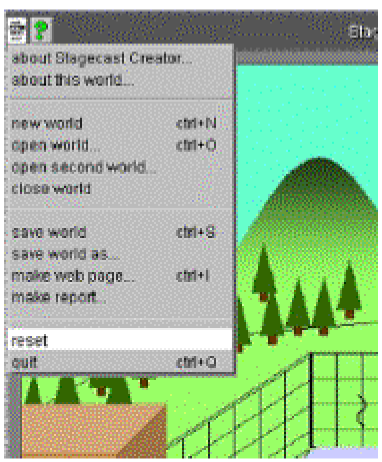
***Click*** on **Play** 

- Notice how the kids change.

Stop button



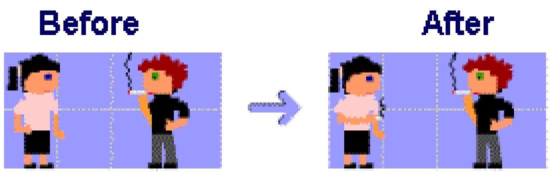
***Click*** on **Stop**  after you have watched the simulation a few times.

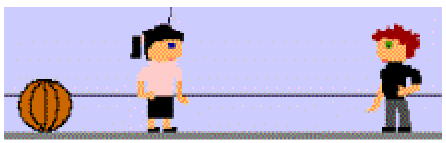


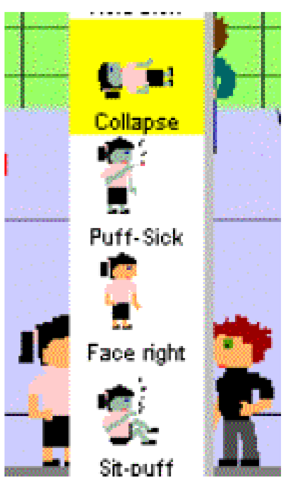

Reset the 'World.'

- ***Click*** on the '**Creator Menu'**  in the upper left corner of the 'Stage,'
- Then ***click*** on **Reset**.

# Position and appearance matter






- Creator rules depend on the exact circumstances, or situation, being matched before actions can be carried out.

When you play the simulation, the girl and boy are one space apart before they begin smoking.

***Click*** and **hold** as you move, or drag, the girl to a new place in the big picture, or 'Stage,' so that she is further away from the boy, like in the picture on the left. Then ***click*** on **play**

- Notice that nothing happens.

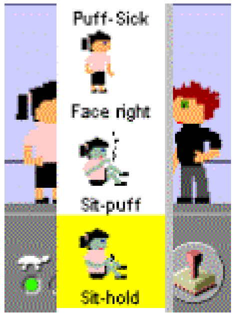
- ***Click*** on **Stop**
- ***Go*** to the '**Creator Menu**' and ***reset*** the simulation.

***Right click*** on the **girl** and ***hold*** it until you have highlighted the '**collapse**' appearance. Collapse Then ***click*** on **play**

- Notice that nothing happens.

- ***Click*** on **Stop**
- ***Go*** to the '**Creator Menu**' and ***reset*** the simulation.
- Kids enjoy learning from simulations that are funny. Why don't we make the simulation funnier?

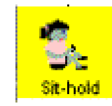
# Making a Simulation Funnier



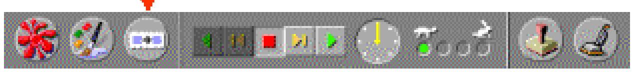

- Let's make the kids collapse from smoking.

We first need to change the appearance of the girl so that she looks the way we want her to look before she collapses.

- ***Right click*** on the **girl** and ***hold*** it until you have highlighted the '**sit-hold**' appearance.

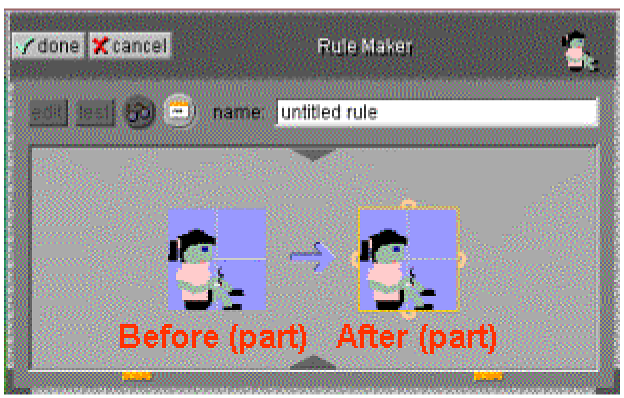



'Make a rule' button



Next, ***click*** on the '**make a rule**' button and then ***click*** on the **girl**

- The 'Rule Maker' window opens and a yellow spotlight, or highlight, appears around the girl.




- Look at the 'Rule Maker.'
- Rules are set up as <u>before-after</u> pairs.

See picture on the left.

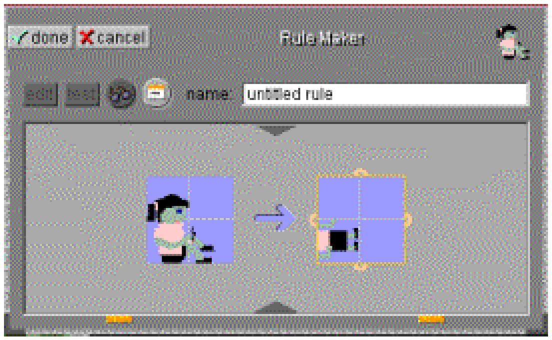
- *IF* the <u>before</u> part of the rule matches a character in the big picture, or 'Stage'

The 'Stage' →

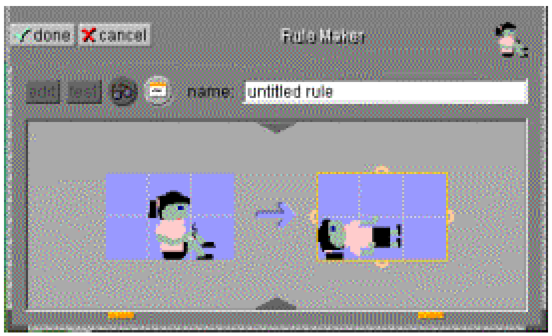
*THEN* that character on the 'Stage' is changed to appear like the <u>after</u> part of the rule.

- So, for our rule to have an effect we need to change the *after* part of the rule.

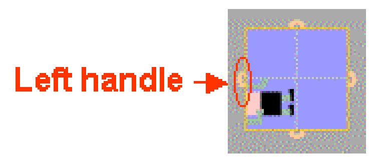
# Making a Simulation Funnier




***Right click*** on the **girl** in the box surrounded by a yellow highlight, which is the 'after' appearance, and ***hold*** it until you have highlighted the '**Collapse**' appearance.




Then ***click*** on the **left handle** of the yellow highlighted line




and **hold** it as you pull, or drag, it over one square to the left. The mouse will look like ↔ before you can pull it. Then you will see the rest of the girl.

***IF you have a problem***

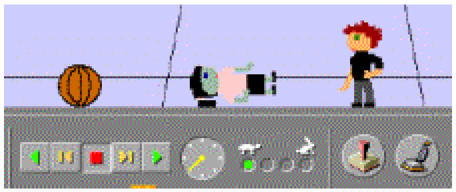
- You can click cancel [✗ cancel] in the 'Rule Maker' and then start over by clicking on the 'Creator Menu' and then on reset.

- ***Click* done** [✓ done]

# Making a Simulation Funnier

- ***Go*** to the '**Creator Menu**' and ***reset*** the simulation.

- ***Play*** the simulation.



Does the girl lie down looking sick and never get up?

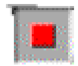
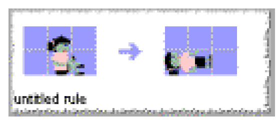
- Then the simulation is working correctly!

***IF this does not happen,***

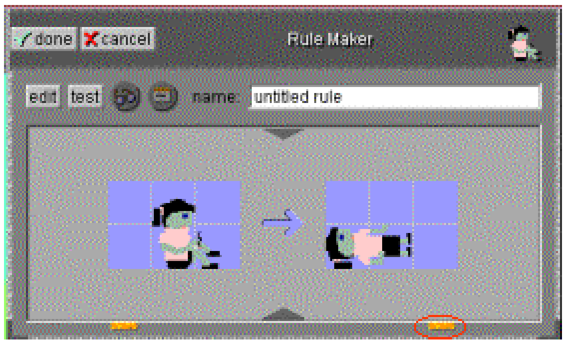
- Double click on the girl. Then click on the 1st rule, named 'untitled rule,' that you just created and use the delete key to delete it. Click on the checkmark at the upper left corner of the girl's 'Rule List' window, and create the rule again. (You would start back at the top of page 5 again.)

- The girl doesn't get up because she has no more rules with her last, 'Collapse' appearance. Why don't we make the simulation a little less absurd?

# Funnier but not Absurd

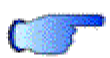
- Let's add a few more recovering appearances and then give the girl her starting 'Face Right' appearance so that the simulation will continue to run.
- ***Stop***  the simulation.
- ***Double click*** on the **girl** to open her list of possible behaviors, or 'Rule List' window.
- Then ***double click*** on the 1st rule, named untitled rule,  that you just created.

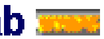


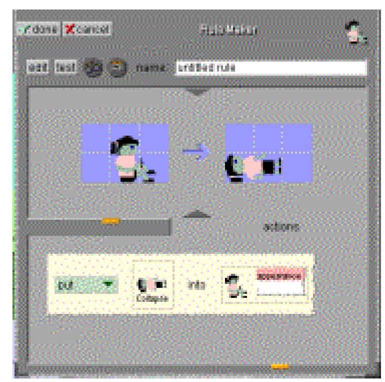


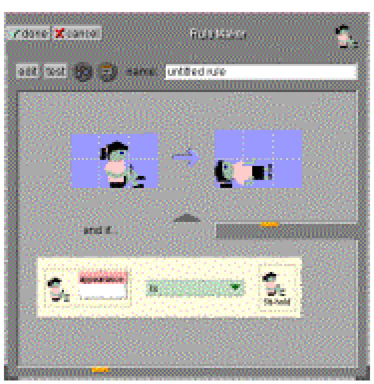

Left tab (closed)

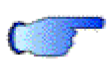
Right orange tab (before clicking/opening)



***Click*** on the __right__ **orange tab**  in the 'Rule Maker' window to see the rule's list of 'actions.' It will look like the picture below.

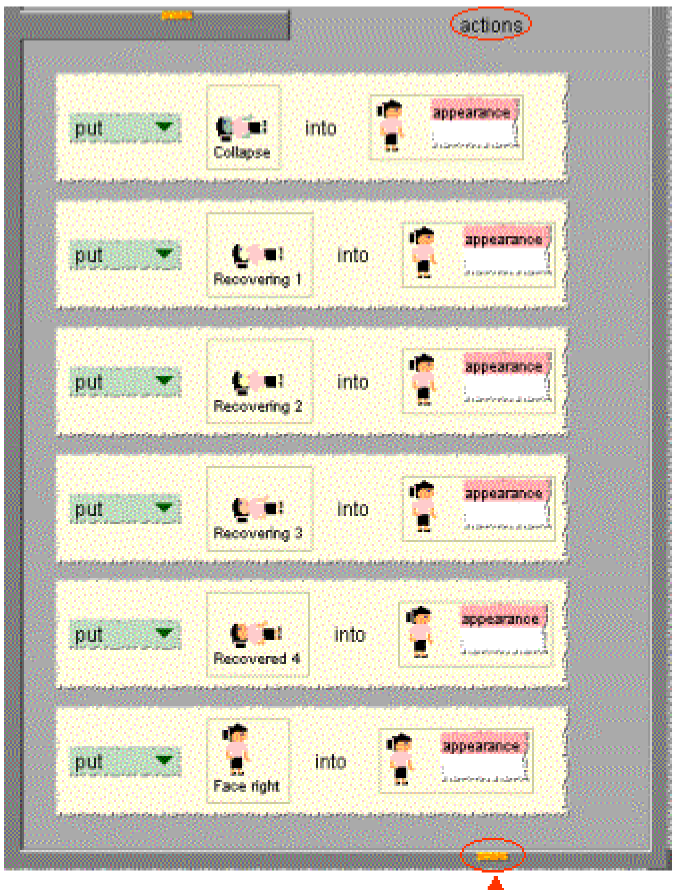






Now press the orange tab on the __left__, and you will see the 'Before' part of the rule, or the tests, not the actions. The 'Rule Maker will then look like the picture on the left.

# Funnier but not Absurd




Right orange tab (opened)

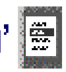
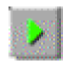
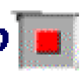
- ***Click*** **edit** in the upper left part of the 'Rule Maker.'
  - You <u>must</u> be in this 'edit mode' to make any changes to a character's rule.
  - You can always enter a character's 'Rule List,' click on a rule, and click edit to change an existing rule.
- In the 'Rule Maker,' ***right click*** on the **girl** in the box surrounded by the yellow highlight and ***hold*** it until you have highlighted the '**Recovering 1**' picture. Then do this again for '**Recovering 2**,' '**Recovering 3**,' '**Recovered 4**,' and then '**Face Right**.'
  - *If you have any problems*, error recovery information is listed on page 11.

You should have a list of actions that looks like the picture on the left

- Make sure that the <u>right</u> orange tab on the 'Rule Maker' is opened so that the word 'actions' appears on the right.
- The amount of the 'Rule Maker' that you will be able to see will vary on different computers. You can ***click*** on the **triangle shaped buttons** in order to see more of, or scroll through, the list.

# Funnier but not Absurd

- You can name the rule if you like by clicking on the white space with the words ‘untitled rule’ and typing in a new name.
- ***Click*** **done** 

- Use the ‘**Creator Menu**’  to ***reset*** the simulation
- ***Play***  the simulation.
- Does the girl lie down, change shades of color, and then get up?
  - Then the simulation is working correctly!
  - Note that the system goes through every action listed in your rule.
- ***Stop***  the simulation.

# Funnier but not Absurd

***If you have any problems,***

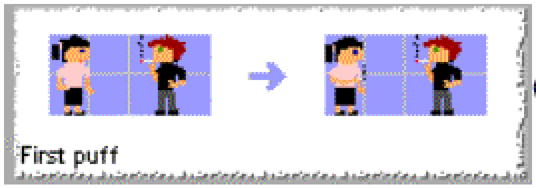
- It is necessary to make any changes in the 'Rule Maker.' If it is not open, double click on the girl, then double click on the 1st rule, and then click edit [edit]
  - You can use the vacuum tool  to delete any unwanted actions by clicking on the vacuum button and then on the the object or action you want to delete.
  - Or, you can reorder the actions in the 'Rule Maker' by clicking on and dragging an action to a new location, which will be shown by a black line.
- If you want to delete the rule and make a brand new rule, it is necessary to go to the 'Rule List.' If it is not open, double click on the girl. Then you can click on the rule and then click on the delete key to delete it.

- Now, make the same changes for the boy 
  - Again, begin by changing the appearance of the boy, on the 'Stage,' so that he looks the way we want him to before he collapses.
  - Then go on to create the same rule for him.
  - To see how you started to create a rule for the girl, go back to *page 5*.
  - Note:
    - The final appearance change will be 'Face Left,' rather than 'Face Right.'
    - You will not move the yellow highlighted box 1 square to the left as was done with the girl

- Simulating a playground with smoking as the only choice of what to do is not very realistic. Why not show that there is another option that the smokers could have chosen?

# The Single-minded Smoker

- Let's show the same girl passing by the basketball in order to quickly get to her smoking partner.



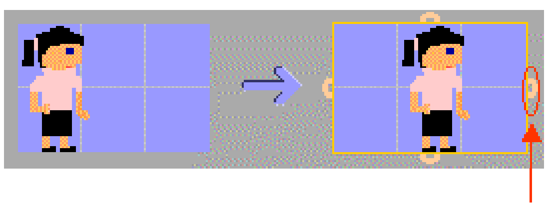

The kids have a 'First puff' rule that says that they should start smoking when they are one square apart, which can be seen on the left. We need to use this information to make a rule for her to walk across the floor.

- Use the 'Creator Menu' to ***reset*** the simulation.

Move the girl to the far left side of the screen.

  - ***Click*** on the **girl** and ***hold*** down until you have moved, or dragged, the character to the far left side of the screen, as is shown in the picture on the left.

- Now ***click*** on the '**make a rule**' button and then ***click*** on the **girl**.



Right handle (after pulled)

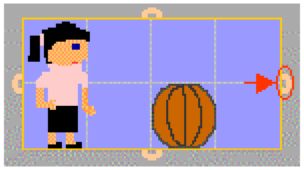
In the 'Rule Maker,' change the 'after' appearance

  - ***Click*** on the **right handle** of the box with the yellow highlight and ***hold*** it to extend it another block forward. Then ***move*** the **girl** forward one block by clicking and holding, so that it looks like the picture on the left.

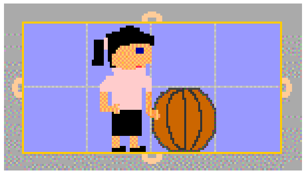
- Click ***done*** done

# The Single-minded Smoker

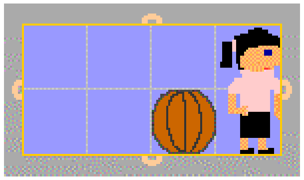
- ***Play*** the simulation
- The girl stops at the basketball. We need to create another rule.
  - *Note that if you have any problems*, error recovery information is listed on page 15.
- Let's make the girl look like she just ignores the basketball and goes right past it.
- ***Stop*** the simulation.
- ***Click*** on the '**make a rule**' button and then on the **girl**.



In the 'Rule Maker,' ***extend*** the box with the yellow highlight forward 2 blocks by pulling the right handle so that it looks like the picture on the left.

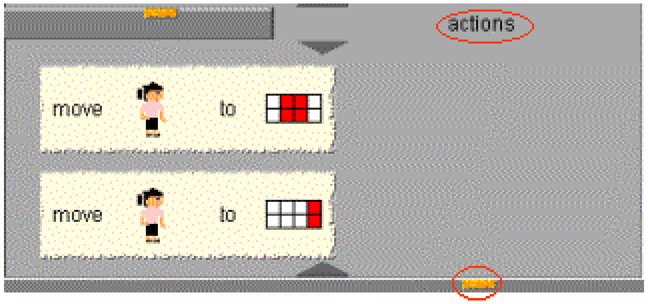


***Move*** the **girl**, by clicking and dragging, so that she is in the square just before the basketball, like the picture on the left.



Now, ***move*** the **girl** so that she is on the other side of the basketball, like the picture on the left.

# The Single-minded Smoker




Notice the actions that you just created, which is in the right orange tab of the 'Rule Maker.' The list should look like the picture on the left

- *Note that if you have any problems*, error recovery information is listed on page 15.

- ***Click* done.**
- Use the 'Creator Menu' to ***reset*** the simulation.
- ***Move*** the **girl** back to the far left (close to the wall).
- ***Play*** the simulation.
- ***Stop*** the simulation when you are finished watching.
- Use the 'Creator Menu' to ***reset*** the simulation.

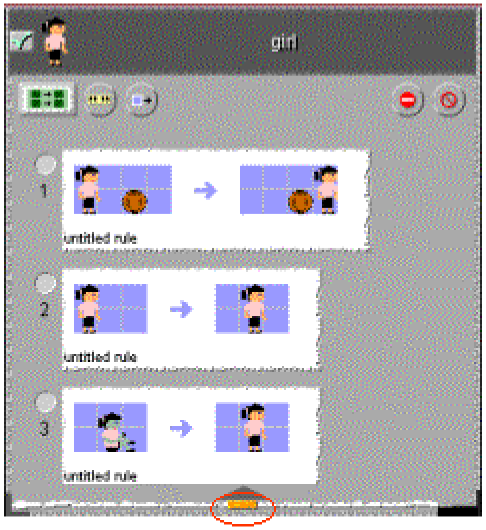
# The Single-minded Smoker

*Again, if you have any problems,*

- It is necessary to make any changes in the ‘Rule Maker.’ If it is not open, double click on the girl, then double click on the 1st rule, and then click edit edit
    - You can use the vacuum tool to delete any unwanted actions by clicking on the vacuum button and then on the the object you want to delete.
    - Or, you can reorder the actions in the ‘Rule Maker’ by clicking on and dragging an action to a new location, which will be shown by a black line.
- If you want to delete the rule and make a brand new rule, it is necessary to go to the ‘Rule List.’ If the ‘Rule List’ is not open, double click on the girl. Then you can click on the rule and then click on the delete key to delete it.

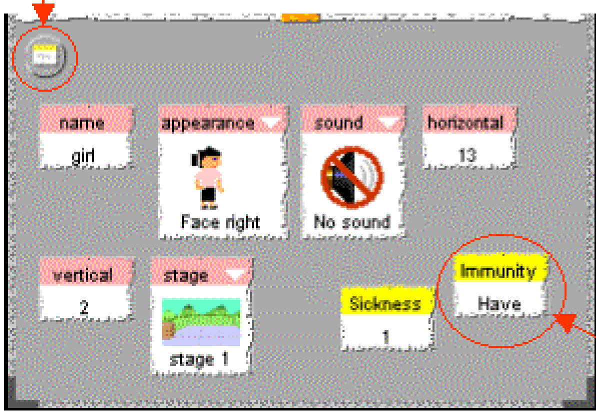
- Once the smokers have started smoking, they both go through the same appearance changes. Why don’t we make the simulation more intriguing by changing the effect that smoking has on one of them?

# Making It More Intriguing




Tab at bottom of 'Rule Maker'

'Create a variable' button

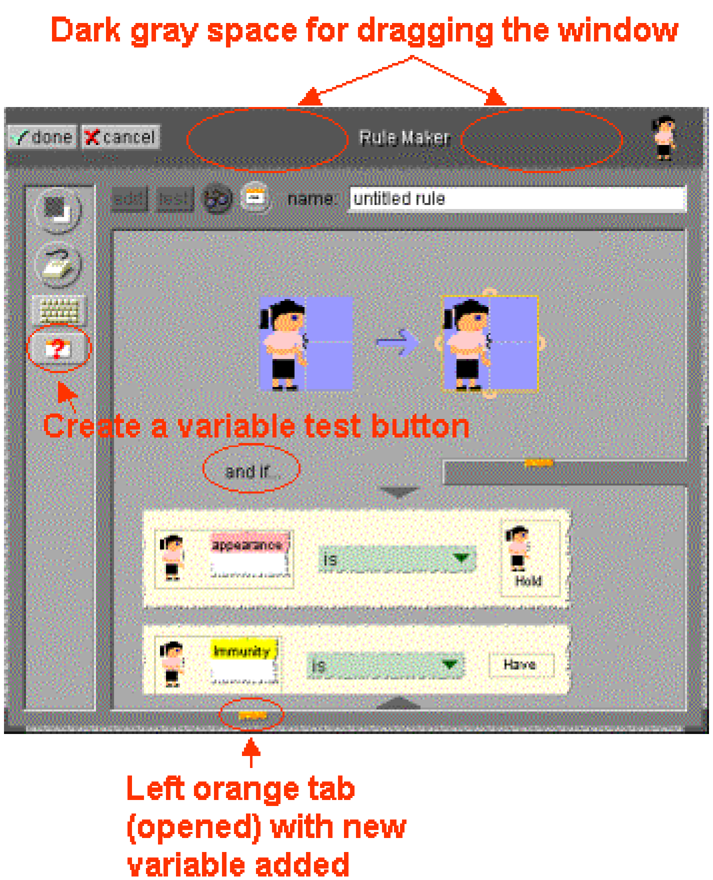


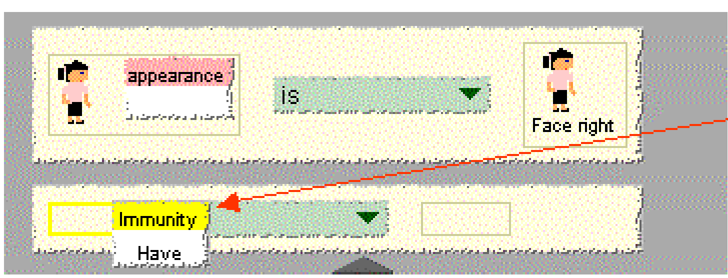

- Let's make one of the kids immune to smoke. To do this, we need to create an immune variable.
  - A variable is a characteristic of a character that has a value and that may determine its behavior.
- First, ***double click*** on the **girl** to open the 'Rule List' window.
  - A window opens with her possible behaviors or rules.
  - Note that this is different from the list of actions found within a rule, like we saw earlier. Within one rule, every created, or listed, action occurs. But, in this window, the rule movement that takes place, or fires, is the first rule in the list that matches the big picture, or 'Stage'.
  - ***Click*** on the **orange tab** at the bottom of the 'Rule Maker' window. Another window will open.

***Click*** on the '**create a variable**' button in the upper left hand corner of the new area and then on a **blank space** in the gray area, as shown on the left.

- ***Click*** on the **yellow space** that says '**variable 1**' and ***type*** the word '**Immunity**.' You may need to use the delete key on the keyboard to delete each letter of the word 'variable 1.'
- Then ***click*** on the **white space** below the word 'Immunity' and give it the value of '**Have**' by ***typing*** that word.
- You have now created a variable called 'Immunity' with the value 'Have.'
- What about the boy? Do you think he has immunity?

# Making It More Intriguing



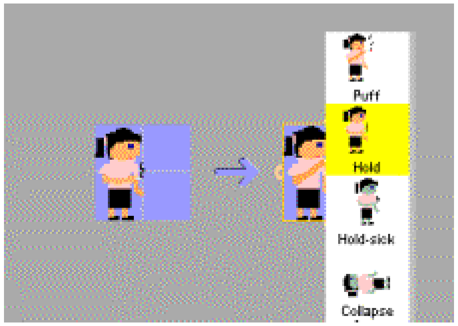

- It is not enough to just create a variable. You have to use a variable in a rule for it to have any effect.
- ***Right click*** on the **girl** on the big 'Stage,' and change her to the '**Hold**' appearance.
- ***Click*** on the '**make a rule**' button and then on the **girl**.
- Note that you will need to move, or drag, the 'Rule Maker' window to the left (covering the 'Stage') during this sequence.
  - You can click on the dark gray space at the top of the window and hold it down as you move the mouse to the left.

In the 'Rule Maker,'

- If the picture does not appear like the one on the left with the words 'and if…,' ***click*** on the **left orange tab** to see the 'before' tests,
- Then ***click*** on the '**create a variable test**,' button 
- ***Click*** on the yellow part of the **'Immunity' variable** and ***hold*** down the mouse button to ***drag*** it into the far left part of the new 'variable test' item in the 'Rule Maker' as shown in the picture to the left. Make sure that the far left part of the segment has a yellow highlight before you let go, as is shown in the lower picture.

*If you have a problem getting the 'Immunity' variable where it should be*, you can use the cancel button  to quit that rule and then create the rule again.

# Making It More Intriguing

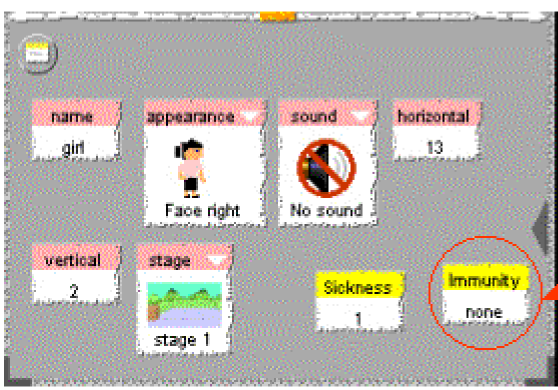



In the 'Rule Maker,' ***right click*** on the **'after' picture** of the girl, which has the yellow highlight, and ***select*** the **'puff'** appearance. Then ***right click*** again and ***select*** the **'hold'** appearance.

- Press the orange tab on the right, and you will see the 'After' part of the rule, or actions.

- You have now given the girl a rule testing the variable that says she can continue to smoke without appearing to get sick.
- ***Click*** **done**.
- Use the 'Creator Menu' to ***reset*** the simulation.
- ***Play*** the simulation and see if the rule works.

  *If the girl gets sick*, you can double click on the girl and use the delete key to delete the 1st rule, that you just created. Then click on the checkmark at the upper left corner of the girl's 'Rule List,' and to create the rule again.



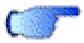

- ***Stop*** the simulation.

Now change the girl's 'Immunity' value in her 'Variable drawer' from 'Have' to 'None'. Go to page 16 to see how to get to the variable drawer.

- ***Play*** the simulation
- Now the girl gets sick. Your rule is working!

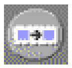
# Quick Reference Sheet

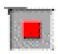

The **star** indicates error recovery information.

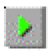

The **finger** indicates which information is exactly associated with the picture on a page.


The **orange tab** indicates a drawer with additional information. It may be open or closed.


The **creator menu button** opens further options, including resetting a world.

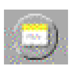

The **make a rule tool** allows a user to create a rule by clicking on it and then on a character on the Stage.


The **stop button** allows a user to stop a simulation.


The **play button** allows a user to play a simulation.


The **vacuum tool** allows a user to delete unwanted characters, rules, or actions.


The **checkmark button** is used to close a character's Rule List.

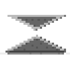

The **create a variable tool** is used to create a variable by clicking on it and then on a blank space in the Variable drawer.


The **create a variable test tool** is used to create a blank variable test in the Rule Maker when it is clicked on.

The **done button** is used to close the Rule Maker when finished creating a rule.

The **cancel button** is used to cancel out of the Rule Maker when you do not want a new rule to be saved.

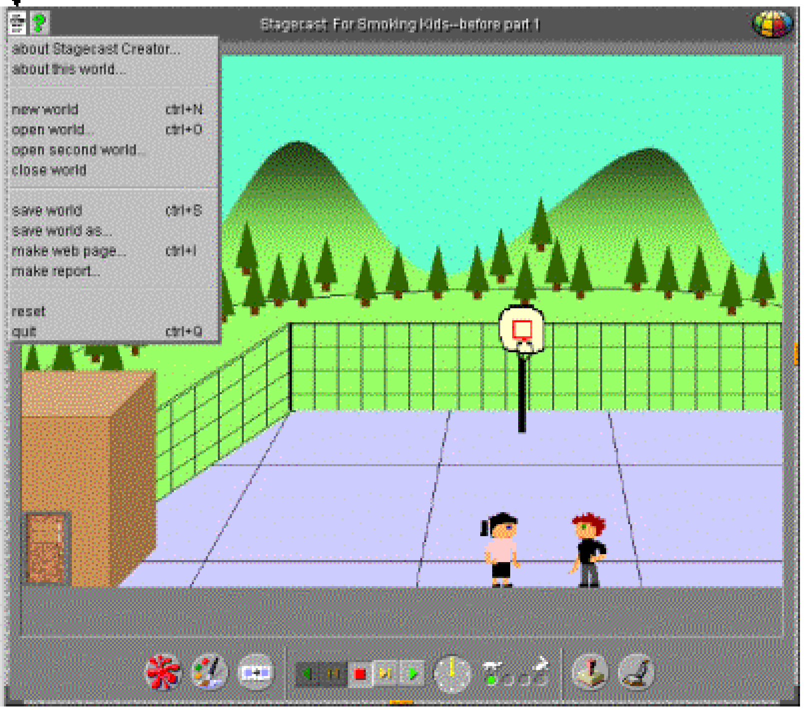
The **edit button** is used to edit a rule when in the Rule Maker.


The **triangles** are used to scroll through the information in the Rule Maker's drawers.

# Layout Overview

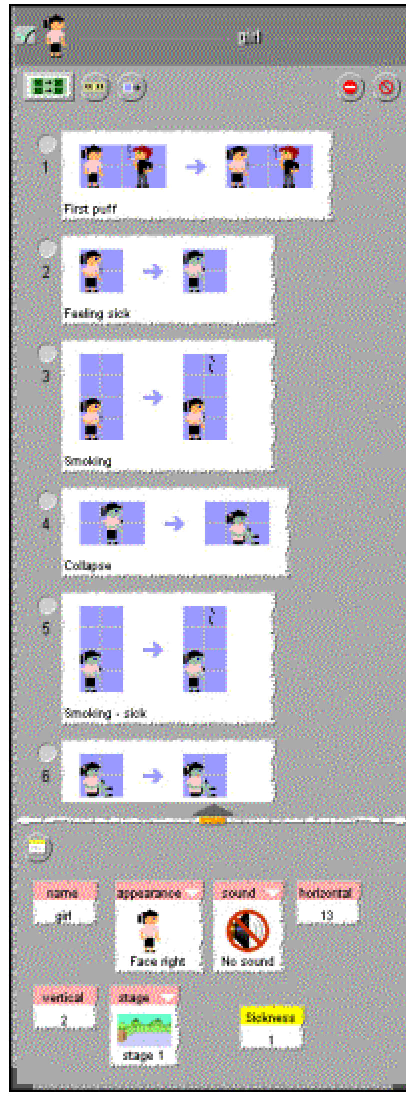
Creator Menu (opened)

The 'Stage'



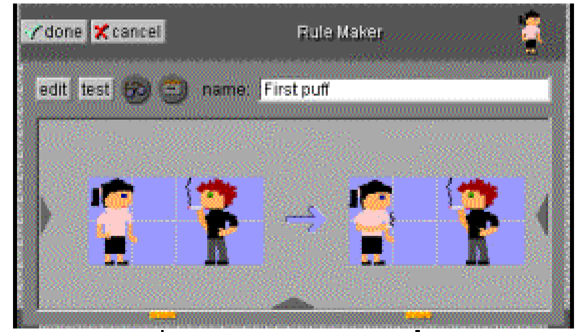

Stage Control Panel drawer (opened)

'Rule List' window for the girl




Variable drawer (opened)

'Rule Maker' window

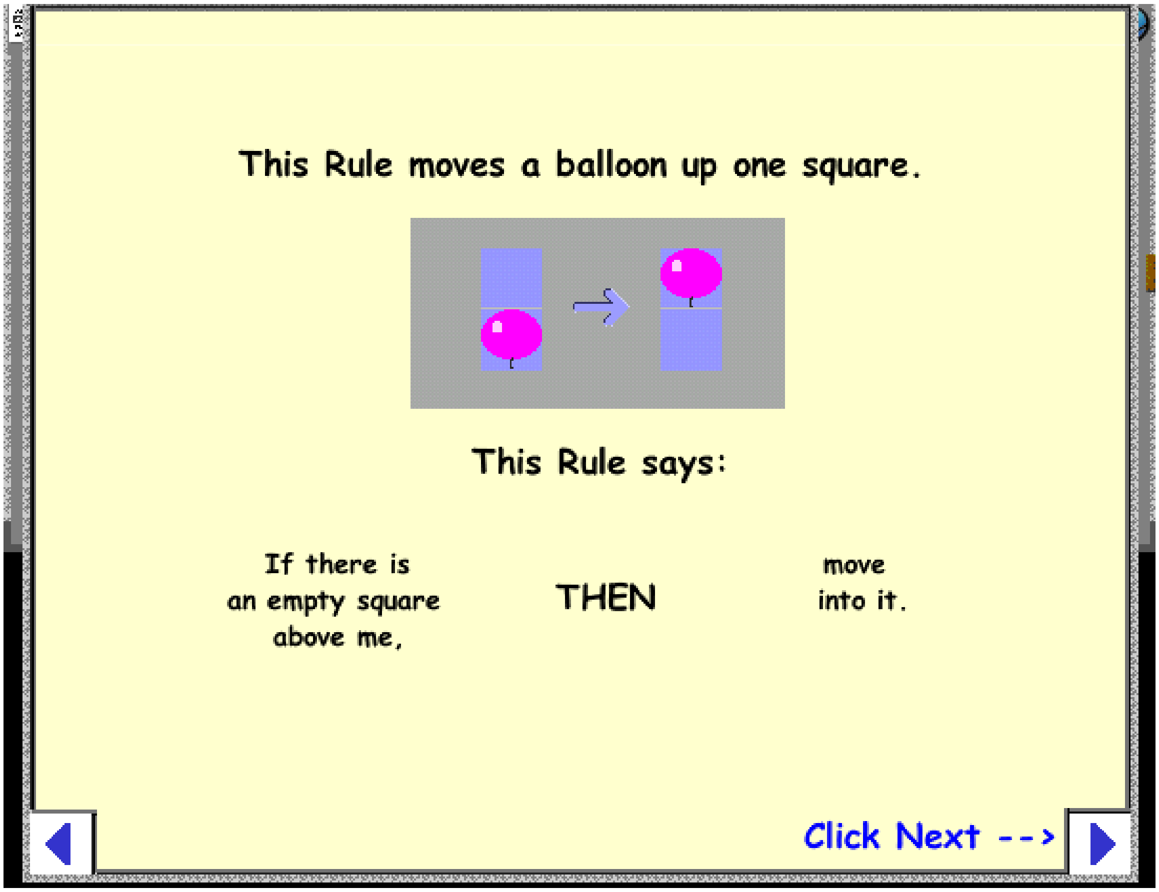



And if, or 'before,' part of the rule drawer (closed)

Actions, or 'after,' part of the rule drawer (closed)

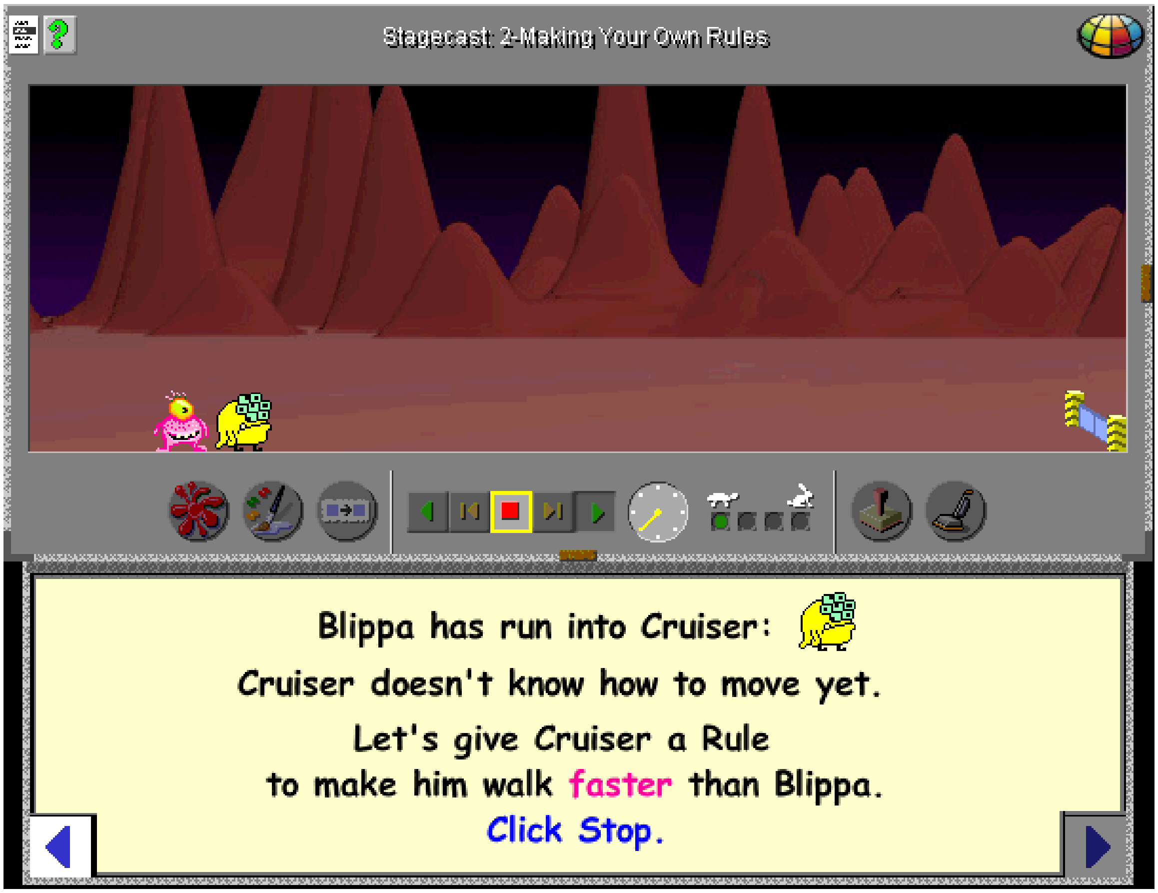
# APPENDIX B: STAGECAST TUTORIAL

*Due to the very large nature of the Stagecast tutorial, only a small portion is being included in this paper.*




Stagecast: 2-Making Your Own Rules
Now let's try out your new Rule!
Click on the Play button.


Stagecast: 2-Making Your Own Rules
Did the balloons float up into the air?
Does the Stage now look like this: ?
Bravo! Your Rule works!!
Click Next -->


Stagecast: 2-Making Your Own Rules
Blippa has run into Cruiser:
Cruiser doesn't know how to move yet.
Let's give Cruiser a Rule
to make him walk faster than Blippa.
Click Stop.


Stagecast: 2-Making Your Own Rules
Challenge #3
Create a Rule to make Cruiser move faster than Blippa.
We can do this by making Cruiser move
two squares at a time, instead of one.
Here's how...
Click Next -->


Stagecast: 2-Making Your Own Rules
Step 1. Click
Click on the Rule tool
and then click on Cruiser.

# APPENDIX C: PERFORMANCE TEST

**<u>Instructions</u>:** Please respond to these statements in the following order by using the simulation World provided.

1. Add a 'Strength' variable and give it the value of 'High.'

2. Using this new variable, add a rule that causes the character to move down the river. Press play to check the simulation.

3. Place the character above the piece of wood. Create a rule so that when the character is above (or gets to) the wood, the boat 'appears' to have flipped over, then 'appears' to have flipped back up, and then stops. Press play to check the simulation.
   <u>Note</u>: You may need to change the appearance of the character *before* you can *play* it.

4. Now, delete the last rule you created for question 3. (You can delete this by clicking on the rule in the 'Rule List' and then pressing the delete key on the keyboard.) Now, create a rule so that the character simply moves around the piece of wood. Press play to check the simulation.
   <u>Note</u>: You may need to change the appearance of the character *before* you *create* the rule.

# APPENDIX D: PERFORMANCE DATA SHEET

| | Task | Check (if completed) | Errors (# of missteps) | Time (start - finish) | | Total Time (per task) |
|---|---|---|---|---|---|---|
| 1. | Double click on character | | | | | |
| | Open character drawer | | | | | |
| | Click on the create a variable button | | | | | |
| | Click on an empty space | | | | | |
| | Change the variable name | | | | | |
| | Insert the value | | | | | |
| 2. | Click on the 'make a rule' button | | | | | |
| | Click on the character | | | | | |
| | (1) Click on the 'create a var. test' button | | | | | |
| | (1) Insert the variable | | | | | |
| | Extend the window | | | | | |
| | Move the character | | | | | |
| | Click done | | | | | |
| | Play the simulation | | | | | |
| | Stop the simulation | | | | | |
| 3. | Move the character | | | | | |
| | Click on the 'make a rule' button | | | | | |
| | Click on the character | | | | | |
| | Extend the window | | | | | |
| | Make the first appearance change | | | | | |
| | Make the second appearance change | | | | | |
| | Click done | | | | | |
| | Play the simulation | | | | | |
| | Stop the simulation | | | | | |

4.

| | | | | | |
|---|---|---|---|---|---|
| Click on the 'make a rule' button | | | | | |
| Click on the character | | | | | |
| Extend the window | | | | | |
| Move the character | | | | | |
| Click done | | | | | |
| Play the simulation | | | | | |
| Stop the simulation | | | | | |

Total # of tasks answered correctly ________

Total # of errors ________

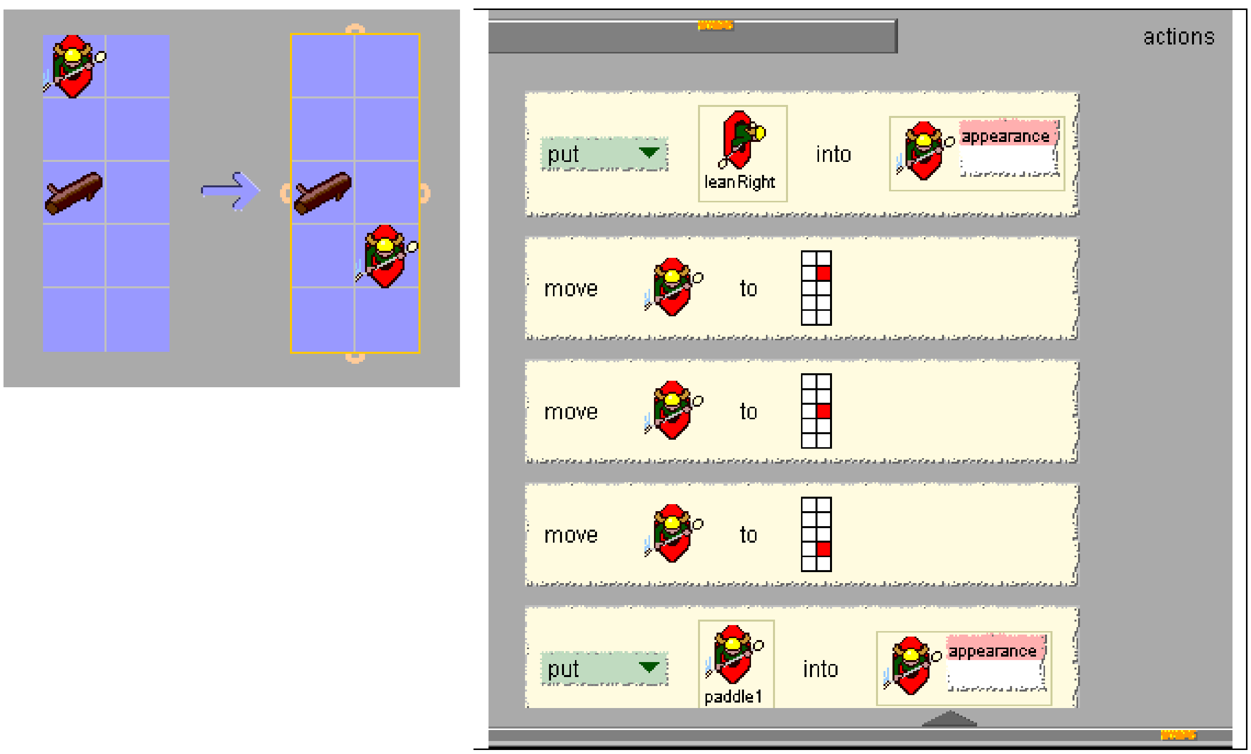
Total time for question 1 tasks ________
Total time for question 2 tasks ________
Total time for question 3 tasks ________
Total time for question 4 tasks ________

# APPENDIX E: KNOWLEDGE TEST

**Instructions:** Please answer the following questions.

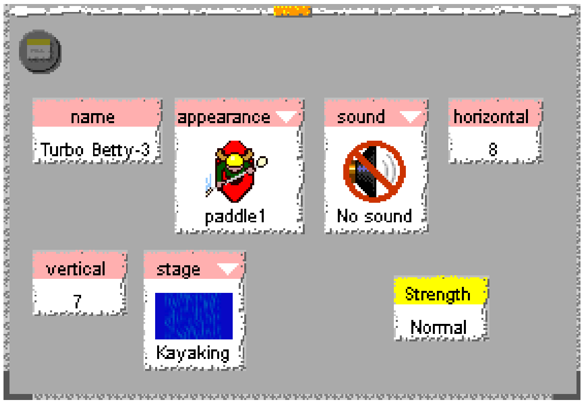
1. For the Kayaking simulation, if the appearance of the character was changed to an appearance that was not specifically listed in your rules, would your character move? _______
   Why or why not?

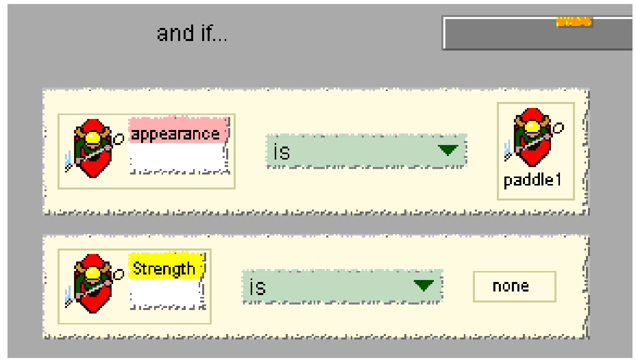
2. Look at the rule below. What would you see when it is used (or fired)?




Please answer using an ordered list.

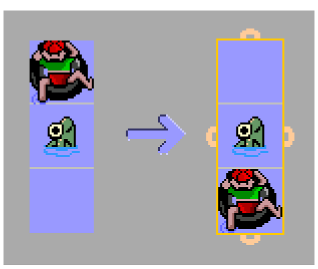
3. If you created a variable with the name 'Strength' and gave it the value 'Normal,' but you created a rule that tests if 'Strength' is 'none,' would the rule apply?
   The pictures below illustrate the changes.

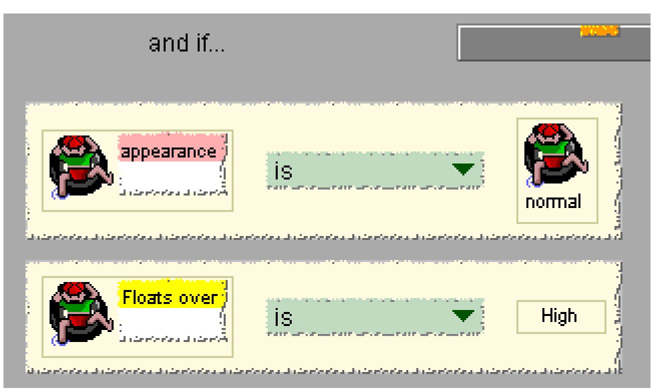


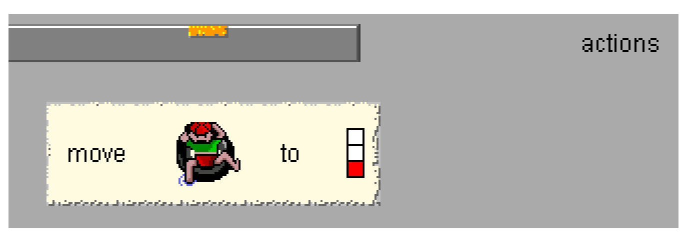




Why or why not?

**For questions 4 and 5, use the following information:**





4. For any given character, what 2 things need to be there for the character to move past the fish?

5. According to this information, the character will simply "appear" below the fish. What could you do to make him float over it?

## APPENDIX F: KNOWLEDGE TEST KEY

| | Necessary answer segments | Check (if answered correctly) |
|---|---|---|
| 1. | No | |
| | Because the character's appearance has to match | |
| | | |
| 2. | Appearance would change | |
| | It would move 3 squares | |
| | Then the appearance would change back | |
| | | |
| 3. | No | |
| | Because the name has to be the same | |
| | | |
| 4. | Appear normal | |
| | Has high 'floats over' value | |
| | | |
| 5. | You would have to add an appearance/action so that the boy is where the fish is | |

Total # of segments answered correctly ___________

## APPENDIX G: SUBJECTIVE QUESTIONNAIRE

**<u>Instructions</u>:** Please respond to the following statements by filling in or marking the circle that most accurately depicts your opinion.

| | strongly agree | agree | neutral | disagree | strongly disagree |
|---|---|---|---|---|---|
| 1. Overall, I found the tutorial learning experience rewarding. | ○ | ○ | ○ | ○ | ○ |
| 2. I think the tutorial took too long before letting me use the software as I wanted to use it. | ○ | ○ | ○ | ○ | ○ |
| 3. I don't think the tutorial took advantage of what I already know. | ○ | ○ | ○ | ○ | ○ |
| 4. I learned very little about Stagecast Creator through the tutorial. | ○ | ○ | ○ | ○ | ○ |
| 5. The tutorial used realistic examples of simulations. | ○ | ○ | ○ | ○ | ○ |
| 6. I learned from the errors I made. | ○ | ○ | ○ | ○ | ○ |
| 7. I am satisfied with my tutorial learning experience. | ○ | ○ | ○ | ○ | ○ |
| 8. I was comfortable with the way I was taught to use Stagecast Creator. | ○ | ○ | ○ | ○ | ○ |
| 9. I feel the tutorial gave me too much information. | ○ | ○ | ○ | ○ | ○ |
| 10. Overall, the tutorial was frustrating. | ○ | ○ | ○ | ○ | ○ |
| 11. I enjoyed learning to use Stagecast Creator. | ○ | ○ | ○ | ○ | ○ |
| 12. The tutorial never allowed me to do anything that was not specified. | ○ | ○ | ○ | ○ | ○ |
| 13. I like the way Stagecast Creator was explained to me. | ○ | ○ | ○ | ○ | ○ |
| 14. I think the tutorial approach used was a very efficient way to teach the material. | ○ | ○ | ○ | ○ | ○ |
| 15. I do not feel that I understand how to use Stagecast Creator. | ○ | ○ | ○ | ○ | ○ |
| 16. I am confident that I have learned enough about Stagecast Creator to use it again on my own. | ○ | ○ | ○ | ○ | ○ |
| 17. There was enough error recovery information given. | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| 18. The instructions were easy to understand. | ○ | ○ | ○ | ○ | ○ |
| 19. I feel motivated to try to use Stagecast Creator again. | ○ | ○ | ○ | ○ | ○ |
| 20. I think the tutorial would have been more effective if it had used simulations that were more realistic. | ○ | ○ | ○ | ○ | ○ |
| 21. I would feel uncomfortable trying to use Stagecast Creator again. | ○ | ○ | ○ | ○ | ○ |
| 22. I understand a great deal of how Stagecast Creator works. | ○ | ○ | ○ | ○ | ○ |
| 23. I found that the tutorial told me many things that I could have learned on my own. | ○ | ○ | ○ | ○ | ○ |
| 24. The tutorial allowed me to quickly start using the software. | ○ | ○ | ○ | ○ | ○ |
| 25. The tutorial spent too much time trying to explain what to do rather than letting me get started. | ○ | ○ | ○ | ○ | ○ |
| 26. I learned how to do something similar to what I would like to do with the software now. | ○ | ○ | ○ | ○ | ○ |
| 27. I was not given the opportunity to improvise while using the tutorial. | ○ | ○ | ○ | ○ | ○ |
| 28. The amount of information provided in the tutorial was adequate for me to understand the areas covered. | ○ | ○ | ○ | ○ | ○ |
| 29. It seemed easy to learn how to use Stagecast Creator. | ○ | ○ | ○ | ○ | ○ |
| 30. The tutorial took advantage of the fact that I learned things as I went along. | ○ | ○ | ○ | ○ | ○ |
| 31. It was hard to follow the tutorial training. | ○ | ○ | ○ | ○ | ○ |
| 32. Overall, I feel prepared to go and use Stagecast Creator own my own. | ○ | ○ | ○ | ○ | ○ |
| 33. The tutorial was easy to follow. | ○ | ○ | ○ | ○ | ○ |
| 34. I found the tutorial training approach used to be very effective. | ○ | ○ | ○ | ○ | ○ |
| 35. I think that the error recovery information was not very effective. | ○ | ○ | ○ | ○ | ○ |

**Please write responses to the following questions.**

Did you like the tutorial? Why or why not?

What, if any, changes would you make to the tutorial?

What did you like best about the tutorial?

What would you add to the tutorial to facilitate learning?

How useful did you find the Quick Reference Sheet?

How frequently did you use the Quick Reference Sheet?

[*]How useful did you find the Overview Layout?

*How frequently did you use the Overview Layout?

*Would you have liked more pictures of the tutorial's buttons and tools to be included within the tutorial's text?

*Would you have liked more or less error recovery information?

*Would you have preferred more or less information per page?

Would you have preferred another font size or style?

How useful did you find the pictures that were included in the tutorial?

Would you have preferred more or less pictures in the tutorial?

* Questions to be given only to participants given the minimalist tutorial.

If you have a choice between working solely on a computer screen or working with a computer screen and paper, which would you choose?

Is there something else that could have been given to you that would have helped you in working on the tutorial?

Did you have problems with any aspect of the tutorial?
If so, please state what they were.

## APPENDIX H: BACKGROUND QUESTIONNAIRE

**Instructions**: Please write a response to the following questions.

1. What is your age? _____
2. What is your gender? ___________
3. What job positions have you held?

_______________________________________________________________

_______________________________________________________________

**Instructions**: Please answer the following questions by circling the response that most accurately depicts your background and experience.

| | | | | |
|---|---|---|---|---|
| 1. How many years have you used a computer? | 0-1 | 2 | 3 | 4 or more |
| 2. On average, how many times do you use a computer per week? | 0-1 | 2-3 | 4-5 | 6 or more |
| 3. On average, how many hours do you spend on a computer when you use it? | 0-1 | 2 | 3 | 4 or more |
| 4. On average, how many times do you e-mail and/or online chat per week? | 0-1 | 2-3 | 4-5 | 6 or more |
| 5. On average, how many hours do you spend on e-mail and/or online chat each time you do so? | 0-1 | 2 | 3 | 4 or more |
| 6. On average, how many times do you use an internet browser, such as, Internet Explorer, AOL, or Netscape per week? (Do not include times spent e-mailing or chatting online.) | 0-1 | 2-3 | 4-5 | 6 or more |
| 7. On average, how many hours do you spend using an internet browser each time you use it? (Do not include time spent e-mailing or chatting online.) | 0-1 | 2-3 | 4-5 | 6 or more |
| 8. Have you ever used spreadsheets, such as in Microsoft Excel? | Yes | | No | |
| 9. Have you ever used a photo editor, such as Photoshop or Microsoft Picture It!? | Yes | | No | |

| | | |
|---|---|---|
| 10. Have you ever used drawing software, such as Corel Draw or MS Paint? | Yes | No |
| 11. Have you ever used a programming language, such as Java, HTML, Authorware, Director, or Visual Basic? | Yes | No |
| 12. Have you ever built web pages, perhaps using Frontpage or Dreamweaver? | Yes | No |
| 13. Have you ever taught high school or college level math? | Yes | No |
| 14. Have you ever taught high school or college level science? | Yes | No |
| 15. Have you ever taught a high school or college level computer class? | Yes | No |
| 16. Have you ever taken computer classes? | Yes | No |
| 17. Have you ever taken a class that was taught on computers? | Yes | No |
| 18. Have you ever taken a college level math or accounting class? | Yes | No |
| 19. Have you ever taken a college level science class? | Yes | No |
| 20. Have you ever taken a college level economics class? | Yes | No |
| 21. Do you play computer games? | Yes | No |

## APPENDIX I: LEARNING STYLE INVENTORY: VERSION 3

**Instructions:** On the following form you will be asked to complete 12 sentences that describe learning. Each has four endings. Rank the endings for each sentence according to how well you think each ending describes the way you learn. Using the spaces provided, write ***4*** next to the sentence ending that describes how you learn the ***best***, and so on down to ***1*** for the sentence ending that seems ***least*** like the way you learn. Be sure to rank all the endings for each sentence unit. Do not make ties.
Hint: Some people find it easiest to decide which phase *best* describes them (4-careful, in the example) and then to decide which phrase is the *least* like them (1-fast). Then they give a *3* to that word in the remaining pair that is most like them (3-logical) and a *2* to the word that is left over (2-happy).

Example:
When I learn

| | | | |
|---|---|---|---|
| **2** | **4** | **1** | **3** |
| I am happy | I am careful | I am fast | I am logical |

1. When I learn

| | | | |
|---|---|---|---|
| ___ | ___ | ___ | ___ |
| I like to deal with my feelings | I like to think about ideas | I like to be doing things | I like to watch and listen |

2. I learn best when

| | | | |
|---|---|---|---|
| ___ | ___ | ___ | ___ |
| I listen and watch carefully | I rely on logical thinking | I trust my hunches and feelings | I work hard to get things done |

3. When I am learning

| | | | |
|---|---|---|---|
| ___ | ___ | ___ | ___ |
| I tend to reason things out | I am responsible about things | I am quiet and reserved | I have strong feelings and reactions |

4. I learn by

| | | | |
|---|---|---|---|
| ___ | ___ | ___ | ___ |
| feeling | doing | watching | thinking |

5. When I learn

| | | | |
|---|---|---|---|
| ______ I am open to new experiences | ______ I look at all sides of issues | ______ I like to analyze things, break them down into their parts | ______ I like to try things out |

6. When I am learning

| | | | |
|---|---|---|---|
| ______ I am an observing person | ______ I am an active person | ______ I am an intuitive person | ______ I am a logical person |

7. I learn best from

| | | | |
|---|---|---|---|
| ______ observation | ______ personal relationships | ______ rational theories | ______ a chance to try out and practice |

8. When I learn

| | | | |
|---|---|---|---|
| ______ I like to see results from my work | ______ I like ideas and theories | ______ I take my time before acting | ______ I feel personally involved in things |

9. I learn best when

| | | | |
|---|---|---|---|
| ______ I rely on my observations | ______ I rely on my feelings | ______ I can try things out for myself | ______ I rely on my ideas |

10. When I am learning

| | | | |
|---|---|---|---|
| ______ I am a reserved person | ______ I am an accepting person | ______ I am a responsible person | ______ I am a rational person |

11. When I learn

| | | | |
|---|---|---|---|
| ______ I get involved | ______ I like to observe | ______ I evaluate things | ______ I like to be active |

12. I learn best when

| | | | |
|---|---|---|---|
| ______ I analyze ideas | ______ I am receptive and open-minded | ______ I am careful | ______ I am practical |

## APPENDIX J: REVISED JENKINS ACTIVITY SURVEY (JAS): FORM C REVISED TO BE USED WITH OLDER ADULTS

**Instructions:** For each question, choose the answer that is true for you, and mark the corresponding response.
Note: Each person is different, so there are no "right" or "wrong" answers.

1. Do you ever have trouble finding time to get your hair cut or styled?

A. Never
B. Occasionally
C. Almost always

2. How often does your job or similar activities "stir you into action"?

A. Less often than most people
B. About average
C. More than most people

3. Is your everyday life filled mostly by

A. problems needing a solution?
B. challenges needing to be met?
C. a rather predictable routine of events?
D. not enough things to keep me interested or busy?

4. Some people live a calm, predictable life. Others find themselves facing unexpected changes, frequent interruptions, inconveniences, or "things going wrong." How often are you faced with these minor (or major) annoyances or frustrations?

A. Several times a day
B. About once a day
C. A few times a week
D. Once a week
E. Once a month or less

5. When you are under pressure or stress, what do you usually do?

A. Do something about it immediately
B. Plan carefully before taking any action

6. Ordinarily, how rapidly do you eat?

A. I'm usually the first one finished.
B. I eat a little faster than average.
C. I eat at about the same speed as most people.
D. I eat more slowly than most people.

7. Has your spouse or a friend ever told you that you eat too fast?

A. Yes, often
B. Yes, once or twice
C. No, never

8. How often do you find yourself doing more than one thing at a time, such as working while eating, reading while dressing, or figuring out problems while driving?

A. I do two things at once whenever practical.
B. I do this only when I'm short of time.
C. I rarely or never do more than one thing at a time.

9. When you listen to someone talking, and this person takes too long to come to the point, how often do you feel like hurrying the person along?

A. Frequently
B. Occasionally
C. Almost never

10. How often do you actually "put words in the person's mouth" in order to speed things up?

A. Frequently
B. Occasionally
C. Almost never

11. If you tell your spouse or a friend that you will meet somewhere at a definite time, how often do you arrive late?

A. Once in a while
B. Rarely
C. I am never late.

12. How often do you find yourself hurrying to get places even when there is plenty of time?

A. Frequently
B. Occasionally
C. Almost never

13. Suppose you are to meet someone at a public place (street corner, building lobby, restaurant) and the other person is already 10 minutes late. What will you do?

A. Sit and wait
B. Walk about while waiting
C. Usually carry some reading matter or writing paper so I can get something done while waiting

14. When you have to "wait in line" at a restaurant, a store, or the post office, what do you do?

A. Accept it calmly
B. Feel impatient but not show it
C. Feel so impatient that someone watching can tell I am restless
D. Refuse to wait in line, and find ways to avoid such delays

15. When you play games with young children about 10 years old (or when you did so in past years), how often do you purposely let them win?

A. Most of the time
B. Half the time
C. Only occasionally
D. Never

16. When you were younger, did most people consider you to be

A. definitely hard-driving and competitive?
B. probably hard-driving and competitive?
C. probably more relaxed and easygoing?
D. definitely more relaxed and easygoing?

17. Nowadays, do you consider yourself to be

A. definitely hard-driving and competitive?
B. probably hard-driving and competitive?
C. probably more relaxed and easygoing?
D. definitely more relaxed and easygoing?

18. Would your spouse (or closest friend) rate you as

A. definitely hard-driving and competitive?
B. probably hard-driving and competitive?
C. probably relaxed and easygoing?
D. definitely relaxed and easygoing?

19. Would your spouse (or closest friend) rate your general level of activity as

A. too slow—should be more active?
B. about average—busy much of the time?
C. too active -- should slow down?

20. Would people you know well agree that you take your work too seriously?

A. Definitely yes
B. Probably yes
C. Probably no
D. Definitely no

21. Would people you know well agree that you have less energy than most people?

A. Definitely yes
B. Probably yes
C. Probably no
D. Definitely no

22. Would people you know well agree that you tend to get irritated easily?

A. Definitely yes
B. Probably yes
C. Probably no
D. Definitely no

23. Would people who know you well agree that you tend to do most things in a hurry?

A. Definitely yes
B. Probably yes
C. Probably no
D. Definitely no

24. Would people who know you well agree that you enjoy a “contest” (competition) and try hard to win?

A. Definitely yes
B. Probably yes
C. Probably no
D. Definitely no

25. How was your temper when you were younger?

A. Fiery and hard to control
B. Strong but controllable
C. No problem
D. I almost never got angry.

26. How is your temper nowadays?

A. Fiery and hard to control
B. Strong but controllable
C. No problem
D. I almost never get angry.

27. When you are in the midst of doing a job or during similar activities and someone (not your boss) interrupts you, how do you usually feel inside?

A. I feel O.K. because I work better after an occasional break.
B. I feel only mildly annoyed.
C. I really feel irritated because most such interruptions are unnecessary.

28. How often are there deadlines on your job or during similar activities?

A. Daily or more often
B. Weekly
C. Monthly or less often
D. Never

29. These deadlines usually carry

A. minor pressure because of their routine nature.
B. considerable pressure, since delay would upset things a great deal.
C. Deadlines never occur.

30. Do you ever set deadlines or quotas for yourself at work, or at home?

A. No
B. Yes, but only occasionally
C. Yes, once a week or more

31. When you have to work against a deadline, what is the quality of your work?

A. Better
B. Worse
C. The same (Pressure makes no difference.)

32. At work or during similar activities, do you ever keep two jobs or projects moving forward at the same time by shifting back and forth rapidly from one to the other?

A. No, never
B. Yes, but only in emergencies
C. Yes, regularly

<u>For questions 33-38</u>, if you are not currently working, think of your most recent job and that time period to answer the questions.

33. Are you content to remain at your present job level for the next five years?

A. Yes
B. No, I want to advance.
C. Definitely no; I strive to advance and would be dissatisfied if not promoted in that length of time.

34. If you had your choice, which would you rather get?

A. A small increase in pay without a promotion to a higher level job
B. A promotion to a higher job without an increase in pay

35. In the past three years, have you ever taken less than your allotted number of vacation days at work or maintained a regular study schedule during school vacations (e.g., Thanksgiving, Christmas)?

A. Yes
B. No
C. My type of job does not provide regular vacations.

36. In the past three years, how has your personal yearly income changed?

A. It has remained the same or gone down.
B. It has gone up slightly (as the result of cost-of-living increases or automatic raises based on years of service).
C. It has gone up considerably.
D. I don't have a regular income.

37. How often do you bring your work home with you at night, or study materials related to your job?

A. Rarely or never
B. Once a week or less
C. More than once a week

38. How often do you go to your place of work when you are not expected to be there (such as nights or weekends)?

A. It is not possible on my job.
B. Rarely or never
C. Occasionally (less than once a week)
D. Once a week or more

39. When you find yourself getting tired on the job or during similar activities, what do you usually do?

A. Slow down for a while until my strength comes back
B. Keep pushing myself at the same pace in spite of tiredness

40. When you are in a group, how often do the other people look to you for leadership?

A. Rarely
B. About as often as they look to others
C. More often than they look to others

41. How often do you make yourself written lists to help you remember what needs to be done?

A. Never
B. Occasionally
C. Frequently

For questions 42-46, compare yourself with the average worker in your present occupation or most recently held occupation, and mark the most accurate description.

42. In amount of effort put forth, I give

A. much more effort.
B. a little more effort.
C. a little less effort.
D. much less effort.

43. In sense of responsibility, I am

A. much more responsible.
B. a little more responsible.
C. a little less responsible.
D. much less responsible.

44. I find it necessary to hurry

A. much more of the time.
B. a little more of the time.
C. a little less of the time.
D. much less of the time.

45. In being precise (careful about detail), I am

A. much more precise.
B. a little more precise.
C. a little less precise.
D. much less precise.

46. I approach life in general

A. much more seriously.
B. a little more seriously.
C. a little less seriously.
D. much less seriously.

For questions 47-49, compare your present work with your work setting five years ago. If you are not currently working, compare your most recent job with the first job you held.

47. I worked more hours per week

A. at my present job.
B. five years ago.
C. Cannot decide

48. I carried more responsibility

A. at my present job.
B. five years ago.
C. Cannot decide

49. I was considered to be at a higher level (in prestige or social position)

A. at my present job.
B. five years ago.
C. Cannot decide

50. How many different job titles have you held in the last 10 years? (Be sure to count shifts in kinds of work, shifts to new employers, and shifts up and down within a firm.)

A. 0-1
B. 2
C. 3
D. 4
E. 5 or more

51. How much schooling did you receive?

A. Graduated from high school
B. Trade school or business college
C. Some college (including junior college)
D. Graduated from a four-year college
E. Post-graduate work at a college or university

52. When you were in school, were you an officer of any group, such as a student council, glee club, 4-H club, sorority or fraternity, or captain of an athletic team?

A. No
B. Yes, I held one such position.
C. Yes, I held two or more such positions.

## APPENDIX K: COMPUTER UNDERSTANDING AND EXPERIENCE (CUE) SCALE

**Instructions**: Please respond to the following statements by circling the number that most accurately depicts your opinion.

1. I frequently read computer magazines or other sources of information that describe new computer technology.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

2. I know how to recover deleted or "lost data" on a computer or PC.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

3. I know what a LAN is.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

4. I know what an operating system is.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

5. I know how to write computer programs.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |



CUE Scale by Denise Potosky & Philip Bobko (1998)

6. I know how to install software on a personal computer.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

7. I know what e-mail is.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

8. I know what a database is.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

9. I am computer literate.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

10. I regularly use a PC for word processing.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

11. I often use a mainframe computer system.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |

12. I am good at using computers.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |



CUE Scale by Denise Potosky & Philip Bobko (1998)

## APPENDIX L: COMPUTER ATTITUDE SCALE (CAS)

**Instructions:** Please respond to the following statements by circling the number that most accurately depicts your opinion.

1. Computers do not scare me at all.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

2. I'm no good with computers.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

3. I would like working with computers.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

4. I will use computers many ways in my life.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

5. Working with a computer would make me very nervous.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

6. Generally I would feel OK about trying a new problem on the computer.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

7. The challenge of solving problems with computers does not appeal to me.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |



CAS by B.H. Loyd and C. Gressard (1984)

8. Learning about computers is a waste of time.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

9. I do not feel threatened when others talk about computers.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

10. I don't think I would do advanced computer work.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

11. I think working with computers would be enjoyable and stimulating.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

12. Learning about computers is worthwhile.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

13. I feel aggressive and hostile toward computers.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

14. I am sure I could do work with computers.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

15. Figuring out computer problems does not appeal to me.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

16. I'll need a firm mastery of computers for my future work.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

17. It wouldn't bother me at all to take computer courses.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

18. I'm not the type to do well with computers.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

19. When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

20. I expect to have little use for computers in my daily life.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

21. Computers make me feel uncomfortable.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

22. I am sure I could learn a computer language.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

23. I don’t understand how some people can spend so much time working with computers and seem to enjoy it.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

24. I can’t think of any way that I will use computers in my career.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

25. I would feel at ease in a computer class.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

26. I think using a computer would be very hard for me.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

27. Once I start to work with the computer, I would find it hard to stop.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

28. Knowing how to work with computers will increase my job possibilities.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

29. I get a sinking feeling when I think of trying to use a computer.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

30. I could get good grades in computer courses.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

31. I will do as little work with computers as possible.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

32. Anything that a computer can be used for, I can do just as well some other way.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

33. I would feel comfortable working with a computer.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

34. I do not think I could handle a computer course.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

35. If a problem is left unsolved in a computer class, I would continue to think about it afterward.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

36. It is important to me to do well in computer classes.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

37. Computers make me feel uneasy and confused.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

38. I have a lot of self-confidence when it comes to working with computers.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

39. I do not enjoy talking with others about computers.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

40. Working with computers will not be important to me in my life's work.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

## APPENDIX M: INFORMED CONSENT FORM

### *Participant Assent Form*

# Virginia Polytechnic Institute and State University

**Informed Consent of Investigative Projects for Participants**

**Title of Project:** Universal Access to Programming: A Cross-Generation Learning Community
**Principal Investigator:** Dr. Mary Beth Rosson, Department of Computer Science, 540-552-6931, rosson@vt.edu
**Other Investigators:** John M. Carroll

**I. The Purpose of this Research/Project**

You are invited to participate in a research project that evaluates learning, use, and informal education supported by the Stagecast Creator visual programming language. Creator is a graphical environment for building simple simulations, and we are interested in how suitable it is for use by individuals of all ages and backgrounds. We will be studying people as they learn to use the environment, and building special learning materials and activities that make it as easy to use as possible.

The background context for the work with Creator will be our community. That is, you will work with materials that are connected to the town of Blacksburg. Some of the projects will be done individually, others will be done with other community members who may have different backgrounds and interests. We are studying the informal education that takes place through these community-oriented projects, as well as how people collaborate on such projects.

This research project will involve a variety of individuals—school children, their teachers, and other members of the community. The research will be performed as part of a project based at Virginia Tech. This project is funded under a grant by the Information Technology Research program of the National Science Foundation (NSF).

**II. Procedures**

Participants involved in the research will be recruited by several means, through classroom invitations, over community email lists, through posters, during visits to other community activities and so on. If you agree to participate, you could be asked to take part in the following research activities:

- Some individuals will be invited to attend brief (e.g., 1-hour) sessions in our facilities at Virginia Tech During these sessions the children will work with materials that we provide, and we will observe their behavior as they use Creator. Other participants will be invited to join us in a week-long brainstorming workshop during the first summer of the project, as we develop and refine the set of Creator projects and activities.
- We would like to observe the network activities of all research participants. Participants will use a community network (part of the BEV) to browse and select Creator projects, and we will collect a computer log of these activities—a record of computer events that occur as people access the projects. Events that we may record include the names of projects that are browsed and selected, the times at which participants sign up for projects or submit completed projects, and the interactions (online chat, email, discussion forums) that go into planning or completing the project as a group.
- We would like all participants to complete questionnaires throughout the study. Some of these questionnaires will ask for general background information (e.g., computer experience, profession), some will be asking questions about the Creator environment or about programming in general. Sometimes psychological scales that measure beliefs about programming ability will be included.
- We will interview some study participants. We will ask questions about use of and reactions to Creator, interactions with other research participants, and what has been learned about programming or about community issues.

**III. Risks**

There are less than minimal risks to you in this research. A small number of participants may experience eye strain from using a computer screen, or uncomfortable feelings from being watched or interviewed about their experiences.

**IV. Benefits of this Project**
While there are no direct benefits to you from this research (other than payment for lab-based activities), you may find the research and the interactions with other community members interesting. Your participation and that of other volunteers should make it possible to better understand the opportunities provided by modern programming environments like Creator.

**V. Extent of Anonymity and Confidentiality**
No one other than investigators will have access to your computer logs, interview data, or questionnaire results without additional written consent from you. Likewise, no printed or electronic rendition of information that could be attributed directly to you will be available to anyone other than the investigators without additional written consent from you. Otherwise, any presentation of this research will replace your name, and those of all other participants, with anonymous codes or names and/or will report data in summarized form only. Any visual data included in professional presentations or publications will be used anonymously. No information identifying you will accompany visual material.

All physical records will be stored in a locked cabinet or desk at Virginia Tech, and computer logs will be stored electronically on a restricted-access computer at Virginia Tech. Only investigators will have access to the locked cabinet or desk and to the restricted-access electronic data. All non-anonymous data will be erased or destroyed when the research project is over.

**VI. Compensation**
Participants volunteering for lab studies will receive $25 for the first session, and $75 for follow-up sessions and interviews. Teachers and community members who participate in the summer workshop will receive $200. There will be an assortment of prizes and awards for high-quality simulation projects that are completed during the study.

**VII. Freedom to Withdraw**
You are free to withdraw from this study at any time without question.

**VIII. Approval of Research**
This research has been approved, as required, by the Institutional Review Board for projects involving human subjects at Virginia Polytechnic Institute and State University and by the Department of Computer Science.

**IX. Subject's Responsibilities**
As outlined above, if you agree to participate, your responsibilities may include:

- Possible participation in one or more 1-hour lab sessions at Virginia Tech, scheduled at your convenience.
- Possible participation in a one-week brainstorming session to design community-oriented simulation projects.
- Access to and interaction with visual simulation programming projects and with other participants in the research. . The amount of time you spend working on these projects will be up to you. As described earlier, computer logs will be created of your network-based activities.
- Completion of brief surveys in association with the lab studies, and at several times during the community-based programming activities. Each survey is likely to require 5-10 minutes to complete.
- Possible face-to-face interviews, about learning and use of Creator and interactions with other study participants. These interviews will take about 30 minutes.

**X. Subject's Permission**
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 participation in the project.

If I participate, I may withdraw at any time without penalty.

| ______________________ | ______________________ | ________ |
|---|---|---|
| **Your Name** (Please print) | **Your Signature** | **Date** |

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

Mary Beth Rosson (Principal Investigator) .......………................... 540-231-6470
John M. Carroll (Co-Investigator) ..……...................................…..... 540-231-8453
David Moore (Chair, IRB Research Division) ............................ 540-231-4991

# APPENDIX N: COVER LETTER

Overall Project Overview:

The Computer Science Department at Virginia Tech is involved in a project that is using computer simulations to allow community members to mentor kids. Stagecast Creator is the software program where these simulations, or animated worlds, are to be created. Currently, individuals are being trained on Stagecast Creator so that they may be a part of Blacksburg's simulation community. As a participant in this study, you will learn how to use Stagecast Creator.

One of the initial aims of this project is working with older adults who might be interested in community oriented activities. As a potential mentor, you are not expected to be an expert on Stagecast Creator. Rather, we are hoping that mentors will use their life experience to generate ideas for simulations and to discuss these projects with other participants. For example, school children might create a simulation about bullies at school, and you might then give them feedback as to how they might change or add to their simulation based on your experience. These simulations and discussions will be available on the Blacksburg Electronic Village (BEV) website.

Specific Study Information:

The purpose of this study is to compare two different types of tutorials, or training manuals. Each individual will receive *only one* of these manuals from which to learn. There is a two-hour time limit set on how much time you may spend with the tutorial and software. Do not worry about finishing the tutorial. No matter how far you get into the tutorial, valuable information will be gained about how training manuals can be better designed in the future. After the two hours are over, or the tutorial is finished, you will be asked some questions about things that you may have learned and about your opinions, and you'll be given one further questionnaire. A part of determining how to better design future manuals is to determine which manual design can best help individuals to learn what they are teaching. The questions were designed so that few people, if anyone, will get all of questions correct. So don't worry; just do your best. All of this information can and will be used to develop recommendations for future training manual designs.

# APPENDIX O: DETAILED DATA ANALYSES OF SIGNIFICANT RESULTS

**One-Way ANOVA: Main Effect of Satisfaction-Related Subjective Questions**

| *Source* | *DF* | *SS* | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| Training Type | 1 | 811.20 | 811.20 | 4.69 | .04 |
| Error | 28 | 4843.60 | 172.99 | | |
| Total | 29 | 5654.80 | | | |

**Three-Way ANOVA: Main Effect of Whether the Tutorial Embedded Information in Real Tasks**

| *Source* | *DF* | *SS* | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| Gender (G) | 1 | 8.04 | 8.04 | 2.93 | .10 |
| Training Type (TT) | 1 | 15.16 | 15.16 | 5.52 | .03 |
| G*TT | 1 | 9.33 | 9.33 | 3.40 | .08 |
| Learning Style (LS) | 1 | .02 | .02 | .01 | .93 |
| G*LS | 1 | 1.29 | 1.29 | .47 | .50 |
| TT*LS | 1 | 7.42 | 7.42 | 2.70 | .11 |
| G*TT*LS | 1 | 3.00 | 3.00 | 1.09 | .31 |
| Error | 22 | 60.4 | 2.74 | | |
| Total | 29 | 102.8 | | | |

**Two-Way ANOVA: Interaction of Satisfaction-Related Subjective Questions**

| *Source* | *DF* | *SS* | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| Gender (G) | 1 | .05 | .05 | .00 | .98 |
| Training Type (TT) | 1 | 1045.10 | 1045.10 | 7.65 | .01 |
| G*TT | 1 | 1022.41 | 1022.41 | 7.48 | .01 |
| Learning Style (LS) | 1 | 166.82 | 166.82 | 1.22 | .28 |
| G*LS | 1 | 5.94 | 5.94 | .04 | .84 |
| TT*LS | 1 | 96.58 | 96.58 | .71 | .41 |
| G*TT*LS | 1 | 303.31 | 303.31 | 2.22 | .15 |
| Error | 22 | 3005.28 | 136.60 | | |
| Total | 29 | 5654.80 | | | |

**One Way ANCOVA**

| *Source* | *DF* | *SS* | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| Training Type | 1 | .27 | .27 | .01 | .92 |
| Age | 1 | 188.68 | 188.68 | 5.84 | .02 |
| Experience | 1 | 381.05 | 381.05 | 11.79 | .002 |
| Error | 26 | 840.35 | 32.32 | | |
| Total | 29 | 1586.30 | | | |

**One Way ANOVA: Time Spent on Tutorial**

| *Source* | *DF* | *SS* | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| Training Type | 1 | 2520.83 | 2520.83 | 6.66 | .015 |
| Error | 28 | 10596.67 | 378.45 | | |
| Total | 29 | 13117.50 | | | |

# VITA

Jennifer A. Wissman was born and raised in Minster, Ohio. In 2000, she received her Bachelor of Arts degree from Miami University, having majored in Psychology and minored in Economics. In 2002, she completed her Master of Science in Industrial and Systems Engineering at Virginia Polytechnic Institute and State University. Through the Human Factors Engineering option, she pursued research in the area of Human-Computer Interaction while working in conjunction with the Computer Science Department. While obtaining her Master's degree, she also spent one semester as a Graduate Teaching Assistant. Jennifer is a member of the American Psychological Association, the Human Factors and Ergonomics Society, and the United Kingdom based Ergonomics Society.