

Effect of Self-Awareness as Induced by the Presence of
Mirrors and Cameras on the Subjective Evaluation
of the Usability of Software

Thesis

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ABSTRACT

EFFECT OF SELF-AWARENESS AS INDUCED BY THE PRESENCE OF MIRRORS AND CAMERAS ON THE SUBJECTIVE EVALUATION OF THE USABILITY OF SOFTWARE

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Software usability testing is frequently performed in a laboratory environment (with mirrors and cameras) or in front of a video camera in a "real world" setting. The presence of the mirrors and/or cameras could create a situation which increased a person's level of self-awareness, potentially changing their attributional process. This paper suggests that subjective ratings of software usability can be viewed as attributions. The rater can attribute their performance to the software program (it was a good or bad program) or to their abilities (I performed well or poorly). Normally a person will attribute their failures to external sources, however, in the presence of mirrors and cameras people are more likely to attribute their failures to themselves. This is particularly pronounced in individuals with a high degree of intrinsic self-consciousness. This study proposed that subjective software evaluations can be affected by a combination of testing environment and personality

characteristics. The results did not support this hypothesis. In the relatively few cases where the hypothesized relationship was significant, high self-consciousness subjects in the mirror conditions provided lower ratings of usability than the other groups. The typical pattern of results was a cross-over effect in which low self-consciousness subjects in the mirror condition and high self-consciousness subjects in the no mirror condition rated the software as more usable than did the other subjects. There are several potential explanations for this failure to support the hypothesis. The most plausible explanation is that subjects never experienced failure. Alternative explanations include: software ratings may not be attributionally based, combining the public self-consciousness and social anxiety subscales to define selfconsciousness may have impacted the results, and the testing environments (mirror or no mirror) may have been too similar.

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CHAPTER 1

INTRODUCTION

The importance of usability of computer software products has been expounded numerous times (Boehm-Davis, 1983, Potosnak and Koffler, 1986, Root and Draper, 1983, Schneier, 1986). One tool which has been used to assess software usability is the usability laboratory. A typical usability laboratory consists of a test area and an observation area. A one-way mirror separates these areas. The test area is furnished in a manner typical of a business office. Subjects are asked to perform tasks utilizing the software being evaluated. During the operation of the computer, researchers in the observation area can monitor users through the one-way mirror.

Performance measures such as the time required to complete a task and the number and severity of errors committed are typically collected. In addition, video cameras are often utilized in order to perform a more detailed analysis of the user's interaction with the software, allowing the researcher to review the statements,

facial expressions and other non-verbal information (Potosnak and Koffler, 1986; Schneier, 1986).

In addition to the performance measures, subjects may also be asked to give a subjective evaluation of their satisfaction with the software. Questions regarding specific features and characteristics of the software are used to provide enhanced focus on the software's strengths and weaknesses.

Whenever software is being evaluated, a number of extraneous factors can influence the outcome (Held and Biers, 1992; Whiteside, Bennet, and Holtzblatt, 1988). These factors can include hardware, user characteristics, user experience and/or training, task characteristics, documentation, stage of software development and evaluation environment. This research will focus on the effects of three of these factors: user characteristics, user experience, and the evaluation environment on the subjective evaluation of the software usability.

It is proposed here that when asked to evaluate computer software for usability, the evaluator makes attributions for their successes and failures while using the software. These attributions can be made to either the program (it was a good or bad program) or to themselves (I did well or poorly). Furthermore, the direction of these attributions (attributing the performance to themselves or the program) is a function of self-awareness.

If indeed subjective evaluations of software usability are demonstrated to be influenced by self-awareness, it would suggest several things. First, the intrusiveness of mirrors and cameras should be minimized and further research should be conducted to determine how the self-awareness effects can best be minimized.

Another approach would include software evaluations in "real world" settings (contextual evaluation) without the use of video cameras or the presence of an evaluator. This would also reiterate the need for multiple (and diverse) measures of software usability.

Effect of the Evaluation Environment

Among the distinctive features of the usability laboratory environment are the presence of mirrors and cameras. A questions that is often asked, and left unanswered, is "what effect, if any, does the presence of mirrors and cameras have on the subjects?" One effect of the presence of mirrors and/or cameras may be to alter the attributions made by the subjects. The presence of video cameras and mirrors may also have an impact the subjects' performance levels.

Attributions

Heider (1944, 1958) pointed out that humans attempt to determine the causes of the events that happen around them. Situations in which an unexpected event happens or a person

experiences failure are particularly likely to elicit causal attributions (Brigham, 1986). Several interrelated biases exist in this attribution process.

In general, people tend to overestimate the amount of influence that dispositional factors play in the behaviors of others (Nisbett, Caputo, Legant, and Marecek, 1973). People tend to view the behaviors of others as rather stable across situations and, as such, due to enduring intrapersonal (or dispositional) factors. This tendency has been called the observer bias (Jones and Nisbett, 1971) or fundamental attribution error (Ross, 1977).

In contrast, most people see situations as the primary influence on their own behaviors ("it depends on the situation"). This bias has been called the actor bias (Jones and Nisbett, 1971).

A second bias in the attribution process is the self-serving bias. Several researchers (Arkin, Gleason and Johnston, 1976; Federoff and Harvey, 1976) have demonstrated that, in general, people tend to make attributions to themselves (dispositional attributions) for successes, while attributing failures to outside factors (situational attribution). This is usually explained as an attempt to defend their ego-integrity or self-esteem (Weary, 1980). This explanation is not accepted unquestioningly (Bradley, 1978; Miller and Ross, 1975; Miller, 1978). Miller and Ross have suggested that these biases can be explained within an

information processing framework. It is argued that, individuals expect to succeed rather than fail and that they are more likely to attribute expected outcomes to themselves than for unexpected outcomes.

There are circumstances when the self-serving bias does not operate as expected (Bradley 1978, Weary 1979). The presence of a mirror or a television camera can result in the person turning their attention toward themselves (Wicklund and Duval, 1971). When people are more self-attentive, they typically make more attributions to themselves (Wicklund and Duval, 1971; Duval and Wicklund, 1973). Greenberg, Pyszczynski and Solomon (1982) found that knowledge of public scrutiny of a test changes the attributions made by subjects about the results of the test. In this study it was found that in a public scrutiny condition, subjects were less likely to attribute their failures to test characteristics than subjects who were not in a public scrutiny condition.

Attributions in Software Usability

This research appears to be relevant to the laboratory software usability evaluations setting. The presence of the mirrors and cameras could be causing the subjects to be more self-attentive than they might typically be. Furthermore, a heightened self-awareness may alter the subjective evaluation of the software usability. If a person who has experienced some degree of failure while using a piece of software is more self-attentive due to the laboratory environment, then

the person may attribute their difficulties to internal characteristics rather than to the software, and therefore may evaluate the software more highly than otherwise would be the case.

Personality Factors and Software Usability

One set of factors that may affect software usability evaluation is the evaluator's personality. Among the personality factors which Schneiderman (1980) suggests may have an influence on programming are: degree of assertiveness, introversion/extroversion, locus of control, anxiety, motivation, tolerance for ambiguity, compulsivity, humility, and tolerance for stress.

Unfortunately, the research on the effects of personality factors in software usability testing is limited. In addition, it is uncertain if personality factors important in computer programming are also important in the evaluation of software usability. The current study will utilize the personality construct of self-consciousness, specifically the Self-Consciousness Scale developed by Fenigstein, Scheier and Buss (1975).

The Self-Consciousness Scale incorporates several personality constructs that Schneiderman suggests, (introversion/extroversion and anxiety) but it also was designed, in part, to differentiate persons in regards to their susceptibility to the effects of cameras and/or mirrors (Fenigstein et al.). Because of this, the Self-Consciousness

Scale seems particularly well suited to studying the potential effects of mirrors and cameras on subjective software evaluation.

Personality Factors and Attributions

Arkin, Appelman and Burger (1980) found that a personality factor (social anxiety) interacted with the degree of public scrutiny. Subjects were divided into two groups based on their scores on the social anxiety subscale of the Fenigstein, Scheier and Buss (1975) Self-Consciousness Scale. The upper and lower third of the distribution were used to produce the two groups. Subjects were randomly assigned to a success group or a failure group. The experimenter provided bogus "performance" feedback to the subjects indicating either success or failure.

Those subjects who scored high on the social anxiety subscale were more likely to attribute their failure to internal factors (themselves) than were subjects who scored low on the social anxiety subscale. Subjects who scored higher in social anxiety assumed more personal responsibility for failures than did subjects who scored lower in social anxiety. This effect was not present in the success group.

In a second study conducted by Arkin et al., discussed in the same article, an interaction was found between social anxiety induced by the situation and dispositional (the personality trait) social anxiety. This interaction was only present in the failure condition.

In the failure condition, individuals who scored high on the social anxiety subscale and who were also in the high situational social anxiety condition were more likely to attribute the outcome to intrapersonal factors than were individuals in any other combination of conditions.

In light of the research (Arkin, Appleman and Burger 1980, Carver and Scheier, 1978) it appears plausible that in the laboratory software evaluation scenario, the presence of the mirrors and cameras may result in users attributing any difficulties they had with the software to themselves rather than to the software. The effect of mirrors and cameras is predicted to be particularly pronounced for subjects who score high in self-consciousness. Subjects who score high in self-consciousness and are placed in the presence of mirrors and cameras are predicted to be the most likely to attribute their failures to themselves resulting in the highest subjective evaluations, that is, rating the software the most usable. Although these subjects may have experienced considerable difficulty using the software, they will rate the software as highly usable.

The Present Study

Two groups of subjects were formed based on their scores on the Self-Consciousness Scale. Subjects were classified into two groups, novice and experienced, based on their previous usage of word processing software. The two levels

of dispositional self-consciousness were factorially combined with the two levels of experience and with two levels of laboratory environment (situational self-awareness). The presence of video cameras and a one-way mirror constituted the high situational self-awareness condition. In the low self-awareness condition, the camera was removed and the mirror was covered with a mini-blind. Subjects were asked to complete a series of tasks using WordStar 3.3. Upon completion of the session the subjects were asked to subjectively evaluate the usability of this piece of software.

This study proposed that during this subjective evaluation the subjects make attributions for their failures. These attributions can be made to either the program (it was a good or bad program) or to themselves (I did well or poorly).

The direction of these attributions, whether the person attributes their performance to the software or to themselves, is predicted to be a function of self-awareness. This self-awareness may be the result of a personality characteristic (self-consciousness). It may also be induced by situational characteristics (the presence of mirrors and cameras). However, it was predicted that the interaction of situational and dispositional self-awareness would result in the greatest effect on subjective ratings.

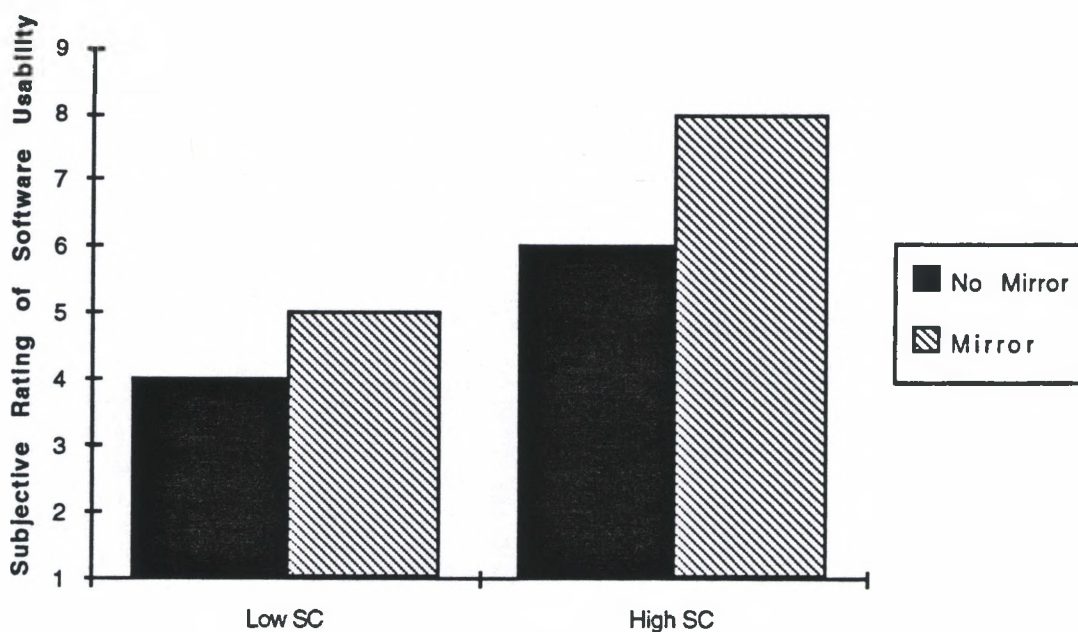


Figure 1. Predicted Interaction

A greater effect of testing environment was predicted for high self-consciousness subjects than for low self-consciousness subjects. It was predicted that subjects who scored high on self-awareness inventories and were placed in an elevated self-awareness condition (in front of a two-way mirror and a videotape camera) would attribute more of their difficulties (or failures) to dispositional factors, rather than to any shortcomings of the software, and will therefore give a subjective evaluation indicating greater usability than will subjects in any other condition.

Testing environment (the presence of mirrors and cameras) and the personality trait of self-consciousness are both anticipated to provide small impacts on the software

usability ratings provided by study participants. These effects are expected to be less pronounced than the interaction between self-consciousness and environment. With the sample size selected for this study (n=40) significant main effects of self-consciousness and environment are not anticipated.

CHAPTER 2

METHOD

Design

This study employed a 2 x 2 x 2 between-subjects factorial design. Two levels of dispositional self-consciousness were obtained by recruiting subjects (see the description in the Subjects section) who scored in the upper and lower thirds of the Self-Consciousness Scale (for a description of this scale see the Instruments section). Two levels of experience (Novice and Experienced) were obtained by recruiting subjects based on their word-processing experience. Subjects were assigned to one of two testing conditions, mirror or no mirror.

The dependent measures for this study were the number of tasks completed, the number of errors, and the subjective ratings of software usability. The performance measures, number of tasks completed and number of errors, were collected by reviewing the saved exercises completed by the subjects. Subjects were also asked to mark a checklist as they completed each task. The saved exercises were compared against this list in determining the number of tasks completed. In process, real-time performance measures, such as the number of failed attempts prior to completing a task

correctly, were not collected. The nature of this study, namely the non-monitored (no mirror or camera) condition, would have interfered with the collection of this type of data.

Subjects

Forty subjects were recruited from the Introductory Psychology pool at the University of Dayton, based on their scores on the Social Anxiety and Public Self-consciousness subscales of the Fenigstein et al. (1975) Self-Consciousness Scale (see discussion in the Instruments section). Only those subjects scoring in the top or bottom third of this self-consciousness distribution were recruited, in replication of the method of Arkin et al. (1980), and Scheier (1976).

Two experience levels of subjects, novice and experienced, were used for this study. Subjects who have used WordStar in the past were excluded from the study. As a result, the subjects were naive to the particular piece of software which they were evaluating. Novice subjects are defined as individuals who have not previously used a word-processor, or a word processing based program editor. Subjects categorized as experienced were familiar with word processing software, but not with the particular program used for evaluation (any version of WordStar).

Subjects were not required to have previously operated a personal computer. Thus the subjects could potentially have a wide range of experience in operating personal computers.

Instruments

Self-Consciousness Scale

Fenigstein, Scheier and Buss (1975) developed a 23-item paper and pencil test of self attention based on the work of Duval and Wicklund (1973). This test, called the Self-Consciousness Scale has three subscales labeled private self consciousness, public self consciousness and social anxiety. These three subscales were identified using a principal components factor analysis and subsequent varimax rotation. The private self consciousness subscale (or factor) measures an individual's tendency to attend to his/her own thoughts and feelings. Fenigstein et al. claim that this dimension corresponds closely to Jung's concept of introversion. The public self consciousness subscale is concerned with an individual's awareness of themselves as a social object. The social anxiety subscale assesses an individual's discomfort in the presence of others. The total scale score is the simple sum of these three subscales.

Fenigstein et al. found two-week test-retest correlations of: .84 for the public self consciousness subscale; .79 for the private self consciousness subscale; .73

for the social anxiety subscale; and .80 on the total Self-Consciousness Scale score.

In a review of the instrument, Osberg (1986) reports that the validity data concerning the Self-Consciousness Scale are voluminous, and that the convergent and divergent validity appear to be well supported. Turner, Scheier, Carver and Ickes (1978) found that the subscales and total scale are distinct from unrelated concepts. Fenigstein et al. (1975) reported that the public self consciousness subscale was moderately correlated with the private self consciousness and social anxiety subscales and that the private self consciousness and social anxiety subscales were uncorrelated.

Previous research has identified that the public self-consciousness and social anxiety subscales identify personality factors that can impact the attribution process. Research has not identified any impacts on attribution based on the private self-consciousness scale. This study used only the public self-consciousness and social anxiety subscales. A weighted average of the questions from these two scales was used in this study. The scales were weighted based on the number of items on the scale, so that both constructs had equal weighting in selecting the groups.

Questionnaire for User Interface Satisfaction

A modified version of the Questionnaire for User Interface Satisfaction (Chin, Diehl and Norman, 1988) adapted by Held (1992) was used for this study. This modified version, found in Appendix B, does not use the entire scale. Additional questions relating to subjects' attributions for successes and failures were appended to the questionnaire. The questionnaire is divided into four sections; general characteristics, specific features, overall evaluation, and attributions. Chin et. al. grouped the questions from the general characteristics and specific features sections into four categories: Learning the Software, Screen Characteristics, Terminology and System Information, and System Capabilities.

Procedure

The potential subjects' experience with word processors was evaluated during mass testing of the psychology subject pool. Two categories of experience were identified, novice and experienced. Subjects who previously used WordStar were disqualified from the study. Novice subjects are defined as individuals who have not previously used a word-processor. Experienced subjects will be familiar with other word processing software, but not WordStar.

Subjects were assigned to two groups based on their levels of dispositional self-consciousness. These two groups were formed by recruiting subjects from the psychology subject pool who completed mass testing and scored in the upper or lower third of the distribution of scores on the self-consciousness scale.

Experience and self-consciousness formed a 2 x 2 factorial combination with 10 subjects per cell. Subjects from each of these cells were randomly assigned to one of two experimental conditions, mirror or no mirror. This resulted in final cell sizes of 5 subjects per cell.

The high situation self-awareness group was placed in front of a two-way mirror and a video camera while operating the computer. The low situation self-awareness group was placed alone in a room. The room was the same in both conditions except for the presence of the mirror and cameras. To accomplish this, a blind was placed across the mirror and the cameras were removed from the room. Subjects in both groups were assured that it is the software, not them, that is being evaluated.

Each subject spent a 90 minute session using the tutorial for WordStar 3.3 provided with the original software disks. The subjects were directed to complete all of the sections of the WordStar 3.3 tutorial program. This tutorial provided the training necessary to complete all of the

procedures that they were asked to complete in the second session.

Within two days of the training session, subjects returned to the laboratory to attempt a series of 10 exercises using Word Star 3.3. These ten exercises contained 54 individual operations. These operations are representative of what Roberts (1977) terms "core tasks". Typical operations included replacing and moving text. Copies of these exercises are located in Appendix C.

A checklist of operations was provided for the subjects, and they were instructed to mark each operation that was completed. Subjects were allowed one hour to complete these operations, in order. Although the subjects were not directed to do so, some subjects skipped individual operations. It was anticipated that few subjects would complete all of the operations.

After completing the hour session, each subject was asked to evaluate the software using the Questionnaire for User Satisfaction developed by Chin, Diehl and Norman (1988) as modified by Held (1992). In addition to the subjective evaluations given by the subjects, several performance measures were collected. The number of operations completed during the session was collected. Furthermore, the number of errors were recorded.

These performance measures were obtained by reviewing the subjects' saved word files and by reviewing the checklist

of completed tasks. When the subject's saved word file matched the changes identified in the exercise operations the operation was scored as correct. When the saved file did not match the requested changes the operation was scored an error. Using this method it could not be determined if a person had completed the operation using the functions requested, or if alternative methods were used to accomplish the objective. For instance, when instructed to use the find and replace command a subject could have used the command as requested or the subject could have visually searched the document, deleted the "find" word, and re-typed the "replace" word. In this example the response would have been scored a successful completion.

CHAPTER 3

RESULTS

Some of the performance data was corrupted due to disk errors. The data for 5 subjects was corrupted beyond repair. These subjects were removed from all further analyses. These 5 subjects were spread across 3 conditions. The number of subjects in each condition is shown in Table 1.

Table 1: Subjects Per Condition

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
Novice	4	5	4	3
Experienced	4	5	5	5

Although there was no missing data for the subjective measures, the data for the same five subjects were excluded from all of the analyses for comparability reasons. However, it will be noted that the pattern of means and significance were consistent with and without the excluded subjects.

The results from each section are presented in consistent formats. For each section, a 2 x 2 x 2 MANOVA was performed. Only those relationships (with the exception of the hypothesized relationship) with significant MANOVA results were then analyzed with ANOVAs for each dependent variable in order to control for familywise error. Where necessary, these results were supplemented by analyses of simple effects. All significant findings are reported in this document. Findings that were not statistically significant are not reported.

In addition, the hypothesized interaction between self-consciousness and environment was analyzed for each dependent variable using a 2 x 2 ANOVA. The results of each of these analyses are presented within the individual results sections. All significant findings regarding the hypothesized relationship are also presented.

Tables containing the means and standard deviations from all analyses are presented in Appendix D.

Performance Measures

It was anticipated that an operator's performance could be directly affected by the experimental conditions and the subsequent subjective ratings could simply be a manifestation of the performance differences rather than the attribution process. In order to assess this possibility two performance measures were collected in this experiment; the number of tasks completed during the session and the number of errors.

The results of the performance analyses are presented in Table 2. No specific hypotheses were developed for performance measures although one might anticipate increased self awareness, resulting from either personality factors or environment (the presence of mirrors and cameras constituting an audience) would deteriorate performance (Geen and Gagne, 1977; Zajonc, 1965). The combination of a highly self-conscious personality with an audience could have a synergistic effect resulting in considerably poorer performance than any other condition. Univariate analyses of the interaction between self-consciousness and testing environment yielded no significant results. The pattern of results are consistent with expectations that highly self-conscious users appeared to perform more poorly, making more errors, than their low-self-consciousness counterparts. The predictions that the presence of mirrors and cameras would also degrade performance and that the combination of high self-consciousness with mirrors and cameras would have an even greater effect do not seem to be supported by this data. This relationship is illustrated in Figure 2.

The MANOVA indicated that the subjects' previous amount of word processing experience ($F = 5.23, p = .012$) and their intrinsic level of self-consciousness ($F = 3.44, p = .047$) affected their performance. Subsequent univariate analyses indicate that experience affected error rates ($F(1,27) = 4.62, p = .041$).

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Table 2. Performance Analyses

Effect		MANOVA	ANOVA	
		Performance	Errors	Attempts
SC x ENV x EXP	F	0.60		
	p	0.559		
ENV x EXP	F	0.40		
	p	0.673		
SC x EXP	F	1.26		
	p	0.301		
SC x ENV	F	1.42	0.06	1.23
	p	0.259	0.800	0.276
EXP	F	5.23	4.62	3.57
	p	0.012	0.041	0.070
ENV	F	0.04		
	p	0.965		
SC	F	3.44	6.20	0.10
	p	0.047	0.019	0.749
Df			(1,27)	
MS error			0.884	153.08

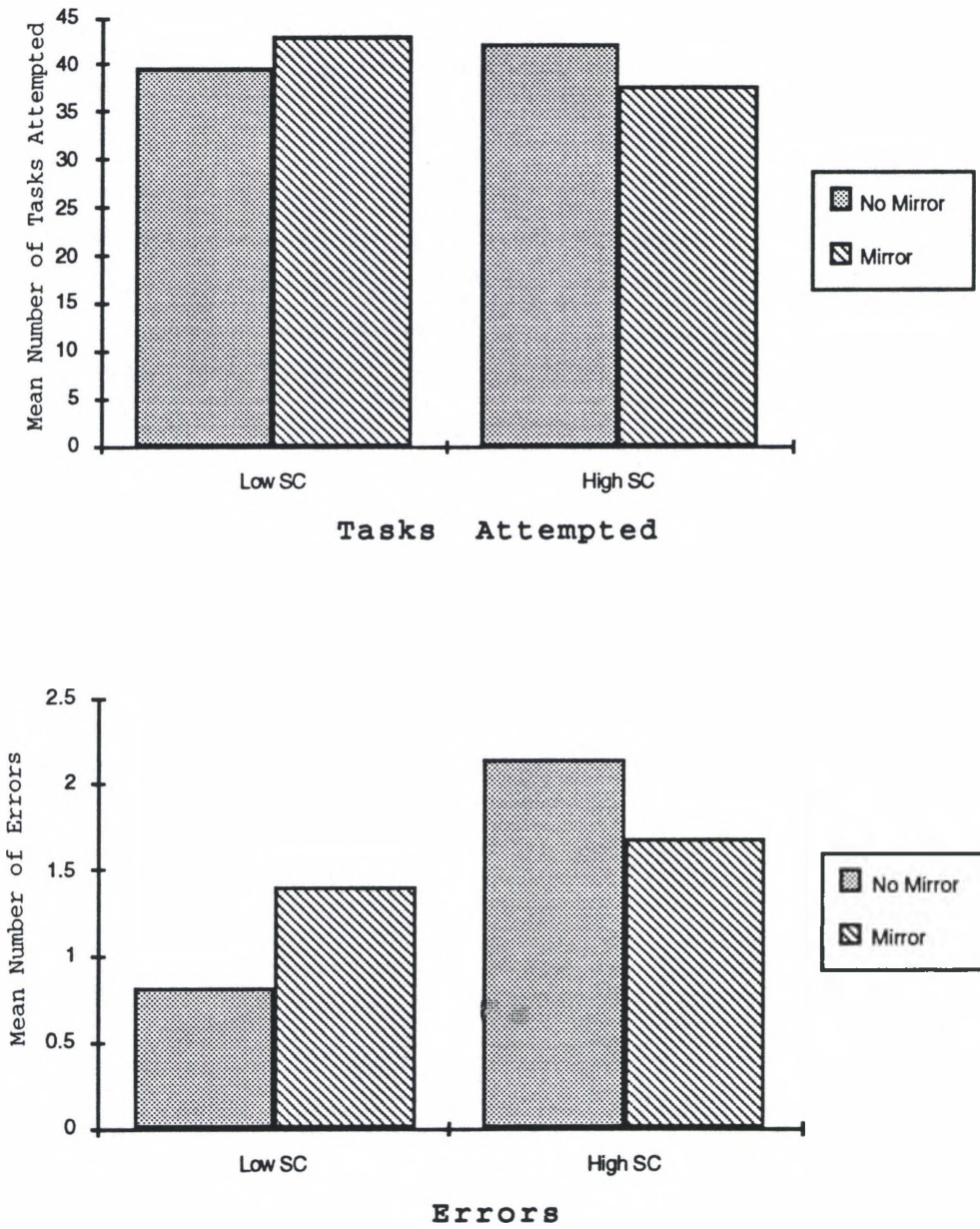


Figure 2. Performance
Self-consciousness by Environment

The error rates are consistent with expectations regarding performance and experience. Experienced subjects committed fewer errors ($m = 1.16$) than did novice subjects ($m = 1.85$). The additional overall word processing experience carried across software platforms to enhance the experienced subjects' performance.

The follow-up univariate analyses also indicated that self-consciousness affected errors ($F(1,27) = 6.20, p = .019$). Subjects who scored high on a self-consciousness inventory made more errors ($m = 1.90$) than their low self-consciousness counterparts ($m = 1.10$).

Subjective Measures

The dependent variable was the subjective evaluation of software usability. The subjective evaluation consisted of four sections: an evaluation of specific features, an evaluation of general characteristics, an overall evaluation, and an attribution evaluation. A copy of the usability survey is presented in Appendix B.

In typical software evaluation studies the ratings of the individual features is important in directing design revision efforts. The focus of this study, however, was to identify the impact of personality and environmental factors on the rating process. As a result, the focus is placed on the differences in ratings between conditions rather than on

the differences between the features or on detailed discussions of the individual features.

Specific Features

Questions from the Specific Features portion of the evaluation form were analyzed in several ways. A factor analysis was performed on Questions 1 through 9. Questions 10, 11, and 12 were grouped with the General Characteristics based on the factors identified by Chin et al. (1988). These results will be discussed within the General Characteristics results section.

Questions 1 through 9 were analyzed using a principal components analysis (with varimax rotation). Four factors had eigenvalues greater than 1. The factor scores are presented in Table 3. These four factors accounted for a total of 76.3% of the variability in the model. Individual questions were assigned to factors based on the value of the loading coefficient. Each question was loaded to the factor on which the question had the largest coefficient. All questions were assigned to factors. Factor names were assigned based on apparent relatedness of questions within the factor.

Table 3. Factor Loading

	Factor 1	Factor 2	Factor 3	Factor 4
Questions	Save Files Exit Load Files	Create Files Enter Text Move Text	Find & Replace Delete Text	Spell Check
Factor Name	System Level Commands	Create	Delete Replace	Spell Check
Eigenvalue	2.912	1.644	1.305	1.006
Percent of Variability	32.4	18.3	14.5	11.2
Cumulative Percent	32.4	50.6	65.1	76.3

Specific feature questions regarding saving files (question 3), exiting (question 4), and loading files (question 5) loaded heavily to factor one--using system level commands. Questions regarding file creation (question 1), entering text (question 2), and move text (question 6) loaded most heavily to factor 2--create or enter new material. The questions which loaded most heavily to the third factor were delete text (question 7) and find and replace (question 8). The third factor is labeled delete/replace. The fourth is labeled spell check after the single question which loaded most heavily to this factor, question 9--spell check.

With the small sample size used in this study using the exact factor loading to derive component scores can lead to spurious results (Stevens, 1986). To avoid this, the mean

values for each question contributing to the factor were utilized for subsequent analyses.

A 2 x 2 x 2 MANOVA was performed using the factor scores (calculated with mean values) as the dependent variables. No significant relationships were identified from this analysis. The results are presented in Table 4. The hypothesis predicted a two-way interaction of self-consciousness by testing environment, where testing environment would have the greatest effect on highly self-conscious users. When high self-consciousness users were placed in the laboratory environment they would rate the software as the most usable. Univariate analyses were conducted for the hypothesized relationships.

The predicted interaction was present in Factor 3-- Delete/Replace ($F(1,25)=5.2$, $p = .033$), however the direction of the results was not in the predicted direction. The interaction, as illustrated in Figure 3, is a cross-over effect. In the mirror condition, low self-consciousness individuals rated the software more usable than did high self-consciousness subjects. However, in the no-mirror condition high self-consciousness rated the software as more usable than did the low self-consciousness subjects. An analysis of simple effect found that neither of these differences were significant. No other results were significant, nor did the pattern of results for any factor support the hypothesis, as illustrated in Figures 4 - 6.

Table 4. Specific Features:
Analysis Results

Effect		MANOVA Specific Features	ANOVA			
			Factor 1	Factor 2	Factor 3	Factor 4
SC x ENV x EXP	F	0.84				
	p	0.519				
ENV x EXP	F	0.30				
	p	0.875				
SC x EXP	F	0.33				
	p	0.853				
SC x ENV	F	1.79	0.12	1.66	5.20	0.23
	p	0.175	0.737	0.212	0.033	0.639
EXP	F	0.31				
	p	0.865				
ENV	F	0.63				
	p	0.648				
SC	F	0.78				
	p	0.550				
Df				(1,21)		
MS error			1.063	0.923	0.931	1.199

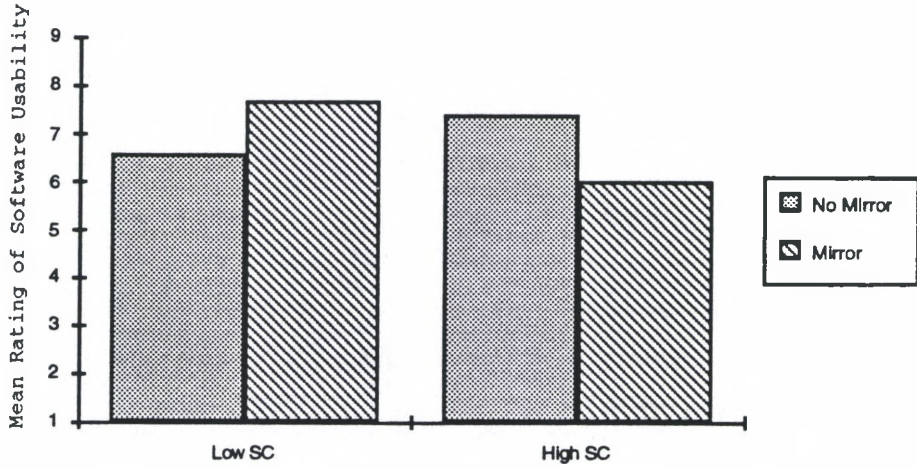


Figure 3. Replace Delete (Factor 3)
Self-consciousness by Environment

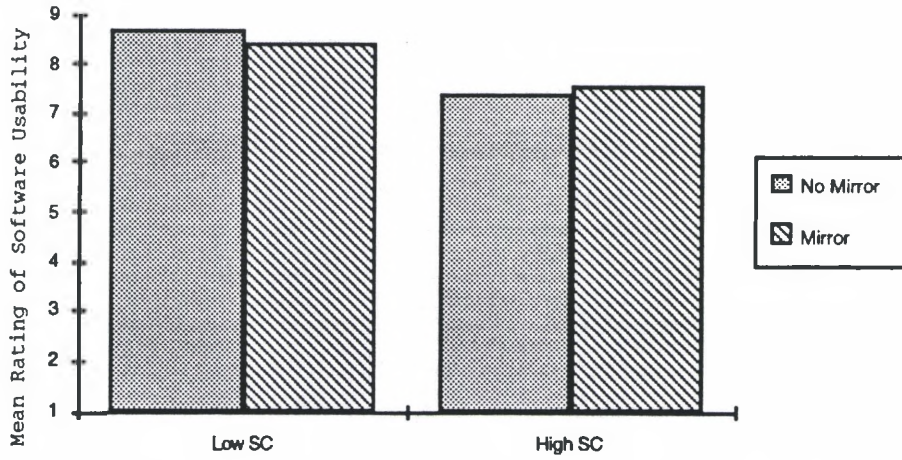
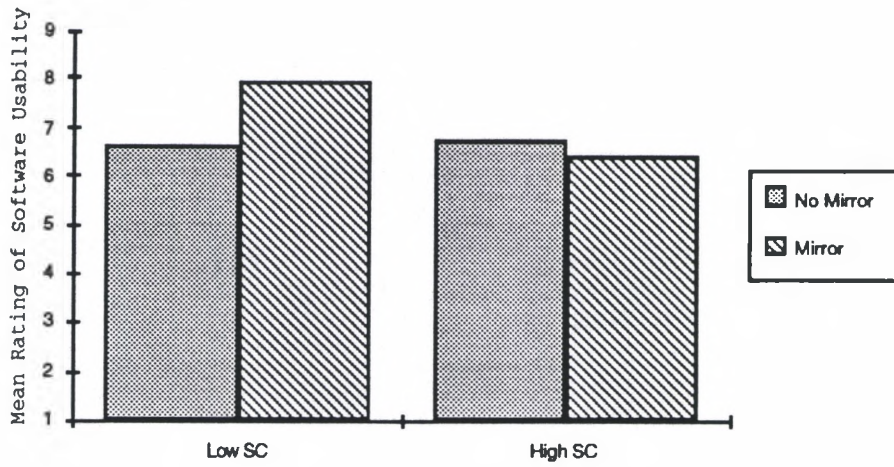
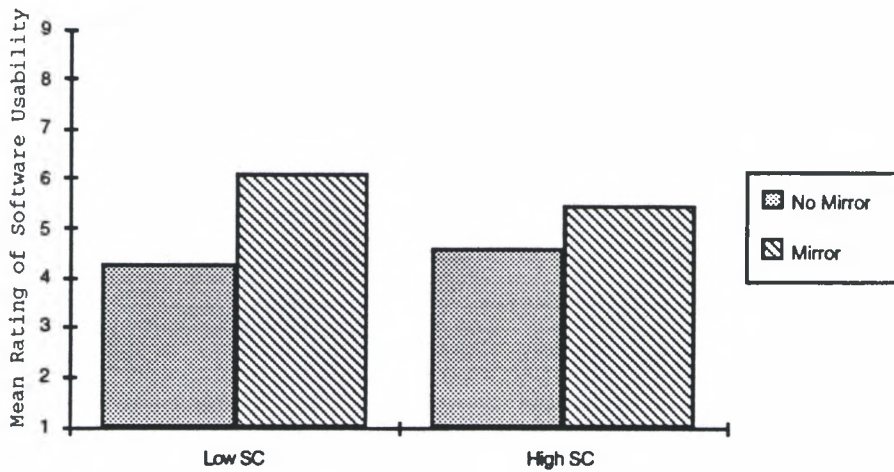


Figure 4. System Commands (Factor 1)
Self-consciousness by Environment



**Figure 5. Create (Factor 2)
Self-consciousness by Environment**



**Figure 6. Spell Check (Factor 4)
Self-consciousness by Environment**

General Characteristics

Questions 10, 11, and 12 from the Specific Features are combined with the General Characteristics section and grouped into four factors identified by Chin et al. (1988). The factors identified dealt with learning the software (LEARNING), screen characteristics (SCREEN), terminology and system information (TSI), and system capabilities (SYSTEM). The scaling polarity of some questions has been reversed for analysis such that a higher score always indicates increased usability.

A MANOVA was performed using these four dependent variables. Multivariate significance ($p = .027$) was obtained for self-consciousness by environment. No other significant results were found. The results are summarized in Table 5.

Subsequent univariate analyses identified that significant relationships existed for LEARNING ($F(1,32) = 5.01, p = .032$) and TSI ($F(1,32) = 9.23, p = .005$). The direction of these relationships did not support the hypothesis. An analysis of simple effects found a significant difference was found between low self-consciousness users in the mirror and no mirror conditions ($F(1,27) = 6.15, p = .020, MS_{\text{Error}} = 1.645$) for TSI. Low self-consciousness subjects in the mirror condition gave higher software usability ratings than low self-consciousness subjects in in the no mirror condition.

Table 5. General Characteristics
Analysis Results

Effect		MANOVA	ANOVA			
		General	Screen	Learning	TSI	System
		Characteristics				
SC x ENV x EXP	F	0.72				
	p	0.587				
ENV x EXP	F	0.27				
	p	0.895				
SC x EXP	F	0.29				
	p	0.885				
SC x ENV	F	2.75	1.82	6.16	7.61	0.63
	p	0.051	0.189	0.020	0.010	0.435
EXP	F	1.11				
	p	3.750				
ENV	F	1.00				
	p	0.427				
SC	F	0.77				
	p	0.555				
Df				(1,27)		
MS error			1.657	0.932	1.645	2.327

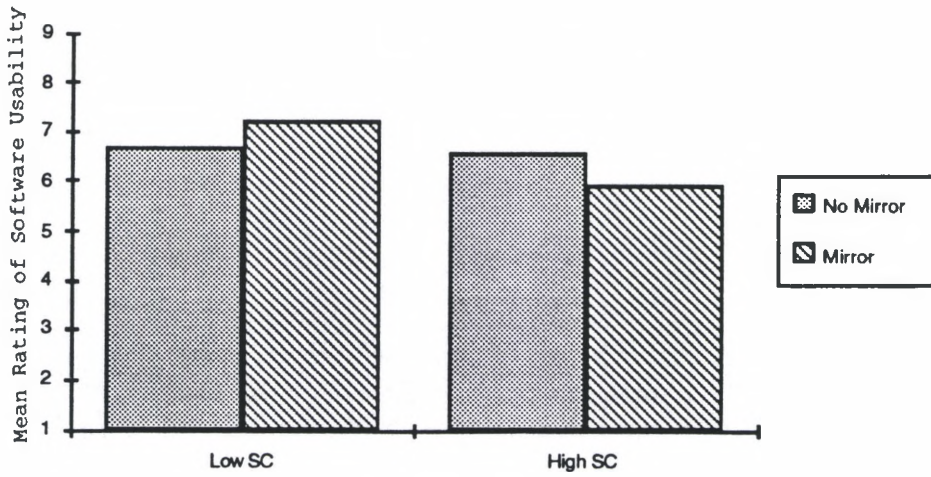
The analysis of simple effects found no significant difference between groups for Learning. Figure 8 shows the learning effect to be a crossover relationship. Low self-consciousness users in the mirror condition and high self-consciousness users in the no-mirror condition rated the software more usable than other users. No other significant results were found, nor did the pattern of any results support the hypothesis. The self-consciousness by environment interaction for each of the characteristics is illustrated in Figures 7 through 10.

Overall Evaluation

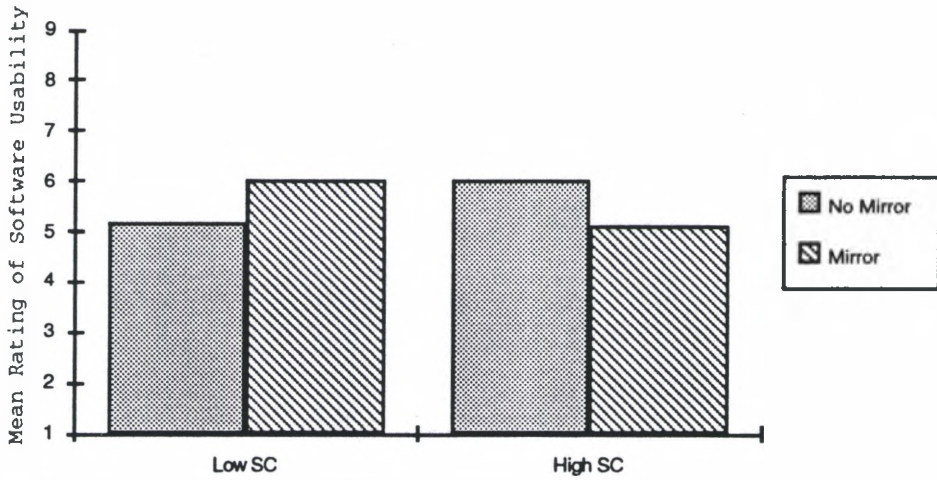
A principal components analysis (with varimax rotation) was performed to identify factors. Three factors had eigenvalues greater than 1, while a fourth factor had an eigenvalue of .858. These four factors, detailed in Table 6, accounted for 78.3% of the variability in the model.

Table 6. Overall Evaluation Factor Loading

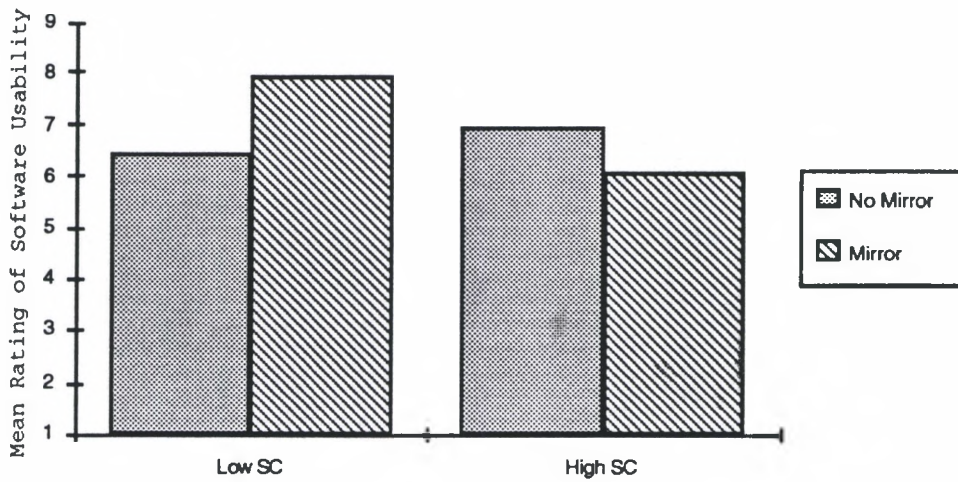
	Factor 1	Factor 2	Factor 3	Factor 4
Questions	Wonderful Easy Satisfying Simple Useful	Power Friendly	Stimulating	Flexible
Factor Name	General Impression	Functionality	Boredom	Flexibility
Eigenvalue	3.796	1.383	1.007	.858
% of Variability	42.2	15.4	11.2	9.5
Cumulative %	42.2	57.6	68.7	78.3



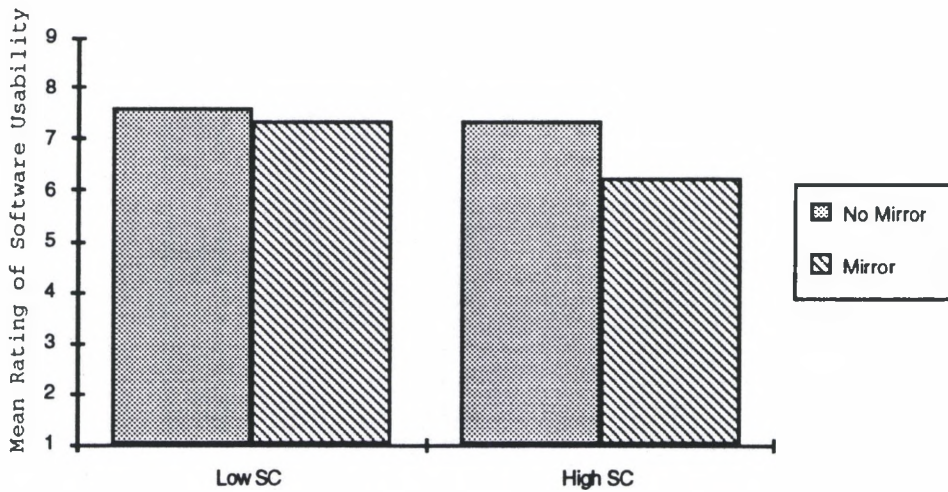
**Figure 7. Screen
Self-consciousness by Environment**



**Figure 8. Learning
Self-consciousness by Environment**



**Figure 9. Terminology and System Info
Self-consciousness by Environment**



**Figure 10. System Capabilities
Self-consciousness by Environment**

Overall evaluation questions 1 (wonderful/terrible), 2 (easy/difficult), 3 (satisfying/frustrating), 6 (simple/complicated), and 8 (useful/useless) loaded heavily to factor one, identified as the general impression factor. Questions 4 (adequate power/inadequate power) and 5 (friendly/unfriendly) loaded most heavily to factor 2 labeled functionality. Question 7 (stimulating/dull) loaded to factor 3 identified as the boredom factor. Question 9 (flexible/rigid) loaded most heavily to factor 4 called the flexibility factor.

As identified previously, the small sample size used in this study can produce unreliable factor loading. As a result the mean scores from the questions loading most heavily to a factor were used in the subsequent analyses rather than factor loadings. A 2 x 2 x 2 MANOVA was performed using the factor scores (calculated with mean values) as the dependent variables. No findings were significant. Table 7 presents the Overall Evaluation analysis results.

A univariate ANOVA was also performed examining the self-consciousness by environment interaction. There were no significant results identified. The pattern of results did not support the hypothesis in any of the factors. On factors 1, 2, and 3 subjects in the high self-consciousness and mirror condition gave the lowest ratings of any group rather than the highest. While on factor 4 subjects in the high

Table 7. Overall Evaluation
Analysis Results

Effect		MANOVA Overall Evaluation	ANOVA			
			Factor 1	Factor 2	Factor 3	Factor 4
SC x ENV x EXP	F	1.77				
	p	0.168				
ENV x EXP	F	0.38				
	p	0.818				
SC x EXP	F	0.45				
	p	0.768				
SC x ENV	F	0.27	0.74	0.25	0.50	0.67
	p	0.895	0.397	0.622	0.486	0.420
EXP	F	0.35				
	p	0.844				
ENV	F	0.89				
	p	0.486				
SC	F	1.78				
	p	0.166				
Df				(1,27)		
MS error			2.272	1.543	3.981	2.658

self-consciousness and mirror condition did give the highest score, it was only marginally higher than other high self-consciousness subjects. The results of the self-consciousness by environment interaction for each of the factors is shown in Figures 11 to 14.

Attribution Evaluation

Subjects were asked to rate the degree of influence that each of 9 potential factors exerted on their performance. These factors were rated on a scale from "strong negative influence" to "strong positive influence". Two classes of factors were rated: factors which were external to the person (e.g. Manuals) and factors which were internal to the person (e.g. ability to learn new skills). These questions were designed to encourage the subjects to make attributions for their successes and failures.

The 9 attribution questions were grouped into 2 classes based on whether these factors addressed objects which were external to the person (such as the manuals) or factors which were internal to the person (such as their ability to learn new skills). The assignment to classes is detailed in Table 8.

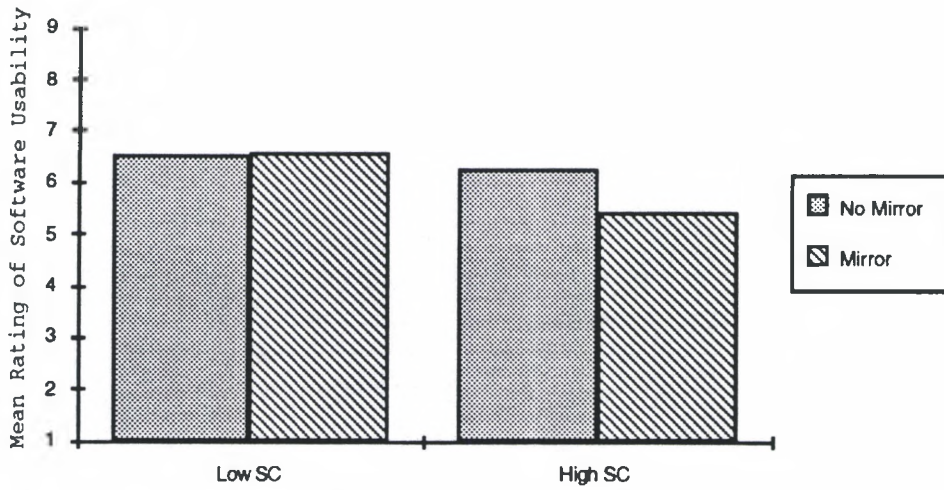


Figure 11. General Impression (Factor 1)
Self-consciousness by Environment

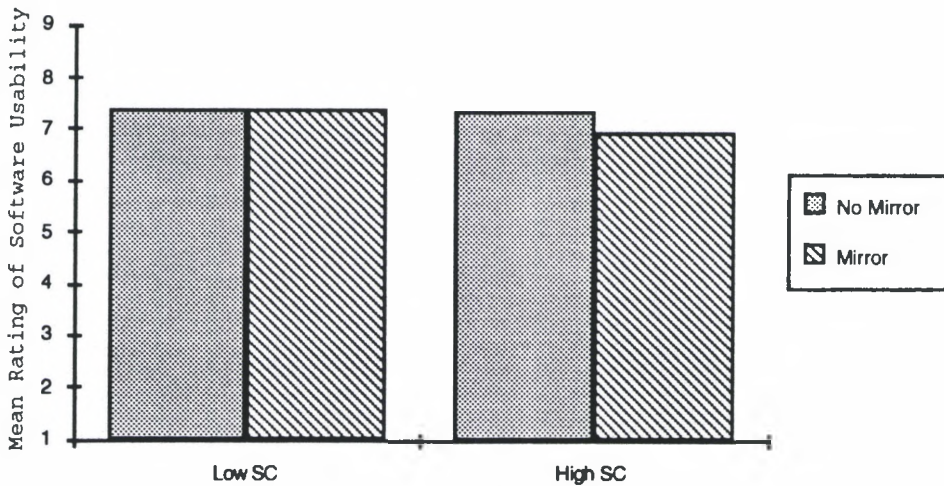
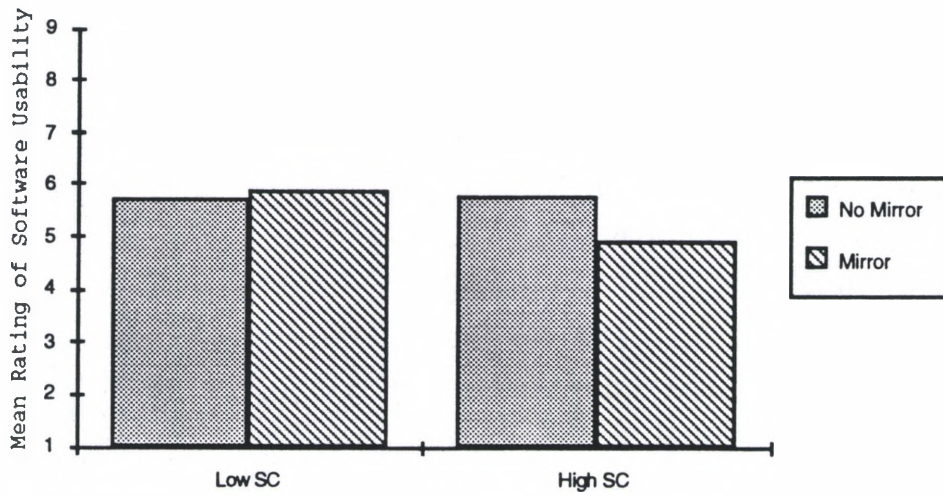
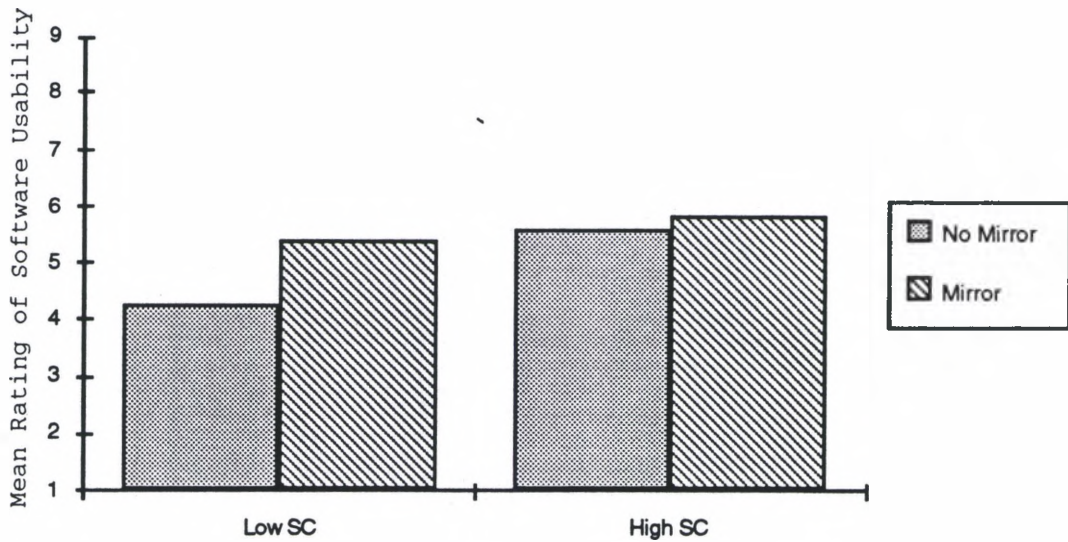


Figure 12. Functionality (Factor 2)
Self-consciousness by Environment



**Figure 13. Boredom (Factor 3)
Self-consciousness by Environment**



**Figure 14. Flexibility (Factor 4)
Self-consciousness by Environment**

Table 8. Attribution Question Categorization

Attribution to:	OTHER	SELF
	Tutor Program	Computer Experience
	Help Menus	Word Processing Experience
	Manuals	Typing Ability
	Menu System	Skill Acquisition
	Session Lengths	

The mean score of those questions grouped into each category were used to form the attribution to **self** and **other** categories. Using the mean ratings for each category, a 2x2x2 MANOVA was performed. Significant results were found for Experience. No other significant results were found.

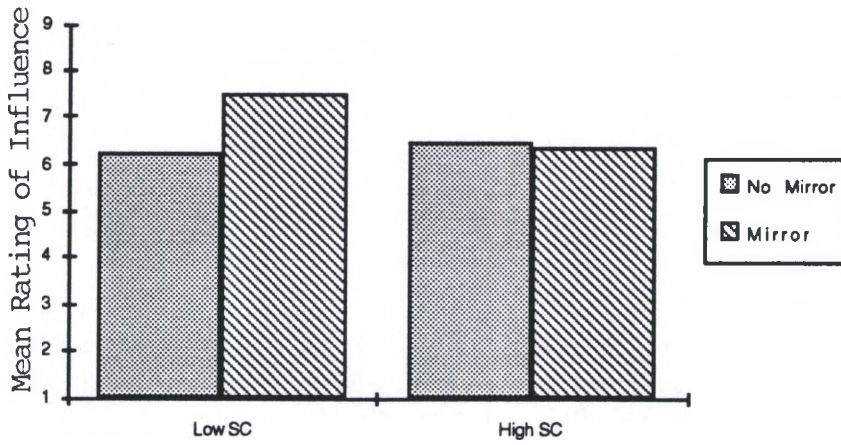
A post hoc univariate analysis was performed evaluating the effects of experience on attribution to self and to other. The results of these analyses are displayed in Table 9. Experienced subjects attributed more of their success ($m = 7.45$) to themselves than did novice subjects ($m = 5.75$). The ANOVA analysis for the self-consciousness by environment interaction yielded no significant results, nor did the pattern of results support the hypothesis.

It was predicted that subjects in the high self-consciousness and mirror condition would have the lowest scores on questions attributing performance to themselves (Self) and the highest scores on questions attributing performance to outside factors (Other). Contrary to

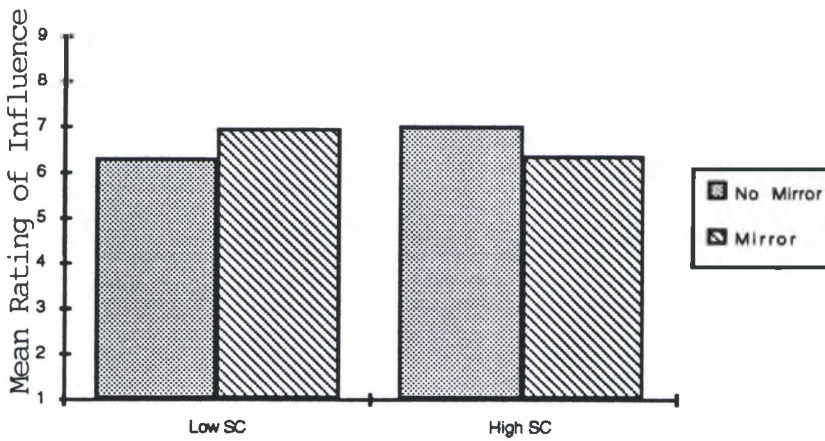
Table 9. Attribution Analysis Results

Effect		MANOVA	ANOVA	
		Attribution	Self	Other
SC x ENV x EXP	F	0.58		
	p	0.567		
ENV x EXP	F	0.23		
	p	0.796		
SC x EXP	F	0.44		
	p	0.652		
SC x ENV	F	0.22	2.86	2.60
	p	0.129	0.103	0.119
EXP	F	10.39	19.86	0.23
	p	0.001	0.000	0.635
ENV	F	1.08		
	p	0.356		
SC	F	0.73		
	p	0.492		
Df			(1,26)	
MS error			1.342	1.182

predictions the high self-consciousness subjects in the mirror condition did not provide lower ratings to Self factors nor higher ratings to Other factors. The ratings are presented in Figures 15 and 16.



**Figure 15. Self Attribution
Self-consciousness by Environment**



**Figure 16. Other Attribution
Self-consciousness by Environment**

CHAPTER 4

DISCUSSION

The results of this study did not support the hypothesis that subjects in a laboratory environment, particularly highly self-conscious subjects, would provide inflated positive ratings of software usability. This hypothesis was based on the research indicating that the presence of mirrors and cameras can alter an individual's attribution patterns, causing a person to attribute errors to themselves artificially inflating the usability rating. It was assumed that subjective software evaluations could be viewed as attributions in which the rater attributed their performance to either themselves or the software.

There are several explanations for the failure to replicate the classic attribution findings in the software evaluation setting. In previous attribution research a subject's actual success or failure was not readily apparent to the subject. The researchers then provided "bogus" performance feedback indicating either success or failure. In a software evaluation setting a subject's performance is much more apparent to the subject and the researcher generally does not provide any performance feedback. It

could be concluded that the shift in the direction of the attributions is dependent upon the ambiguity of the situation or in being provided with "unexpected" results.

Alternatively, these results may be due to methodological shortcomings in the present study. Several plausible methodological explanations exist for this failure to support the hypothesis.

Subjects Never Experienced Failure

The literature on which this experiment is based (Arkin et al., 1980 and Scheier 1976) contains only examples in which the outcome, success or failure, is "controlled" by the experimenter. In these classic studies the subjects' performance level is apparent. The nature of this experiment is such that the subject may not have a clear understanding of their own performance level. The hypothesized ratings were based upon subjects experiencing *failure*. In the lack of specific feedback regarding success or failure subjects may have considered themselves successful.

This research methodology also differed from most usability tests in that subjects did not have to stay on a difficult task until they completed the task. The nature of the unobserved (no mirrors or cameras) condition, allowed subjects to skip difficult tasks, or complete them through alternate methods, without intervention from the researcher. In order to keep the conditions comparable, no intervention was made in the mirror and camera condition either. As a

result subjects in this experiment may have been less likely to experience failure than most usability testing subjects.

Weary (1980) has demonstrated that the degree of self attribution differs between failure and success conditions. This research also indicates that environment interacts with level of success in the effects on self attribution. No mention is made of the effects of self-consciousness traits. A successful subject is likely to make different attributions than a non-successful subject.

Alternatively, subjects may not have experienced failure because the tasks selected may have been too easy. Many subjects (14 of 40) attempted all tasks. The mean number of errors was 3.28 from a possible of 52 tasks. Based on this data it appears that many subjects were, in fact, relatively successful in performing the tasks. Future studies should consider selecting a more difficult task set.

Combining Scales Impacted Results

Combining the social anxiety and public self-consciousness scales may have impacted the results in this study. Previous research indicated that both of these "traits" individually interacted with environment to impact on subjects' attributions. This study utilized a mean of these two trait scales. It is conceivable that this approach did not identify those individuals highest in these traits, due to the low correlation (.20) between these scales (Fenigstein, Scheier, and Buss, 1975). Selecting subjects

based on one scale or the other may have produced the expected results, and is recommended for future studies.

It must be noted, however, that this combination of scales did result in anticipated performance differences between groups. Users in the high self-consciousness group made more errors than did users in the low self-consciousness group. This suggests that the combined scales may have produced a valid measure of self-consciousness.

Environmental Conditions Were too Similar

The two testing environments, mirror and no mirror, may have been too similar, reducing the effect of this variable. Both conditions retained a laboratory *environment*, both conditions presented subjects with a checklist regarding the number of steps completed, and all subjects saved work files. In addition, all subject entered the testing room past a series of laboratory rooms. Subjects in both conditions may have perceived a "public scrutiny" condition negating the planned differences in conditions. More carefully selected testing settings in which the laboratory setting is not as apparent is recommended for future studies.

Conclusions

The possible effects that the testing environment may have on the subjective evaluation of software usability is still unclear. Due to the equivocal results, additional research in this area is important because of the number of

flaws in the research design. Future research should consider several enhancements to this research design. First, the collection of additional performance data (ideally a keystroke by keystroke data capture) to accompany the subjective data may clarify the relationship between actual performance and subjective ratings. Second, the selection of more difficult tasks may help insure that subjects experience some degree of failure. Third, the difference between the two testing environment could be increased. Finally, one subscale from the self-consciousness scale should be selected rather than trying to combine two scales. The social anxiety subscale is recommended since this scale was used in the previous research (Arkin, Appelman, and Burger, 1980) on which this study is most closely modeled.

If the results of this research are taken at face value, in spite of the research shortcomings, it would question the applicability of the self-serving bias research to the software testing environment. The classic self-serving bias research is very structured, providing controlled feedback regarding performance. Subjects were informed of their "performance" level. In a less structured environment these results may not hold true. Additional studies of attribution shifts without controlled feedback are needed to bolster this theoretical approach.

Alternatively, it could be concluded that subjective software evaluations are not attributions in the theoretical

sense. As a result the underlying assumption on which this research was based, that subjective evaluations operate similarly to attributions, is invalid.

APPENDIX A
SELF-CONSCIOUSNESS SCALE

Instructions:

On the following page are 23 statements that may or may not be characteristic of you. Please read each one carefully and decide if it is characteristic of you or not. Use the blank next to each statement to mark your responses. Please respond to all items, and use the following response pattern:

Mark A: if the statement is extremely uncharacteristic of you.

Mark B: if the statement is somewhat uncharacteristic of you.

Mark C: if the statement is neither characteristic or uncharacteristic of you.

Mark D: if the statement is somewhat characteristic of you.

Mark E: if the statement is extremely characteristic of you.

- _____1. I'm always trying to figure myself out.
- _____2. I'm concerned about my style of doing things.
- _____3. Generally, I'm not very aware of myself.
- _____4. It takes me time to overcome my shyness in new situations.
- _____5. I reflect about myself a lot.
- _____6. I'm concerned about the way I present myself.
- _____7. I'm often the subject of my own fantasies.
- _____8. I have trouble working when someone is watching me.
- _____9. I never scrutinize myself.
- _____10. I get embarrassed very easily.
- _____11. I'm self-conscious about the way I look.
- _____12. I don't find it hard to talk to strangers.
- _____13. I'm generally attentive to my inner feelings.
- _____14. I usually worry about making a good impression.
- _____15. I'm constantly examining my motives.
- _____16. I feel anxious when I speak in front of a group.
- _____17. One of the last thing I do before I leave my house is look in the mirror.
- _____18. I sometimes have the feeling that I'm off somewhere watching myself.
- _____19. I'm concerned about what other people think of me.
- _____20. I'm alert to changes in my mood.
- _____21. I'm aware of the way my mind works when I work through a problem.
- _____22. Large groups make me nervous.

APPENDIX B

QUESTIONNAIRE FOR USER INTERFACE SATISFACTION (Modified)

Name _____

Evaluation of
WordStar 3.3

The following represent specific dimensions along which we would like you to evaluate WordStar 3.3. Associated with each dimension is a number scale which indicates degrees of opinion between two opposite extremes of that dimension. Circle the number which represents your evaluation of specific features and general characteristics of WordStar 3.3 along the specific dimensions.

I. EVALUATION OF SPECIFIC FEATURES

Ability to:	Difficult									Easy
Create a new file	1	2	3	4	5	6	7	8	9	
Enter text into a file	1	2	3	4	5	6	7	8	9	
Save a file	1	2	3	4	5	6	7	8	9	
Exit	1	2	3	4	5	6	7	8	9	
Load an existing file	1	2	3	4	5	6	7	8	9	
Move text	1	2	3	4	5	6	7	8	9	
Delete text	1	2	3	4	5	6	7	8	9	
Find and replace	1	2	3	4	5	6	7	8	9	
Use a spell checker	1	2	3	4	5	6	7	8	9	
Use the help screen	1	2	3	4	5	6	7	8	9	
Use the menus	1	2	3	4	5	6	7	8	9	
Move around the screen	1	2	3	4	5	6	7	8	9	

II. EVALUATION OF GENERAL CHARACTERISTICS

Organization of information on the screens:

CONFUSING 1 2 3 4 5 6 7 8 9 VERY CLEAR

Overall appearance of the screens:

PLEASANT 1 2 3 4 5 6 7 8 9 UNPLEASANT

Ability to figure out what to do on each screen:

DIFFICULT 1 2 3 4 5 6 7 8 9 EASY

Use of terms throughout the system:

INCONSISTENT 1 2 3 4 5 6 7 8 9 CONSISTENT

Placement of messages on the screens:

INCONSISTENT 1 2 3 4 5 6 7 8 9 CONSISTENT

Computer keeps you informed about what it is doing:

ALWAYS 1 2 3 4 5 6 7 8 9 NEVER

Learning to operate the software

EASY 1 2 3 4 5 6 7 8 9 DIFFICULT

Remembering names and uses of commands:

DIFFICULT 1 2 3 4 5 6 7 8 9 EASY

Tasks can be performed in a straight-forward manner:

NEVER 1 2 3 4 5 6 7 8 9 ALWAYS

Help messages on the screen:

HELPFUL 1 2 3 4 5 6 7 8 9 UNHELPFUL

Supplementary reference material:

HELPFUL 1 2 3 4 5 6 7 8 9 UNHELPFUL

System response time:

FAST 1 2 3 4 5 6 7 8 9 SLOW

Correcting mistakes:

DIFFICULT 1 2 3 4 5 6 7 8 9 EASY

III. OVERALL EVALUATION

The following are pairs of adjectives which represent opposite extremes of a dimension. Associated with each dimension is a number scale which indicates degrees of opinion along that dimension. Circle the number which best represents your overall evaluation of WordStar 3.3 along the specified dimensions.

WONDERFUL	1	2	3	4	5	6	7	8	9	TERRIBLE
DIFFICULT	1	2	3	4	5	6	7	8	9	EASY
SATISFYING	1	2	3	4	5	6	7	8	9	FRUSTRATING
INADEQUATE POWER	1	2	3	4	5	6	7	8	9	ADEQUATE POWER
UNFRIENDLY	1	2	3	4	5	6	7	8	9	FRIENDLY
SIMPLE	1	2	3	4	5	6	7	8	9	COMPLICATED
DULL	1	2	3	4	5	6	7	8	9	STIMULATING
USEFUL	1	2	3	4	5	6	7	8	9	USELESS
RIGID	1	2	3	4	5	6	7	8	9	FLEXIBLE

Overall Rating (check one):

- Excellent
- Good
- Average
- Fair
- Poor
- Not Usable

Please indicate how much influence each of the following factors had on your ability to perform the tasks.

	Strong Negative Influence					Strong Positive Influence			
	1	2	3	4	5	6	7	8	9
Tutor program	1	2	3	4	5	6	7	8	9
Help menus	1	2	3	4	5	6	7	8	9
Manuals	1	2	3	4	5	6	7	8	9
Menu system	1	2	3	4	5	6	7	8	9
Session lengths	1	2	3	4	5	6	7	8	9
Your experience with computers	1	2	3	4	5	6	7	8	9
Your experience with word processors	1	2	3	4	5	6	7	8	9
Your typing	1	2	3	4	5	6	7	8	9
Your ability to learn new skills	1	2	3	4	5	6	7	8	9

APPENDIX C
TASKS ASSIGNED TO SUBJECTS

DOCUMENT 1

My dear Mr. Grauer:

Thank you for your check for \$10.50 which accompanied your order of July 7. You should receive the goods within twenty-four hours, as we have already shipped them.

We are taking the liberty of enclosing a special announcement of a discount sale, to be held next month, that we are sending now to a selected list of customers.

Yours very truly,
Pat Fennimore

DOCUMENT 2

A ~~Friday~~, 8 April 1976

Dear Sir or Madam:

I take genuine pleasure in recommending Robin Smart as Office Manager in your organization.

For many years I have known her personally, as well as her family, and during her five years in business I have followed her progress with much interest. She is a young woman of culture and education, high ideals, and sound integrity. Her originality of ideas and capacity for hard work have been outstanding characteristics ever since her high-school days. So far as I am concerned, you may tell her what I have said--I've often told her so myself.

B I honestly believe that your firm would be fortunate in obtaining her services.

C ~~Sincerely yours~~, Very truly yours,
Dale Stokely

DOCUMENT 3

D Greetingings:

E Will you please send me infor^{ti}on on your grounds service for suburban residences? If it is what I need and want, and is satisfactory as to price, I shall be glad to subscribe to it. I might wish partial, or perhaps complete, service.

f I have a ~~rather large~~ ten-room house, situated on two acres of ground. There is a privet hedge extending for ^{one} hundred and fifty feet along the front; two flower gardens, approximately 60 by 15 feet, in the rear; and two large lawns to be kept weeded and mowed. There is also a considerable number of shrubs and a grape arbor that require pruning. Will you knidly let me know, too, if
H your service is year-round, including ~~clearing~~ of walks and driveways after winter storms?

I I shall appre_ciate hearing from you as soon as possible.

J Yours^ltruly,
Les Eggleston

DOCUMENT 4

Lee Caulkins
2320 S. Sevren St.
Meadow City, La.

K 25 May 1977

My dear Lee Caulkins:

L ~~Thank you for bringing your missing order to our attention.~~ This
M note is to confirm our telephone conversation, according to your
request.

We would willingly take the blame if it were ours, but we have checked thoroughly on the delay in delivery of your order, and have found that everything was promptly and efficiently taken care of at this end. The order was correctly filled, carefully packed, and promptly shipped on June 16, via Trans-State Trucking Service.

N We have already reported your complaint to that service. ^{trailer} A tracer
D is now out. In the meantime, however, we have made up a duplicate of your order and it is already on its way to you by special truck, at our expense. As you see, we have done our best to correct matters, for we value you as one of our most highly esteemed customers. Thank you for letting us know at once about the delay, and we trust that you will receive the duplicate shipment promptly.

Yours very truly,
Jan Ward

We fail to understand how this trouble occurred.

DOCUMENT 5

Dear Sir:

This is a special letter to you as one of our most valued dealer-customers.

Because of the steady pressure of costs, we shall regretfully be obliged to advance by ten per cent our entire line of pen-and-pencil sets, beginning the first of this coming month. Even at some loss to ourselves, we have postponed taking this step until the last possible moment.

Of course, our Sales Department will send you an official notice within a day or two, but we feel that there are certain especially good business friends--you among them--who deserve preliminary notification like this.

As you know, we do not carry a very large stock, so act now and place your order while you can still benefit from this special opportunity.

Yours truly,
Kelly R. Kennedy

DOCUMENT 6

4 November 1951

Dear Customer:

This is our Tenth Anniversary--but you are having the party!

Q After all, that's absolutely appropriate, for it's you, and other
R good and loyal customers like you, who, by their generous and
continual patronage, have made our mail-order business flourish,
so each of our anniversaries has been bigger and better.

5 All our patrons, old and new, can enjoy the party for the next two
weeks. And it will really be a good party--with a dozen great
bargains for you and hundreds of other friends. ~~These bargains
cannot be duplicated by any department store in your area.~~

The enclosed post cards, which can be used for your orders, give
you an idea of what is in store for you.

7 (Note, for instance, how we have slashed prices on men's fine
handkerchiefs with corded borders and rolled edges; spun nylon
socks; three-year-guaranteed stainless-steel cutlery; long-wearing
auto-seat covers; and other items.

Look over the enclosed cards now, and find out what are the
articles that you want and need. We may not be able to offer you
these wonderfully low anniversary prices again--these phenomenal
savings for you, your family, your home.

You have a week's trial, free, of any starred article you select.
Merchandise is prepaid to your door. If you're not entirely
satisfied, return the goods, and owe us nothing.

U Yours for anniversary savings,
Dana E. Hastings
President, Buy-Mail Corporation

Y Enclosures

This opportunity may not occur
again. Mail your order cards
IMMEDIATELY!

DOCUMENT 7

W Blake's Large Appliances
 4321 S. Wescombe St. 512 Prospect Ave.
 Rock Island, Illinois

X 18 May 1973

Greetings:

Y I am answering promptly your letter of yesterday, urging me to settle my account, now three months overdue, for I want you to know that I am sincere and have no desire to disregard my obligations.

Z In reply to a similar letter of yours two weeks ago, I explained that I was having some financial difficulty, and asked that you bear with me a little longer. You know that until recently my credit with you was excellent, and this fact should convince you that I am not now trying to evade my just debts. Certainly such is not the case.

AA ~~Here is a fuller explanation of my situation:~~

I did not go into details before, because I presumed that my statement about financial troubles would be satisfactory to you. But now let me tell you that within the period in question both my husband and I have been ill, and that my husband's case has required very considerable medical expense and hospitalization.)

BB (Moreover, since my work is on a straight commission basis, and I was ill for some time, my income was seriously depleted.

CC I feel sure that you will understand my explanation, which is given in all good faith and without exaggeration. I should be glad to refer you to our physician for corroboration of my statements. I merely ask that you grant me a little more time and I will fully meet all my obligations.

DD Yours very truly,
 Kimberly M Heatley

Now I am back at work,
 but I cannot very soon
 recoup my losses, particularly
 since my husband is still
 under a physician's care.

DOCUMENT 8

My dear Mr. Atkinson:

You remember the series of cartoons, "What's wrong with this picture?"

Well, how about this one?

EE You're a bit late waking up, on a cold winter morning. The house seems unusually chilly. You dress ~~in a flash~~ and rush down to the furnace. You guessed it--the fire needs artificial respiration, and a lot of it. It's dying. You desperately get to work--and you know what happens at a time like this. Everything goes wrong.

FF
66 You shake the grate, as a terrier shakes a rat--yes, there are a few red coals. So you shovel the ashes and dead coals from under the grate, nicking your hand on the edge of the furnace, and covering your suit and hair with a fine white dust. Now you shovel fresh coal on top of the red embers, open the draft wide, and tear
66 upstairs to clean up, shave, and bolt down some breakfast. Then back downstairs, keeping your fingers crossed. No good. The fire is dead!

HH ^{Well, you know the rest.}
~~You are certainly familiar with the rest of the story.~~ Empty the remains, wrestle with coal and kindling, perhaps some of it damp, miss a couple of trains, and finally get to the office an hour or so late, and all out of sorts. And this is a repeat performance--perhaps sometimes with your wife in the uncomfortable starring role, when you are away.

II (Our E-Z Automatic Stoker will solve your problem.)

Quiet, dependable, it feeds coal to your furnace as needed, and it is equipped with a thermostat so that you can get just the heat you want. And it is simply and quickly installed.

Mail the card enclosed, or telephone Atwater 341, and our representative will call on you at once and inform you of the exact cost of an installation for you.

JT Yours very truly,
E-Z Automatic Stoker, Inc.

P.S. The present moderate prices may have to be raised. Don't delay. Act now.

DOCUMENT 9

Dear Madam:

I am taking the liberty of writing this letter to you, the Editor-in-Chief, because I believe that you personally may be interested in my services.

LI, AN After my college graduation, I worked three years for the Benson Publishing Company, in the Assistant Editor's office. My work comprised editing manuscripts of many types, helping in the interviewing of prospective authors, conferring with the Assistant Editor about the acceptance of manuscripts, and doing considerable research and rewriting on some of those that were accepted.

NN I am twenty-four years old, unmarried, a graduate of Columbia University, School of Journalism, 1969, rating among the first five of a class numbering one hundred. During my college years, I worked for three summers in the Production Department of Rivers and Company, assisting in various capacities and learning methods and techniques in preparation for an editorial career. In my junior and senior years, I was Assistant Editor of the college newspaper, The Spectator.

OO, PP QQ For the last two years, I have been Assistant Editor at Wesley House, and in that capacity, I have handled a great deal of the fiction that the firm has published during the past year.

RA Here, again, I have worked with authors, including much consultation and collaboration while they were writing their manuscripts. This procedure saved the firm considerable editorial expense after the manuscripts were accepted for publication. My relations in my present position are mutually pleasant, but I feel I can use my ability to still better advantage. I believe that my services are worth \$200 a week.

SS I should sincerely appreciate the courtesy of an interview at your convenience. ~~I am sure this would be to our mutual benefit.~~

In that event, I shall of course bring with me the best of references
Very truly yours,
Kelly M. Starr

JK P.S. If you need to reach me during the day, please call 619-3100, extension 515.

DOCUMENT 10

Dear Sandy,

I just can't get used to the fact that you're not in our old home town any more, nor in the office with me. Let's see, how long is it now since you left here? The calendar says it is eight months, and you can't argue with the calendar, though I'm inclined to do just that.

UU Neither of us is a very good correspondant, but I think it's my
VV turn to write, and first of all I want to say, give me more news about yourself. Is the new job out there on the Coast proving worth your having made the move? Is the manager easy to get along with, and does he appreciate your talents and ability? I've heard he is rather "hard boiled." How about recreation? Is there a good bowling club for you to join? I know you'd be lost without one.
WW Have you found a good apartment? Last time you wrote, you were still looking.

XX As for me, you'll be glad to hear that I am to be promoted next month--Assistant Sales Manager, no less! You'll have to call me "Ma'am" after this. I'll get considerably more salary and that will be most welcome, with the cost of living apparently going up indefinitely. Lou Mayer and I plan to spend our vacation together next summer at Lake Placid. He likes the outdoors as much as I do.
YY Chris Turner in our office--you remember her--has at last become engaged to Pat Macy, the Personnel Manager. We all saw that coming--or perhaps she didn't. And, oh yes, the town has condemned the property at 12 Walnut Street. About time, everybody says. It certainly was an eyesore.

Well, that's about all. How am I doing? Please do at least as well when you answer, and let that be soon, Sandy.
ZZ As Always,
Lee

Checklist

Document 1

- _____ Create the document EX1
- _____ Type the letter
- _____ Save the document EX1

Document 2

- _____ Get the file EX2
- _____ A) Add the date line
- _____ B) Remove the paragraph without using the "del" key
- _____ C) Change the closing as indicated
- _____ Save the file EX2

Document 3

- _____ Get the file EX3
- _____ D) Correct the spelling
- _____ E) Correct the spelling
- _____ F) Remove the words indicated
- _____ G) Add the word "about" where indicated
- _____ H) Change "clearing" to "shoveling" without using the "del" key
- _____ I) Eliminate the unwanted space
- _____ J) Separate the words with a space
- _____ Save the file EX3

Document 4

- _____ Get the file EX4
- _____ K) Move the date line -- do not delete and retype
- _____ L) Erase the first sentence
- _____ M) Combine these two paragraphs
- _____ N) Combine these sentences as indicated
- _____ O) Add the indicated sentence
- _____ Save the file EX4

Document 5

- _____ Get the file EX5
- _____ P) Using the functions of WordStar, find the word "stock"
- _____ Save the file EX5

Document 6

- _____ Get the file Q1
- _____ Q) Correct the spelling
- _____ R) Add the word "that"
- _____ S) Delete the sentence
- _____ T) Combine these paragraphs
- _____ U) Add the paragraph as indicated
- _____ V) Add "enclosures"
- _____ Save the file Q1

Document 7

- _____ Get the file Q2
- _____ W) Change the address
- _____ X) Move the date
- _____ Z) Place a space between the words
- _____ G) Add the word "about" where indicated
- _____ AA) Remove the paragraph
- _____ BB) Combine these paragraphs
- _____ CC) Add the paragraph indicated
- _____ DD) Add the closing
- _____ Save the file Q2

Document 8

- _____ Get the file Q3
- _____ EE) Change "in a flash" to "hurriedly"
- _____ FF) Add a space between the words
- _____ GG) Correct the spelling
- _____ HH) Change the sentence
- _____ II) Combine the paragraphs
- _____ JJ) Place the P.S. into the body of the letter
- _____ Save the file Q3

Document 9

- _____ Get the file Q4
- _____ KK) Find the word "saved" in the letter
- _____ LL) Add the word "different"
- _____ MM) Eliminate the unwanted space
- _____ NN) Move this paragraph
- _____ OO) Add a period
- _____ PP) Delete the "and"; Capitalize the "i"
- _____ QQ) Combine the paragraphs
- _____ RR) Start a new paragraph
- _____ SS) Replace the sentence with the one indicated
- _____ TT) Delete the P.S.
- _____ Save the file Q4

Document 10

- _____ Get the file Q5
- _____ UU) Correct the spelling
- _____ VV) Add the space
- _____ WW) Move the last two sentences
- _____ XX) Change "call me" to "address me as"
- _____ YY) Begin a new paragraph
- _____ ZZ) Add the closing "As always"
- _____ Save the file Q5

APPENDIX D
DATA RESULTS

**Performance Means
Novice**

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
Attempts	35.50 (11.56)	37.40 (20.07)	44.00 (11.31)	28.67 (7.57)
Errors	0.85 (1.01)	2.48 (0.89)	1.82 (0.75)	2.23 (1.23)

Experienced

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
Attempts	43.25 (3.10)	46.40 (9.53)	41.60 (15.90)	46.40 (7.40)
Errors	0.75 (0.50)	1.78 (0.53)	0.97 (1.03)	1.12 (1.30)

**Specific Features Means
Novice**

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
Factor 1				
System Commands	8.44 (0.51)	7.93 (1.36)	8.33 (0.82)	7.11 (2.01)
Factor 2				
Create	6.22 (3.10)	6.48 (1.19)	7.17 (1.55)	7.00 (0.67)
Factor 3				
Delete/Replace	6.67 (1.89)	6.90 (1.78)	7.38 (1.25)	5.83 (1.04)
Factor 4				
Spell Check	4.00 (1.00)	4.60 (2.97)	6.50 (1.92)	5.67 (3.06)

Experienced

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
Factor 1				
System Commands	8.83 (0.24)	6.83 (3.15)	8.44 (0.96)	8.00 (1.03)
Factor 2				
Create	7.00 (0.00)	7.00 (2.11)	8.67 (0.00)	5.80 (1.61)
Factor 3				
Delete/Replace	6.50 (0.71)	7.88 (0.75)	8.00 (1.00)	6.20 (1.61)
Factor 4				
Spell Check	4.50 (2.12)	4.50 (2.52)	5.67 (1.17)	5.20 (3.42)

Overall Evaluation Means

		Novice			
		No Mirror		Mirror	
		Low SC	High SC	Low SC	High SC
Factor 1					
General Impressions	6.80 (1.61)	6.48 (1.21)	7.10 (1.16)	5.40 (1.11)	
Factor 2					
Functionality	7.75 (0.96)	7.60 (0.82)	7.00 (2.04)	7.00 (0.87)	
Factor 3					
Boredom	6.50 (2.08)	6.00 (2.00)	6.50 (1.29)	4.67 (2.52)	
Factor 4					
Flexibility	4.75 (0.50)	5.00 (1.41)	5.00 (2.71)	6.67 (1.58)	
		Experienced			
		No Mirror		Mirror	
		Low SC	High SC	Low SC	High SC
Factor 1					
General Impressions	6.20 (1.12)	6.04 (2.24)	6.00 (1.88)	5.44 (0.91)	
Factor 2					
Functionality	7.00 (1.08)	7.10 (1.39)	7.80 (0.57)	6.90 (1.56)	
Factor 3					
Boredom	5.00 (2.00)	5.60 (2.07)	5.20 (2.17)	5.20 (1.79)	
Factor 4					
Flexibility	3.75 (1.50)	6.20 (1.92)	5.80 (1.30)	5.00 (1.41)	

General Characteristic Means**Novice**

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
SCR	7.10 (1.09)	6.60 (1.33)	7.45 (0.77)	6.00 (1.00)
LNG	5.53 (1.33)	5.70 (0.76)	6.04 (0.61)	5.10 (1.48)
TSI	7.08 (2.35)	7.20 (1.21)	8.00 (0.86)	6.44 (0.77)
SC	7.63 (0.75)	6.80 (2.78)	6.88 (1.65)	6.67 (1.44)

Experienced

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
SCR	6.25 (0.19)	6.52 (2.20)	6.96 (1.14)	5.80 (1.18)
LNG	5.03 (0.99)	6.30 (1.14)	5.97 (0.71)	5.07 (0.69)
TSI	5.75 (1.62)	6.73 (1.14)	7.93 (0.64)	5.73 (0.98)
SC	7.63 (1.25)	7.90 (1.03)	7.80 (1.10)	5.80 (1.03)

Attribution Category Means**Novice**

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
Self	5.18 (1.20)	5.45 (2.19)	7.17 (0.88)	5.17 (1.04)
Other	6.50 (1.82)	7.04 (0.74)	7.07 (0.90)	6.63 (0.71)

Experienced

	No Mirror		Mirror	
	Low SC	High SC	Low SC	High SC
Self	7.31 (0.63)	7.45 (0.37)	7.90 (0.58)	7.55 (1.08)
Other	6.15 (0.64)	6.88 (1.41)	6.80 (1.07)	6.36 (0.68)

APPENDIX E
INSTRUCTIONS

Day 1 Instructions No Mirror Condition

Day 1 Instructions

Thank you in advance for your participation in an evaluation of WordStar 3.3. WordStar is a commonly used word processing package, which has several versions including the one that you will be learning. In learning to use a word processor, you will find that it will assist you to prepare letters and reports. It can be quite useful to you while a student and later in life.

Today will be spent learning to operate WordStar 3.3. You will be provided with a computerized tutorial to assist you in this process. This tutorial consists of several lessons; please complete them in order. Pay careful attention to each exercise, as you will need these skills later. In addition to the tutorial program, there will be a manual available which you can refer to as necessary.

In two days you will return to this room to complete an evaluation of the software. At this point you will be asked to complete a series of tasks using WordStar and then share your impressions of using it.

I want to make it clear at this point that it is WordStar that is being evaluated in this experiment, not you. You play an important part in this evaluation because it is you who will be providing us information about the usability of this product.

Do you have any questions?

Day 1 Instructions Mirror Condition

Day 1 Instructions

Thank you in advance for your participation in an evaluation of WordStar 3.3. WordStar is a commonly used word processing package, which has several versions including the one that you will be learning. In learning to use a word processor, you will find that it will assist you to prepare letters and reports. It can be quite useful to you while a student and later in life.

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In two days you will return to this room to complete an evaluation of the software. At this point you will be asked to complete a series of tasks using WordStar and then share your impressions of using it.

You have undoubtedly noticed the mirrors and cameras which are present in this room. These are present to help identify areas of the software and manual which are especially troublesome. I will be observing through this mirror and the camera will tape these sessions for later analysis. Do not be nervous about the presence of the camera and mirrors, you will find that after a short time you will not even notice they exist.

I want to make it clear at this point that it is WordStar that is being evaluated in this experiment, not you. You play an important part in this evaluation because it is you who will be providing us information about the usability of this product.

Do you have any questions?

Day 1 & 2 Instructions All Conditions

You are now ready to begin the first day's activities. Today you will be learning to use WordStar. The computer has been turned on and a menu from which you can access each of the lessons is on the screen. Please complete each of the lessons in order. If for some reason you encounter a problem from which you cannot recover, knock on this door and I will assist you.

If for any reason you feel uncomfortable during these sessions, you have the right to end the session; however, you will only be given credit for the actual time you participated.

Do you have any questions?

Instructions for Completing Tutorials

Please remember to pay close attention to the information in the tutorials. Avoid the temptation to merely press the keys that the program tells you to press. Take the time to understand what you are doing. This will help you both in the next part of the evaluation, and also in using a word processor for personal projects.

In order to start the tutorials once you have entered WordStar, you should choose the "Run a program" option from the menu. Do this by pressing "R". The first program you will use is the quick tutor. Choose this selection from the options. Complete all of the exercises in this lesson.

Repeat this procedure choosing "Tutor1" as the program.

Repeat this procedure choosing "Tutor2" as the program. Start with Option 1. For "Tutor3" you may start with Option 2. For Tutors 4-6 start with Option 1.

Instructions Day 2

Today you are going to evaluate the usability of WordStar. You will be given a series of tasks to perform. The directions for each task are provided, along with a checklist, on separate sheets of paper. Please attempt each task in order. If you cannot complete a task, you may go on to the next task. As you complete each task, please mark it off on the checklist provided. In many cases there will be more than one way to complete a task. Sometimes you will be instructed to use, or not to use, a particular feature. Please follow these directions. When no stipulations are provided, you may complete the task however you see fit. There are many tasks and you will probably not finish. That is alright, remember, it is WordStar, not YOU, that is being evaluated.

If you have any difficulties using WordStar to complete these tasks, you may use the help menu or the manuals. As you complete the exercises, keep in mind that you will be evaluating the usability of WordStar at the end of this session. Keep in mind those features that were especially difficult or easy to use. Also make mental notes about what you like and dislike about WordStar. If you have used other word processors, try to avoid the temptation to make comparisons.

Thank you for your participation in this study. Do you have any questions before we begin?

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