Using Protocol Analysis to Help Determine the Behavioral Function of Conducting Safety Observations

Alicia M. Alvero
Western Michigan University

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USING PROTOCOL ANALYSIS TO HELP DETERMINE THE BEHAVIORAL FUNCTION OF CONDUCTING SAFETY OBSERVATIONS

by

Alicia M. Alvero

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USING PROTOCOL ANALYSIS TO HELP DETERMINE THE BEHAVIORAL FUNCTION OF CONDUCTING SAFETY OBSERVATIONS

Alicia M. Alvero, Ph.D.
Western Michigan University, 2003

Recent research endeavors have demonstrated the existence of an *observer effect*. In other words, conducting safety observations increases the safety performance of the observer, and may result in safety-related verbalizations. The purpose of this study was to help determine whether observers make self-verbalizations regarding their safety performance and whether these reports are functionally related to safety performance. In order to answer these questions two experiments were conducted using both protocol analysis and the silent dog method. Protocol analysis is used by cognitive scientists to analyze the thoughts of a person as they perform a task, and the silent dog method allows researchers to determine the behavioral function of the thoughts or verbalizations that occur during task completion.

The objective of Experiment 1 was two-fold: (a) to show that safety performance with continuous, concurrent talk-aloud procedures is functionally equivalent to safety performance without talk-aloud reports, and (b) to demonstrate that safety performance is altered when participants were presented with a distracter task. A multiple baseline counterbalanced across three postural safety behaviors was conducted in a laboratory setting. Participants were randomly assigned to one of two groups: talk-aloud or silent group. Both groups performed an assembly task and were exposed to an information,
observation and distracter phase. Participants conducted safety observations on a confederate’s performance during the observation phase. The safety-related verbalizations made during this phase were recorded, analyzed, and used to establish descriptions of safety rules. These descriptions were presented to Experiment 2 participants in place of the observation phase. The goal of Experiment 2 was to demonstrate that the safety-related verbalizations made by Experiment 1 participants were task-relevant and functionally related to safety performance.

The results from both Experiments 1 and 2 provide strong support for the existence of a functional relationship between safety-related verbalizations and increases in safety performance. These results also seem to suggest that conducting safety observations may serve a (a) rule generating function, and/or (b) self-monitoring function. This is a first step toward helping determine the behavioral function of conducting safety observations and understanding the observation process employed by behavioral safety processes.
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<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xv</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xvi</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Self-Monitoring</td>
<td>5</td>
</tr>
<tr>
<td>Protocol Analysis</td>
<td>10</td>
</tr>
<tr>
<td>Silent Dog Method</td>
<td>13</td>
</tr>
<tr>
<td>Control 1</td>
<td>14</td>
</tr>
<tr>
<td>Control 2</td>
<td>15</td>
</tr>
<tr>
<td>Control 3</td>
<td>16</td>
</tr>
<tr>
<td>Purpose</td>
<td>17</td>
</tr>
<tr>
<td>EXPERIMENT 1</td>
<td>19</td>
</tr>
<tr>
<td>METHOD</td>
<td>19</td>
</tr>
<tr>
<td>Rationale</td>
<td>19</td>
</tr>
<tr>
<td>Participants</td>
<td>20</td>
</tr>
<tr>
<td>Setting and Materials</td>
<td>20</td>
</tr>
<tr>
<td>Definition of Dependent Variables</td>
<td>21</td>
</tr>
<tr>
<td>Primary Variables</td>
<td>21</td>
</tr>
<tr>
<td>Safety Performance</td>
<td>21</td>
</tr>
<tr>
<td>Safety-Related Verbalizations</td>
<td>22</td>
</tr>
<tr>
<td>Secondary Variables</td>
<td>24</td>
</tr>
</tbody>
</table>
Table of Contents - continued

METHOD

Productivity Performance ................................................................. 24
Productivity Accuracy ................................................................. 25
Accuracy of Participant Observations ............................................. 25

Measurement of Dependent Variables ........................................... 26
Primary Variables .............................................................................. 26
Safety Performance .......................................................................... 26
Safety-Related Verbalizations .......................................................... 26
Secondary Variables ......................................................................... 27
Productivity Performance and Accuracy ........................................... 27
Accuracy of Participant Observations ............................................. 27

Interobserver Agreement ................................................................. 27
Independent Variables ..................................................................... 29
Procedures ..................................................................................... 29
Duration .......................................................................................... 29
Participant Recruitment ................................................................. 30
Group Assignment ........................................................................... 30
Talk-Aloud Training ......................................................................... 31
Baseline ........................................................................................... 31
Information Phase ............................................................................ 32
Observation Phase ........................................................................... 33
# Table of Contents - continued

## METHOD

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation plus Distracter Phase</td>
<td>35</td>
</tr>
<tr>
<td>Integrity of the Independent Variables</td>
<td>36</td>
</tr>
<tr>
<td>Experimental Design</td>
<td>37</td>
</tr>
<tr>
<td>Stability Criteria</td>
<td>37</td>
</tr>
<tr>
<td>Analysis of Verbal Data</td>
<td>38</td>
</tr>
<tr>
<td>Exit Interviews and Debriefing</td>
<td>39</td>
</tr>
<tr>
<td>Informed Consent Process</td>
<td>40</td>
</tr>
<tr>
<td>Human Subjects Protection</td>
<td>40</td>
</tr>
</tbody>
</table>

## RESULTS

<table>
<thead>
<tr>
<th>Participant 0A</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Performance</td>
<td>41</td>
</tr>
<tr>
<td>Productivity Performance and Accuracy</td>
<td>43</td>
</tr>
<tr>
<td>Accuracy of Observations</td>
<td>43</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participant 1A</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Performance</td>
<td>43</td>
</tr>
<tr>
<td>Productivity Performance and Accuracy</td>
<td>45</td>
</tr>
<tr>
<td>Accuracy of Observations</td>
<td>45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participant 2A</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Performance</td>
<td>46</td>
</tr>
<tr>
<td>Productivity Performance and Accuracy</td>
<td>48</td>
</tr>
</tbody>
</table>
RESULTS

Accuracy of Observations ................................................................. 48
Participant 3B ................................................................................... 48
Safety Performance .......................................................................... 50
Productivity Performance and Accuracy .............................................. 50
Accuracy of Observations ................................................................. 50
Participant 5B ................................................................................... 52
Safety Performance .......................................................................... 52
Productivity Performance and Accuracy .............................................. 52
Accuracy of Observations ................................................................. 53
Participant 6A ................................................................................... 53
Safety Performance .......................................................................... 53
Productivity Performance and Accuracy .............................................. 55
Accuracy of Observations ................................................................. 55
Participant 7B ................................................................................... 55
Safety Performance .......................................................................... 57
Productivity Performance and Accuracy .............................................. 57
Accuracy of Observations ................................................................. 57
Participant 8B ................................................................................... 58
Safety Performance .......................................................................... 58
Productivity Performance and Accuracy .............................................. 60
Table of Contents - continued

RESULTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy of Observations</td>
<td>60</td>
</tr>
<tr>
<td>Participant 9A</td>
<td>60</td>
</tr>
<tr>
<td>Safety Performance</td>
<td>60</td>
</tr>
<tr>
<td>Productivity Performance and Accuracy</td>
<td>62</td>
</tr>
<tr>
<td>Accuracy of Observations</td>
<td>62</td>
</tr>
<tr>
<td>Participant 10A</td>
<td>63</td>
</tr>
<tr>
<td>Safety Performance</td>
<td>63</td>
</tr>
<tr>
<td>Productivity Performance and Accuracy</td>
<td>65</td>
</tr>
<tr>
<td>Accuracy of Observations</td>
<td>65</td>
</tr>
<tr>
<td>Participant 11B</td>
<td>65</td>
</tr>
<tr>
<td>Safety Performance</td>
<td>65</td>
</tr>
<tr>
<td>Productivity Performance and Accuracy</td>
<td>67</td>
</tr>
<tr>
<td>Accuracy of Observations</td>
<td>67</td>
</tr>
<tr>
<td>Analysis of Verbal Data</td>
<td>68</td>
</tr>
<tr>
<td>Safety-Related Verbalizations</td>
<td>71</td>
</tr>
<tr>
<td>Group Safety Performance Comparisons</td>
<td>78</td>
</tr>
<tr>
<td>Exit Interviews</td>
<td>78</td>
</tr>
<tr>
<td>Interobserver Agreement</td>
<td>81</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>83</td>
</tr>
<tr>
<td>Overall Effects of Information</td>
<td>84</td>
</tr>
</tbody>
</table>

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# DISCUSSION

Overall Effects of Conducting Observations ............................................................. 85
Productivity Performance and Accuracy ................................................................. 88
Accuracy of Participant Observations ................................................................. 89
Silent Dog Method Control 1 ........................................................................... 91
Silent Dog Method Control 2 ........................................................................... 95
Silent Dog Method Control 3 ........................................................................... 96

# EXPERIMENT 2 ........................................................................................................ 98

## METHOD ......................................................................................................................... 98

Rationale .................................................................................................................. 98
Participants ............................................................................................................. 99
Setting and Materials ............................................................................................... 99
Definition of Dependent Variables ........................................................................ 100

### Primary Variables .................................................................................................. 100

Safety Performance ................................................................................................. 100
Rule Descriptions and Safety-Related Verbalizations ..................................... 100

### Secondary Variables ............................................................................................. 102

Productivity Performance ..................................................................................... 102
Productivity Accuracy ........................................................................................... 102

# Measurement of Dependent Variables .................................................................. 102

### Primary Variables .................................................................................................. 102
Table of Contents - continued

METHOD

Safety Performance ................................................................. 102
Rule Descriptions and Safety-Related Verbalizations .......... 102
Secondary Variables .............................................................. 103
Productivity Performance and Accuracy ......................... 103
Interobserver Agreement ...................................................... 103
Independent Variable .......................................................... 104
Procedures .......................................................... 105
Talk-Aloud Training .............................................................. 105
Baseline .......................................................... 105
Rule Description Phase ...................................................... 105
Integrity of the Independent Variable ............................. 107
Experimental Design .......................................................... 107
Stability Criteria .............................................................. 108
Exit Interviews and Debriefing ........................................ 108
Informed Consent Process ............................................. 108
Human Subjects Protection .............................................. 109

RESULTS ................................................................ 110

Participant 12B ................................................................ 110
Safety Performance ..................................................... 110
Productivity Performance and Accuracy ..................... 110
# Table of Contents - continued

## RESULTS

Participant 13B .............................................................................................................. 110

Figure 23. Data for Participant 13B.Safety Performance ........................................ 112

Safety Performance ............................................................................................ 113

Productivity Performance and Accuracy ......................................................... 113

Participant 14A .............................................................................................................. 113

Safety Performance ............................................................................................ 113

Productivity Performance and Accuracy ......................................................... 115

Participant 15A ............................................................................................................. 115

Safety Performance ............................................................................................ 115

Productivity Performance and Accuracy ......................................................... 115

Rule Descriptions and Safety-Related Verbalizations ............................................ 117

Exit Interviews ........................................................................................................ 124

Interobserver Agreement ......................................................................................... 126

## DISCUSSION ..............................................................................................................

Productivity Performance and Accuracy ......................................................... 127

Silent Dog Method Control 3 ...................................................................................... 128

## GENERAL DISCUSSION ......................................................................................

Rule Generating Function ...................................................................................... 132

Rules as Conditioned Establishing Operations .................................................. 135

Self-Monitoring ....................................................................................................... 136
Table of Contents - continued

GENERAL DISCUSSION

Strengths and Weaknesses ................................................................................. 139
Future Research ................................................................................................. 144

ENDNOTES ........................................................................................................... 147

APPENDICES

A. Safety Information Sheet Provided to Participants in Group A .......... 148
B. Safety Information Sheet Provided to Participants in Group B .......... 150
C. Safety Checklist Used to Collect Data on Participants’ Performance ...... 152
D. Safety Checklist Used by Participants in Group A to Score Video .... 154
E. Safety Checklist Used by Participants in Group B to Score Video .... 156
F. Safety Checklist Used by Participants in Both Groups to Score Video on All Target Behaviors ............................................................... 158
G. Participant Productivity Log Sheet ................................................................. 160
H. Script of the Study Description Read Aloud to Participants at the Start of the Information Phase .............................................................. 162
I. Oral Recruitment Script ................................................................................. 164
J. Talk-Aloud Instructions .................................................................................. 166
K. Example Instructions of Tasks to be Performed by Participants ......... 168
L. Script of the Oral Instructions Provided to Participants in the Talk-Aloud Group at the Start of Baseline ......................................................... 170

xii

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Table of Contents - continued

APPENDICES

M. Script of the Oral Instructions Provided to Participants in the Silent Group at the Start of Baseline ............................................................... 172

N. Script of Oral Instructions Given to Participants about Conducting Observations .................................................................................. 174

O. Script of Oral Instructions Given to All Participants at the Start of the Distracter Task ................................................................................ 176

P. Transcription of the Distracter Task .............................................................................................................................. 178

Q. Coding Category Sheet .............................................................................................................................................. 184

R. Experiment 1 Exit Interview ........................................................................................................................................ 186

S. Experiment 1 Debriefing Script ....................................................................................................................................... 188

T. Script for Consent Process ........................................................................................................................................ 190

U. Consent Form ............................................................................................................................................................ 192

V. Protocol Clearance from the Human Subjects Institutional Review Board .................................................................................. 195

W. Rule Descriptions Given to Experiment 2 Participants Regarding Feet Position .............................................................................................. 197

X. Rule Descriptions Given to Experiment 2 Participants Regarding Back and Shoulder Position .............................................................................. 199

Y. Rule Descriptions Given to Experiment 2 Participants Regarding Back, Shoulder and Feet Position .......................................................... 201

Z. Segments Coded as General Safety-Related Statements ................................................................................................. 203

AA. Segments Coded as Specific Safety-Related Statements ............................................................................................. 207
Table of Contents - continued

APPENDICES

BB. Script of Oral Instructions Given to Experiment 2 Group “A” Participants at the Start of the Rule Description Phase ................................. 209

CC. Script of Oral Instructions Given to Experiment 2 Group “B” Participants at the Start of the Rule Description Phase ............................... 211

DD. Script of Oral Instructions Given to All Experiment 2 Participants When Second Set of Target Behavior Were Introduced to the Rule Description Phase ................................................. 213

EE. Experiment 2 Exit Interview ............................................................................ 215

FF. Experiment 2 Debriefing Script ...................................................................... 217

GG. Safety-Related Verbalizations Made by Experiment 2 Participants .......... 219

REFERENCES ................................................................................................................... 221
LIST OF TABLES

1. Classification of Intervals Used to Calculate Verbal Probabilities .................. 23
2. Distribution of Groups and Experimental Phases ........................................... 36
1. Data for Participant 0A ................................................................. 42
2. Data for Participant 1A ................................................................. 44
3. Data for Participant 2A ................................................................. 47
4. Data for Participant 3B ................................................................. 49
5. Data for Participant 5B ................................................................. 51
6. Data for Participant 6A ................................................................. 54
7. Data for Participant 7B ................................................................. 56
8. Data for Participant 8B ................................................................. 59
9. Data for Participant 9A ................................................................. 61
10. Data for Participant 10A ............................................................. 64
11. Data for Participant 11B ............................................................. 66
12. Average Number of Segments Per Participant, Per Session
    Distributed by Phase ................................................................. 68
13. Percentage of Segments Coded into Each Category for Each Phase .......... 70
14. Percentage of Safety-Related Segments Coded into Each Category.......... 71
15. Participant 0A Cumulative Safe Performance .................................. 73
16. Participant 1A Cumulative Safe Performance .................................. 74
17. Participant 2A Cumulative Safe Performance .................................. 75
18. Participant 3B Cumulative Safe Performance .................................. 76
19. Participant 5B Cumulative Safe Performance .................................. 77
20. Percent Agreement Between Data Collectors ..................................... 81
List of Figures - continued

22. Data for Participant 12B ..................................................................................... 111
23. Data for Participant 13B ..................................................................................... 112
24. Data for Participant 14A ..................................................................................... 114
25. Data for Participant 15A ..................................................................................... 116
26. Percentage of Safety Statements Classified into Each Category ..................... 118
27. Participant 12B Cumulative Safe Performance .................................................. 120
28. Participant 13B Cumulative Safe Performance .................................................. 121
29. Participant 14A Cumulative Safe Performance .................................................. 122
30. Participant 15A Cumulative Safe Performance .................................................. 123
31. Percent Agreement Between Data Collectors .................................................... 126
INTRODUCTION

The prevention of injuries undoubtedly would profit our nation’s industries and economy. In 2000 alone, a total of 5.3 million nonfatal injuries were reported in private industry workplaces, resulting in a rate of 6.1 cases per 100 equivalent full-time workers\(^1\) (U.S. Bureau of Labor Statistics, 2001a). Manufacturing industries had the highest incident rates (9.0) among goods-producing industries with 1.4 million nonfatal injuries. Some 245 million workdays are lost to injuries each year, 10 times more than the average number of days lost each year in labor strikes. If improved working conditions cut lost time by one day per worker per year, as much as $15 billion could be added to our nation’s economy (Witt, 1980). In 1999, assemblers, operators and fabricators within the manufacturing industry reported 720,000 nonfatal occupational injuries and illnesses involving days away from work\(^2\), the highest number among all industries (U.S. Bureau of Labor Statistics, 2001b). Of these reported injuries, 248,000 involved musculoskeletal disorders\(^3\), often as a result of reaching, twisting, overexertion or repetition. Clearly, the manufacturing industry would benefit from the deterrence of such ergonomic injuries and the application of preventative safety processes.

Behavior-based safety (BBS) is a proactive approach to improving safety within organizations that utilizes behavior analysis principles. The distinguishing feature between BBS processes and more traditional safety management approaches is a focus on critical behaviors that prevent injuries rather than focusing on accident rates and workplace conditions alone. Therefore, BBS is considered a proactive...
approach versus more traditional reactive approaches toward safety. The BBS approach aims to decrease the number of at-risk behaviors and increase the number of safe behaviors within an organization in order to decrease injuries (McSween, 1995).

Extensive scientific experimentation has resulted in the identification of the principal components of effective BBS processes (Komaki, 1986; Komaki, Heinzmann, & Lawson, 1980; Sulzer-Azaroff & Fellner, 1984). Successful BBS processes normally include: assessment and identification of performance targets, development and implementation of a behavioral observation process, review of observation data, and implementation of a behavioral feedback process. The observation process involves training employees to conduct safety observations using a behavioral checklist. When conducting observations, observers (i.e., trained employees) approach other employees, observe, and score their performance using the behavioral checklist. Some research suggests that the observation process itself may serve as an effective tool in increasing the safety performance of the observer (Alvero & Austin, in press). These findings are especially important because consultants have called for employee or research-driven safety programs (Krause, 1997; McSween, 1995), representing a shift from the earlier management-driven programs (for an example of these, see Komaki, Barwick, & Scott, 1978).

This shift to employee-driven programs raises questions about which activities are the most beneficial for employees to participate in. Some have argued that participating as an observer is critical for changing behavior (McSween, 1995). There are two fundamental questions related to conducting BBS observations: "Do
observers perform more safely as a result of conducting observations?" and "If conducting observations changes behavior, how can we explain this effect?"

Recent research endeavors (Alvero & Austin, in press, 2002; Sasson, 2002) have targeted the first question and demonstrated the existence of an observer effect: conducting safety observations significantly improves the safety performance of safety observers. Alvero and Austin (in press) was the first in a series of studies designed to scientifically assess the existence of the observer effect. An ABC multiple baseline counterbalanced across two sets of office behaviors was used to evaluate the effects of observation on the behavior of observers. Two observation rooms were each equipped with a computer, desk, chair, telephone and bookshelf to resemble an office environment. Each room was furnished with a video camera, mounted in the corner of the room. The cameras were connected to a television and VCR, located in a nearby control room, and were used to record all sessions. Twelve undergraduate students served as participants and were asked to perform several tasks to resemble office work. These tasks included typing, lifting, and using the telephone.

During each baseline session, participants were asked to follow a list of instructions. Each instruction involved one of the three above-mentioned tasks, and sessions lasted exactly 15 minutes. Two independent variables were presented, each during a different phase after baseline. The information phase followed baseline and consisted of providing participants with definitions on how to safely perform four of the eight target behaviors. Six participants (group A) received information on the
following four, of eight, target behaviors: (1) back and (2) leg position during lifts; (3) neck and (4) wrist position while typing. The second group of six participants (group B) received information on the remaining target behaviors: (5) back, (6) shoulder, and (7) feet position while sitting; and (8) neck position while using the telephone. The purpose of this phase was to eliminate demand characteristics that are often displayed by participants taking part in a lab study (Kazdin, 1992). The second intervention involved conducting safety observations. During this phase participants observed a video of an experimental confederate performing office behaviors and collected data on the confederate’s safety performance using one of several safety checklists. Each group used a checklist comprised of the same target behaviors presented during the information phase (group A: behaviors 1 – 4, group B: behaviors 5 – 8). After performance stabilized on the first four behaviors, the remaining four behaviors were targeted by adding them to the safety checklist.

Throughout all phases of the study, safety performance data were collected for each participant on the eight above-mentioned target behaviors. All dependent variables, except lifting, were defined in terms of the percentage of intervals in which they occurred. Percentage occurrence was calculated by adding the number of intervals in which each safe behavior was observed, dividing it by the total number of observation intervals and multiplying by 100%. Safe lifting frequency was counted and reported as a percentage of total number of lifts.

Baseline safety performance for all target behaviors averaged 6.1% for group A and 9.9% for group B. Averages during the information phase were 15.4% for
group A and 26.4% for group B. Groups A and B averaged 75.9% and 72.9%, respectively, during the observation phase. One participant, from group A, was available for baseline follow-up one year later. Her performance showed no decrement from the previous observation phase: all behaviors averaged 100%. The results of this study suggest that significant improvements in observer safety performance occur as a result of conducting safety observations. Alvero and Austin (in press) provide evidence to support the existence of an “observer effect”, but it remains unclear why these substantial increases in safety performance occurred during the observation phase and not during the information phase. Exit interviews conducted with each participant suggested that participants may have been prompting themselves, self-monitoring or self-evaluating safety performance. For example, one participant reported, “When I’d catch myself being unsafe I’d tell myself, ‘I’m not supposed to be doing this’, or ‘I have to do this correctly’”. Statements such as these seem to indicate that an analysis of participants’ self-verbalizations may be a step in the right direction toward answering the second fundamental question related to conducting BBS observations: “If conducting observations changes behavior, how can we explain this effect?”

Self-Monitoring

If indeed, safety observers are self-monitoring or self-evaluating safety performance, the self-monitoring literature may help explain the possible reasons observer safety performance increases as a result of conducting safety observations.
Self-monitoring is a useful technique in applied settings for both assessment and intervention purposes (Nelson, Boykin, & Hayes, 1982). When self-monitoring, the participant notes and records the occurrences of his or her own target behaviors (Nelson et al., 1982). This method of self-recording often serves as an effective intervention for increasing the frequency of desirable behaviors (e.g., Johnson & White, 1971; Lam, Cole, Shapiro, & Bambara, 1994) and decreasing the frequency of undesirable behaviors (e.g., Abrams & Wilson, 1979; Romanczyk, 1974). Wood, Murdock, Cronin, Dawson, and Kirby (1998) evaluated the effects of self-monitoring on the on-task behaviors of four at-risk middle school students across several academic settings. The primary dependent variable was the percentage of time each student was engaged in on-task behavior. During baseline, student 1 averaged less than 40% of time on-task across all three settings; students 2, 3 and 4 each averaged 30%. With the introduction of the self-monitoring condition, there was an increase in the time on-task: students 1 and 3 averaged 80% and students 2 and 4 engaged in on-task behavior approximately 70% of the time across all three academic settings.

Self-monitoring techniques have also have been used to improve safety in an office environment. McCann and Sulzer-Azaroff (1996) decreased the risk of carpal tunnel syndrome (CTS) during keyboard entry tasks through a combination of training, self-monitoring, feedback, goal-setting, and reinforcement. Secretaries were first trained to self-monitor either their posture or hand-wrist positions. The second phase involved goal-setting (GS), feedback (FB), reinforcement (R+) and the continuation of self-monitoring. GS, FB, and R+ were presented at the beginning of
each session based on data scored from the previous sessions. Reinforcement was provided for progress and attainment of goals, and FB was based on safe performance and accuracy of self-recording. The group that self-monitored their posture performance showed a rapid increase in correct posture during the self-monitoring phase. When FB, GS, and R+ were added to self-monitoring, the near-perfect level of performance continued. Although this group did not monitor their hand-wrist performance, there were significant improvements noted on this behavior. The data for the group that self-monitored hand-wrist position showed moderate improvement initially, but it was not until FB, GS, and R+ were added that performance accelerated sharply. It is interesting to note that posture performance also increased although it was not the targeted behavior for this group. In other words, substantial improvements occurred on the variables that were not specifically targeted. Probe data were also collected to determine the degree to which learned behaviors generalized from the laboratory setting to the natural work setting. These data indicated a close correlation between performance in the work setting and in the laboratory.

The effectiveness of self-monitoring as an independent variable has been referred to as a reactive effect, that is, the very act of self-recording causes the behavior to change in frequency (Nelson et al., 1982). There are three widely accepted views explaining such reactivity. Kanfer (1970; Kanfer & Gaelick-Buys, 1991) proposed a three-stage model of self-regulation. The first stage is self-monitoring, the second is self-evaluation and the third involves self-consequation.
This theory suggests that favorable self-evaluation produces positive self-consequation, which then leads to an increase in behavior, whereas unfavorable self-evaluation leads to opposite results. Therefore, reactivity occurs when people observe their own behavior and self-deliver consequences.

The second view that explains this reactive effect was proposed by Rachlin (1974). The first stage of this view also starts with self-monitoring of the target behavior. The person may or may not then engage in self-administered consequences contingent on the occurrences of the target behavior. According to Rachlin, the self-recording response, the self-administered consequences, or a combination of the response and consequences, serve as cues to "remind" the person of the external environmental consequences that actually control response frequency.


The entire self-monitoring procedure (instructions, recording devices, self-monitoring behaviors, and so on), rather than only the self-monitoring per se, cues likely environmental consequences for the response. No special distinction is drawn between self-monitoring, monitoring by others, or other types of cues — any manipulation that makes more obvious the likely environmental consequences of the behavior can be reactive.

In other words, the self-monitoring process seems to prompt behavior change that is ultimately controlled by external consequences (Nelson et al., 1982). There is
one primary distinction among the three different views mentioned above. Kanfer and Rachlin emphasize behavioral antecedents (the self-monitored behavior) as initiators of reactivity, while Nelson and Hayes suggest that the triggering stimulus is not solely the self-monitoring response itself, but rather, the entire self-recording procedure (Nelson & Hayes, 1981). Furthermore, the view of Nelson and Hayes suggests that observing the behavior of others can produce reactivity through the same mechanisms as self-monitoring.

Although the above-described literature may help explain the possible behavioral effects monitoring one's own behavior may have on performance, it is important to note: safety observers conduct observations, or monitor, the behavior of others. In other words, the majority of the self-monitoring research describes the effects of monitoring one's own behavior, whereas, the present study is interested in the potential self-evaluating or self-monitoring effects that result from evaluating or monitoring the behavior of others. Therefore, the question of interest is, "If conducting observations changes behavior, how can we explain this effect?"

The present study attempted to answer this question, however, there were complex methodological and measurement issues involved in determining why observing the behavior of others affects the observer. Based on results of previous research, I speculated that understanding this issue would require understanding the various "thoughts" and "cognition" of the observer. In other words, it required examination of the sometimes covert verbalizations evoked before and after participants conduct observations of the behavior of others. To overcome this
methodological challenge, I used a special set of procedures designed to collect data on these typically unobservable phenomena.

Protocol Analysis

Protocol analysis is a reliable and valid tool used in cognitive psychology to analyze the thoughts of a person as they perform a task (Austin & Delaney, 1998; Ericsson & Simon, 1993). The term “protocol analysis” has been used to describe a variety of methods for obtaining verbal reports. Throughout this prospectus I use the term to refer to the set of procedures described by Ericsson and Simon (1993), that is, the use of concurrent verbal reports. In this method, participants are trained to “think” or talk aloud while performing a task so that their concurrent, task-related “thoughts” or verbalizations may be recorded and later analyzed. In other words, participants are instructed to talk aloud to themselves while working on a task so that experimenters can obtain a permanent record of the verbalizations that typically occur during task performance. These verbalizations are typically not available to the researcher when the participant performs the task in silence. Because we do not typically speak aloud to ourselves in such a detailed manner, participants require some training to talk aloud concurrently with task performance. Participants are provided with basic talk-aloud instructions, and are then given practice problems in which it is easy to verbalize concurrently and from which they become familiar with the procedure (Ericsson & Simon, 1993). During each experimental trial, the sole
The purpose of the researcher is to prompt the participant to continue talking aloud during any substantial period of silence.

All participant verbalizations that occur during experimental trials are then transcribed into text, or protocols. Each protocol is then segmented, each segment corresponding to a statement. A segment may be a clause or statement, but are often abbreviated to phrases, and even to single words (Ericsson & Simon, 1993). The size of the segments depends on two factors: (1) the level at which the data become orderly, and (2) the variables of interest, which are often based on the phenomenon being studied (Austin & Delaney, 1998). Protocol segments are then randomly reordered and presented to coders who categorize each segment based on a coding scheme devised by the researcher. Behavior analysts assume that segments will be coded in efforts to identify functional relationships (Austin & Delaney, 1998). For the purposes of this research, segments will be coded in an effort to identify a functional relationship between safety-related verbalizations and safety performance. After encoding, segments are then rearranged into their original order for analysis.

Checks on interrater reliability are performed on all processes: transcription of verbalizations, and encoding of protocol segments (Ericsson & Simon, 1993).

Although protocol analysis is a useful tool for obtaining the verbalizations that occur during task performance, two main problems exist with using the methods, exactly as described above, for the present study. The first problem is related to the novelty of this research and the second to the variable of interest, specifically, the potential functional relationship between verbalizations and safety performance.
Protocol analysis is most often used for problem-solving tasks or tasks that are well-defined and have only one correct answer (Austin & Delaney, 1998; Ericsson & Simon, 1993). Therefore, verbalizations for each problem often fall into a pattern of common actions that frequently occur during problem-solving. For example, Bhaskar and Simon (1977) assumed that all protocol segments from an engineering thermodynamics task could be encoded as one of a small list of actions, such as: choose system, notice keyword, write energy equation, revise equation, find value of variable, solve energy equation, check units. It is very unlikely that this will be the case for the present study for two reasons. First of all, the task of interest, safety performance, is not well-defined in terms of having only one correct answer. Undoubtedly, there is only one way to perform a task safely, but it is not likely to observe only one type of verbalization, or pattern of verbalizations, related to increases in safety performance. It is not even clear if safety-related verbalizations are likely to covary with increases in safety behavior (thus, the reason for performing this experiment). The second reason it is unlikely all protocol segments could be encoded as one of a small list of acts is because participants performed several tasks simultaneously (two of these tasks were measured: an assembly task while performing safely). Using protocol analysis to obtain important verbal information about this second (safety performance), and perhaps “subtask”, is novel. Therefore, it is not clear whether the above-described protocol analysis method is best designed to approach this novel experiment.
The second concern with using this traditionally cognitive approach is related to the research variable of interest. Protocol analysis (as described above) is used to determine verbalizations that covary with correct performance, but I am more interested in why conducting safety observations results in increases in safety performance. I hypothesize that participants' safety-related verbalizations are functionally related to safety performance behavior change. Because of the differences between the typical applications of protocol analysis and the present study, a more behavioral approach to protocol analysis seems more appropriate. Although a behavior analytic approach will not solve the concerns related to the novelty of this research, it will address the issue related to the functional relationship of interest.

Silent Dog Method

A slightly modified version of protocol analysis, the “silent dog” method of analyzing the impact of self-generated rules, allows researchers to determine the behavioral function of the thoughts and verbalizations that occur during task completion (Hayes, White, & Bissett, 1998). For this reason, the silent dog method can be used to help us determine what “thoughts” or verbalizations (if any) are controlling participant safety behaviors after participants conduct safety observations on the behavior(s) of others. In other words, the silent dog method allows us to determine if conducting safety observations increases the observer's safety performance as a result of self-evaluation, in part, or if the behavior change is simply
contingency shaped (i.e., under the direct control of reinforcement and physiological cues). The additional controls specified in the silent dog method are necessary to determine if verbal reports are functionally equivalent to rules and thus, result in safety performance changes. The necessity for these added controls is efficiently explained by Hayes et al. (1998, p. 58):

Cognitive and behavioral psychologists ask different questions, and their interest in protocol analysis differs for that reason. Cognitive psychologists want to know (a) whether underlying cognitive processes are revealed in verbal reports, and (b) if so, whether those processes are the same as would be occurring without verbal reports. Conversely, behavioral psychologists want to know (a) whether ongoing task-related behavior is governed by covert verbal rules, and (b) if so, whether the overt verbalization is functionally (not literally) equivalent to these rules.

Control 1

There are three controls in the silent dog method, and all three must be present in order to determine the functional nature of self-rules, should any exist (Hayes et al., 1998). First, it must be shown that performance on a task with continuous, concurrent talk-aloud procedures is functionally equivalent to performance without talk-aloud reports (i.e., it must be demonstrated that talking aloud during a task does not alter task performance). For example, if a person is given an arithmetic problem to solve, they should arrive at the same answer whether or not they are asked to talk
aloud as they solve the equation. We would not expect overt verbalizations to alter performance because solving arithmetic equations is largely a rule-governed process. If task performance is equivalent under the talk-aloud and silent conditions, then we must determine why these stimuli made no functional difference. According to Hayes et al. (1998) one possibility is that (a) self-talk (both covert and overt) is functioning as a rule, and (b) there is no functional difference between the verbal report of self-talk in the talk-aloud condition and the self-rules in the silent condition. However, other possibilities exist and therefore other controls are necessary to provide protection in this case (Hayes et al., 1998). For example, it is possible that verbalizations are functionally unrelated to task performance and thus, performance under both conditions is similar.

Control 2

In order to meet the second control, Hayes et al. (1998) state that it must be demonstrated that task performance is altered when participants are presented with a distracter task (i.e., performance is altered because the distracter prevents self-generation of rules or self-evaluative thoughts). Consider, for example, a person performing a detailed and complex assembly task and concurrently talking aloud. If the person were instructed to solve arithmetic problems simultaneously with the assembly task, we would expect such instructions to alter any verbalizations that would otherwise be present because the instructions demand a shift in task. If assembly task performance is governed by rules, then we would see a change in
productivity performance compared to non-distracter conditions. The presence of a distracter task prevents a person from verbalizing rules and therefore, alters any performance that is functionally related to these rules. "If no change in performance occurs, then there is no reason to suspect that the verbal protocol from the continuous talk-aloud condition is functionally a self-rule" (Hayes et al., 1998, p. 61).

Control 3

The third control ensures that the absence of an effect between performance in the talk-aloud and silent condition (the result of Control 1) is not because the task is contingency-shaped or that verbalizations are automatic or task irrelevant (Hayes et al., 1998). This is achieved by employing relevant elements of the verbal report (produced in Control 1) as an external rule to new participants. After the protocol segments (produced from Control 1) are encoded and analyzed, any information relevant to the task of interest (for the purpose of this study it is safety performance) is used to formulate rules (e.g., "I should keep my feet flat on the floor in order to be safe and comfortable"). These rules, in turn, are presented to a new group of participants and should alter performance (i.e., safety performance). "If the performance is rule governed and the self-reports are task relevant then presenting them as external rules should alter performance" (Hayes et al., 1998, p. 61).

Wulfert, Dougher, and Greenway (1991) conducted two stimulus equivalence experiments, which together are examples of research that met the criterion specified in the above-description of Control 3. During Experiment 1 participants were first
trained to think aloud and then to form stimulus equivalence classes. Following training, participants were tested to assess the emergence of stimulus equivalence classes. The verbal analysis results from Experiment 1 suggested that participants who described sample and comparison stimuli as unitary compounds were more likely to fail equivalence tests compared to those who described the relations among stimuli. A second experiment was designed to study the effects of responding to compound stimuli on equivalence class formation under more controlled circumstances. Based on the results of the protocol analysis of Experiment 1 participant verbalizations, manipulations were made to the stimulus equivalence pretraining to form two groups: (a) those trained to respond to compound stimuli and (b) those trained to respond to the relation between stimuli. Following pretraining, each group was trained to think aloud and then tested on stimulus equivalence class formations. The results of Experiment 2 supported those of Experiment 1: 6 of the 7 participants in the compounding group failed the equivalence tests, and the same number of participants in the relational group passed the test with few, if any, errors. The authors claimed that, “these findings demonstrate the utility of analyzing verbal reports to identify possible variables that can be manipulated experimentally” (Wulfert et al., 1991, p. 489).

Purpose

Recent research endeavors have demonstrated the existence of an “observer effect” (Alvero & Austin, in press, 2002; Sasson, 2002). In other words, conducting
safety observations increases the safety performance of the observer. This study attempted to explore the nature of this effect in more detail. The exit interviews conducted after my thesis research (Alvero & Austin, in press) seemed to indicate that participants self-evaluate, self-monitor, or self-generate rules regarding safety performance as a result of conducting observations. The purpose of this study was to help determine whether observers make self-verbalizations regarding their safety performance and whether these reports are functionally related to safety performance. In order to answer these questions I utilized both protocol analysis (Ericsson & Simon, 1993) and the “silent dog” method (Hayes et al., 1998). Protocol analysis is used by cognitive scientists to analyze the thoughts of a person as they perform a task, and the silent dog method allows researchers to determine the behavioral function of the thoughts and verbalizations that occur during task completion.
EXPERIMENT 1

METHOD

Rationale

The purpose of Experiment 1 was to satisfy the first and second control requirements described in the silent dog method literature. The first goal of Experiment 1 was to show that safety performance with continuous, concurrent talk-aloud procedures is functionally equivalent to safety performance without talk-aloud reports. In order to demonstrate this first control requirement, there were two groups in Experiment 1: a talk-aloud group and a silent group. The second goal of Experiment 1 was to demonstrate that safety performance is altered when participants were presented with a distracter task. The purpose of this second control is to further strengthen the hypothesis that safety-related verbalizations may be functionally related to increases in safety performance. In other words, if we suspect increases in safety performance are functionally related to safety-related verbalizations then we would expect a distracter task, which prevents the occurrence of safety-related verbalizations, to alter, or decrease, safety performance. In order to demonstrate this second control requirement, participants in both the talk-aloud and silent groups were exposed to a distracter task phase.
Participants

Participants were eleven undergraduate students at Western Michigan University in Kalamazoo, Michigan. Participants were asked if they were aware of the nature of the study to ensure that none of the participants had more information than the others regarding its purpose and procedures. Any participant stating he or she knew the purpose of the study concerned safety was not permitted to continue with the study because this knowledge was expected to interfere with the independent variables of this study. No participant was dismissed because he or she knew the purpose of the study. All participants were between 18 and 35 years of age, and were compensated $5.00 an hour for their participation throughout the study.

Setting and Materials

The study took place in a research lab located on the university campus. The lab consists of two observation rooms equipped with video cameras and one video monitoring and recording room. These rooms are furnished with the following: a model AFCCD video camera mounted in the upper right-hand corner of the room, a table, a chair, a plastic string approximately five feet in length, and six containers of plastic colored beads. The video monitoring and recording room are equipped with two 17” Phillips color televisions, two Panasonic AG 1320 4 Head VCRs and two remote controls to control the video cameras in the observation rooms.

The information sheets (see Appendices A and B) used during the first intervention phase contained one and two target behaviors, respectively, and
definitions of how to perform them safely. Four checklists were used to collect safety data on the target behaviors. One checklist (see Appendix C) was used by the researcher to collect data on each participant’s performance during each session throughout all phases of the study. The participants used one of several checklists (see Appendices D, E, and F) to collect data when conducting observations during the observation intervention phase. Participants viewed a 5-minute video of an experimental confederate performing the same assembly task that participants performed during the study. Videotapes were used to record the behavior of all participants during all sessions throughout the study.

Definition of Dependent Variables

Primary Variables

Safety Performance

All primary dependent variables were defined in terms of the percentage of intervals in which they occurred. Percentage occurrence was calculated by adding the number of intervals in which each safe behavior was observed, dividing it by the total number of observation intervals and multiplying by 100%.

The safety related target behaviors were all related to sitting posture, and their definitions were as follows:

Sitting – (a) back upright - upright, parallel to the back of the chair (not leaning at an angle against it), (b) shoulders aligned with back – shoulders in line with
the back, not slouched forward, (c) both feet on the floor – both feet should be flat on
the floors (ball of foot and heel should touch floor).

Government ergonomic reports were reviewed in order to determine the
appropriate definition for proper sitting position (National Institute for Occupational
above-listed behaviors and definitions were consistently mentioned in the
documents reviewed.

Safety-Related Verbalizations

A safety-related verbalization was defined as any vocal-verbalization that was
related to safety and/or any of the above-mentioned target behaviors. For example, if
a participant stated, “let me keep my feet flat,” “I should sit safely,” or “oops, I forgot
to straighten my back,” it was counted as one safety-related verbalization. The
number of safety-related verbalizations and the 30-second intervals in which each
occurred were tracked and these data were used to calculate several averages,
including probabilities. It is important to mention that these data were calculated only
for the sessions within the observation phase because the interest of this research is in
the relationship between safety-related verbalizations and increases in safety that
occur as a result of conducting observations. The reversal observation phase was not
included in this analysis because no safety-related verbalizations occurred during this
phase for any of the talk-aloud participants. Therefore, sessions within the baseline,
information, observation plus distracter, and reversal observation phases were not

22

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included in the following calculations. (1) The percentage of observation sessions with safety-related verbalizations was calculated by adding the total number of sessions in which at least one safety-related verbalization occurred, dividing it by the total number of sessions and multiplying by 100%. (2) The average number of safety-related verbalizations that occurred per observation session was calculated by adding the total number of safety-related verbalizations and dividing it by the total number of sessions in the observation phase. (3) The probability that an increase in safety occurred within, or immediately following, a 30-second interval in which a safety-related verbalization occurred was calculated by adding the total number of times an increase in safety occurred within the same 30-second interval, or the interval immediately following the interval in which a safety-related verbalization occurred, dividing by the total number of safety-related verbalization intervals (A/E in Table 1) and multiplying by 100%. An “increase in safety” was defined as an

Table 1

<table>
<thead>
<tr>
<th>Interval Description</th>
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</thead>
<tbody>
<tr>
<td>A Number of times an increase in safety occurred within, or immediately following, a safety-related verbalization interval</td>
</tr>
<tr>
<td>B Number of times an increase in safety occurred in the absence of a safety-related verbalization interval</td>
</tr>
<tr>
<td>C Number of safe intervals that immediately follow a non-safety-related verbalization interval</td>
</tr>
<tr>
<td>D Number of safe intervals that immediately follow a safety-related verbalization interval</td>
</tr>
<tr>
<td>E Number of safety-related verbalization intervals</td>
</tr>
<tr>
<td>F Number of non-safety-related verbalization intervals</td>
</tr>
</tbody>
</table>
interval which was scored as "safe" and was preceded by an interval scored as "unsafe." (4) The probability that an increase in safety occurred in the absence of a preceding verbalization interval was calculated by adding the total number of times an increase in safety occurred without a safety verbalization, dividing by the total number of non-safety-related verbalization intervals (defined as verbalization intervals that did not include a safety-related verbalization) (B/F in Table 1) and multiplying by 100%. (5) The probability that a safe interval occurred immediately after a safety-related verbalization interval was calculated by adding the total number of safe intervals that immediately followed a safety-related verbalization interval, dividing by the total number of intervals in which a safety-related verbalization occurred (D/E in Table 1) and multiplying by 100%. (6) The probability that a safe interval occurred immediately after a non-safety-related verbalization interval was calculated by adding the total number of safe intervals that immediately followed a non-safety-related verbalization interval, dividing by the total number of non-safety-related verbalization intervals (C/F). For more information concerning the analysis of verbal data, please refer to the corresponding subsection (page 37).

Secondary Variables

Productivity Performance

Productivity performance was defined as the number of beads thread onto the string during the 15-minute work session.
Productivity Accuracy

Productivity accuracy was defined as the percentage of beads thread in the correct color sequence. Accuracy percentage was calculated by subtracting the number of errors (e.g., if a gray bead was arranged where there should have been a blue bead, this counted as an error) from the total number of beads thread onto the string, dividing it by the total number of beads thread onto the string, and multiplying by 100%.

Accuracy of Participant Observations

Accuracy data were calculated on the safety observations participants conducted on the “confederate” behavior. The researcher coded all “confederate” observation sessions using the same checklist as the participants (see Appendices D, E, and F). An agreement was defined as any occurrence in which both the researcher and participant scored the same mark (safe or unsafe) for a behavior. Accuracy of participant observations was calculated as follows: the number of agreements divided by the number of agreements plus disagreements multiplied by 100%. Observation accuracy was calculated for each target behavior measured by the participant.
Measurement of Dependent Variables

Primary Variables

Safety Performance

Each session was videotaped and scored at a later time by an undergraduate researcher who was blind to all conditions, except the talk aloud and silent conditions, and goals of the experiment. The coder used a checklist containing definitions for the target behaviors and how to perform them safely (see Appendix C). A 30-second momentary time sampling procedure was used for data collection. Every 30 seconds, data were collected for behaviors occurring at that moment. A behavior was scored as being safe when it satisfied the definition listed on the checklist.

Safety-Related Verbalizations

The above-mentioned videotapes were also used to collect measures of safety-related verbalizations emitted by participants in the talk-aloud group. The same undergraduate researcher collected both the above-mentioned safety performance data and the data on the intervals in which a safety-related verbalization occurred. The checklist (see Appendix C) used to collect safety performance data was designed to allow the researcher to indicate the occurrences of safety-related verbalizations. Each 30-second interval box, on the checklist, also included a row in which occurrences of safety-related verbalizations were marked. A different group of undergraduate researchers transcribed the vocal-verbalizations into text throughout the course of the...
study. The percentage of sessions with safety-related verbalizations and the number of safety-related verbalizations within each session were calculated at the end of the study, after the transcriptions were completed.

Secondary Variables

Productivity Performance and Accuracy

At the end of each session, the researcher or undergraduate researcher collected the string of beads completed by the participant, and counted the total number of beads thread onto the string. The task instruction sheet provided to the participant at the start of the session was used to insure that the correct color sequence was followed. Data on the number of errors made were collected in order to calculate productivity accuracy. The total number of beads and errors was entered onto the productivity data sheet (see Appendix G).

Accuracy of Participant Observations

After the conclusion of the study, the researcher used the observation data collection sheets used by the participants (see Appendices D, E, and F) to conduct safety observations to calculate the accuracy of participant safety observations.

Interobserver Agreement

Interobserver agreement was calculated on the primary dependent variables, or safety-related target behaviors. As a reliability check, the researcher coded 30% of
all sessions using the same checklist as the undergraduate coder (see Appendix C). An agreement was defined as any occurrence in which both the researcher and coder scored the same mark (safe or unsafe) for a behavior. Interobserver agreement between the researcher and the coder was calculated as follows: the number of occurrences divided by the number of occurrences plus nonoccurrences multiplied by 100%. Interobserver agreement was also conducted on all transcriptions of talk-aloud participant sessions. At the end of the study, when all transcriptions were completed, an undergraduate researcher compared the written text with the audio statements. This was done by listening to each videotaped session while reading the typewritten text, and all discrepancies, or disagreements were noted. An agreement was defined as any verbalization, or word, in which both the undergraduate researcher and transcriber identified as the same. Interobserver agreement between the undergraduate researcher and transcriber was calculated as follows: the number of agreements divided by the number of agreements plus disagreements multiplied by 100%. Any discrepancies, or disagreements were reviewed by the researcher and corrected to ensure 100% accuracy. Interobserver agreement was also calculated on all coded segments. Two undergraduate researchers coded 100% of the segments. An agreement was defined as any occurrence in which both undergraduate researchers classified a segment into the same category. Interobserver agreement between the undergraduate researchers was calculated as follows: the number of agreements divided by the number of agreements plus disagreements multiplied by 100%.
Independent Variables

Two independent variables were presented, each during a different phase after baseline (phase 1). At the start of the information phase (phase 2), participants were told the purpose of the study was “to observe individual safety behaviors in an assembly environment” (see Appendix H). Participants were presented with written information (see Appendices A and B) listing one or two target behaviors and definitions of how to perform them safely. The information presented to each participant was determined by the group to which they were randomly assigned. This written information was provided for five minutes at the start of each session during the information phase. During the third phase, participants conducted observations. Participants were asked to observe a video of an experimental confederate performing an assembly task, and collect data on that person’s safety performance using a safety checklist (see Appendices D, E, and F).

Procedures

The basic procedures of this study, used to measure the safety performance of safety observers, were modeled after those used by Alvero and Austin (in press).

Duration

Each session lasted approximately 15 to 20 minutes depending on the phase of the experiment (baseline sessions lasted approximately 15 minutes; information and observation sessions lasted approximately 20 minutes: 15 minutes for the beading
task and 5 minutes for the presession task). Participants were allowed to complete a maximum of 2 sessions per day. The average duration of participation was 24 sessions over 6 weeks.

Participant Recruitment

An attempt was made to select all of the required participants from an existing "participant pool" list. A list had been compiled of undergraduate students who have offered to assist in research studies. These students had either approached their instructors or the Society for Performance Management (a university student organization) or otherwise shown interest in participating. There was a need for more participants, and therefore, the student investigator made an announcement (see Appendix I) at various undergraduate psychology courses until enough participants volunteered.

Group Assignment

Before the start of the study, participants were randomly assigned to one of two groups: a talk aloud or a silent group. Those in the talk aloud group were trained to talk aloud by completing a practice session and were instructed to talk aloud during all phases of the study. Participants assigned to the silent group participated throughout the study without talking aloud during sessions.
Talk-Aloud Training

Participants in the talk aloud group were trained on how to talk or "think" aloud using a slightly modified version of the standard think-aloud instructions (see Appendix J) developed by Ericsson and Simon (1993). Participants practiced this procedure until they reported feeling comfortable talking aloud throughout the session. A two-way beeping device was placed in the observation room during the session. The student investigator "beeped" the device if participants were silent for more than 5 seconds to remind them to continue talking aloud.

Baseline

Participants assigned to the silent group participated throughout the baseline phase without talking aloud, while those in the talk-aloud group continuously talked aloud during each session in the baseline phase.

At the start of each baseline session, all participants were handed a list of instructions (see Appendix K) and were asked by either the graduate researcher or the undergraduate research assistant to perform the assembly task described in the instructions. The researchers followed a script (see Appendix L for the talk aloud group and Appendix M for the silent group) when delivering the instructions to each participant to ensure the consistency of the instructional set. The assembly task involved stringing beads onto a plastic string in a specific color order. This task was repeated throughout the 15-minute duration of the session, thus trying to simulate the work a person might perform on an assembly line. Then, either the graduate
researcher or the undergraduate assistant knocked on the door to signal the end of the session. Therefore, each baseline session lasted approximately 15 minutes. Participants remained in this phase until safety performance stabilized. During all sessions, participants were constantly monitored in the control room by a researcher via video monitoring.

**Information Phase**

Participants assigned to the silent condition participated throughout the information phase without talking aloud, while those in the talk-aloud condition continuously talked aloud during each session in the information phase.

During the first session of the information phase, all participants were informed about the nature of the study. Participants were given a handout containing definitions for one, or two, of the three target behaviors and how to perform them safely. Six participants (3 from the silent group and 3 from the talk-aloud group) comprised “Group A” and received information on one target behavior (feet position when sitting, see Appendix A). The remaining five participants (3 from the silent group and 2 from the talk-aloud group) comprised “Group B” and received information on the other two target behaviors (back and shoulder position when sitting, see Appendix B). Pilot data and previous research (Alvero & Austin, in press; 2002) suggested that back and shoulder position, when sitting, strongly covary. Therefore, back and shoulder position were presented as a “set” of behaviors rather than individually. Either the graduate researcher or the undergraduate research
assistant informed the participant of the purpose of the study, and again, the researchers followed a script (see Appendix H) to ensure that each participant was given the same instructions. Participants were given the definition handout (Appendix A or B) at the start of each session within this phase. They were required to review this information for five minutes before they were handed the list of tasks to perform. The remainder of the session followed the same procedures as those during baseline. Participants remained in this phase until performance stabilized. The purpose of this intervention phase was to eliminate demand characteristics that are often displayed by participants taking part in a lab study (Kazdin, 1992).

**Observation Phase**

Participants assigned to the silent group participated throughout the observation phase without talking aloud, while those in the talk-aloud group continuously talked aloud during each session in the observation phase.

At the start of each session during the observation phase, participants were asked to observe and score a 5-minute video of an experimental confederate performing the same assembly task the participant was to perform during each session. The experimental confederate performed both safe and unsafe behaviors on some videos, whereas other videos were made up of all safe or all unsafe behaviors. During each observation session, one of five different videos was scored, but all participants were exposed to the same video order during the study. Participants were asked to collect data on the same target behavior(s) introduced in the information
phase (group A: feet position; group B: back and shoulder position) while they
observed the video. Participants scored the confederate's relevant safety behavior
using a checklist (see Appendices D and E). The checklist was comprised of the
relevant target behaviors and definitions of how to perform them safely. Participants
scored the video using a whole interval recording procedure. They scored a behavior
as safe or unsafe after each 30-second interval. The behavior must have occurred
safely throughout the entire interval to be scored as "safe", otherwise the behavior
was scored as "unsafe". The exact instructions that were given to the participants was
read from a script (see Appendix N). After conducting the 5-minute observation,
participants were given a list of assembly task instructions to perform, and for the
remainder of the session procedures mirrored those during baseline. Participants
scored one of five different 5-minute videos before every session during the
observation phase.

After safety performance stabilized on the first target behavior(s) introduced
to the observation phase, the remaining target behavior(s) were added to the
observation checklist (see Appendix F). Therefore, participants were asked to collect
data for all three behaviors during the second portion of the observation phase. The
same instructions were read to each participant when the remaining target behavior(s)
were added onto the checklist (see Appendix N). Participants remained in this phase
until performance stabilized.
Observation plus Distracter Phase

After safety performance stabilized, participants in both the talk-aloud and silent conditions continued to conduct safety observations before each session, but they were also presented with a "cognitive distracter" (e.g., a "repeat after me" and problem solving task). Participants were exposed to the distracter task after they conducted the safety observations and during the beading assembly task. The researchers provided the participants with the headset along with the assembly task instructions and read a script (see Appendix O) that explained what they were to do with the headset. The distracter that was presented during this phase required participants to wear a headset attached to a handheld tape player, repeat what was said on the tape, and attempt to solve the problems presented on the tape (see Appendix P for a transcription of the distracter task). This distracter prevented self-evaluation regarding safety performance, and as a result, safety performance decreased. Pilot data were collected to insure that the distracter task was compatible with beading and safety performance. In other words, all three tasks could be completed at once, physically speaking. The goal of this phase was to satisfy the second control requirement of the silent dog method described earlier (see page 11).

I have provided a table below to clarify the groups (talk-aloud and silent) and subgroups (groups A and B) and to which experimental phases each was exposed.
Table 2
Distribution of Groups and Experimental Phases

<table>
<thead>
<tr>
<th>Groups</th>
<th>Phases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BSL</td>
</tr>
<tr>
<td>Talk-Aloud</td>
<td>X X</td>
</tr>
<tr>
<td>Group A</td>
<td></td>
</tr>
<tr>
<td>Talk-Aloud</td>
<td>X</td>
</tr>
<tr>
<td>Group B</td>
<td></td>
</tr>
<tr>
<td>Silent</td>
<td>X</td>
</tr>
<tr>
<td>Group A</td>
<td></td>
</tr>
<tr>
<td>Silent</td>
<td>X</td>
</tr>
<tr>
<td>Group B</td>
<td></td>
</tr>
</tbody>
</table>

Legend. BSL: baseline INFO: information phase OBS: observation phase OBS+DIST: observation plus distracter phase X: indicates exposure to phase

Integrity of the Independent Variables

Scripts were used for all of the verbal instructions that were given to the participants by the researchers. This ensured that all participants were exposed to the same instructional set. The researcher collected the safety checklists used by the participants during the observation phase. This provided verification that participants conducted observations during the session. The videos shown to the participants were kept in a specific order to ensure that all participants were exposed to the same video sequence. All participants were instructed to talk-aloud during the distracter task phase to ensure that all participants were exposed to the distracter task. The
researcher reviewed the videotaped distracter phase sessions to ensure that all participants engaged in the distracter task.

Experimental Design

A between groups research design was used to make comparisons between the talk-aloud and silent groups. This satisfied the silent dog method control 1 requirement described earlier (see page 14). A within-subjects, ABCDC (A: baseline, B: information, C: observation, D: observation and distracter) design was used with a multiple baseline design counterbalanced across behaviors during the observation phase. That is, the observation phase was first implemented for one (or 2) of the three target behaviors. After performance on the first behavior(s) stabilized, the next behavior(s) were exposed to the observation phase.

Stability Criteria

Data were considered stable if data points for three consecutive sessions fell within 30 percentage points (plus or minus 15 percentage points) of each other and were not trending upwards. Participants remained in each phase for a minimum of three sessions and a maximum of nine sessions. A maximum length for each phase was established in case the data were too variable and the stability criteria were not reached.
Analysis of Verbal Data

Throughout the course of the experiment, verbalizations for all participants in the talk-aloud condition were transcribed into text. The text files were then divided into segments. A segment may be a sentence, clause, phrase or even a single word depending on the organization of a person's oral prose (Ericsson & Simon, 1993). Segments were then randomly reordered, and presented out of context to coders who rated each segment into one of the following categories (see Appendix Q for the Coding Category Sheet used by the coders): (1) off-task statements (e.g., I have to go class, etc.), (2) environmental factors (e.g., this desk is too high; the room is too cold, etc.), (3) assembly task-related (e.g., orange, blue, green, I need to untangle this string etc.), (4) target behavior-related (sitting like this is so uncomfortable, my shoulders ache, etc.), (5) general safety-related statement (e.g., I should sit properly so I don't ache, my feet are nailed to the floor, etc.), (6) specific safety-related statement (e.g., repetition of any part of the safety definitions provided on the safety checklists), and (7) general statements concerning the study (e.g., I wonder what this study is about, How much time do I have left, etc.). The coded segments were then reassembled in their original order for analysis.

Analysis of the coded segments included calculating the total number of verbalization segments that occurred in each phase for all participants in the talk-aloud group. The percentage of segments that were coded into each category was also calculated for each phase for the group. The percentage of segments which were coded into each of the safety-related categories (e.g., general safety-related and
specific-safety related) was also calculated (e.g., the percentage of general-safety related verbalizations versus specific-safety related).

After an analysis of the protocols, descriptions of safety rules were generated that were representative of the safety-related verbalizations that occurred concurrent with any increases observed in safety behavior for Control I talk-aloud participants. These categories were formulated as a direct result of the coding categories used during the coding of segments.

Exit Interviews and Debriefing

At the end of the last session, participants were asked a series of questions (see Appendix R) concerning the experiment, and then they were given an explanation about the nature of the experiment (see Appendix S). The questions and explanation were read to each participant by the experimenter. The purpose of debriefing each participant was two-fold: (a) to obtain as much information as possible about participant safety performance and related safety verbalizations, or lack thereof, and (b) to insure that all participants understood the nature of the study and to answer any of their questions regarding their participation. It was hoped that this information would help in determining the behavioral principles responsible for any changes that occurred in safety performance.
Informed Consent Process

The consent process occurred at the start of each participant’s initial session. Either the graduate or undergraduate research assistant read a script (see Appendix T) and reviewed the consent form (see Appendix U) with each participant. Participation in Experiment 1 did not begin until the participant read and signed the consent form.

Human Subjects Protection

This project (both Experiment 1 and 2) was approved by the Human Subjects Institutional Review Board (see Appendix V).
RESULTS

Participants 0A through 5B comprised the talk-aloud group, and participants 6A through 11B were members of the silent group. The letter "A" represents the group assignment where group A was first exposed to feet placement and group B was first exposed to back and shoulder position.

Participant 0A

Figure 1 displays the safety performance, productivity performance, and productivity accuracy of participant 0A during the course of the experiment and the accuracy of participant observations during the observation phases and observation plus distracter phase.

Safety Performance

Back position averaged 3.9% (SD: 7.4; range: 0% to 23%) safe during baseline, 85.3% (SD: 6.8; range: 80% to 93%) during the observation phase, 15% (SD: 10.3; range: 7% to 30%) during the observation plus distracter phase, and performance increased to 93% when the observation phase was reintroduced. Shoulder position averaged 3.7% (SD: 8.5; range: 0% to 27%) safe in baseline, 81% (SD: 18.2; range: 60% to 93%) in the observation phase, and 3.3% (SD: 2.9; range: 0% to 7%) in the observation plus distracter phase. Safe shoulder performance increased to 93% when the observation phase was reintroduced. Feet position averaged 0% safe during baseline, 50% (SD: 44; range: 0% to 100%) during the
Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 1. Data for Participant 0A.
information phase, 97.8% (SD: 2.8; range: 93% to 100%) during the observation phase, 50.8% (SD: 28; range: 10% to 73%) during the observation plus distracter phase, and performance increased to 97% safe when the distracter task was withdrawn.

Productivity Performance and Accuracy

As displayed in Figure 1, participant 0A averaged 166 (SD: 64.7; range: 74 to 278) threaded beads during each session with an average of 99.5% (SD: 1.9; range: 92% to 100%) color sequence accuracy.

Accuracy of Observations

Figure 1 also displays the accuracy of participant 0A's observations conducted on confederate safety performance. Accuracy on all three target behaviors averaged 100% throughout the observation phases and observation plus distracter phase.

Participant 1A

Figure 2 displays the safety performance, productivity performance, and productivity accuracy of participant 1A during the course of the experiment and the accuracy of participant observations during the observation phases and observation plus distracter phase.
Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 2. Data for Participant 1A.
Safety Performance

Average safety levels for back position were 1.7% (SD: 3.7; range: 0% to 13%), 85.1% (SD: 25.9; range: 39% to 100%), 8% (SD 8.5; range: 0% to 17%) and 100% across all four phases, respectively, as shown in Figure 2. Shoulder position averaged 0.8% (SD: 2.8; range: 0% to 10%) in baseline, 83.3% (SD: 29.3; range: 30% to 100%) for the observation phase, 5.3% (SD: 6.8; range: 0% to 13%) in the observation plus distracter phase, and 100% when the observation phase was reintroduced. Participant 1A averaged 27.6% (SD: 39.6; range: 3% to 73%) safe for feet position during the baseline phase, 80.6% (SD: 9.8; range: 70% to 97%) and 95% (SD: 14.3; range: 50% to 100%) during the information and observation phases, respectively. Average safety levels for feet position decreased to 57% (SD: 26.5; range: 27% to 77%) during the observation plus distracter phase and increased to 100% when the distracter task was withdrawn.

Productivity Performance and Accuracy

Participant 1A averaged 302 (SD: 60.7; range: 147 to 390) beads and 99.3% (SD: 1.8; range: 92% to 100%) accuracy during each session, as shown in Figure 2.

Accuracy of Observations

When conducting observations on confederate safety performance, participant 1A averaged 96.7% (SD: 6.5; range: 80% to 100%) accuracy for back position,
90.8% (SD: 10.8; range: 70% to 100%) for shoulder position, and 98.8% (SD: 3.3; range: 90% to 100%) for feet position, as shown in Figure 2.

Participant 2A

Figure 3 shows participant 2A’s safety performance, productivity performance, and productivity accuracy during the course of the experiment as well as the accuracy of participant observations during the observation phases and observation plus distracter phase.

Safety Performance

Safe back position averaged 1.1% (SD: 2; range: 0% to 7%) in baseline, 98.8% (SD: 2.9; range: 93% to 100%) in the observation phase, 40% (SD: 26.5; range: 10% to 60%) in the observation plus distracter phase, and 95% (SD: 2.8; range: 93% to 97%) when the observation phase was reintroduced. Shoulder position averaged 0% safe in baseline, and increased to 95.6% (SD: 9.2; range: 77% to 100%) in the observation phase. Safe shoulder position then decreased to an average of 21% (SD: 15.9; range: 3% to 33%) in the observation plus distracter phase, and again increased to 81.5% (SD: 2.1; range: 80% to 83%) when the distracter task was withdrawn. Average safety levels for feet position were 14.3% (SD: 15.9; range: 0% to 33%) during baseline, 60.5% (SD: 22.2; range: 33% to 83%) in the information phase, 93.7% (SD: 11.9; range: 63% to 100%) during the observation phase, 73.7%
Figure 3. Data for Participant 2A.

Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

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(SD: 5.8; range: 67% to 77%) during the observation plus distracter phase, and 96.5% (SD: 4.9; range: 93% to 100%) when the observation phase was reintroduced.

Productivity Performance and Accuracy

Participant 2A averaged 269 (SD: 64.1; range: 112 to 339) beads and 98.8% (SD: 1.5; range: 94% to 100%) accuracy during each session, as shown in Figure 3.

Accuracy of Observations

Figure 3 also displays the accuracy of participant 2A's observations conducted on confederate safety performance. Accuracy averaged 79% (SD: 21.7; range: 40% to 100%) on back position, 91.8% (SD: 18.3; range: 40% to 100%) on shoulder position, and 87.3% (SD: 26.9; range: 10% to 100%) on feet position across the observation phases and observation plus distracter phase.

Participant 3B

Figure 4 displays the safety performance, productivity performance, and productivity accuracy of participant 3B during the course of the experiment and the accuracy of participant observations during the observation phase and observation plus distracter phase.
Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 4. Data for Participant 3B.
Safety Performance

Back position averaged 0.8% (SD: 1.5; range: 0% to 3%) safe during baseline, 1.1% (SD: 1.9; range: 0% to 3%) during the information phase, 80.8% (SD: 21.6; range: 37% to 100%) during the observation phase, and 12.5% (SD: 5.6; range: 7% to 20%) in the observation plus distracter phase. Shoulder position averaged 0% safe in baseline, 1.1% (SD: 1.9; range: 0% to 3%) in the information phase, 76.6% (SD: 23.7; range: 37% to 100%) in the observation phase, and 4.8% (SD: 5.7; range: 0% to 13%) in the observation plus distracter phase. Feet position averaged 0% safe during baseline, 2.4% (SD: 6.4; range: 0% to 17%) during the observation phase, and 3.3% (SD: 6.5; range: 0% to 13%) in the observation plus distracter phase.

Productivity Performance and Accuracy

As displayed in Figure 4, participant 3B averaged 288 (SD: 97.8; range: 39 to 420) threaded beads during each session with an average of 98.5% (SD: 2.1; range: 92% to 100%) color sequence accuracy.

Accuracy of Observations

Participant 3B averaged 94.4% (SD: 11.5; range: 60% to 100%) accuracy when scoring safe back position on a confederate’s performance. Observation accuracy averaged 85% (SD: 20.3; range: 40% to 100%) for shoulder position and 88% (SD: 18.3; range: 50% to 100%) on feet position, as shown in Figure 4.
Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 5. Data for Participant 5B.
Participant 5B

Figure 5 displays the safety performance, productivity performance, and productivity accuracy of participant 5B during the course of the experiment and the accuracy of participant observations during the observation phases and observation plus distracter phase.

Safety Performance

Average safety levels for back position were 0%, 11% (SD: 10.1; range: 0% to 20%), 85.2% (SD 11.9; range: 67% to 100%), 9% (SD: 8.4; range: 0% to 20%), and 97% across all five phases, respectively, as shown in Figure 5. Shoulder position averaged 0% in baseline, 9% (SD: 8.5; range: 0% to 10%) in the information phase, 76% (SD: 17.6; range: 37% to 100%) during the observation phase, 6.8% (SD: 7.4; range: 0% to 17%) in the observation plus distracter phase, and 97% when the distracter task was withdrawn. Participant 5B averaged 31.3% (SD: 35.1; range: 0% to 80%) safe for feet position during the baseline phase, 98% (SD: 3.1; range: 93% to 100%) and 20.1% (SD: 19.4; range: 0% to 30%) during the observation and observation plus distracter phases, respectively. Average safety levels for feet position then increased to 100% when the observation phase was reintroduced.

Productivity Performance and Accuracy

Participant 5B averaged 272 (SD: 37.9; range: 170 to 340) beads and 99.9% (SD: 0.4; range: 99% to 100%) accuracy during each session, as shown in Figure 5.
Accuracy of Observations

When conducting observations on confederate safety performance, participant 5B averaged 80% (SD: 29.8; range: 10% to 100%) accuracy for back position, 90.6% (SD: 10.3; range: 80% to 100%) for shoulder position, and 100% for feet position.

Participant 6A

Figure 6 shows participant 6A’s safety performance, productivity performance, and productivity accuracy during the course of the experiment as well as the accuracy of participant observations during the observation phases and observation plus distracter phase.

Safety Performance

Safe back position averaged 1% (SD: 2; range: 0% to 7%) in baseline, 54.1% (SD: 35.4; range: 7% to 93%) in the observation phase, 25% (SD: 11.3; range: 17% to 33%) in the observation plus distracter phase, and increased to 67% when the observation phase was reintroduced. Shoulder position averaged 0.4% (SD: 1.1; range: 0% to 3%) safe in baseline, and increased to 48.6% (SD: 35.2; range: 0% to 93%) in the observation phase. Safe shoulder position then decreased to an average of 5% (SD: 7.1; range: 0% to 10%) in the observation plus distracter phase, and again increased to 37% when the distracter task was withdrawn. Average safety levels for feet position were 13.3% (SD: 32.7; range: 0% to 80%) during baseline, 95.9% (SD: 4.4; range: 90% to 100%) in the information phase, 100% during the
Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 6. Data for Participant 6A.
observation phase, 71.5% (SD: 40.3; range: 43% to 100%) during the observation plus distracter phase, and 100% when the observation phase was reintroduced.

Productivity Performance and Accuracy

Participant 6A averaged 393 (SD: 64.2; range: 187 to 470) beads and 99.7% (SD: 1; range: 95% to 100%) accuracy during each session, as shown in Figure 6.

Accuracy of Observations

Figure 6 also displays the accuracy of participant 6A’s observations conducted on confederate safety performance. Accuracy averaged 86.4% (SD: 20.6; range: 40% to 100%) on back position, 87.3% (SD: 21; range: 40% to 100%) on shoulder position, and 93.6% (SD: 12.8; range: 60% to 100%) on feet position across the observation phases and observation plus distracter phase.

Participant 7B

Figure 7 displays the safety performance, productivity performance, and productivity accuracy of participant 7B during the course of the experiment and the accuracy of participant observations during the observation phases and observation plus distracter phase.
Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 7. Data for Participant 7B.
Safety Performance

Back position averaged 6.3% (SD: 8.6; range: 0% to 23%) safe during baseline, 98.6% (SD: 2.7; range: 93% to 100%) during the information phase, 98.9% (SD: 2.4; range: 93% to 100%) during the observation phase, and 70% (SD: 4.2; range: 67% to 73%) in the observation plus distracter phase. Safe back position increased to 90% when the observation phase was reintroduced. Shoulder position averaged 0.5% (range: 0% to 3%) safe in baseline, 95% (SD: 7.1; range: 80% to 100%) in the information phase, 98.9% (SD: 2.4; range: 93% to 100%) in the observation phase, 63.5% (SD: 4.9; range: 60% to 67%) in the observation plus distracter phase, and 87% when the observation phase was reintroduced. Feet position averaged 8.4% (SD: 26.5; range: 0% to 86%) safe during baseline, 59.4% (SD: 54.2; range: 0% to 100%) during the observation phase, 0% in the observation plus distracter phase, and 100% when the distracter task was withdrawn.

Productivity Performance and Accuracy

As displayed in Figure 7, participant 7B averaged 386 (SD: 72.2; range: 160 to 434) threaded beads during each session with an average of 99.8% (SD: 1; range: 95% to 100%) color sequence accuracy.

Accuracy of Observations

Participant 7B averaged 80.8% (SD: 34.8; range: 20% to 100%) accuracy when scoring safe back position on a confederate’s performance. Observation
accuracy averaged 84.2% (SD: 29; range: 0% to 100%) for shoulder position and 95% (SD: 9.3; range: 80% to 100%) on feet position, as shown in Figure 7.

Participant 8B

Figure 8 displays the safety performance, productivity performance, and productivity accuracy of participant 8B during the course of the experiment and the accuracy of participant observations during the observation phases and observation plus distracter phase.

Safety Performance

Average safety levels for back position were 2.4% (SD: 2.5; range: 0% to 6%), 4.3% (SD: 5.1; range: 0% to 10%), 82.5% (SD 17.4; range: 50% to 100%), 46.5% (SD: 19; range: 33% to 60%), and 93.5% (SD: 9.2; range: 87% to 100%) across the five phases, respectively, as shown in Figure 8. Shoulder position averaged 0% in both the baseline and information phases, 78.5% (SD: 17.5; range: 50% to 100%) during the observation phase, 46.5% (SD: 19; range: 33% to 60%) in the observation plus distracter phase, and 91.5% (SD: 12; range: 83% to 100%) when the observation phase was reintroduced. Participant 8B averaged 6.7% (SD: 25.8; range: 0% to 100%) safe for feet position during the baseline phase, 92% (SD: 7.6; range: 80% to 100%) and 16.5% (SD: 23.3; range: 0% to 33%) during the observation and observation plus distracter phases, respectively. Average safety
**Legend.** Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 8. Data for Participant 8B.
levels for feet position then increased to 98.5% (SD: 2.1; range: 97% to 100%) when
the distracter task was withdrawn.

**Productivity Performance and Accuracy**

Participant 8B averaged 260 (SD: 56.8; range: 120 to 378) beads and 99.6%
(SD: 0.8; range: 97% to 100%) accuracy during each session, as shown in Figure 8.

**Accuracy of Observations**

When conducting observations on confederate safety performance, participant
8B averaged 71.9% (SD: 33.9; range: 10% to 100%) accuracy for back position,
82.5% (SD: 27; range: 20% to 100%) for shoulder position, and 94.4% (SD: 8.8;
range: 80% to 100%) for feet position.

**Participant 9A**

Figure 9 shows participant 9A's safety performance, productivity
performance, and productivity accuracy during the course of the experiment as well
as the accuracy of participant observations during the observation phases and
observation plus distracter phase.

**Safety Performance**

Safe back position averaged 1% (SD: 3.3; range: 0% to 13%) in baseline,
89.8% (SD: 14.3; range: 57% to 100%) in the observation phase, 38.5% (SD: 54.4;
Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 9. Data for Participant 9A.
range: 0% to 77%) in the observation plus distracter phase, and 93% when the observation phase was reintroduced. Shoulder position averaged 1% (SD: 3.3; range: 0% to 13%) safe in baseline, and increased to 89.8% (SD: 14.3; range: 57% to 100%) in the observation phase. Safe shoulder position then decreased to an average of 38.5% (SD: 54.4; range: 0% to 77%) in the observation plus distracter phase, and again increased to 93% when the distracter task was withdrawn. Average safety levels for feet position were 0% during baseline, 79% (SD: 35.9; range: 13% to 100%) in the information phase, 95.7% (SD: 12.5; range: 53% to 100%) during the observation phase, 96% (SD: 4.9; range: 93% to 100%) during the observation plus distracter phase, and 100% when the observation phase was reintroduced.

Productivity Performance and Accuracy

Participant 9A averaged 306 (SD: 33.5; range: 236 to 354) beads and 99.7% (SD: 0.4; range: 99% to 100%) accuracy during each session, as shown in Figure 9.

Accuracy of Observations

Figure 9 also displays the accuracy of participant 9A’s observations conducted on confederate safety performance. Accuracy averaged 72.7% (SD: 37.7; range: 10% to 100%) on back position, 91.8% (SD: 18.3; range: 40% to 100%) on shoulder position, and 97.5% (SD: 7.5; range: 70% to 100%) on feet position across the observation phases and observation plus distracter phase.

62

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Participant 10A

Figure 10 displays the safety performance, productivity performance, and productivity accuracy of participant 10A during the course of the experiment and the accuracy of participant observations during the observation phases and observation plus distracter phase.

Safety Performance

Average safety levels for back position were 0.8% (SD: 2.1; range: 0% to 7%), 99.2% (SD: 1.4; range: 97% to 100%), 36.5% (SD9.2; range: 30% to 43%) and 100% across all four phases, respectively, as shown in Figure 10. Shoulder position averaged 0.3% (SD: 0.9; range: 0% to 3%) in baseline, 99.5% (SD: 1.2; range: 97% to 100%) for the observation phase, 20% (SD 4.2; range: 17% to 23%) in the observation plus distracter phase, and 100% when the observation phase was reintroduced. Participant 10A averaged 33.3% (SD: 45.3; range: 0% to 100%) safe for feet position during the baseline phase, 99% (SD: 1.7; range: 97% to 100%) and 99.8% (SD: 0.8; range: 97% to 100%) during the information and observation phases, respectively. Average safety levels for feet position decreased to 95% (SD 7.1; range: 90% to 100%) during the observation plus distracter phase and increased to 100% when the distracter task was withdrawn.
 Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An “X” indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A “+” indicates the reversal to the observation phase.

Figure 10. Data for Participant 10A.
Productivity Performance and Accuracy

Participant 10A averaged 301 (SD: 24.5; range: 248 to 354) beads and 97.1% (SD: 14.3; range: 27% to 100%) accuracy during each session, as shown in Figure 10.

Accuracy of Observations

When conducting observations on confederate safety performance, participant 10A averaged 75.7% (SD: 31.3; range: 10% to 100%) accuracy for back position, 89.3% (SD: 17.7; range: 40% to 100%) for shoulder position, and 96.3% (SD: 7.6; range: 80% to 100%) for feet position, as shown in Figure 10.

Participant 11B

Figure 11 displays the safety performance, productivity performance, and productivity accuracy of participant 11B during the course of the experiment and the accuracy of participant observations during the observation phases and observation plus distracter phase.

Safety Performance

Back position averaged 2.5% (SD: 3.3; range: 0% to 7%) safe during baseline, 12.4% (SD: 15.4; range: 0% to 37%) during the information phase, 98.1% (SD: 3.8; range: 90% to 100%) during the observation phase, 15.7% (SD: 21.4; range: 0% to 40%) in the observation plus distracter phase, and 100% when the
Legend. Solid circles indicate participant safety performance on the top three graphs, then productivity performance and accuracy on the following corresponding graphs. Open circles indicate the accuracy of participant safety observations. Open squares indicate the start of the information phase. Open triangles indicate the start of the observation phase for the first set of target behaviors. An "X" indicates the start of the observation phase for the second set of target behaviors. Open diamonds indicate the start of the observation and distracter phase. A "+" indicates the reversal to the observation phase.

Figure 11. Data for Participant 11B.
observation phase was reintroduced. Shoulder position averaged 2.5% (SD: 3.3; range: 0% to 7%) safe in baseline, 12.4% (SD: 15.4; range: 0% to 37%) in the information phase, 98.1% (SD: 3.8; range: 90% to 100%) in the observation phase, 15.7% (SD: 21.4; range: 0% to 40%) in the observation plus distracter phase, and 100% when the distracter task was withdrawn. Feet position averaged 73.2% (SD: 42.8; range: 0% to 100%) safe during baseline, 100% during the observation phase, 95.7% (SD: 7.5; range: 87% to 100%) in the observation plus distracter phase, and 100% when the observation phase was reintroduced.

Productivity Performance and Accuracy

As displayed in Figure 11, participant 11B averaged 272 (SD: 51.7; range: 120 to 324) threaded beads during each session with an average of 99.8% (SD: 0.5; range: 98% to 100%) color sequence accuracy.

Accuracy of Observations

Participant 11B averaged 93.1% (SD: 22.1; range: 20% to 100%) accuracy when scoring safe back position on a confederate's performance. Observation accuracy averaged 100% for shoulder position and 98.8% (SD: 3.5; range: 90% to 100%) on feet position, as shown in Figure 11.
Analysis of Verbal Data

Figure 12 displays the average number of segments per session across all participants in the talk-aloud group (Participants 0A, 1A, 2A, 3B, and 5B) distributed across each phase (baseline, information, observation, and reversal to observation) with the exception of the distracter phase. All verbalizations that occurred during the distracter phase were directly related to the distracter task (see Appendix P), and therefore, were not included in the above-mentioned calculation. The average number of segments per session for baseline was 99.3, the average was 80.6 for the information phase, and 70.8 and 55.8 for the observation phase and reversal to observation phase, respectively. The total number of segments coded for baseline phase sessions was 1,788; 1,531 were coded for information phase sessions, 3,612 and 223 were coded for the observation phase and reversal to observation phase sessions, respectively.

![Average Number of Segments Per Session](image)

Figure 12. Average Number of Segments Per Participant, Per Session Distributed by Phase.
The percentage of segments which were coded into each category (see “Analysis of Verbal Data” subsection on page 37 for more details) was also calculated for each phase and is displayed in Figure 13. The percentage of segments coded into the “off-task statement” category during baseline sessions was 38.7, 1.6% were coded into the “environmental factors” category, 53.2% into the “assembly-task related” category, 1.3% into the “target behavior-related”, and 5.2% were coded as “research related.” Segments which occurred during the information phase sessions were distributed as follows: 22% into the “off-task” category, 1% into each of the following categories: “environmental factors,” “target behavior-related,” and “general safety-related,” 70% of the segments were coded as “assembly task-related,” and 5% as “research related.” Observation phase segments were coded as follows: 33% were coded as “off-task statements”, 2.7% were related to environmental factors, 56.6% were related to the assembly task, 1.3% were coded into the “target behavior-related” category, 1.7% and 0.2% were coded as general and specific safety-related, respectively, and 4.5% were categorized as research related. The percentage of segments coded into the “off-task statement” category during the reversal to observation phase was 12.6, 3% were coded into the “environmental factors” category, 79% were categorized as assembly-task related, 0.4% and 5% were coded as target behavior-related and research related, respectively.
Figure 13. Percentage of Segments Coded into Each Category for Each Phase.
The total number of segments which were coded into the safety-related categories (e.g., general safety-related and specific safety-related) was calculated and the percentage of segments which were coded into each of the two categories was calculated. Out of a total of 132 segments coded as safety-related, the percentage of segments coded as general-safety related was 89.4, and 10.6% were coded as specific safety-related. This distribution is shown in Figure 14.

![Distribution of Safety-Related Verbalizations by Category](image)

Figure 14. Percentage of Safety-Related Segments Coded into Each Category.

Safety-Related Verbalizations

Two of the five participants in the talk-aloud group did not make any safety-related verbalizations throughout the observation phase, and of the remaining three none made any safety-related verbalizations during the reversal observation phase. Therefore, for the following analyses I only included data related to safety verbalizations from the first observation phase for the three talk-aloud participants.
that stated safety-related verbalizations throughout this phase: participants 0A, 2A, and 5B.

The percentage of observation sessions with at least one safety-related verbalization was 100% for participant 0A, 90% for participant 2A, 58% for participant 5B, and 79% when averaged across the three participants. Participant 0A averaged 3 safety-related verbalizations per observation session, and participants 2A and 5B each averaged 2 and 1.3, respectively. The number of safety verbalizations per observation session when averaged across all three participants was 1.93.

The probability that an increase in safety occurred immediately following, or within, a 30-second interval in which a safety-related verbalization occurred was 14%, 13%, and 12% for participants 0A, 2A, and 5B, respectively. When averaged across the group, the probability of this occurrence was 13%. The probability that an increase in safety occurred in the absence of a preceding safety-related verbalization was 4.6% when averaged across all three participants. The probability of such an increase in safety was 3.9% for participant 0A, 1.2% for participant 2A, and 7.4% for participant 5B. The probability that a safe interval occurred immediately following a safety verbalization interval was 100% for both participants 0A and 5B, and 96% for participant 2A. When averaged across the group, the probability was 98%. The probability that a safe interval occurred immediately following a non-safety-related verbalization interval was 62.5% for participant 0A, 83.2% for participant 2A, and 74.1% for participant 5B. When averaged across the three participants, the probability of such an occurrence was 75.1%.
Below I have included some cumulative graphs for each of the talk-aloud participants to provide both examples and non-examples of sessions with safety-related verbalizations. The purpose of including these graphs is to provide a visual "summary" of safety performance within a sample of sessions, and a visual example of some of the above-mentioned probabilities. Each graph shows the cumulative number of safe 30-second intervals during a 15-minute session.

Legend. An open circle indicates that a safety-related verbalization occurred during the 30-second interval.

Figure 15. Participant 0A Cumulative Safe Performance.
Legend. An open circle indicates that a safety-related verbalization occurred during the 30-second interval.

Figure 16. Participant 1A Cumulative Safe Performance.
Legend. An open circle indicates that a safety-related verbalization occurred during the 30-second interval.

Figure 17. Participant 2A Cumulative Safe Performance.
Legend. An open circle indicates that a safety-related verbalization occurred during the 30-second interval.

Figure 18. Participant 3B Cumulative Safe Performance.
Legend. An open circle indicates that a safety-related verbalization occurred during the 30-second interval.

Figure 19. Participant 5B Cumulative Safe Performance.
Group Safety Performance Comparisons

Participants in the talk-aloud condition averaged 82% safe performance on the target behaviors during the observation phase, and participants in the silent condition averaged 89.5% safe performance. Statistical analyses were conducted on observation phase safety data between the talk-aloud and silent condition groups to determine if a statistical significance existed between groups. Independent sample t-tests revealed a statistically significant difference ($t=.011$, $p<.05$, $df=221.2$) between group observation phase means. Huitema (1985) argued that problems of autocorrelation are not inherent to behavioral data by definition, and therefore, the most appropriate statistical analyses should rely on the relevant experimental question. Based on this argument, it was considered appropriate to treat each safety score as an independent observation.

Exit Interviews

Below is a list of the questions asked to each participant at the end of the last session and a summary of their answers. Participants in the silent group (Participants 6A through 11B) were asked questions 1 through 4, and those in the talk-aloud group (Participants 0A through 5B) were asked questions 1 through 3 and 5 through 8. Participant 3B did not attend the last session, and therefore, was not available for the exit interview. The questions are separated into those posed to the talk-aloud group and those posed to the silent group. Each question listed is followed by the answers given by each participant. Often the same answers were given by more than one
participant, and each set of answers is represented by the letter “A” and the numbers “1” through “8”.

Q1 (Question #1): What did you think the study was about? (Answer 1) given by participants 6A and 7B: to see how many beads we could string and something about safety; (A2): participant 0A, 2A, 5B: to look at assembly line performance and how being safe or being distracted changed performance; (A3): participant 8B: to see how annoyed people would get with scoring a video and having to be safe; (A4): participants 1A, 9A, 10B, and 11B: to look at safety and see if we knew the difference between safe and unsafe by scoring the videos.

Q2: Why do you think that your safety performance did/did not change throughout the course of the study? (A1) participant 6A: because I signed a contract (information sheet) to change my feet performance, but not my for my back and shoulders, so I didn’t work so hard on them, (A2) participant 7B: because I was supposed to, I signed a paper about being safe for my back, I didn’t really know if I was supposed to do my feet safe too; (A3): I thought if I did everything safe I could stop sitting in the other room for five minutes or stop having to watch those videos; (A4): participants 0A, 1A, 2A, 9A, 10B, 11B: after I knew what to do and saw the difference between safe and unsafe it made it easier to do, (A5) participant 5B: after watching the video it made me begin to think about how correct posture really is good for you and so I started to do it, but sometimes it was uncomfortable and I’d begin to lean because it’s a habit.
Q3: Do you think you performed more safely after conducting safety observations? (A1): participants 6A and 7B: I don’t really think so at first, maybe at the end, (A2) participants 0A, 1A, 2A, 5B, 8B, 9A, 10A, 11B: yes.

Q4: Did you have to remind yourself in order to perform safely? (A1): participant 8B: no, not really; (A2): participants 6A: yes, especially when I’d feel my feet move; (A3): participants 7B, 9A, 10B, 11B: yes, all of the time, especially when I realized I was unsafe.

Q5: You did/did not make verbalizations regarding your safety performance. Does this surprise you? (A1) participant 1A (did not make verbalizations): yes, I thought I did sometimes; (A2): 0A, 2A, and 5B (did make verbalizations): no, I knew that I reminded myself.

Q6: Why did/didn’t you make these verbalizations? (A1): participants 1A (did not make verbalizations): I think because I thought about it so quickly and while I was doing something else, and a lot of times it was right in the beginning, so it never crossed my mind to say it out loud because it was so fast; (A2): participant 5B (did make verbalizations): because I needed to remind myself to be safe, although sometimes it got me thinking about a lot of other things; (A3): participants 0A and 2A(did make verbalizations): I wanted to make sure I was being safe and sometimes I’d catch myself doing something wrong.

Q7: Do you think these verbalizations or “reminders” were necessary to perform safely? (A1) participant 1A: I’m not sure, I think so; (A2): participants 0A, 2A, and 5B: yes, definitely.
Q8: Is there something I could have stated to you at the start of the study to increase the chances of you making safety-related verbalizations? (A): participants 0A, 1A, 2A, and 5B: I don’t really know, I don’t think so.

Interobserver Agreement

Agreement between observers on participant safety performance averaged 96.8% (SD: 3.1; range: 89% to 100%) and can be seen in Figure 20.

Figure 20. Percent Agreement Between Data Collectors.

Interobserver agreement was conducted on all verbal transcriptions and averaged 99.5% (SD: 0.92; range: 96.7% to 100%). All discrepancies found by the undergraduate researcher were reviewed, and corrected, by the graduate researcher to ensure accuracy. Interobserver agreement was also conducted on all coded segments...
and averaged 99.85% (SD: 0.09; range: 99.8% to 100%). All discrepancies were reviewed by the graduate researcher and coded into the category that most closely described the contents of the segment.
DISCUSSION

The purpose of Experiment 1 was two-fold: (1) to determine if observers make safety-related verbalizations as a result of conducting safety observations, and if so (2) to help determine if a functional relationship existed between these verbalizations and increases in safety performance by employing the procedures described as the silent dog method (Hayes et al., 1998). An attempt to achieve these goals was made by employing the three control requirements described by Hayes, White, and Bissett (1998). The goals of Experiment 1 were to satisfy the first and second control requirements of the silent dog method, and establish a framework for the methods, specifically for the independent variable, used in Experiment 2 (the goal of which was to satisfy the third control requirement). According to Hayes et al. (1998) all three controls must be present in order to determine the functional nature of self-rules or self-verbalizations, should any exist. The results from Experiment 1 suggest that observers make safety-related verbalizations as a result of conducting observations. The results also meet the second and third silent dog method control requirements, but whether the first control was met is unclear. According to the analysis posed by Hayes et al. (1998), analyzing the results within the context of the silent dog method requirements will help determine if the results of Experiment 1 suggest the existence of a functional relationship between safety-related verbalizations and increases in observer safety performance.

Throughout Experiment 1, data were collected on several variables other than those specifically related to safety verbalizations and the silent dog method control
requirements (i.e., safety performance, productivity performance, etc.). Therefore, before discussing the above-mentioned issues, I will discuss the other variables measured throughout the study.

Overall Effects of Information

The information phase had varied effects on performance across participants: no effect, a weak effect, or a strong effect. Sixteen target behaviors across eleven participants were exposed to the information phase. No effect was defined as no difference between baseline and information phase means. A weak effect was considered a difference of 25% or less between baseline and information phase means, and a strong effect was a difference of more than 25% between means. The presentation of safety definition information had no effect on four target behaviors: (a) participant 3B, back and shoulder position, and (b) participant 8B, back and shoulder position. Weak increases in safety performance were observed in four behaviors across two participants: (a) participant 5B, back and shoulder position, and (b) participant 11B, back and shoulder position. The presentation of information resulted in strong effects for eight target behaviors across seven participants: (a) participant 7B, back and shoulder position, and (b) participants 0A, 1A, 2A, 6A, 9A, and 10A, feet position. In conclusion, the strongest effects were primarily observed in feet position, and the weakest, or no, effects were observed for back and shoulder position. The substantial improvements observed in feet position are consistent with previous research findings (Alvero & Austin, in press, 2002; Sasson, 2002), and it is
likely these sizeable improvements occurred because it was the least effortful behavior to engage in.

**Overall Effects of Conducting Observations**

There were four observable trends in performance as a result of conducting observations: no effects, weak effects, gradual effects, and strong effects. Thirty-three target behaviors across eleven participants were exposed to the observation phase. No effect was defined as no difference between the observation phase mean and the phase mean that immediately preceded the observation phase. The observation phase had no effects on six target behaviors: (a) participant 3B, feet position, (b) participant 6A, feet position, (c) participant 7B, back and shoulder position, (d) participant 10A, feet position, and (e) participant 11B, feet position. Increases in safety performance were not possible for participants 6A, 7B, 10A, and 11B because safety performance on the above-listed behaviors averaged 95% or higher in the phase preceding the observation phase. Conducting safety observations did not increase feet position safety performance for participant 3B. Although this participant was unavailable for an exit interview, the experimenter noted several comments made by participant 3B during the observation phase (these comments were made directly to the experimenter, and not during an experimental session, and therefore, were not tape recorded or transcribed). On several occasions, participant 3B said, “I know I should put my feet flat, but it’s just too uncomfortable” and “I don’t know how anyone can have their feet flat and their back and shoulders straight.
at the same time, it’s just too hard." These statements seem to suggest a lack of motivation to perform feet position safely, and therefore, resulted in no change in feet performance during the observation phase.

An effect was considered weak if there was a difference of 25% or less between the observation phase and the preceding phase means. Weak effects were observed in two target behaviors: (a) participant 1A, feet position, and (b) participant 9A, feet position. Safety performance on the above-mentioned behaviors was considerably high during the phase preceding the observation phase, and therefore, the potential for improvement was minimal.

A gradual effect was defined as an initial increase of 50% or less between the first observation phase data point and the preceding data point, and a gradual, and steady, increase in safety performance during the remainder of the observation phase. Gradual increases in safety performance were observed in five target behaviors: (a) participant 5B, shoulder position, (b) participant 6A, back and shoulder position, and (c) participant 8B, back and shoulder position. A clear example of this effect can be seen in participant 8B back and shoulder safety performance (Figure 8). Performance on each of these behaviors increased from 0% safe during baseline to 50% during the first observation phase session. Back and shoulder positions gradually increased during the remainder of the observation phase and reached 100% safe within the last three sessions of the phase.

A strong effect was considered a difference of more than 25% between the observation phase and the preceding phase means, but excluded the behaviors that
met the criteria specified for "gradual effects." Safety performance increased dramatically for twenty, of the thirty-three, behaviors targeted during the observation phase. A clear example of this strong effect can be seen in participant 2A back and shoulder safety performance (Figure 3). Performance on each of these behaviors increased from 0% safe during baseline to 100% during the first observation phase session.

A slight change in the protocol used during the observation phase occurred toward the end of Experiment 1, and requires a brief explanation. The graphs showing participant 9A and 10A safety performance (Figures 9 and 10, respectively) have an arrow pointing toward an observation phase data point and include the phrase "change in definition" underneath the arrow. I developed a "concern" in back and shoulder safety performance for participants 9A and 10A when collecting interobserver agreement data. Both participants had changed their performance, as a result of conducting safety observations, to meet the safety definition provided on the data collection sheet. Safe back position was defined as: back upright, parallel to the back of the chair (not leaning against it), and safe shoulder position was defined as: shoulders in line with the back, not slouched forward. Although back and shoulder safety performance, for both participants 9A and 10B, met these criteria, both participants began to lean on the chair's armrest. Therefore, participants were leaning toward the side, something not considered "safe" (Office of Health and Safety Information System, 1998), but not explicitly clarified in the definition provided to them on the safety checklist. Because both participants did keep their back straight
and shoulders were aligned with the back, they were scored as performing these behaviors safe. Despite this, I felt it was necessary to make an attempt to further change their performance to exclude "leaning toward a side." A slight change was made to the safety definitions included on the safety checklist. Back and shoulder safety definitions were changed to include the phrase "not leaning toward any side." This change occurred during session 22 for participant, and during session 21 for participant 10A. At the start of the above-specified sessions, each participant was instructed to review the checklist before conducting a safety observation because slight changes had been made to the checklist. As a result of this modification to the checklist, both participants no longer leaned toward the side. It is important to reiterate that these slight changes to the safety checklist only occurred for participants 9A and 10B and are indicated on their corresponding safety performance graphs.

Productivity Performance and Accuracy

Productivity performance and accuracy data were primarily collected to ensure that an inverse relationship did not exist between safety and productivity. In other words, these data provide an indication as to whether or not productivity performance and accuracy decrease as safety performance increases. The results of Experiment 1 do not indicate the existence of any such inverse relationship. Implementation of the information phase and the observation phase appeared to have no effect on productivity performance and accuracy. Decreases in productivity and accuracy were observed with the implementation of the distracter task. These notable
decreases seem to suggest that productivity and accuracy may be functionally related to some type of verbal behavior. The results of Experiment 1 do not permit any concrete conclusions regarding this hypothesis to be drawn because these were not the primary variables of interest, and thus, no experimental manipulations were made to address this issue. The productivity performance and accuracy data collected during Experiment 1 may be interpreted as a measure of social validity. An intervention, such as conducting safety observations within a behavior-based safety process, would not be accepted by organizations if increases in safety resulted in decreases in performance. The productivity data collected during Experiment 1 provide some empirical evidence to suggest that productivity remains unchanged by improvements in safety behavior.

Accuracy of Participant Observations

The accuracy of participant observations observed during Experiment 1 does not appear to be correlated with safety performance. This general conclusion was drawn based on the lack of observable trends between variables, but no formal deduction can be made based on these observations. As with the other secondary variables measured during Experiment 1, no concrete conclusions can be drawn regarding the possible relationship between accuracy of observations and safety performance because no experimental manipulations were made to address this issue.

Safety-Related Verbalizations
As previously stated, one of the main purposes of Experiment 1 was to determine if observers make safety-related verbalizations as a result of conducting safety observations. To determine if this assumption was accurate it was necessary to examine the sometimes covert verbalizations evoked after participants conduct safety observations of the behavior of others. To document the occurrences of these verbalizations, I used a special set of procedures designed to collect data on these typically unobservable phenomena, specifically, the protocol analysis procedure (Ericsson & Simon, 1993). Five of the eleven Experiment 1 participants were trained to continuously talk-aloud throughout all phases of the study. An analysis of the verbal data measured for talk-aloud participants revealed the occurrence of safety-related verbalizations as a result of conducting safety observation for three of the five talk-aloud participants. Safety-related verbalizations were not made during baseline, but the percentage of observation sessions with at least one safety-related verbalization was 79% when averaged across the three participants. Because the analysis of verbal data suggest that observers make safety-related verbalizations as a result of conducting safety observations an attempt was made to achieve the second objective of Experiment 1 and help determine if a functional relationship existed between these verbalizations and increases in safety performance. This was done by employing the procedures described in the silent dog method (Hayes et al., 1998).
Silent Dog Method Control 1

The first silent dog method control states it must be shown that performance on a task with continuous, concurrent talk-aloud procedures is functionally equivalent to performance without talk-aloud reports (i.e., it must be demonstrated that talking aloud during a task does not alter performance). How one should demonstrate the equivalence between group performances is not specified. In other words, "How do we know if safety performance for talk-aloud participants is equivalent to the safety performance of silent group participants?" is not a question that can easily be answered. The first step toward finding an answer was made by conducting between group statistical analyses on safety performance. Due to the experimental question of interest, group comparisons were made only for safety performance data measured during the observation phase. The overall purpose of this research was to help determine the behavioral function of conducting safety observations. Therefore, the main variable of interest was the safety performance that resulted from conducting safety observations, and group comparisons were only made for the data relevant to this variable. Statistical analyses revealed that a statistically significant difference existed between silent and talk-aloud group observation phase means at the .05 significance level. In other words, the probability that the observed difference between the group means (talk-aloud group averaged 82% safe performance; silent group averaged 89.5% safe performance) would have occurred by chance, and not due to sampling error (commonly referred to as Type 1 errors), is less than .05. Although the results of the statistical analyses revealed a statistically significant
difference between group observation phase means it is difficult to draw a definite practical conclusion regarding the equivalence, or lack thereof, between group safety performance.

The debate between the practical and statistical significance of data and the benefits of using inferential statistics in behavioral research are prevalent and ongoing disputes (e.g., Baer, 1977; Baum, 1983; Hopkins, Cole, & Mason, 1998; Kahler, Stuart, & Lejuez, 2001; Michael, 1974). According to Baer (1977), relying on statistics alone to make conclusions regarding the differences between two groups may result in error that, in fact, can be substantially reduced if the data are carefully examined using visual analysis. For example, if the probability used in a statistical test is low enough (such as 0.05), it will likely be concluded that each examined condition does affect behavior differently. “But it will always be remembered that this conclusion could be an error, and in fact, that proceeding in this manner will virtually guarantee that some 5% of all such scientific conclusions are error” (Baer, 1977, p. 169). When using the individual-subject paradigm, these types of error probabilities are not computable. Despite this, comparing the possible differences between groups through visual analysis can decrease the probability of making such errors. Baer justifies this point and states:

...a difference has to be seen to be affirmed. A comparison of differences treated by skeptical examinations by eye, and by computation of the probability that they arose by chance from a zero-difference population, suggests strongly that much smaller and less consistent differences can be
validated by computation than by inspection. That is, in the individual-subject paradigm, the probability of Type 1 errors is not known with any precision, but is clearly much smaller than 0.05. (p. 169)

“Visual inspection of single-subject data is far and away the most popular and most often published means of data analysis published in the applied behavior analytic literature” (Mawhinney & Austin, 1999, p.66). Certain guidelines for performing a fine-grained analysis of behavioral data have been developed and are widely-accepted (Mawhinney & Austin, 1999; Parsonson, 1999; Parsonson & Baer, 1992). According to Parsonson (1999), the fine-grained analysis of graphs relies upon inspection and evaluation of several characteristics.

In particular, the following data path characteristics systematically are examined: Changes in level, trend, variability or stability and/or patterns or sequences in the data within and/or between experimental conditions; the range and any overlapping of the data points between experimental conditions; and, the number of data points in an experimental condition. (p. 47)

Figure 21 shows average safety performance for both the talk-aloud and silent groups across the baseline and observation phases. A fine-grained visual analysis, using the guidelines listed above, of these graphs does not seem to reveal any substantial differences between group safety performances. In other words, there does not appear to be any substantial differences in trend, variability or stability, patterns or sequences in the data within and/or between experimental conditions.
between talk-aloud and silent group safety performance. According to Parsonson (1999), employing a fine-grained visual analysis of graphs “contributes to the functional analysis of behavior in ways that cannot be obtained from routine application of statistics” (p. 50). The results revealed through visual analysis of group safety performance, and the above-discussed arguments against the significance of statistical results, suggest Experiment 1 results satisfy the first silent dog method control.

Figure 21. Talk-Aloud and Silent Group Average Safety Performance.
Silent Dog Method Control 2

The second silent dog method control states that it must be demonstrated that task performance is altered when participants are presented with a distracter task (i.e., performance is altered because the distracter prevents self-generation of rules or self-evaluative verbalizations). Experiment 1 results clearly show safety performance, for all participants, was substantially decreased with the introduction of the distracter task, thus, meeting the silent dog method control 2 requirement. The silent dog method states it is necessary to present the distracter task to talk-aloud participants, but does not specify whether or not it is necessary to present the distracter task to the participants in the silent group. Despite this, both groups of participants, in Experiment 1, were exposed to the distracter task phase. The rationale for this decision underlies the purpose, or hypothesis, of the present research. The purpose of this research is to suggest that a functional relationship exists between safety-related verbalizations and increases in safety, therefore, it seems reasonable to suggest that silent group participants also made safety-related verbalizations because of the observed safety performance improvements. As a result of this assumption, the only difference between groups was that one group made overt verbalizations (talk-aloud group) while the other made covert verbalizations (silent group). Exposing both groups to the distracter phase also allowed for more replications of the distraction effect on safety performance.

The purpose of exposing participants to a distracter task was to prevent participants from verbalizing rules and therefore, altering any performance that was
functionally related to these rules (Hayes et al., 1998). Therefore, participants in both groups were presented with a distracter task in an attempt to further strengthen the suggestion that a functional relationship exists between safety-verbalizations, both overt and covert, and safety performance. Safety performance on all target behaviors decreased an average of 60% for the talk-aloud group, and 44% for the silent group with the presentation of the distracter task, and increased an average of 70% and 48% for each group, respectively, upon its removal. These substantial results from Experiment 1 clearly seem to meet the silent dog method control 2 requirements, and help support the hypothesis of the present research.

Silent Dog Method Control 3

One of the main purposes of Experiment 1 was to help establish the framework for the methods used in Experiment 2 (control 3 requirement). According to Hayes et al. (1998), the third control ensures that the absence of an effect between performance in the talk-aloud and silent condition (the results of control 1, Experiment 1) is not because the task is contingency-shaped or that verbalizations are automatic or task irrelevant. This is achieved by employing relevant elements of the verbal reports (produced in control 1) as an external rule to new participants in Experiment 2. Because it was concluded that there was no practical significance between talk-aloud and silent group safety performance during the observation phase, thus meeting the requirements of the first silent dog method control, the verbal reports produced by Experiment 1 talk-aloud participants were used to generate description
of safety rules which were presented to Experiment 2 participants in place of the second independent variable: the observation phase.
EXPERIMENT 2

METHOD

Rationale

The purpose of Experiment 2 was to satisfy the third control requirement described in the silent dog method. The third control ensures that the absence of an effect between performance in the talk-aloud and silent groups is not because the task is contingency-shaped or that verbalizations are automatic or task irrelevant (Hayes et al., 1998). In order to demonstrate this third control requirement, description of safety rules were generated based on the analysis of verbal report data produced in Experiment 1. These description of safety rules were presented to a group of new participants in place of the second independent variable: the observation phase. Participants were asked to remind themselves of the description of safety rules at the start of each session and anytime they noticed a change in the target behavior(s) performance. These instructions were developed based on both the analysis of verbal data and exit interview results from Experiment 1. During the exit interviews, participants explained how they “caught” themselves performing unsafely and then reminded themselves to perform safely. Participants also said that often they only had to remind themselves to perform safely at the start of the session (see page 77).
Participants

Participants were four undergraduate students. Two students were enrolled at Western Michigan University and the other two were enrolled at Kalamazoo College, both are located in Kalamazoo, Michigan. The selection criteria used were the same as those described in Experiment 1 (see page 20). All participants were between 18 and 22 years of age, and were compensated $5.00 an hour for their participation throughout the study.

Setting and Materials

The study took place in the same research labs described in (see page 20). The rule description sheets (see Appendices W, X, Y) used during the description of rules phase contained descriptions of safety rules for one, two, or three of the target behaviors, respectively. One checklist (see Appendix C) was used by the researcher to collect data on each participant’s safety performance during each session throughout all phases. Videotapes were used to record the behavior of all participants during all sessions throughout the study.
Definition of Dependent Variables

Primary Variables

Safety Performance

The same safety performance definition described in Experiment 1 was applied to Experiment 2 (see page 21).

Rule Descriptions and Safety-Related Verbalizations

A rule description statement was defined as the repetition of the safety rules presented to participants during the description of rules phase. A safety-related verbalization was defined as any vocal-verbalization that was related to safety, specifically, statements related to any of the three target behaviors (i.e., back, shoulder or feet position) exposed to the rule description intervention. The number of rule description statements and safety-related verbalizations and the 30-second intervals in which each occurred were tracked and these data were used to calculate the same averages and probabilities used in Experiment 1 (see page 22).

Therefore, sessions within the rule description phase were included in the following calculations. (1) The percentage of observation sessions with safety-related verbalizations was calculated by adding the total number of sessions in which at least one safety-related verbalization occurred, dividing it by the total number of sessions and multiplying by 100%. (2) The average number of safety-related verbalizations that occurred per observation session was calculated by adding the total number of
safety-related verbalizations and dividing it by the total number of sessions in the observation phase. (3) The probability than an increase in safety occurred within, or immediately following, a 30-second interval in which a safety-related verbalization occurred was calculated by adding the total number of times an increase in safety occurred within the same 30-second interval, or the interval immediately following the interval in which a safety-related verbalization occurred, dividing by the total number of verbalization intervals (A/E in Table 1, page 23) and multiplying by 100%. An “increase in safety” was defined as an interval which was scored as “safe” and was preceded by an interval scored as “unsafe.” (4) The probability that an increase in safety occurred in the absence of a preceding verbalization interval was calculated by adding the total number of times an increase in safety occurred without a safety verbalization, dividing by the total number of non-safety-related verbalization intervals (B/F in Table 1, page 23) and multiplying by 100%. (5) The probability that a safe interval occurred immediately after a safety-related verbalization interval was calculated by adding the total number of safe intervals that immediately followed a safety-related verbalization interval, dividing by the total number of intervals in which a safety-related verbalization occurred (D/E in Table 1, page 23) and multiplying by 100%. (6) The probability that a safe interval occurred immediately after a non-safety-related verbalization interval was calculated by adding the total number of safe intervals that immediately followed a non-safety-related verbalization interval, dividing by the total number of non-safety-related verbalization intervals (C/F in Table 1, page 23).
Secondary Variables

Productivity Performance

The same productivity performance definition described in Experiment 1 subsection was applied to Experiment 2 (see page 24).

Productivity Accuracy

The same productivity accuracy definition described in Experiment 1 was applied to Experiment 2 (see page 24).

Measurement of Dependent Variables

Primary Variables

Safety Performance

The measurement system described in Experiment 1 was also used to collect safety performance data for Experiment 2 participants (see page 25).

Rule Descriptions and Safety-Related Verbalizations

The videotapes used to collect safety performance data were used to obtain rule description and safety-related verbalization occurrence data. The same undergraduate researcher collected both the above-mentioned safety performance data and data on the intervals in which rule description statements and safety-related verbalizations occurred. The procedures used to collect these data were the same as
those applied to Experiment 1 (see page 26). The percentage of sessions with rule
description statements and/or safety-related verbalizations and the number of
occurrences within each session were calculated at the end of the study. Each rule
description statement and safety-related verbalization was transcribed after each
description of rules phase session throughout Experiment 2.

Secondary Variables

Productivity Performance and Accuracy

The measurement system described for Experiment 1 was also used to collect
productivity performance and accuracy data for Experiment 2 participants (see page
26).

Interobserver Agreement

Interobserver agreement was calculated on safety-related target behaviors, and
the interobserver agreement procedure used for Experiment 1 was also applied to
Experiment 2 (see page 27). Interobserver agreement was also conducted on the
transcriptions of all rule description statements and safety-related verbalizations. The
graduate researcher compared the written text with the audio statements. This was
done by listening to each videotaped session while reading the typewritten text. An
agreement was defined as any verbalization, or word, in which both the transcriber
and graduate researcher identified as the same. Interobserver agreement between the
researcher and transcriber was calculated as follows: the number of agreements
divided by the number of agreements plus disagreements multiplied by 100%. Interobserver agreement was also calculated on the coding of verbalizations as "safety rule descriptions" or "variations of the safety rule." The graduate researcher and an undergraduate researcher coded 100% of the safety-related verbalizations. An agreement was defined as any occurrence in which both undergraduate researchers classified a safety-related verbalization into the same category. Interobserver agreement between the researchers was calculated as follows: the number of agreements divided by the number of agreements plus disagreements multiplied by 100%.

Independent Variable

One independent variable was presented during the description of rules phase after baseline. At the start of the description of rules phase, participants were given descriptions of safety rules for one (see Appendix W), or two (see Appendix X), of the three target behaviors. The initial rules presented to each participant were determined by the group to which they were randomly assigned (described below). Participants were required to memorize the rules and were then asked to remind themselves of these rules before beginning the assembly bead task and anytime they noticed a change in the behaviors described in the rules. After safety performance stabilized on the first set of target behaviors exposed to the rules phase, the remaining target behaviors were added to the safety rules sheet (see Appendix Y).
Procedures

Talk-Aloud Training

All participants were trained on how to talk or “think” aloud using the same training procedures followed as those for Experiment 1 (see page 30). Participants were instructed to talk aloud during all phases of Experiment 2.

Baseline

At the start of each baseline session, all participants were handed a list of instructions (see Appendix K) and were asked to perform the assembly task described in the instructions. This task was repeated throughout the 15-minute duration of the session, and participants continuously spoke aloud during the session. The exact procedures followed were the same as those described in Experiment 1 (see page 31).

Rule Description Phase

The rule descriptions were developed based on the verbal data analysis from the first experiment. These “rules” were generated using the segments that were coded as “general safety-related verbalizations” (see page 37). The reason these rules were “general” versus “specific” is because the general safety-related verbalizations occurred with much more frequency than did the more specific safety-related statements. Of the safety-related verbalizations that occurred during Experiment 1, 89.4% of them were coded as “general safety-related”, and 10.6% were coded as
“specific safety-related” (see Appendices Z and AA for a list of all segments coded in the general and specific safety-related categories, respectively). Therefore, I chose to model the “rules” for this phase after the general safety statements. The “general rule” used to describe safe feet position was, *I need to keep my feet flat on the floor. I should keep my back and shoulders straight and not slouch or lean in any direction,* was used to describe safe back and shoulder position.

At the start of each session during this phase, participants were given descriptions of safety rules for one, or two, of the three target behaviors. Two participants comprised “Group A” and were exposed to rules for one target behavior (feet position when sitting, see Appendix W). The remaining two participants comprised “Group B” and were exposed to rules for the other two target behaviors (back and shoulder position when sitting, see Appendix X).

At the start of each session during the rule description phase, and before going into the work environment, participants were asked to review the rule descriptions (see Appendices W and X) until they memorized the rules. Participants were “quizzed” (see Appendices BB and CC) on the rules before each session throughout the phase by the researcher to ensure that participants had learned the rules, and then participants were instructed to prompt themselves of these rules at the start of each work session and anytime they noticed a change in the position of the behaviors described by the rules. Participants were then given a list of assembly task instructions to perform, and the procedures were identical to those described in baseline.
After performance stabilized for the first target behavior(s) introduced to the rule description phase, the remaining target behavior(s) were added to the rule descriptions (see Appendix Y). Researchers followed a script (see Appendix DD) and quizzed participants on all rules and instructed participants to prompt themselves of these rules at the start of each work session and anytime they noticed a change in the position of the behaviors described by the rules. Participants remained in this phase until performance stabilized.

Integrity of the Independent Variable

Scripts were used for all of the verbal instructions that were given to the participants by the researchers. This ensured that all participants were exposed to the same instructional set. Participants were asked to review the rule descriptions and were then “quizzed” (see Appendices BB and CC) on the rules by the researcher to ensure that participants had learned the rules. Videos were also scored to determine if participants stated safety-related verbalizations, or rules, aloud while they performed the assembly task. This further ensured that participants read and memorized the stated rules and therefore, were exposed to the independent variable.

Experimental Design

A multiple baseline across behaviors design was used to evaluate the impact of the rule statements on safety behavior. The rule statement was first implemented
for one (or two) of the three target behaviors. After performance on the first
behavior(s) stabilized, the next behavior(s) were exposed to the rules.

Stability Criteria

The stability criteria used for Experiment 1 were also applied in Experiment 2
(see page 37).

Exit Interviews and Debriefing

At the end of the last session, Experiment 2 participants were asked a series of
questions (see Appendix EE) concerning the experiment, and then they were given an
explanation about the nature of the experiment (see Appendix FF). The questions and
explanation were read to each participant by the experimenter. The purpose of
debriefing each participant was two-fold: (a) to obtain as much information as
possible about participant safety performance and the possible effects of stating
safety-related statements, and (b) to insure that all participants understood the nature
of the study and to answer any of their questions regarding their participation.

Informed Consent Process

The consent process occurred at the start of each participant’s initial session.
Either the graduate or undergraduate research assistant read a script (see Appendix T)
and reviewed the consent form (see Appendix U) with each participant. Participation
in Experiment 2 did not begin until the participant read and signed the consent form.
Human Subjects Protection

This project (both Experiment 1 and 2) was approved by the Human Subjects Institutional Review Board (see Appendix V).
RESULTS

Participant 12B

Figure 21 displays the safety performance, productivity performance, and productivity accuracy of participant 12B during the course of the experiment.

Safety Performance

Safe back position averaged 27.4% (SD: 16.7; range 10% to 50%) during baseline and 97.2% (SD: 2.6; range 83% to 100%) during the rule description phase. Shoulder position averaged 24.8% (SD: 17.9; range 10% to 50%) safe in baseline and 96.6% (SD: 3.5; range 83% to 100%) in the rule description phase. Feet position averaged 21.1% (SD: 29.9; range 0% to 93%) and 100% during baseline and rule description phases, respectively.

Productivity Performance and Accuracy

Participant 12B averaged 443 (SD: 37.2; range 369 to 505) beads during each session with an average of 100% color sequence accuracy.

Participant 13B

Figure 22 displays the safety performance, productivity performance, and productivity accuracy of participant 13B during the course of the experiment.

110

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Legend. Open squares indicate the start of the rule description phase for the first set of target behaviors. An open triangle indicates the start of the rule description phase for the second set of target behaviors.

Figure 22. Data for Participant 12B.
Legend. Open squares indicate the start of the rule description phase for the first set of target behaviors. An open triangle indicates the start of the rule description phase for the second set of target behaviors.

Figure 23. Data for Participant 13B.
Safety Performance

Average safety levels for back position were 7.3% (SD: 10.9; range 0% to 23%) and 95.8% (SD: 8.2; range 80% to 100%) during the baseline and rule description phases, respectively. Safe shoulder position averaged 6.5% (SD: 11.1; range 0% to 23%) in baseline and 96.9% (SD: 8.2; range 80% to 100%) in the rule description phase. Participant 13B averaged 57.2% (SD: 39.5; range 0% to 100%) safe for feet position during the baseline phase and 100% during the rule description phase.

Productivity Performance and Accuracy

Participant 13B averaged 359 (SD: 48.8; range 263 to 422) beads and 99.8% (SD: 0.6; range 98% to 100%) accuracy during each session.

Participant 14A

Figure 23 displays the safety performance, productivity performance, and productivity accuracy of participant 14A during the course of the experiment.

Safety Performance

Back position averaged 3.3% (SD: 6.7; range 0% to 20%) safe during baseline and 99.6% (SD: 1.1; range 97% to 100%) safe during the rule description phase. Safe shoulder position averaged 2% (SD: 3.6; range 0% to 10%) in baseline and 99.6% (SD: 1.1; range 97% to 100%) in the rule description phase. Average safety levels for
Legend. Open squares indicate the start of the rule description phase for the first set of target behaviors. An open triangle indicates the start of the rule description phase for the second set of target behaviors.

Figure 24. Data for Participant 14A.
feet position were 15\% (SD: 18.2; range 0\% to 37\%) during baseline and 99.8\% (SD: 0.8; range 97\% to 100\%) during the rule description phase.

**Productivity Performance and Accuracy**

Participant 14A averaged 314 (SD: 30.4; range 236 to 377) beads and 100\% accuracy throughout the experiment.

**Participant 15A**

Figure 24 displays the safety performance, productivity performance, and productivity accuracy of participant 15A during the course of the experiment.

**Safety Performance**

Safe back position averaged 0\% during baseline and 100\% during the rule description phase. Shoulder position averaged 0\% safe in baseline and 97.9\% (SD: 6; range 83\% to 100\%) in the rule description phase. Feet position averaged 3.5\% (SD: 4; range 0\% to 7\%) and 100\% during baseline and rule description phases, respectively.

**Productivity Performance and Accuracy**

Participant 15A averaged 305 (SD: 30.9; range 226 to 348) beads during each session with an average of 99.9\% (SD: 0.2; range 99\% to 100\%) color sequence accuracy.
Legend. Open squares indicate the start of the rule description phase for the first set of target behaviors. An open triangle indicates the start of the rule description phase for the second set of target behaviors.

Figure 25. Data for Participant 15A.
All four participants made safety rule description statements and/or safety-related verbalizations (defined as any variation of the rule; please see Appendix GG for a complete list of these safety-related verbalizations) during the description of rules phase. Safety rule descriptions were defined as the complete, or partial, repetition of the safety rules presented to them during the rule description phase. The percentage of rule description phase sessions with at least one safety rule description statement or safety-related verbalization was 100% for participant 12B, 38% for participant 13B, and 100% for both participants 14A and 15A. Across the four participants, the average number of safety statements (both rules and variations thereof) was 1.08 per session during the rule description phase. The total number of verbalizations which were categorized as either safety rule description statements or safety-related verbalizations was calculated and the percentage of verbalizations which were categorized into each of the two categories was calculated. Out of a total of 81 safety statements, the percentage of verbalizations categorized as rule description statements was 59, and 41% were categorized as safety-related statements. This distribution is shown in Figure 25.
Participant 12B made a total of 23 safety statements during the rules phase, and 100% of these statements were complete repetition of the safety rules, or safety rule description statements. Participant 13B made eight safety statements during the first seven sessions within the rules phase; 25% of these statements were safety rule descriptions and 75% were considered safety-related verbalizations or variations of the rule. This participant did not make any safety-related statements during the remaining nine rule description phase sessions. Participant 14A made a total of 32 safety statements during the rules phase. Of these statements, 37.5% were exact safety rule description statements and 62.5% were some variation of the rule. Participant 15A made 18 safety statements; 61% of the statements were a complete repetition of the safety rules and the remaining 39% of statements were safety-related statements.
The probability that an increase in safety occurred immediately following, or within, a 30-second interval in which a safety-related verbalization occurred was 4%, 38%, 6%, and 0% for participants 12B, 13B, 14A, and 15A, respectively. When averaged across the group, probability of this occurrence was 6%. The probability that an increase in safety occurred in the absence of a preceding safety-related verbalization was 0.8% when averaged across all participants. The probability of such an increase in safety was 1.2% for participant 12B, 1.5% for participant 13B, and 0% for both participants 14A and 15A. The probability that a safe interval occurred immediately following a safety verbalization interval was 100% for all four Experiment 2 participants. The probability that a safe interval occurred immediately following a non-safety-related verbalization interval was 91.9% for participant 12B, 96% for participant 13B, 93.3% for participant 14A, and 95.5% for participant 15A. When averaged across the four participants, the probability of such an occurrence was 94.1%.

Below I have included some cumulative graphs for each of the Experiment 2 participants to provide both examples and non-examples of sessions with safety-related verbalizations and safety rule description statements. The purpose of including these graphs is to provide a visual “summary” of safety performance within a sample of sessions. Each graph shows the cumulative number of safe 30-second intervals across the duration of each 15-minute session.
Legend. An open circle indicates a safety-related verbalization occurred during the 30-second interval.

Figure 27. Participant 12B Cumulative Safe Performance.
**Legend.** An open circle indicates a safety-related verbalization occurred during the 30-second interval.

Figure 28. Participant 13B Cumulative Safe Performance.
Legend. An open circle indicates a safety-related verbalization occurred during the 30-second interval.

Figure 29. Participant 14A Cumulative Safe Performance.
Legend. An open circle indicates a safety-related verbalization occurred during the 30-second interval.

Figure 30. Participant 15A Cumulative Safe Performance.
Exit Interviews

Below is a list of the questions asked to each participant in Experiment 2 at the end of the last session and a summary of their answers. Participants in group “A” (Participants 14A and 15A) were asked questions 1 through 6, and those in the group “B” (Participants 12B and 13B) were asked questions 1 through 7. Each question listed is followed by the answers given by each participant.

Q1: What did you think the study was about? (A1): participant 12B: increasing safe posture at work; (A2): participant 13B: looking at how well I did the job with posture, bead accuracy and number of beads I put on the string; (A3): participant 14A: employee thoughts on repetitive work; (A4) participant 15A: employee concentration when working on bead patterns and how the concentration changes with different positions

Q2: Did you feel the safety statements provided you with enough information to perform safely? (A1): participant 12B: yes, because the task was simple; (A2): participants 13B and 14A: yes; (A3): participant 15A: yes, I thought they were extremely explanatory.

Q3: Why do you think repeating the statements improved your safety performance? (A1) participant 12B: because the statements reminded me what I was supposed to do and it helped me focus on the behaviors; (A2): participants 13B: because the statements helped me know what I was supposed to do and I was able to correct my posture when I repeated them, although eventually sitting correctly became a habit and I didn’t have to repeat the statements any more; (A3)
14A: repeating the statements reminded me what I was supposed to do; (A4) 

participant 15A: saying the statements reminded me to do the behaviors correctly. 

Q4: Oftentimes you did not repeat the statement exactly as you had memorized it. Why? (A1): participant 12B: because I knew the entire definition and felt that a shorter version was okay as a reminder; (A2): participant 13B: I felt what I said was just as effective because I knew what I had to do without repeating the entire statement; (A3): participant 14A: my version was just as effective for me; (A4) 

participant 15A: I knew the general idea and I felt it was just as effective. 

Q5: Did you remind yourself to be safe at times other than when you repeated the statement? (A1): participant 12B: no, every time I caught myself being unsafe I said the statement; (A2): participant 13B: yes, but I didn’t say anything out loud; (A3) participant 14A: no; (A4) participant 15A: probably yes, I sometimes asked myself, “Is this considered safe?” 

Q6: How did you “know” if you were safe? (A1) participant 12B: I just did the opposite of unsafe; (A2) participant 13B: I just tried to follow the definition; (A3) participant 14A: I based my back and shoulder safety against the amount of contact I had with the chair, and I tried to move my arms more than my shoulders; (A4) participant 15A: I just used my judgment. 

Q7: Your feet position safety performance increased when you were given the safety statements regarding back and shoulder performance. Did you realize this occurred? And why do you think it occurred? (A1) participant 12B: when I aligned my back with the back of the chair my feet automatically were flat on the floor; (A2)
participant 13B: keeping my feet flat on the floor helped me keep my back and shoulders straight, crossing my legs made me want to lean and slouch.

Interobserver Agreement

Agreement between observers on participant safety performance averaged 99.8% (SD: 0.58; range 98% to 100%) and can be seen in Figure 31.

Figure 31. Percent Agreement Between Data Collectors.

Interobserver agreement was conducted on all transcriptions of rule description statements and safety-related verbalizations and averaged 100%. Interobserver agreement was also conducted on all coded safety-related verbalizations and averaged 100%.
DISCUSSION

The purpose of Experiment 2 was to satisfy the third control requirement of the silent dog method (Hayes et al., 1998). According to Hayes et al. (1998), "If the performance is rule governed and the self-reports are task relevant, then presenting them as external rules should alter performance" (p. 61). In other words, if safety performance is rule-governed and the safety-related verbalizations (from Experiment 1) are task relevant, then presenting descriptions of safety rules (based on the safety-related verbalizations) to Experiment 2 participants, in place of conducting safety observations, should alter safety performance. The occurrence of an increase in safety performance as a result of the presentation of descriptions of safety rules would, therefore, satisfy the third control requirement of the silent dog method.

Throughout Experiment 2, data were also collected for productivity performance and accuracy. Therefore, before discussing the issues related to the main focus of Experiment 2, I will discuss these two secondary variables measured throughout the study.

Productivity Performance and Accuracy

The productivity performance and accuracy data measured during Experiment 2 support the conclusions drawn from Experiment 1, and do not suggest the existence of an inverse relationship between productivity and safety performance. Productivity performance and accuracy did not systematically change with the implementation of the description of safety rules phase across any Experiment 2 participants.

127
The results from Experiment 2 visibly demonstrate an increase in safety performance, thus satisfying the third control. The safety verbalizations made by Experiment 2 participants raise some interesting issues not commonly encountered in experiments that typically employ protocol analysis or the silent dog method. Protocol analysis is most often used for problem-solving tasks or tasks that are well-defined and have only one correct answer (Austin & Delaney, 1998; Ericsson & Simon, 1993). Therefore, verbalizations for each problem often fall into a pattern of common actions that frequently occur during problem-solving (e.g., Bhaskar & Simon, 1977). This “pattern” of common actions results in a “pattern” of specific task-related verbalizations which are, in turn, presented to a new group of participants. This new group of participants follow this same “pattern” of verbalizations thus, altering task performance (e.g., Wulfert et al., 1991). Unlike these traditional problem-solving tasks, the present task of interest, safety performance, is not well-defined in terms of having only one correct answer, and therefore, task-related verbalizations did not fall into any such “pattern.” The safety-related verbalizations made by Experiment 1 participants varied, and as a result were coded into one of two “broad” descriptor categories: general safety-related and specific-safety-related verbalizations. These “variety” of general safety-related verbalizations were used to generate the descriptions of safety rules presented to Experiment 2 participants. Although safety performance increased substantially for all Experiment 2 participants with the presentation of the descriptions of safety rules,
what may be of most interest were the safety-related statements made by the participants. Three of the four participants made novel safety-related verbalizations, defined as variations from the descriptions of safety rules presented to them during the corresponding phase. These variations made up 41% of all safety statements made during Experiment 2.

The reason these verbalizations may be of such interest relates back to the issue regarding the "typical" studies which employ the silent dog method. This method is most commonly used to determine if a functional relationship exists between "specific" verbalizations and task performance. Because Experiment 2 resulted in variations of safety statements, rather than repetitions of the descriptions of safety rules, it may be possible to generalize conclusions regarding the functional relationship between verbalizations and performance to a broad category of safety verbalizations, versus particular words.

At this point, it important to recall the purpose of silent dog method control 3 was to demonstrate that safety performance was rule-governed and safety-related verbalizations were task relevant. According to Hayes et al. (1998) this could be achieved by presenting the safety-related verbalizations (made by Experiment 1 participants) as external rules to Experiment 2 participants in an attempt to alter, or increase, safety performance. Although Experiment 2 participants did not always repeat the description of safety rules verbatim, their safety performance did improve as a result of the presentation of the descriptions. Therefore, the results of
Experiment 2 strongly suggest the third control requirements described in the silent dog method were met.
GENERAL DISCUSSION

The overall purpose of this research was to help determine the behavioral function of conducting safety observations. I hypothesized that safety observers make safety-related verbalizations as a result of conducting observations. Therefore, the more specific objectives of this research were to determine if, in fact, safety observers make these verbalizations, and if so, to determine if the safety-related verbalizations were functionally related to increases in safety performance.

The results from Experiment 1 suggest safety observers make safety-related verbalizations as a result of conducting observations. Using the procedures described in the protocol analysis literature (Ericsson & Simon, 1993), and training a group of participants to continuously talk aloud after conducting safety observations, allowed for the measurement of safety-related verbalization occurrences. The silent dog method control requirements provided the framework for helping determine if a functional relationship existed between safety-related verbalizations and increases in safety performance. According to Hayes et al. (1998), all three control requirements must be present to determine whether ongoing task-related behavior is governed by covert verbal rules, and if so, whether the overt verbalizations are functionally equivalent to those rules. The results from both Experiments 1 and 2 appear to satisfy all three of the silent dog method control requirements and thus, provide strong support for the existence of a functional relationship between safety-related verbalizations and increases in safety performance. These results also seem to support the suggestion that conducting safety observations may serve (a) a rule
generating function, and/or (b) an antecedent, or self-monitoring, function. This is a first step toward helping determine the behavioral function of conducting safety observations. Discussing (a) how the results of this research support the above-mentioned behavioral functions, (b) the strengths and weaknesses of this study, and (c) suggesting future research will place us even closer toward understanding the observation process employed by behavioral safety processes.

Rule Generating Function

A theoretical analysis of research interventions in organizational behavior management (OBM) conducted by Malott, Shimamune, and Malott (1992) revealed several important points that may help support the suggestion that conducting safety observations serves a rule generating function. (1) In OBM settings, the natural contingencies for desired behaviors are generally too small or too improbable to control desired performance. (2) The OBM interventions included in the review involved adding analog contingencies. According to Malott et al., "the intervention contingencies were analogs, because their outcomes were too delayed to reinforce or punish the target behavior (p. 104)." Despite this, the intervention contingencies reviewed did tend to support the target performance. Therefore, (3) Malott et al., inferred direct-acting contingencies, specifically escape and punishment contingencies, to explain the effectiveness of the interventions. (4) The theoretical analysis also stated it was necessary for participants to be able to state rules
describing the intervention contingencies in order for those contingencies to be effective.

According to Malott (1992), most behaviors desired by industries are controlled by ineffective natural contingencies in which the consequences of the desired behavior are too small and too improbable to control the behavior. In the area of safety, the desired behavior is to perform a job safely (e.g., aligning shoulders with the back, not slouching forward), but what is the natural contingency for safe behaviors? According to Malott (1992), the natural contingency is an ineffective analog to avoidance. The response of aligning shoulders with the back produces a slight decrease in the probability of suffering from shoulder discomfort or a cumulative shoulder injury. The decrement in the probability of avoiding the consequence (discomfort or injury) is too small to reinforce the safe behavior, making this contingency ineffective. Therefore, some type of performance management contingency must be established in order to increase safety behaviors. In the context of this research, conducting safety observations was the intervention used to increase safety performance.

The results of this research suggest participants established some type of a rule as a result of conducting observations. Several participants made safety-related verbalizations, after conducting safety observations, that seem to indicate they were following a rule. Examples of these statements include, “I want to put my arms on the armrests, but then I’ll be leaning”, “Can’t lean back in the chair”, “I need to remember to keep my feet flat on the floor”, “I should keep my back straight and
have good posture”, and “oops, that’s two to three minutes of being unsafe”. According to the analysis provided by Malott (1992), it is plausible that participants stated rules describing indirect-acting contingencies (e.g., “I should perform safely so I can be scored safe, or I should I perform safely so I can please the researcher), and safe behaviors were controlled by direct-acting escape contingencies (e.g., fear of not being scored safe, or fear of displeasing the researcher). The verbal reports measured throughout this study did not yield any complete contingency-specifying rule statements. In other words, participants did not explicitly describe aloud the indirect-acting-contingencies they may have generated after conducting safety observations. Some researchers suggest it may not be necessary for verbal stimuli to overtly include contingency-specifying stimuli in order to be considered a rule (Blakely & Schlinger, 1987; Schlinger, 1993). According to Schlinger (1993),

In sophisticated listeners it is common for a single word to have function-altering effects. For example, if someone is about to eat some food and someone else says, “poison,” this alters the evocative function of the sight of the food in the sense that it decreases the momentary probability of the behavior of putting it in the mouth. Some might suggest that there is an implicit contingency-specifying stimulus (CSS) in the word ‘poison’ (e.g., ‘If you eat this food you will get very sick’). (p. 12)

Therefore, regardless of the form of the verbal stimulus, if it alters the function of a stimulus then it may be considered a rule (Schlinger, 1987). Hence, it is plausible that some of the statements observed throughout this experiment can be considered
rules, and the above-quoted statement perhaps explains why explicit contingency-specifying statements were not observed. Regardless of this issue, the verbal reports do seem to provide enough evidence to suggest that participants self-generated rules as a result of conducting observations. Therefore, Malott et al. (1992) would argue that the safe behaviors were controlled by direct-acting reinforcement (including presentation of reinforcers, escape, and avoidance) and punishment (usually penalty) contingencies specified by the self-generated rules.

Rules as Conditioned Establishing Operations

The above analysis suggests participants self-generated rules regarding safety performance, but it does not explain how rules govern behavior. Malott (1992) suggests "the rule statement might function as a conditioned establishing operation (Michael, 1982) that establishes noncompliance with the rule as a learned aversive condition. (Some would call that aversive condition fear, or guilt, or anxiety, or nervousness)." An establishing operation (EO) is a motivative variable that has at least two effects, (1) it alters the value of consequences, and (2) momentarily increases the frequency of behavior that has been correlated with the consequences whose value has been altered (Michael, 1993). A conditioned establishing operation (CEO) is a motivative variable that generally involves secondary or conditioned reinforcers instead of primary reinforcers such as food and water (a surrogate CEO is an exception to this definition; Michael, 1993). The rules generated by participants (after conducting observations) may have altered the value of several safety-related
outcomes. For example, a participant might slouch his/her back (unsafe behavior) because it is more comfortable than positioning the back upright, parallel to the back of the chair (safe behavior). A rule statement regarding safe back position might alter the value of positioning the back upright, making it less aversive, signaling compliance with the rule. In this example, the feeling of the back upright against the chair could become a positive consequence, signaling compliance with the rule and avoidance of noncompliance (the self-generated aversive condition), thereby evoking behavior (positioning back upright) that produced that consequence. In summary, self-generation of safety rules may be viewed as a motivative variable that has the following two effects: (1) it alters the value of consequences such as safe body positioning (e.g., feeling the back upright against the back of the chair), making them less aversive, and (2) momentarily increases the frequency of safe behaviors (e.g., positioning back upright) that have been correlated with the consequences whose value has been altered.

Self-Monitoring

The verbal reports made by Experiment 1 participants indicate they self-monitored safety performance after conducting safety observations. Some examples of safety-related verbalizations that support this theory include: “I almost moved my feet”, “Feet on the floor”, “I’m slouching”, and “Sitting properly, sitting properly.” An often cited explanation for the effectiveness of self-monitoring as an independent variable is the “reactive effect” (Nelson et al., 1982), and this explanation may also
describe the effects of conducting safety observations. As previously mentioned, there are three widely accepted views explaining reactivity. I will analyze the effects of conducting safety observations from each of the three standpoints. The theory proposed by Kanfer and Gaelick-Buys (1991) might suggest that a participant would self-compare his or her safety behaviors to the definitions provided on the checklist, or with confederate performance (e.g., "When I sit on the chair, do I place both feet flat on the floor?"), then he or she would self-deliver consequences contingent on his or her own performance of the target behaviors. In other words, the self-delivered consequences would maintain safe performance. Evidence of the self-delivery of consequences was reported by two Experiment 1 participants during the exit interviews. Participants 0A, and 2A reported when they caught themselves being unsafe, they'd correct their performance, in other words, they self-delivered consequences contingent on their performance. Rachlin (1974) might suggest that the recording response, the self-administered consequences, or a combination of the two serve as cues to "remind" the participant of the external environmental consequences (e.g., the avoidance of injury, the avoidance of noncompliance with self-generated rules) that actually control response frequency. During the exit interviews, participant 6A stated she had to remind herself to perform safely "especially when I'd feel my feet move." Participants 7B, 9A, 10B, and 11B all stated that they had to remind themselves to perform safely "all of the time, especially when I realized I was unsafe." These statements seem to provide evidence to support Rachlin's theory. Hayes and Nelson (1983) might add that the entire self-recording
procedure (e.g., the video, the checklist, the target behaviors, the confederate’s performance) serves as an initiator of reactivity. In other words, everything associated with the observation process would make more obvious the environmental consequences, or perhaps self-generated consequences (such as those specified in self-generated rule statements).

Self-Generation of Rules vs. Self-Monitoring?

Several questions arise as a result of discussing the possible rule-generating and self-monitoring functions of safety observations. First is whether it is even logical to separate the two effects. How can a person ensure he or she is complying with a rule if he or she does not monitor behavior? A person may engage in safe behaviors to escape a self-generated aversive condition, such as noncompliance to a safety rule, but in order to perform safely he or she must self-monitor relevant safety behavior. Similarly, an administrative assistant may be prompted to self-monitor her timeliness of task completions when she sees her “inbox” overflowing with work. As a result of self-monitoring her timeliness, she may begin to self-generate rules about her performance (e.g., “If I cut down the time I spend off-task, I may have an empty ‘inbox’ by the end of the day”). Another interesting issue concerns the temporal relationship between the two effects (assuming one is not exclusive of the other). Did participants begin to self-monitor safety performance as a result of conducting observations which then resulted in the self-generation of safety rules? Or, did participants self-generate rules as a result of conducting observations, which then...
resulted in self-monitoring of safety performance? Unfortunately, the results of this research cannot provide concrete answers to these questions, and may actually result in more questions.

The intervention to which Experiment 2 participants were exposed involved two components: rules and a “suggestion” to self-monitor. Participants were (a) provided with descriptions of safety rules and (b) were instructed to state these descriptions at the start of the session and anytime they noticed a change in the relevant behavior(s). Although participants were not explicitly instructed to follow the rules, just to repeat them, it is plausible that the latter part of these instructions (part “b”) “suggested” participants should follow the rules and self-monitor their performance. The results of Experiment 2 indicate participants followed the descriptions of safety rules (safety performance substantially increased during the corresponding phase) and self-monitored their safety performance (repetition of descriptions of safety rules and novel safety-verbalizations were made). Therefore, it is not known (a) whether participants would have self-monitored their performance had they only been provided with the rules (and not asked to repeat them), or (b) whether participants would have self-generated rules as a result of being instructed to self-monitor but not given the descriptions of safety rules.

Strengths and Weaknesses

One of the most notable strengths of the present study is the use, and thorough analysis, of verbal data to help determine the behavioral function of an intervention
(conducting safety observations). The use of verbal reports to assess their effects on performance, and help determine the behavioral function of interventions used in the field of organizational behavior management has been suggested many times. Agnew and Redmon (1992) suggested the “analyses of contingencies based on rules raises several possibilities for future OBM research” (p. 72), and suggested participants should be interviewed after an experiment to determine the nature of rules used. Perone (1988) suggested that more use should be made of self-report data, and also suggested verbal reports be used (a) as primary data, and (b) for explanatory purposes in understanding behavior patterns. Mawhinney and Austin (1999) suggested the use of concurrent verbal reports could help explain differences in levels of performance. Despite the prevalence of these suggestions, few in the field of OBM, have implemented them (Agnew & Redmon, 1992).

Although the use of verbal reports was a major strength of the study, it was also a weakness. The quantity of verbal data produced throughout the study was overwhelming and the analyses of these data were extremely time consuming. Transcription of verbalizations alone required approximately 75 hours per participant. Despite this apparent weakness, the benefits seem to outweigh the costs. The results of this research are the first to provide strong support for the existence of a functional relationship between safety-related verbalizations and safety performance. The results of such exhaustive data collection procedures and analyses have also brought us one step toward closer toward understanding the behavioral mechanisms
responsible for the effectiveness of conducting safety observations, and thus, may be able to help improve the effectiveness of the behavioral safety process.

Another strength of this study is that it was a first attempt to help determine the behavioral function of conducting safety observations. Although conducting observations has been demonstrated to be an effective intervention for increasing safety performance (Alvero & Austin, in press; 2002; Sasson, 2002), this was the first attempt to help determine the behavioral mechanisms responsible for its effectiveness. The results of this first attempt can serve as a framework for future research, which may result in a more "concrete" answer to the present experimental question.

A unique strength of this study is the fact that it is the first to use protocol analysis and the silent dog method to measure and evaluate the verbalizations relevant to an ill-defined task. As previously mentioned, the experiments which typically employ protocol analysis and the silent dog method, involve tasks that are well-defined and have only one answer (Ball, Langholtz, Auble, & Sopchak, 1998; Bhaskar & Simon, 1977; Wulfert, Dougher, & Greenway, 1991). Unlike these typical experiments, the present experiment attempted to record and analyze verbalizations related to safety performance: a task that occurs concurrently with many other tasks, and is not well-defined in terms of having only one answer. This unique strength could also be considered a weakness. The ill-defined nature of safety performance resulted in a large quantity of "irrelevant" verbal data (98.8% of segments coded), and a very small quantity of safety-relevant data (1.2% of segments coded).
coded). In other words, only 1.2% of the verbalizations made by Experiment 1 participants were used to help determine if a functional relationship existed between safety-related verbalizations and increases in safety performance. Another weakness related to this issue were the omissions of safety-related verbalizations from several participant verbal reports (participants 1A and 3B), and from all participant verbal reports during the observation reversal phase. The talk-aloud training procedures used throughout this study were largely based on the procedures employed by protocol analysis (Ericsson & Simon, 1993), and thus, were designed to collect verbal reports from well-defined tasks that are well-defined and only have one answer. Therefore, these training procedures may not be well-equipped to capture verbalizations relevant to an ill-defined task, such as safety performance. The answers given by participant 1A during the exit interview seem to support this conclusion. When informed that she had not made any verbalizations regarding safety performance, and then asked if this information surprised her, participant 1A replied, “yes, I thought I did (make safety verbalizations) sometimes.” Participant 1A was then asked why she did not make these verbalizations, and she answered, “I think because I thought about it so quickly and while I was doing something else, and a lot of times it was right in the beginning, so it never crossed my mind to say it out loud because it was so fast.” It is more difficult to speculate regarding the omission of safety-related verbalizations during the observation reversal phase. One possible explanation is that participants simply “forgot” the talk-aloud training procedures after exposure to the distracter task and were eager to complete the study.
Another weakness of the study may have been the combination of the time-sampling procedure used to collect safety performance with the frequency measure used to collect safety-related verbalizations. As mentioned in the method sections, safety performance data were collected using a 30-second momentary time-sampling procedure and the occurrence of safety-related verbalizations were indicated within the corresponding 30-second interval. The problem with this combination was the lack, or omission, of possible valuable information regarding the relationship between safety performance and safety-related verbalization occurrences. For example, if a participant placed a foot on the leg of the chair (unsafe behavior), stated a safety-related verbalization (e.g., “I have to keep my feet flat on the floor”), then placed both feet flat on the floor (safe behavior) all during the same 30-second interval, this correlation, would have been omitted. In other words, the data collection procedure used throughout the study would reveal an interval scored as “safe” (the participant corrected his or her unsafe behavior before the end of the 30-second interval) and the occurrence of a safety-related verbalization within the corresponding “safe” interval. Another problem with this combination of data collection procedures was the addition of possible “misleading” information regarding the relationship between safety performance and safety-related verbalization occurrences. For example, if a participant dropped a bead on the floor and bent his/her back to pick the bead up off the floor, and this occurred at the end of a 30-second interval, the interval would have been scored as “unsafe” (the participant’s back was not upright). As a result, the data
would reveal an interval scored as "unsafe" without the occurrence of a safety-related verbalization (the participant would not have considered themselves to be unsafe).

Future Research

Future research endeavors designed to determine the behavioral function of conducting safety observations should consider the above-mentioned weaknesses and modify procedures accordingly. For example, the omission of explicit contingency-specifying rule statements may have been prevented by having instructed participants to talk aloud throughout the entire observation procedure, before they began the assembly bead task, and as they performed the bead task. It is plausible that participants self-generated explicit rule statements while conducting safety observations or as they prepared to begin the assembly task. Advancing the start of the talk-aloud procedure to include the observation process may "capture" these statements, assuming such statements were made. Unfortunately, whether such contingency-specifying rule statements were made cannot be determined based on the results of the present research. Another suggestion, related to this issue, concerns the talk-aloud training procedures used in the present research, which involved solving arithmetic problems aloud. As previously mentioned, these training procedures were based on the procedures employed by protocol analysis (Ericsson & Simon, 1993), and thus, were designed to collect verbal reports from "primary" tasks versus ill-defined tasks, such as safety performance. The lack of similarity between the example used in the training process and experimental condition may explain why
two of the five talk-aloud participants from Experiment 1 did not make any safety-related verbalizations throughout the observation phase. Increasing the similarity between the training procedure condition and the experimental condition may help solve this problem.

The most important suggestion for similar future endeavors involves a change in the data collection procedure used to measure safety performance. Perhaps a whole-interval sampling procedure would result in more accurate information regarding the relationship between safety performance and safety-related verbalizations. Employing this procedure would require behavior to occur "safely" during the entire interval, versus at the end of the interval (the method used throughout this study). In other words, if a participant were to perform a behavior unsafely, even for a short period of time, the corresponding interval would be scored "unsafe." This procedure would clearly eliminate one of the concerns discussed earlier, specifically the omission of correlations between safety-related verbalizations and changes in safety performance. For example, if a whole-interval sampling procedure is used, and a participant placed a foot on the leg of the chair (unsafe behavior), stated a safety-related verbalization (e.g., "I have to keep my feet flat on the floor"), then placed both feet flat on the floor (safe behavior) all during the same 30-second interval, this correlation would be captured. In other words, the whole-interval sampling procedure would reveal an interval scored as "unsafe" and the occurrence of a safety-related verbalization within the corresponding interval, thus capturing important information concerning the correlational, and perhaps causal,
relationships between the two variables of interest. Unfortunately, employing the whole-interval sampling procedure would not eliminate the second concern discussed earlier, specifically the addition of possible "misleading" information regarding the relationship between safety performance and safety-related verbalization occurrences, but this second concern does not seem to be as critical as the first because it does not include the occurrence of safety-related verbalizations. Though the results of this research met all three silent dog method control requirements, and therefore, suggest the existence of a functional relationship between safety-related verbalizations and increases in safety performance, more useful information may have been obtained had a whole-interval sampling procedure been employed, and thus, is strongly recommended.

In summary, the present study involved exhaustive data collection procedures and required time-consuming data analyses, but the results are significant and are considered worth the effort. The results of this study (a) are the first to demonstrate the existence of a functional relationship between safety-related verbalizations and increases in safety performance, (b) provide a framework for similar future endeavors in the field of OBM, specifically in the area of safety, and (c) raise interesting questions concerning the possible behavioral functions of conducting safety observations.
ENDNOTES

1The incidence rates represent the number of injuries per 100 full-time workers and were calculated as: (N/EH) x 200,000, where

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>number of injuries</td>
</tr>
<tr>
<td>EH</td>
<td>total hours worked by all employees during the calendar year</td>
</tr>
<tr>
<td>200,000</td>
<td>base for 100 equivalent full-time workers (working 40 hours per week, 50 weeks per year)</td>
</tr>
</tbody>
</table>


2Days away from work include those which result in days away from work with or without restricted work activity (U.S. Bureau of Labor Statistics, 2001b).

3Includes cases where the nature of injury is: sprains, strains, tears; back pain, hurt back; soreness, pain, hurt, except back; carpal tunnel syndrome; hernia; or musculoskeletal system and connective tissue diseases and disorders and when the event or exposure leading to the injury or illness is: bodily reaction/bending, climbing, crawling, reaching, twisting; overexertion; or repetition. Cases of Raynaud's phenomenon, tarsal tunnel syndrome, and herniated spinal discs are not included (U.S. Bureau of Labor Statistics, 2001b).

4The method is labeled the silent dog method, after the Sherlock Holmes' mystery Silver Blaze in which Holmes knew the identity of a murderer because the dog in the stable had not barked when a horse was removed (Doyle, 1892/1986). In the silent dog method, it is the lack of a behavioral effect of self-report that suggests that performance is governed by a self-generated rule and that the verbal report is functionally similar to that rule (Hayes et al., 1998, p. 60).
Appendix A

Safety Information Sheet Provided to Participants in Group A
OFFICE SAFETY

WHEN SITTING

☐ Both feet should be flat on the floor: ball and heel of each foot should touch floor

Participant Signature ___________________________ Date ___________________________
Appendix B

Safety Information Sheet Provided to Participants in Group B
OFFICE SAFETY

WHEN SITTING

☐ Back should be upright: parallel to the back of the chair (not leaning against it)

☐ Shoulders should be aligned with the back: shoulders in line with the back, not slouched forward

Participant Signature __________________________ Date ________________
Appendix C

Safety Checklist Used to Collect Data on Participants’ Performance
## Sitting Behaviors

<table>
<thead>
<tr>
<th>Sitting Behaviors</th>
<th>Safe/Unsafe</th>
<th>#Safe/#Unsafe</th>
<th>% Safe</th>
</tr>
</thead>
</table>

### Back Upright
- Upright, parallel to the back of the chair (not leaning against it)

### Shoulders Aligned with Back
- Shoulders in line with the back, not slouched forward

### Both feet on the floor
- Both feet should be flat on the floors (ball of foot and heel should touch floor)

S: Behavior was performed Safely  U: Behavior was performed Unsafely
Appendix D

Safety Checklist Used by Participants in Group A to Score Video
<table>
<thead>
<tr>
<th>BEHAVIOR</th>
<th>:30</th>
<th>1:00</th>
<th>1:30</th>
<th>2:00</th>
<th>2:30</th>
<th>3:00</th>
<th>3:30</th>
<th>4:00</th>
<th>4:30</th>
<th>5:00</th>
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</thead>
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<tr>
<td>Both feet on the floor -</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>both feet should be flat on</td>
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<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
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<td>U</td>
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<td>U</td>
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<td>the floors (ball of foot and</td>
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<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>heel should touch floor)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

S: Behavior was performed Safely U: Behavior was performed Unsafely N/A: Behavior did not occur during the interval
Appendix E

Safety Checklist Used by Participants in Group B to Score Video
<table>
<thead>
<tr>
<th>Behavior</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>Back Upright - upright, parallel to the back of the chair (not leaning at an angle against it)</td>
<td></td>
</tr>
<tr>
<td>Back Upright: S: Behavior was performed Safely U: Behavior was performed Unsafely N/A: Behavior did not occur during the interval</td>
<td></td>
</tr>
<tr>
<td>Shoulders Aligned with Back - shoulders in line with the back, not slouched forward</td>
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</tr>
</tbody>
</table>

SITTING
Appendix F

Safety Checklist Used by Participants in Both Groups to Score Video on All Target Behaviors
<table>
<thead>
<tr>
<th>BEHAVIOR</th>
<th>BACK UPRIGHT</th>
<th>SHOULders ALIGNED WITH BACK</th>
<th>BOTH FEET ON THE FLOOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>:30</td>
<td>1:00</td>
<td>1:30</td>
</tr>
<tr>
<td>Score</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>N/A</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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Appendix G

Participant Productivity Log Sheet
Participant #: 

<table>
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<tr>
<th>Session</th>
<th># of Errors</th>
<th># of Beads</th>
<th>% Accurate</th>
<th>Session</th>
<th># of Errors</th>
<th># of Beads</th>
<th>% Accurate</th>
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</tbody>
</table>
Appendix H

Script of the Study Description Read Aloud to Participants at the Start of the Information Phase
To be read by either the graduate researcher or the undergraduate research assistant.

"The purpose of this study is to observe individual safety behaviors in an assembly line environment. Here's a list of the behaviors and their definitions to give you a better understanding of the study. Take a moment to read over this information before going to work in your assembly room."
Appendix I

Oral Recruitment Script
"Hi, my name is Alicia Alvero and I am conducting a research study for my dissertation. The purpose of my visit to your classroom is to recruit participants. In order to qualify as a participant, you must be around during the Fall session.

Participation would involve performing an assembly task: placing beads on a string. Sessions will last between 20 to 30 minutes and I need students to perform approximately 20 sessions over about 6 to 10 weeks. You can schedule up to 4 sessions a week, with a minimum of a 1 day break between sessions. Therefore, the exact length of participation will vary from student to student, depending on your schedule.

Participants will be paid $5 an hour, the minimum you will be paid per session is $2.50. If you are interested in participating, please put your name on the sign-up sheet that I will pass around the class. Please indicate the easiest way to reach you, either phone or email. Again, remember that you must be around during the Fall session in order to participate. Thank you for your time."
Appendix J

Talk-Aloud Instructions

166
In this experiment, we are interested in what you think about while you perform tasks. In order to do this I am going to ask you to THINK ALOUD as you work on any task. What I mean by think aloud is that I want you to tell me EVERYTHING you are thinking from the time you are first presented with a task, to the time you have completed the task. I don’t want you to try to plan out what you say or try to explain to me what you are saying. Just act as if you are alone in the room speaking to yourself. It is important that you keep talking. If you are silent for more than 5 seconds, you will hear a beeping sound to remind you to continue talking aloud. Do you understand what I want you to do?

Now let’s practice this procedure. I will present you with some basic math problems, and I would like you to talk aloud CONSTANTLY from the time I present each problem until you have given your final answer to the question. Now let’s begin....

What is 49 + 51?
What is 12 + 18?
What is 122 + 136?
What is 203 + 145?
What is 450 + 298?
Appendix K

Example Instructions of Tasks to be Performed by Participants
INSTRUCTIONS

For the purpose of this study, your role is that of an assembly line worker.

Continuously string beads in the following color order:

1) Blue
2) Orange
3) Green
4) Red
5) Yellow
6) Purple
7) Brown
8) Clear
9) Black

NOTE: Color order will vary from session to session, but the instructions will remain constant.
Appendix L

Script of the Oral Instructions Provided to Participants in the
Talk Aloud Group at the Start of Baseline
To be read by the student investigator.

“For the purpose of this study, Room 2513 will serve as your work environment. You will be required to engage in an assembly task that is described on the instructions I’ve handed you. After 15 minutes of work, I will knock on the door to signal the end of your session. At that time, come back to this room for payment.

Please remember that you must TALK ALOUD the entire time you are in your work environment. Just act as if you are alone in the room speaking to yourself. It is most important that you keep talking. If you are silent for more than 5 seconds you will hear a beeping sound to remind you to continue speaking aloud.

You can take as many breaks as you need. Restroom and water fountains can be found outside the room to the right. If, at any time throughout the session you feel tired, you are encouraged to take a break.”
Appendix M

Script of the Oral Instructions Provided to Participants in the Silent Group at the Start of Baseline
To be read by the student investigator.

“For the purpose of this study, Room 2513 will serve as your work environment. You will be required to engage in an assembly task that is described on the instructions I’ve handed you. After 15 minutes of work, I will knock on the door to signal the end of your session. At that time, come back to this room for payment.

You can take as many breaks as you need. Restroom and water fountains can be found outside the room to the right. If, at any time throughout the session you feel tired, you are encouraged to take a break.”
Appendix N

Script of Oral Instructions Given to Participants about Conducting Observations
"Before going to work in your office today, I’d like you to observe a 5 minute video of a person working in an assembly line setting. Here are the behaviors you will be looking for (hand them the checklist). After 30 seconds, you will score each behavior under the appropriate column (for example, 30 second column, 1-minute column, etc.) as "safe", "unsafe" or "N/A" if the behavior was not observed during that 30-second interval. In order for a behavior to be scored as "safe", it MUST be performed safely during the entire interval, or entire 30 seconds. I will start this stopwatch when I start the video so you will be able to see when 30 seconds go by. Remember, after every 30 seconds, score the behaviors and move the next column, until you have scored all ten columns (one for each 30-second interval). Do you have any questions?

I will stand outside and wait for you. After watching the video, open the door and turn the checklist over to me and then go into the area designated for your work and start your work for the day. Now take a few minutes to familiarize yourself with the checklist, and let me know when you’re done. (Start the video after they’ve looked over the checklist).
Appendix O

Script of Oral Instructions Given to All Participants at the Start of the Distracter Phase
To be read by either the graduate researcher or the undergraduate research assistant.

“Today we are going to present a new task. Before beginning your assembly work today I’d like you to put this headset on, and press play once you enter your workroom and immediately after closing the door. Repeat everything aloud that is said on the tape and try to solve the problems as well. Try as best you can, but remember that you must continuously repeat what is said while working on your assembly task. Do you have any questions?”
Appendix P

Transcription of the Distracter Task
What are the colors of the rainbow?
What is 51 + 43?
What is 64 + 12?
What is 17 + 56?
What does R E A D I N G spell?
What are the vowels in the alphabet?
What does E L E P H A N T spell?
What is 25 - 15?
Plus 14?
What are the 4 seasons?
What are the abbreviations for each of these states?
Alabama Arizona California Connecticut
District of Columbia Florida Delaware Indiana
Iowa Kansas Kentucky Illinois
Hawaii Georgia Idaho Louisiana
Michigan Minnesota Mississippi Nevada
Maine Missouri New Jersey New York
Nebraska Montana New Mexico North Carolina
North Carolina Ohio Oklahoma New York
Pennsylvania Texas Tennessee North Carolina
Rhode Island Wyoming Wisconsin

Spell Philadelphia.
What does P A S A D E N A spell?
What is 125 + 63?
What is 14 + 23?
Repeat after me: Manitoba Nova Scotia New Brunswick
Alberta British Columbia Ontario
Jamaica Trinidad Tobago Calgary

What was the first word on the list?
Count backwards from 15 to 1.
What does D I C T A T I O N spell?
Name 5 animals.
Name 5 mammals.
Repeat after me: Dog Fish Shark
Cat Elephant Turtle Cow Snake

What was the 3rd word on the list?

Spell Atlantic
Spell Florida
Spell Reinforcer
Spell Colorado
Spell Antecedent
Spell Consequence
Spell Locket
Spell Alphabet
Spell California

How many times do I say the number fourteen?
10 14 26 28 14 101 2 15 14 24 68 73
14 83 99 200 14 6 8 14 25 14 26 27
14 89 79 74 14 86 14 93 92 13 16 14

What is 14 + 73?
What is 85 – 12?
What is 32 + 93?
Count by 5’s up to 100.
Say the entire alphabet.

How many times do I say orange?
red blue orange white gray orange
blue purple orange pink black orange
brown white yellow orange yellow orange
red green black orange white red
blue green orange red orange blue
orange green purple white orange pink

How many days are in a year?
How many seconds are in 3 minutes?
How many days are in a leap year?
How many hours are in a day?
How many days are in 2 years?
How many hours are in 4 days?
How many minutes are in 7 hours?
What is 89 + 22?
What is 89 – 22?
What states start with the letter M?
Spell Fort Lauderdale

180
Spell Grand Junction
Spell Fort Pierce
Spell Gainesville
Spell Sacramento

How many times do I say 26?

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<td>13</td>
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How many seconds are in 1 hour?
How many days are in 7 weeks?
How many weeks are in a year?
How many hours are in 6 days?
What is 51 + 73?
What is 46 + 12?
What is 65 + 17?
What does DEMONSTRATED spell?
What does HERALD spell?
Spell Washington
Spell University
Spell Traverse City

How many times do I say the letter K?

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</table>

Repeat after me: Alex Barbie Catherine
David Ernie Fay
George Harriett Iris
Justin Katie Linda
Monica Noel Omar
Peter Ruth Susan
Trisha Umberto Victor
Wilma Xavier Yasmine
Zach

What name started with the letter W?
What name started with the letter D?
What name started with the letter Z?
What is 18 + 23?
What is 49 - 28?
What is 33 + 67?
Count by 2’s up to 100.

What color do red & white make?
   red & yellow?
   yellow & blue?
   blue & red?
   green & yellow?
   blue & white?

Mary is 38 and her son is 13. How old was Mary when she had her son? How old will he be when she is 46?

How many times do I say Spring?

<table>
<thead>
<tr>
<th>Fall</th>
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<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
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<td>Fall</td>
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<td>Fall</td>
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<td>Winter</td>
<td>Spring</td>
<td>Summer</td>
<td>Spring</td>
<td>Fall</td>
<td>Winter</td>
</tr>
<tr>
<td>Winter</td>
<td>Spring</td>
<td>Summer</td>
<td>Summer</td>
<td>Winter</td>
<td>Fall</td>
</tr>
</tbody>
</table>

Count backwards from 50 to 1.

Spell sandwich
Spell pastrami
Spell bratwurst
Spell bagel
Spell macaroni
Spell salami
Spell spaghetti
Spell bologna
Spell potato
What are the 7 continents?
How many weekdays are in a week?
How many weekdays are in a year?
How many weekends are in a year?
What are the days of the week?
What are the months of the year?
What is 47 - 16?
What is 83 + 28?

How many times do I say 7?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>6</th>
<th>7</th>
<th>7</th>
<th>8</th>
<th>10</th>
<th>14</th>
<th>7</th>
<th>5</th>
<th>7</th>
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<td>13</td>
<td>15</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>
Say the alphabet, but skip the vowels.
Name 4 of the 7 oceans.
Count by 10’s to 350.

Spell automobile
Spell compressor
Spell downtown
Spell ignition
Spell Michelin
Spell championship
Spell receive
Spell friendship
Spell carbon dioxide
Spell oxygen

What is 28 + 29?
What is 19 + 36?
What is 39 + 94?
Say the alphabet backwards.

How many times do I say black?

gray    white    black    red    blue    black
black   white    yellow   green   gray    white
black   yellow   black    blue    red    orange
black   black    white    yellow   gray
green   cream    yellow   white    black    red
black   blue     black    orange   black    yellow
yellow  white    black    black    green    purple
orange  black    yellow   black    black    black

What is 24 + 68?
What is 35 - 13?
What is 64 + 12?
What is 99 + 12?
What 85 - 13?
What is 13 + 15?
What is 78 - 35? + 12? - 4?
Appendix Q

Coding Category Sheet
<table>
<thead>
<tr>
<th>CODE</th>
<th>TYPE OF STATEMENT</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Off-Task Statement</td>
<td>I have to study for an exam, I really need to clean my apartment, I can’t wait to go out tomorrow, etc.</td>
</tr>
<tr>
<td>2</td>
<td>Environmental Factors</td>
<td>This desk is too high, This room is too cold/warm, I should take off my sweater Let me lower this chair</td>
</tr>
<tr>
<td>3</td>
<td>Assembly-Task Related</td>
<td>Any color or color sequence: blue, orange, gray, etc. I need to untangle this string The containers are in an odd order I wonder if anyone’s ever filled up this string How many more do I have to go? 2, 4, 6, 8, 10</td>
</tr>
<tr>
<td>4</td>
<td>Target Behavior-Related</td>
<td>Sitting like this is so uncomfortable, I don’t know how people can sit like this, People who work like this for a long time must really be uncomfortable I have such bad posture My shoulders ache</td>
</tr>
<tr>
<td>5</td>
<td>General Safety-Related</td>
<td>If I sit properly, I might not be so uncomfortable I should remember to keep my feet flat, back upright, etc. I'm still sitting properly I started to lean, I shouldn’t do that Let’s sit down properly My feet are nailed to the floor I think I’m supposed to be following the procedures on the paper I just read.</td>
</tr>
<tr>
<td>6</td>
<td>Specific Safety-Related</td>
<td>Repetition of any part of the following safety definitions: Back Upright: upright, parallel to the back of the chair (not leaning against it) Shoulders Aligned with Back: shoulders in line with the back, not slouched forward Both feet on the floor: both feet should be flat on the floors (ball of foot and heel should touch floor)</td>
</tr>
<tr>
<td>7</td>
<td>General Statements Concerning the Study</td>
<td>I wonder what this study is about I think I was quiet for more than 10 seconds I wonder why I have to talk like this, it feels awkward Why do I have to score those videos It’s hard to score those videos I wonder if they’re looking at how fast you can bead in different situations.</td>
</tr>
</tbody>
</table>
Appendix R

Experiment 1 Exit Interview
To be read by the student investigator.

What did you think the study was about?

Why do you think that your safety performance changed throughout the course of the study?

Do you think you performed more safely after conducting safety observations?

Talk-Aloud Participants:

You did/did not make verbalizations regarding your safety performance. Does this surprise you?

Why did/didn’t you make these verbalizations?

Do you think these verbalizations or “reminders” were necessary to perform safely?

Is there something I could have stated to you at the start of the study to increase the chances of you making safety-related verbalizations?

Silent Group Participants:

Did you have to remind yourself in order to perform safely?
Appendix S

Experiment 1 Debriefing Script
To be read by the student investigator.

In a behavior-based safety process, some employees are required to conduct safety observations on other employees. Previous research seems to suggest that observer safety performance increases just as a result of conducting these observations. The purpose of this study was to determine why a person's safety performance increases after they conduct safety observations on another person's performance. Some participants were required to talk aloud as they performed tasks and others were not. You were in the talk aloud/no talk aloud group.

(If in the no talk aloud group): We measured your safety performance throughout the study to insure that there were no differences in performance as a result of talking aloud.

(If in the talk aloud group): We measured your safety performance as well as your verbal reports (what you said during each session) throughout the study to try and determine why your safety performance changed. Everything you said will now be entered into a computer and we will try to analyze the verbal data to find an answer.

Thank you for participating in this study. Do you have any questions?
Appendix T

Script for Consent Process
To be read by the student investigator.

"Before you begin participation in this study you must carefully read and sign a consent form. I will read over the consent form with you. If you have any questions concerning the information we go over, please feel free to ask them."

(Hand the participant a consent form and read it aloud to them.) Then ask, "Do you have any questions? Please sign one copy of the consent form for my records, and keep the other copy for your records."
Appendix U

Consent Form
Observing Performance in an Assembly Line Setting

Alicia M. Alvero and John Austin
WESTERN MICHIGAN UNIVERSITY

My name is Alicia Alvero and I am a graduate student in the Department of Psychology at Western Michigan University. You are invited to participate in a research study that will evaluate performance in a simulated assembly line setting.

Explanation of Study Procedures. Participation will involve performing an assembly task: placing beads on a string. Sessions will last between 20 to 30 minutes and I need students to perform approximately 20 sessions over about 6 to 10 weeks. You can schedule up to 4 sessions a week, with a minimum of a 1 day break between sessions. Therefore, the exact length of participation will vary from student to student, depending on your schedule.

Video Taping. All sessions will be video taped. These video tapes will be used to collect visual and audio information. Tapes will be labeled with an ID number assigned to you, and will not be labeled with any other information. The tapes will only be used for data collection, after which they will be placed under lock and key for a period of three years and then destroyed.

Payment. You will receive $5.00 per hour for participation in this study which will be rounded up to the nearest half-hour, so the least you will receive for a session will be $2.50.

Benefits. You will not receive any direct benefits for participation, except the money you earn.

Risks. Because the tasks involved in this study are ones that students perform frequently, this research involves no risk greater than that in your daily life. During sessions you may experience minor fatigue. This will be offset by allowing you to take breaks if you feel tired. As in all research, there may be unforeseen risks to the participant. If an accidental injury occurs, appropriate emergency measures will be taken; however, no compensation or additional treatment will be made available to you except otherwise stated in this consent form.
Confidentiality. All information obtained in this study will remain strictly confidential. A number will be assigned to you and will be used to identify your data. When results are publicly presented, you will not be identified. By signing this consent form, you will be giving permission for data obtained in this study to be presented in professional presentations and publications. Videotapes will not be used for public presentation.

Voluntary participation. Your participation in this study is completely voluntary. You are free to withdraw at any time without penalty, and you will receive compensation for the amount of time you participated. Your participation in this study, or your withdrawal from it will not affect your grades in any courses. At the end of the study, the experimenter will answer any questions you have and explain how your data helped us learn more about performance in an office.

Who to contact with questions. If you have any questions about this study you may call Alicia Alvero at 385-8164. In addition, Dr. Austin, my faculty advisor can be reached at 387-4495. You may also contact the Chair, Human Subjects Institutional Review Board at 387-8293 or the Vice President for Research, 387-8298 if questions or problems arise during the course of the study.

This consent document has been approved for use for one year by the Human Subjects Institutional review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Subjects should not sign this document if the corner does not show a stamped date and signature.

Your signature below indicated that you read the above information and agree to participate in the study.

______________________  ______________________
Participant Signature   Date

Please keep the attached copy of this form for your records
Appendix V

Protocol Clearance from the Human Subjects
Institutional Review Board
Date:  March 21, 2002

To:  John Austin, Principal Investigator
     Alicia Alvero, Student Investigator for dissertation

From: Mary Lagerwey, Chair

Re:  HSIRB Project Number: 02-01-18

This letter will serve as confirmation that your research project entitled “Using Protocol Analysis to Determine the Behavioral Function of Conducting Safety Observations” has been approved under the expedited category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination:  March 21, 2003
Appendix W

Rule Descriptions Given to Experiment 2 Participants
Regarding Feet Position
Please read over the following statement until you are able to recite them aloud without referring to the sheet.

I need to keep my feet flat on the floor

Please inform the researcher when you are done.

__________________________________________  ____________
Participant Signature                           Date

Researcher Verification: ____________________________
Appendix X

Rule Descriptions Given to Experiment 2 Participants
Regarding Back and Shoulder Position
Please read over the following statement until you are able to recite them aloud without referring to the sheet.

I should keep my back and shoulders straight and not slouch or lean in any direction.

Please inform the researcher when you are done.

_________________________________________  _____________
Participant Signature                        Date

Researcher Verification: _________________________
Appendix Y

Rule Descriptions Given to Experiment 2 Participants Regarding Back, Shoulder and Feet Position
Please read over the following statements until you are able to recite them aloud without referring to the sheet.

**I need to keep my feet flat on the floor.**

**I should keep my back and shoulders straight and not slouch or lean in any direction.**

Please inform the researcher when you are done.

____________________________  ________________________
Participant Signature          Date

Researcher Verification: ______________________________
Appendix Z

Segments Coded as General Safety-Related Statements
I wonder whether or not I was put two feet on the floor
do
that's probably cause im not sitting up straight
I definitly feel more self conscious about where my feet are at after doing that or the thing that we just did
um I feel like I have to sit with my feet on the floor all the time
flat on the floor so maybe its not part of the procedure maybe its just a trip up or something
I really do feel like my feet are bound to the floor
definitely more aware of where my feet should be according to what im doing in the room
then again maybe it has nothing to do with my feet being on the floor
I feel like it does so I keep them flat on the floor
but ill start out trying to keep my back and everything in mind
its much easier to keep your back and everything in line when you sit like this
do but after doing those worksheets I bet you a lot of people do (sit perfectly)
now you are working more efficiently than when you were slouching or not sitting up right or something and
maybe you are more cautious and aware when you sit like this
well I sorta think im aligned correctly with my back but it hurts your arm a little bit
I’m slouching
And then there we go and okay now I hope the whole time Im sitting I think about that whole proper posture technique it was so hard
I better remember to keep my feet flat
I’m doing a good job of keeping my feet on the ground even though I don’t like it
keep my feet on the floor
Doing a good job keeping my feet on the ground
I should keep my feet flat on the floor
oops I have to keep my feet on the ground
its uncomfortable for me to keep my feet flat on the ground
Keep my feet flat on the ground
Keep my feet flat on the ground
Keep my feet down
Make sure my feet are flat on then ground
keep my feet flat on the floor
ooh #### lifting my heel up its gonna ruin then interval
Oops I lifted my toe up its gonna ruin the interval
I forgot to put my feet flat on the floor how could I
Oh that’s probably two or three minutes of my heels being up
I gotta make sure I keep them flat the rest of the time
I hate keeping my feet still like this
I ## picked my foot up to move it
I’m doing a good job of keeping my feet flat on the floor
speaking of which I gotta make sure I keep mine flat
I'm doing a good job of keeping my feet on the floor
feet on the floor
have to keep my feet flat on the floor
Awe man I lifted my foot up so much for that ###
I better keep all my damn three behaviors straight today
I think I might lean forward a little bit
normally I just have horrible posture so its gonna be hard for me to sit up like this
I gotta make sure not to slouch forward
I'm doing good at keeping my feet flat
Keep my feet flat and my shoulders straight and my back straight
Can't lean back against the chair
I'm leaning against the chair not suppose to do that but that's too bad for today
I gotta sit up straight keep my feet flat and my shoulders straight easy enough
I wanna lean back against the chair but # that will ruin my posture
oh man I gotta work on my posture for some reason I forgot about sitting straight and
all that stuff
just remember to keep my posture good
I wanna rest my arms on the arm rest but then I think I'd be slouching
No cant cross my legs got to sit straight up ok
shoulders # crossing my legs nope #
ok guess I have to put my feet on the floor but I prefer not to #
sit up nice and straight
I'm leaning too that's a bad habit I have not sit straight up but it is a bad habit that
you know what if I'm doing anything right doing anything wrong according to that
list I see I am doing stuff wrong
I should only move my shoulders cause they don't move that well in my body
I'm sitting here leaning sure that's not good posture and
that's what this is all about good posture no leaning only do everything you know
pretty good
Im sitting up straight you know my hamstrings but
when you get used to it it feels a little bit better that slouching so it should help
posture and everything
Put my feet on the ground I feel tension on my back
this does not do just moving round here doing this and the shoulder so we have no
back problems
will sit up straight proper posture but you know that is what you need and one arm
just doing this gets to your shoulder
sitting properly sitting properly
I understand sitting properly is good for the back it does help
but people most people aren't used to sitting properly and when they do things and
kind of sitting back you know sitting up straight is when you slouch and it poor
posture but takes pain off your back
but after you get used to it the pain sitting properly will go away and less health problems
for good posture you’ll have straight back your ah vertebrae will be straight and all that great stuff
but it does get you used to sitting proper when sitting
like back problems head loss injuries and all that good stuff and carpal tunnel and poor posture could be reason I don’t know but it could possibly been and I’m not used to sitting properly unless you are brain dead and not used to change but you know but most people that do it aren’t and if they make it they aren’t formed properly you know okay go to and we
Appendix AA

Segments Coded as Specific Safety-Related Statements
now ball to heal to perform the behavior safely
I am sitting with 2 feet on the floor ball to heal just in case
my feet are still on the floor flat ball to heel or heel to ball or something
my feet are flat on the floor
and my shoulders aligned with my back
I wonder oops I wonder if people actually sit like this in the work area ball to heel
back straight aligned with the chair
like I said the worst thing about that is the shoulders sitting up back straight and
without slouching and it does get to you if you are just doing it with one part of your
body it does hurt
Appendix BB

Script of Oral Instructions Given to Experiment 2 Group “A” Participants at the Start of the Rule Description Phase
SCRIPT FOR RULES PHASE “A”

Hand the participant the rules sheet.

State the following to the participant:

“Please read over the following statement until you are able to recite it aloud without referring to the sheet. Please let me know when you feel you have memorized the statement.”

After the participant has memorized the statement, please state the following:

“Please repeat the statement you have just memorized”

They should state:

I need to keep my feet flat on the floor

If they correctly state the above sentence, have them sign the rules sheet & then you should sign the form to verify they have correctly repeated the statement.

Then read the following:

“Now you will go to your work room and perform the assembly task. Please remind yourself of the statement you have just read immediately after sitting down and before beginning your work. You should also remind yourself of this statement anytime you notice a change in your feet position.”
Appendix CC

Script of Oral Instructions Given to Experiment 2 Group “B” Participants at the Start of the Rule Description Phase
SCRIPT FOR RULES PHASE “B”

Hand the participant the rules sheet.

State the following to the participant:

"Please read over the following statement until you are able to recite it aloud without referring to the sheet. Please let me know when you feel you have memorized the statement."

After the participant has memorized the statement, please state the following:

"Please repeat the statement you have just memorized"

They should state:

I should keep my back and shoulders straight and not slouch or lean in any direction.

If they correctly state the above sentence, have them sign the rules sheet & then you should sign the form to verify they have correctly repeated the statement.

Then read the following:

"Now you will go to your work room and perform the assembly task. Please remind yourself of the statement you have just read immediately after sitting down and before beginning your work. You should also remind yourself of this statement anytime you notice a change in your back or shoulder positions."
Appendix DD

Script of Oral Instructions Given to All Experiment 2 Participants
When Second Set of Target Behaviors Were
Introduced to the Rule Description Phase
SCRIPT FOR RULES PHASE “C”

Hand the participant the rules sheet.

State the following to the participant:

“A NEW STATEMENT HAS BEEN ADDED TO YOUR SHEET. Please read over the following statements until you are able to recite them aloud without referring to the sheet. Please let me know when you feel you have memorized the statements.”

After the participant has memorized the statements, please state the following:

“Please repeat the statements you have just memorized”

They should state:

I need to keep my feet flat on the floor

I should keep my back and shoulders straight and not slouch or lean in any direction.

If they correctly state the above sentences, have them sign the rules sheet & then you should sign the form to verify they have correctly repeated the statement.

Then read the following:

“Now you will go to your work room and perform the assembly task. Please remind yourself of the statements you have just read immediately after sitting down and before beginning your work. You should also remind yourself of these statements anytime you notice a change in your feet, back or shoulder positions.”

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Appendix EE

Experiment 2 Exit Interview
To be read by the student investigator.

What did you think the study was about?

Did you feel the safety statements provided you with enough information to perform safely?

Why do you think repeating the statements improved your safety performance?

Oftentimes you did not repeat the statement exactly as you had memorized it. Why?

Did you remind yourself to be safe at times other than when you repeated the statement?

How did you “know” if you were safe?

Group “A” Participants:

Your feet position safety performance increased when you were given the safety statements regarding back and shoulder performance. Did you realize this occurred?

And why do you think it occurred?
Appendix FF

Experiment 2 Debriefing Script
To be read by the student investigator.

In a behavior-based safety process, some employees are required to conduct safety observations on other employees. Previous research seems to suggest that observer safety performance increases just as a result of conducting these observations, and that observers make safety-related statements to themselves after conducting observations. The purpose of this study was to try and determine if these safety statements are somehow related to increases in safety. This experiment was actually the second part of a more in-depth study. The first experiment was used to obtain examples of the safety-related verbalizations made by safety observers. As a participant in this study you were given safety statements that were developed based on experiment 1 data. I wanted to see if repeating these safety statements to yourself would increase safety performance.

I measured your safety performance as well as whether or not you repeated the safety statements to yourself throughout the study. Your data will be used to try and support the hypothesis that safety-related verbalizations may be functionally related to increases in safety performance.

Thank you for participating in this study. Do you have any questions?
Appendix GG

Safety-Related Verbalizations Made by Experiment 2 Participants
Careful not to slouch now
I should not slouch or lean in any direction
I forgot about the slouching and shoulder thing
I'm very tempted to slouch
Maybe that's why my back is sore from doing this and having to keep my back and
shoulders straight and not lean or slouch in any direction
Let's keep my back straight
Oops, I have to keep my back and shoulders straight
Keeping my feet flat is hard because I want to stretch
Here we go with our feet flat on the floor
Feet flat
Feet flat, back and shoulders straight, no leaning or slouching
Can't lean can't slouch, can't lean can't slouch
It's tough keeping my shoulders straight or not leaning
I almost moved my feet
Keeping my back and shoulders straight makes this difficult
Feet flat, no leaning or slouching
Feet flat on the floor, no leaning or slouching in any direction
Oh, oh, I have to lean
Keep my feet flat, shoulders and back straight and no slouching
Feet flat, no leaning or slouching in any direction
I'm breaking the back and shoulder rule
Keep feet flat, no leaning or slouching
I'm breaking the rules again, feet flat, back and shoulders straight
Keep your feet flat, shoulders and back straight or you will be kicked out of the study
I'm breaking the rules, I'm going to get kicked out, feet flat, back and shoulders
straight
Sorry, I'm slouching, keep my feet flat
Feet flat, back and shoulders straight, no lean or slouch
Back and shoulders straight, feet flat
I can't slouch
Back shoulders straight and not lean or slouch to any side
Feet were flat on the floor, but that wasn't working
Back and shoulders straight and not slouch
I have to bend over
Back and shoulders straight
REFERENCES


223


Western Michigan University, Society for the Advancement of Behavior Analysis.


