ASSESSING THE EFFICICACY OF TRAINING TARGETING CONTEXTUAL COMMENTS IN BEHAVIOR BASED SAFETY OBSERVATIONS

A Thesis
by
DANIELLE C. KRETSCHMER

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DANIELLE C. KRETSCHMER
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APPROVED BY:

_____
Timothy D. Ludwig
Chairperson, Thesis Committee

_____
Cynthia M. Anderson
Member, Thesis Committee

_____
Brian Whitaker
Member, Thesis Committee

_____
James C. Denniston
Chairperson, Department of Psychology

_____
Max C. Poole
Dean, Gratis William Graduate School

Abstract

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Danielle C. Kretschmer
B.A., University of Nevada, Reno
M.A., Appalachian State University

Chairperson: Timothy D. Ludwig

This study examines the efficacy of a training program to influence context-rich comments on Behavior Based Safety observation forms. Comments that provide contextual information about observed behaviors can be valuable in Behavior Based Safety programs. Comments with greater depth about the context maintaining observed behaviors allow analysts to make better informed decisions regarding empirically based, safety interventions. Training was provided to safety representatives of 9 workgroups within 2 regional divisions of a petroleum company. These representatives then delivered training to the general workforce. Training included guided practice and feedback on writing effective comments. Over 10,000 observation forms from a company's Behavior Based Safety Process were analyzed prior to and after the training delivery to assess improvements in contextual comments. Results indicated that behavioral training was associated with an increase in each of the contextual comments including Behavior, Context, Explanation and Action. This study helps to provide a framework for future research in the area of contextual comment writing and the contingencies that manage this behavior.

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Danielle C. Kretschmer
Appalachian State University

Assessing the Efficacy of Training Targeting Contextual Comments in Behavior Based Safety Observations

Introduction and Literature Review

Behavior Based Safety is a scientifically validated system of maintaining safe behavior in the workplace based on the work of B. F. Skinner and W. Edwards Deming (Geller, 2005). Where traditional safety management processes overly focus on outcomes of behavior, Behavior Based Safety focuses on the behaviors associated with risk and safe performance. Behavior Based Safety has been scientifically studied as an efficacious approach to injury reduction in numerous settings (see Boitnott & Ludwig, 2012 for a literature review) including:

- health care (e.g. Alavosius & Sulzer-Azaroff, 1985, 1986, 1990; Babcock, Sulzer-Azaroff, Sanderson, & Scibek, 1992; DeVries, Burnette, & Redirion, 1991; Fleming & Sulzer-Azaroff, 1992; Stephens & Ludwig, 2005; Sulzer-Azaroff & Alavosius, 1988);
- construction (e.g., Austin, Kessler, Riccobono, & Bailey, 1996; Mattila & Hyödynmaa, 1988; Mattilla, Rantanen, & Hyttinen, 1994; Saari & Naesaenan, 1989; Salminen & Saari, 1997);
- occupational driving (e.g., Austin, Siggurdsson, & Schpak, 2005; Geller 1984: Geller & Hahn, 1984; Geller & Lehman, 1991; Larson et al., 1980;

Ludwig, Biggs, Wagner, & Geller, 2002; Ludwig & Geller, 1991, 1997, 1999a, 1999b, 2000; Ludwig, Geller, & Clarke, 2010);

- ergonomics (Blake, 1991; Gravina, Hazel, & Austin, 2007);
- trucking (e.g., Cohen & Jensen, 1984; Olson & Austin, 2001);
- industrial plants and distribution centers (e.g., Cooper & Newbold, 1994; Fellner & Sulzer-Azaroff, 1984, 1985; Hopkins, Conard, Dangel, Fitch, Smith, & Anger, 1986; Hopkins, Conrad, & Smith, 1986; Komaki, Barwick, & Scott, 1978; Komaki, Heinzmann, & Lawson, 1980; Krause, Hidley, & Lareau, 1993; Laitinen & Järvinen, 1995; Reber & Wallin, 1984a, 1984b; Reber Wallin & Chhokar, 1984, 1990; Reber, Wallin, & Duhon, 1993; Sulzer-Azaroff, Loafman, Merante, & Hlavacek, 1990; Zohar & Fussfield, 1981); and
- mining (e.g., Fox, 1976; Fox, Hopkins, & Anger, 1987); other settings (e.g., Grindle, Dickinson, & Boettcher, 2000; Sulzer-Azaroff & Austin, 2000).

Sulzer-Azaroff and Austin (2000) outline the basic elements of the Behavior Based Safety process. The first element is pinpointing behaviors: pinpointing is used to identify and define specific, observable, and measurable active behaviors that are correlated with past and potential injuries (Agnew & Daniels, 2010; McSween, 1995). The second is measuring behaviors: measuring behavior allows analysts to assess trends over time. This is best accomplished through a peer-to-peer observation method with a behavior checklist (Geller, 1996). The third elements is performance feedback: behavioral feedback has a robust impact on behaviors related safety (e.g., Fox & Sulzer-Azaroff, 1989; Komaki et al., 1978; Ludwig & Geller, 2000). Feedback is effective because it a) specifies the behaviors to change, b) describes the context of the behavior (e.g., why the behavior puts the individual at-risk in the

work situation), and c) reinforces safe behavior (Agnew & Daniels, 2010; Geller, 1996; Komaki et al., 1978; McSween, 1995). As stated by Sulzer-Azaroff and Austin (2000) in most Behavior Based Safety processes feedback is achieved through the verbal interaction between the observer and the observed. This interaction should always focus on positive feedback, but provide negative feedback when necessary. The final element of a Behavior Based Safety process is reinforcing progress: reinforcing progress includes data collection, trending, problem solving, and the intervention process.

Most Behavior Based Safety processes utilize peer-to-peer observations and feedback where employees observe each other's behavior while on the job and record their observations on a behavioral checklist. The peers then discuss the checklist and the behaviors observed providing praise for safe behavior and corrective feedback for at-risk behaviors. Information from these checklists is then tracked across time and analyzed to understand and mitigate the causes of at-risk behavior. Behavioral observation checklists are useful tracking behavior and providing feedback.

Checklists

Checklists are a behavior management tool that function to improve and manage employee performance (Bacon, Fulton, & Malott, 1983). Checklists serve as proximal prompts for the performer; these checklists are often ordered in a desired behavior chain (Elvik, 2004) to promote consistency of a process. Checklists allow complex tasks to be broken down into smaller components such as individual behaviors. They function to deconstruct processes into discrete, observable elements of expected performance and function to organize behavior while reducing variability.

The Checklist Manifesto by Atul Gawande (2010) popularized the use of checklists as an organizational tool. When solving problems or performing complex behaviors, such as aviation or surgery, Gawande asserted that it is easy to make mistakes and ignore simple solutions. He provided multiple case studies utilizing checklists to improve performance and minimize error in healthcare settings. Consulting agencies such as Continuous Learning Group and Aubrey Daniels International have used checklists as tools to both track and manipulate behavior in organizations.

The utility of checklists has been examined extensively in the research literature. For example, checklists have been used to shape and maintain performance in retail stores (Ludwig, 2007; Rodriguez et al., 2006), and in healthcare (Langeland, Johnson, & Mawhinney, 1997). Chang, Du, & Shen (2012) showed that engineers could use checklists to drive efficiency, effectiveness, and quality when completing projects. The manufacturing industry has used checklists to improve environmental performance, housekeeping, health, and safety (Khamis et al., 2009).

A checklist serves as an antecedent or prompt for a performer. Ludwig (2014) discussed creating and utilizing a checklist to be reminded of each item needed in a task. Checklists are often present during a task physically proximal to the behavior, which strengthens the impact of the antecedent (Heidemeier, Heike, & Bittner, 2012). Checklists can also act as a consequence for the performer (Ludwig, 2014). Checking an item is associated with the completion of a task component thereby contributing to completion of the task as a whole. One example can be seen in the way that checklists are used to track fitness.

Checklists can be used to observe other individuals' performance such as in Behavior Based Safety. Observers can use checklists to guide their judgments for acceptable behavior,

to thoroughly cover important elements of a task, and prompt verbal feedback provided to the performer. A good observer tracks completion rates over time and gives reinforcement for progress (Daniels & Bailey, 2014). Checklists used by external observers have been shown to improve overall performance (Bacon, Fulton, & Malott, 1983) especially when paired with performance feedback (Goomas & Ludwig, 2007; Alvero & Austin 2004; Alvero, Rost, & Austin, 2008). Interactions between observers and performers create interlocking contingencies that can affect the behavior of both parties (Alvero & Austin, 2004).

In a typical safety process, observers complete checklists and provide immediate feedback (Sulzer-Azeroff & Austin, 2000). Completed checklists are then logged into a database and used to track safety performance over time. This information is used to provide performance feedback to employee work teams (Sulzer-Azeroff & Austin, 2000). Effectively designed checklists inform and shape Behavior Based Safety through every step of the process.

Checklists, like any other tool, are only as useful as they are engineered to be. Checklists can be over-engineered when they include too many pinpoints. Checklists are meant to be tools that facilitate quick evaluations of performance; if they cannot be completed in a few minutes their accuracy will diminish. Ludwig (2014) noted that when checklists are extensively detailed or complex, the response cost is too high to reasonably expect users to complete them accurately. This can result in a phenomenon colloquially called “pencil whipping,” where checklists are completed apart from task completion, either before, after, or even in the absence of the task. To combat this process, Ludwig (2014) suggests that checklists be built intelligently. Checklists should be developed by those

involved in the process, target critical behaviors, and remain flexible documents: ready to adapt as the process changes over time.

Comments in Checklists

Many checklists contain both a strict binary check form and a comments section. By providing space for elaboration in a comment section, checklists can be shortened. With comments we can reduce response costs yet still capture vital, contextual information.

Although, there is little research focused on the content of comments in behavioral literature, a theoretical foundation for their utility is exemplified in other fields. Performance management experts have drawn on the literature from Industrial-Organizational Psychology, psychology, human resource management, and communication to provide support for the claim that the content of comments matters. More explicitly, the design and information contained within a comment will have an effect on the subsequent reaction to and use of the comment itself.

Numerical ratings are sometimes paired with written comments for use in performance appraisals (Brutus, 2010). The content of these comments have been systematically assessed for their impact on the cognitions and behavior of both the writer and recipient of the comment. Smither and Walker (2004) found a significant link between the characteristics of comments and subsequent job performance. These researchers provided evidence that feedback could be improved as a function of contextual elements in the comment. These elements included the amount of narrative comments present in feedback, the positivity of comments, and a focus on behavior or the task rather than on the individual on a trait level within comment. David (2013) further studied the role of narrative

performance comments on performance and found that feedback that was directive or prescriptive was more effective at changing employee behavior.

Brutus (2010) assessed variation in formats and processes that underlie creating and receiving comments. He suggested that in order to provide comments, the appraiser has to more thoroughly assess and justify ratings. Because of this the participant is provided a more detailed account of their performance. This allows for more useful feedback than numerical ratings alone. Further, comments that were prescriptive in nature fostered greater behavior change.

Comments and Behavior Based Safety

Kirkland and Manoogian (1998) argue that descriptions of behavior should also include a description of the situation and the consequences of behavior. These descriptions could be said to provide "context" to the behavioral observation through comments. Context should describe the variables within the environment that may be operating on the targeted behavior. This context is important because it provides the means to understand, predict, and provide better control over behavior (Daniels & Bailey 2014).

Thus, comments added to Behavior Based Safety checklists can provide the context associated with the behavior(s) being observed. A comment should serve to target a specific behavior, define what characteristics of the behavior are safe or unsafe, and help form the immediate verbal feedback which should be focused on reinforcing safe behavior or correcting at-risk behavior. This information combined creates a contextual comment.

Contextual information in a comment can act as a guide for observers to provide immediate feedback to the performer and help them accomplish more effective on-the-spot problem solving. Teams can look at contextual comments after the fact to do more

programmatic problem solving in the creation of behavior change interventions (Agnew & Daniels, 2010; Geller 1996; Geller, 2005; McSween, 1995). This information can be aggregated across a workgroup and tracked over time to provide group-level feedback thereby creating a metacontingency to maintain behaviors across many people acting in many roles (Glenn, 1986). In these metacontingencies, outcomes from sets of interlocking contingencies from peer-to-peer observation and feedback sessions end up affecting organizational processes such as operational procedures, tools, training, and other management systems.

Within the metacontingencies developed in Behavior Based Safety programs the quality of written feedback can indeed affect future process change. Without a comments section, checklist descriptive statistics serve as the only means of information about what behaviors safety interventions should target. Comments allow for supplementary qualitative information to be considered alongside the quantifiable data. Contextual comments provide the environmental and historical context surrounding and supporting behavior allowing the data analysts to better understand the behavioral trends.

For example, if the data trends suggest that employees are risking straining their backs safety personnel may hold awareness meetings about proper lifting techniques. This antecedent-based intervention may not fix the actual contextual components exerting control over the at-risk behavior; and therefore would likely be ineffective in changing the behavior. Instead, comments may suggest the context wherein behavior is occurring may discourage employees asking for help when faced with a heavy load. With this additional information, a more pointed intervention can be used (e.g. team lifting reinforcement).

Only one previous study has been done to assess the affect of comment quality in Behavior Based Safety processes. This study was performed in the same Midwestern refinery as the current study; however, they used a different subset of participants and operationalization of quality. Dagen, Aalavosius, and Harshbarger (2009) studied the quality of safety observations and suggested that comments should be evaluated on their ability to support the Behavior Based Safety process. In their study, a "quality comment" was operationally defined by the number of words a comment contained: the more words, the higher the quality. Experimenters facilitated weekly feedback between foreman and their frontline employees regarding the number of safety observations conducted and the written comments in those observations. Feedback included observation rate, number of observations with written comments, and the number of words in the comments. As a result, comments on observation cards occurred more frequently and contained more words.

The current study seeks to move beyond the quantity-based definition of quality comments found in Dagen, Aalavosius, and Harshbarger (2009) to include contextual elements suggested by Kirkland and Manoogian (1998). Hovardas, Tsivitanidou, and Zacharia (2014) demonstrated that comments that follow a predetermined structure boost feedback utility (Gamlem & Munthe, 2014). Creating a rubric for contextual elements could facilitate immediate feedback and provide more information to effectively guide pointed safety intervention efforts.

Design of a Contextual Comment

The creation of a rubric prompting contextual elements of quality comments could provide an antecedent to guide comment writers. The three-term contingency (Hayes, 1986) describes the surrounding context of a behavior. Antecedents are stimuli from the

environment that affect the probability of a response; consequences are defined as any stimulus that follows a behavior in an operant response pattern also affecting the probability of repeating the behavior chain (Pierce & Cheney, 2004).

Literature on functional job analyses can also be applied in the creation of a rubric. Fine (1989) sought to provide a structure for the functional job analysis used to describe task-level information. He contended that when defining job tasks, sentences should describe what the worker did using an action verb (e.g., the 'what') followed by the object of the verb (e.g., the 'to whom'). Additional information about the purpose of the action, tools, and antecedents can be added. These functional job analysis components can be used to compliment the elements described in the three-term contingency in the creation of a rubric for contextual comments.

Based on the information found in behavior science and Industrial-Organizational Psychology literature a contextual comment should use a) an action verb to target a behavior (e.g., Behavior), b) provide information about what the behavior is being done to and why (e.g., Context), c) what is done at the time of the behavior to mitigate risks or reinforce safe behavior (e.g., Action on Scene), and d) what hazards and risks are present or absent (e.g., Hazards and Risks Mitigated).

For example, the following comment includes all of the aforementioned elements of a contextual comment, building scaffold overhead of work going on below (targets behavior and provides context). Had tape upstairs (antecedent) letting people know not to work below (consequence) but none at ground level. I talked to them and asked them to put up tape at ground level (action on scene to mitigate risk) so people would know not to enter area below where they were building scaffold, or there are hoses on the ground from machines that will

pose a tripping hazard (mitigated risk). Notified other workers (action on scene) for them to reroute hoses or get a tree.

While writing contextual comments has multiple benefits, it takes more time and effort to write comments, which may be especially punishing in some populations of employees who rarely practice their writing skills. Training is an antecedent that may help build skill in writing contextual comments thereby reducing the negative consequences experienced by employees.

Increasing Contextual Comments through Behavioral Training

In applied settings, training is generally the first step taken in closing the gap between skill deficiencies and proficiencies (Noe, 2013). Behavioral training is an effective antecedent-based strategy for obtaining and mastering new skills (Brethower & Smalley,1998). According to these authors behavioral training is using job-like materials and procedures to help learners become capable of excellent performance. These authors described four components of effective behavioral training: a) skills analysis, b) exemplars, c) guided practice, and d) feedback.

The skill of the learner must be taken into account when developing training (Blanchard & Thacker, 2010; Brethower & Smalley, 1998). After assessing skills of learners training can be designed that focuses on building the necessary skills. In training, providing general information about the skills can help to foster the learner's development (Noe, 2013).

Following basic skills introduction, a trainer should provide an exemplar of desired performance to give the learner a frame of reference (Blanchard & Thacker, 2010; Brethower & Smalley, 1998; Uggerslev & Sulsky, 2008). An exemplar possesses and exhibits all of the markers of perfect performance; they act as an unflawed example, functioning to guide

development and cultivate desired performance. Brethower and Smalley (1998) further discuss exemplars in the context of training. These authors suggest that exemplars are useful in providing archetypes for learners to follow.

Following the introduction of an exemplar, guided practice and feedback can be used to build skill to an acceptable level (Brethower & Smalley,1998; Noe, 2013; Daniels & Bailey, 2014; Blanchard & Thacker, 2010). Guided practice is interactional instruction in which the teacher provides guidance to the learner through the process of skill acquisition. Guided practice allows learners to be exposed to scenarios and practice their skills in a controlled environment. Pairing guided practice with feedback further develops skills based on the instructor's criterion. The repeated paring of guided practice feedback helps skills generalize outside of the practice setting (Brethower & Smalley, 1998).

The present study sought to evaluate the efficacy of behavioral training methods on comment writing on Behavior Based Safety checklists. The objective of this training was to teach PICNIC and ABC analyses (Daniels & Bailey, 2014) and how these tools fit into the context of Behavior Based Safety. Training also covered the process through which data are accumulated and used in the company's Behavior Based Safety process and how to write contextual comments. In addition, guided practice and feedback was used in an initial training for a group of safety representatives. Trainees practiced writing contextual comments on Behavior Based Safety observation cards. After receiving initial training, safety representatives then trained their respective work groups continuing a 'train-the-trainer' process. The efficacy of training was assessed by rating comments for contextual elements for the period prior to and after training. Thus, the current study is exploratory in nature and

seeks to assess the effects of behavioral training on employees' ability to write contextual comments on observations in a Behavior Based Safety process.

Method

Setting and Participants

A petroleum refinery in the Midwest United States (Refinery A) served as the test site for behavioral training targeting contextual comments. A second petroleum refinery in the same geographic area served as a comparison group (Refinery B). Both refineries produced the same products and were owned by the same company operating under the same corporate standards. Refinery A employed approximately 700 internal employees and 300 contract workers; produced 209,000 barrels of petroleum products daily. Refinery B was smaller; it employed 300 internal employees and 350 contract workers and produced 80,000 barrels of petroleum products daily.

The participants were refinery employees and imbedded contractor workforces of these refineries. Within Refinery A, five workgroups participated: a warehouse workgroup with 10 participants, a hole watch/fire watch workgroup with 12 participants, a lab workgroup with 34 participants, a scaffolding workgroup with 50 participants, two general construction workgroups with 150 (construction 1) and 84 (construction 2) participants. The general construction workgroup with 84 participants acted as a comparison group within the refinery due to their lack of subsequent training. Within Refinery B workgroups were combined because there were no direct comparisons for the workgroups in Refinery A available due to the nature of the data management system this refinery used.

Both sites had successful Behavior Based Safety processes certified by the Cambridge Center for Behavioral Sciences (Marathon Petroleum Company, Illinois Refining

Division - Re-Accreditation Application, 2008) and containing checklists, peer-to-peer observations and feedback. The Behavior Based Safety processes were employee-owned and managed: meaning the employees ran the process themselves. Employees were involved in the design and daily duties of the process. Employees conducted voluntary observations on peers and provided feedback. No names were associated with the behavioral observations and no punitive action could be made based on observations. Employees also input the data, served as committee members who analyzed data, provided feedback to their workgroups, and helped create safety interventions aimed at areas of risk.

Ethical Considerations

An officer representing both refineries signed a Memorandum of Understanding stating that the researcher and trained assistants were given permission to perform descriptive and inferential analyses on the provided data (see Appendix A). Employees within the company understood that their representatives were allowed to look at the information provided on observation cards and use this information to target potential risks. No names were recorded and observation data was not used for disciplinary action in any way. Training was completed by an employee of Refinery A's safety contractor. The research team was granted permission to analyze the comments, in aggregate, to track the efficacy of the training. The Institutional Review Board of Appalachian State University approved this research study (IRB 15-0132; see Appendix B).

Materials

Behavioral observation checklist. Observation checklists used in the Behavior Based Safety programs at the refineries contained comment sections. The header of the card included the following logistical information: workgroup being observed, time of day,

location, number of people observed, and the task being observed. The lower section of the card consisted of a checklist form broken into the different categories: people, procedures, tools, personal protective equipment, and work environment. These categories were further broken into discrete behaviors such as over extending or wearing goggles. For each category behaviors were marked as safe, at-risk (e.g., opportunities for improvement), or conditional. Conditional items required external resources to fix and were not behavioral (e.g., broken handrails, leaky valves).

The back of the card listed barriers to behavior. Barriers were numbered and were used to provide information about why an unsafe behavior was exhibited. Barriers allowed observers to indicate what contributed to the at-risk behaviors thereby providing some contextual information that can be used for subsequent interventions. When marking that a behavior is unsafe, users were instructed to indicate the barrier by placing a number in the box corresponding to barriers such as business systems, equipment, personal factors, culture personal choice, and unsure of safe practices.

The back of the card also contained an open-ended comments section with no instructions. When an at-risk behavior was noted, observers were to complete the open-ended section attempting to describe why the at-risk behavior was performed. (see Appendix C for a blank example of the observation card).

At Refinery B, A Scantron™ sheet served as the behavioral checklist during short observations of on-the-job behavior targeting the presence of safe and at-risk behaviors. (see Appendix D for an example of a blank Scantron™ sheet). The comment section on Refinery B's card was not open-ended. Instead it contained a rubric divided into three components: a)

describe the at-risk behaviors observed, b) why was the at-risk behavior performed, and c) what corrective action was taken at the time of the observation.

Both refineries stored the information from behavioral observation cards in databases that spanned many years. Comments were entered into the database verbatim from the observation card. Data from these databases were electronically transferred to the research team and used for the analyses of training efficacy.

Procedures and Data Analysis

For each entry, observer comments were scored by research assistants as either present (1) or absent (0) form the comment using the following nominal scale:

a) Conditional comment. Conditional comments made reference to equipment issues that represented hazards in the workplace (e.g., leaky valve, broken pipe).

b) Targeted behavior written. Comments that targeted behaviors include an action verb (e.g., welding, lifting).

c) Context provided. Comments that provided information about what the action was done to (e.g., welding a pipe, lifting a box).

d) Possible or mitigated injury. Comments that addressed the possible or mitigated injury described possible consequences of the at risk behavior (e.g., building scaffold overhead of work going on below. Had tape upstairs letting people know not to work below but none at ground level. I talked to them and asked them to put up tape at ground level so people would know not to enter area below where they were building scaffold).

e) Action on scene. Comments that detailed the immediate feedback interaction or what was done at the time of the observation (e.g., I told him to get a face shield, I thanked him for wearing gloves).

This nominal scale allowed for each comment to have multiple elements recorded.

Reliability Check

Research assistants were trained to transcribe the original data into an excel document. Transcribing training consisted of guided practice and feedback with example comments. The nominal scale was described and examples were provided of comments that contained content consistent with each anchor of the scale. Following that introduction, transcribers were shown a comment and practiced coding using the nominal scale. The experimenter gathered their coded data and assessed for accuracy. When discrepancies occurred the experimenter explained what the comment's coded numbers would actually be and why. When all of the transcriber's collectively completed five correctly coded comments training was concluded.

Inter-rater reliability was assessed by having 4,000 (37%) of the comments coded by two research assistants working independently, and comparing their answers against each other. One research assistant coded a comment for all of the nominal fields; then on a separate occasion a second researcher coded the same comment for all of the nominal fields. The percent of agreement for each field would then be separately calculated for each nominal field individually. The average percentage agreement for each of the six nominal categories was calculating by summing number of times two research assistants agreed on the occurrence of a nominal variable and dividing this by the total number of comments for each nominal category. The inter-rater reliability for each nominal category met or exceeded an

80% standard for both refineries on each of the nominal categories that served as dependent variables (Copeland, 2013).

Integrity Check

An integrity test was done to ensure that the training was consistent across workgroups and contained the behavioral elements intended. Workgroup training sessions were evaluated by a trained integrity assessor using a checklist. The experimenter trained the integrity assessors by instructing them on what to look for and how to use the checklist. Two managers served as integrity assessors. These assessors attended the original training and were given an overview of the checklist by the experimenter. Integrity assessors attended workgroup training events. They were provided a checklist by the experimenter to ensure the above-indicated elements were present during training. Checklist items included: covering the three essentials to a quality comment, the basics of applied behavior analysis, guided practice, and feedback. The scale was a simple yes or no for each checklists element. They were not directed to step in if elements of training were not present; they were simply instructed to make note of the missing information on the checklist. The integrity checks completed by trained managers revealed that 100% of the workgroup training sessions provided the same training components (e.g. a discussion of behavior analysis, guided practice paired with feedback, and a breakdown of the quality comment rubric) as the original training.

Design

This study used an A (baseline or Phase 1), A' (initial training of trainers), B (training of workgroups or Phase 2) design across workgroups at the experimental (Refinery A) with a

non-treatment comparison site (Refinery B). The baseline phase culminated in the training of the entire workforce (A') represented in the Phase 1 analysis.

A train the trainer format was used in which an initial training took place with safety representatives from individual work groups; then those representatives performed a subsequent training to the general work force. A 23-week baseline phase was compiled from archival data. The initial training of trainers took place over two days. Those trainers then held 4-hour sessions with their workgroups in a staggered implementation over an 8-week period (A'). The warehouse workgroup held a subsequent training session two weeks after the initial training. The experimental construction workgroup and the scaffolding group held subsequent training sessions three weeks after the initial training. The lab workgroup held a subsequent training session four weeks after the initial training. The hole watch/fire watch workgroup held a subsequent training session eight weeks after the initial training.

Data were then tracked for 29 weeks to assess the efficacy of the training on comment content. Employees were aware that the company collected the data to use for safety management, but were unaware that there was a study going on to assess the impact of training. The comparison group received no training during the period of the study.

Throughout the course in a normal year of operation, refineries often go through periods of maintenance that require the shut down and start up of one or more processing units. This is referred to as a "turnaround." A unit of the refinery is shut down, taken apart, cleaned, old equipment is replaced or fixed, and then the unit is restarted. Turnarounds are different from normal operational periods. There are more people on processing units during this time and several thousand contractors are brought in to accompany the imbedded contractors and regular employees. There are also dedicated observers that are assigned by

the company to perform observations during this time. These dedicated observers were trained in the same fashion as the original trainers.

During the time of this study Refinery A went through two turnarounds: one during baseline and one after the intervention. The turnaround during baseline lasted for eight weeks; the turnaround after the training sessions took place over nine weeks. Due to the difference in the nature of the work being done and the personnel on site, data for turnaround activities were not analyzed.

Independent Variable

Contextual comment skills training. A train-the-trainer process was used to deliver contextual comment training to the workgroups in Refinery A. Training was initially provided to safety representatives. These representatives then trained their respective workgroups.

Initial training consisted of didactic instruction through the use of a PowerPoint paired with guided activities and practice. This training was implemented over two days with twelve hours of instructions and participation each day; a one hour lunch was provided both days. It began with an introduction to applied behavior analysis including a discussion about antecedents, consequence, interlocking contingencies, and the complexity of understanding and predicting human behavior. Participants were taught an interactive PIC/NIC analysis, in which the student chooses a behavior and labels the positive or negative immediate, or delayed, and certain or uncertain antecedents and consequences of the behavior (Daniels & Bailey, 2014). Next, the refinery's history with Behavior Based Safety was covered. The observation card was discussed along with a description of how data is used to make decisions. Past examples of how data were used to implement successful interventions were

discussed. A new comment rubric was introduced by breaking down the elements of a contextual comment. Participants were taught that contextual comments a) pinpoint behaviors, b) provide context about what the worker was operating, c) assess the mitigated or presented risk, and d) detail the immediate feedback interaction that occurred.

Guided practice was facilitated by role-play. One participant would act out a typical refining task (e.g., operating a crane) while the other completed an observation. After completing the form, participants were thanked and provided individualized feedback using the contextual elements of the comment(s) written on the card. The learners were allowed to make up their own scenarios for the role-play. The trainer, using a simple count method of the nominal categories mentioned earlier, provided this feedback orally. This role-playing exercise was repeated until all participants achieved a successful practice observation that included all of the nominal elements.

Representatives trained within the initial training subsequently acted as trainers to their individual workgroups. Trainers were given autonomy to decide when they trained their workgroups, but a 2-month deadline was set. Trainers were then provided with PowerPoints imbedded with the role-playing activities and told to conduct their training to the workforce using the same format as the initial training: introduce behavior analysis, the new comment structure, provide practice writing comments, and give performance feedback to their workgroups during workforce training. They were free to use their own experience to provide relevant examples, but the content was to remain the same.

Results

Data Summary and Inclusion Criteria

A total of 9,053 observations containing comments were analyzed across workgroups from Refinery A and 1,504 observations were analyzed from Refinery B for a total of 10,557 comments. Each comment was coded dichotomously for the six nominal dependent variables resulting in the analysis of 63,342 written instances associated with behavioral observations.

Overall results were analyzed by aggregating across workgroups due to absences of comments over periods of the study for some workgroups. Analyses used means of each DV during the phase for comparisons. Exploratory analyses individually coded and tracked workgroup-specific data in cumulative graphs at the end of this section.

An inclusion criterion was applied to the data to determine when there was enough data to reliably analyze results. Each workgroup was required to have at least 100 comments outside of the turnaround periods. At Refinery A the hole watch fire watch group and construction 2 were not included in the aggregate analysis because they did not meet inclusion criterion. Thus, the data for Refinery A during normal operation hours consisted of the following workgroups: scaffolding, construction 1, lab, and the warehouse. Due to the differences in operation and personnel during turnaround that data was excluded from the analyses.

Overall Results

Initial analyses were designed to assess changes in the contextual categories at Refinery A that received the training intervention compared to Refinery B that received no treatment. Subsequently, the main effects across phases for each contextual category for comments from Refinery A were analyzed as a composite group aggregated across individual

workgroups. Chi-square analyses were used to compare percentages of comments with each dependent variable from the baseline against the experimental phase.

Table 1 shows the changes in percentages of each dependent variable over experimental phases for Refinery A and Refinery B. A Chi-square test of independence was calculated comparing the frequency of Conditional comments for Refinery A compared to Refinery B. Results indicated an overall effect by phase (χ^2 (2) =41.90, $p < .001$; contingency coefficient = .289). Adjusted standardized residuals demonstrated that, compared to Refinery B, Conditional comments were less frequent for Refinery A from Phase 1 to Phase 2 (-6.5; 79.5% vs. 20.5%, respectively).

A Chi-square test of independence was calculated comparing the frequency of Behavior in comments for Refinery A compared to Refinery B. Results indicated an overall effect by phase (χ^2 (2) =335.11, $p < .001$; contingency coefficient = .303). Adjusted standardized residuals demonstrated that, compared to Refinery B, comments with a behavior were more frequent for Refinery A from Phase 1 to Phase 2 (18.3; 18.7% vs. 81.3%, respectively).

A Chi-square test of independence was calculated comparing the frequency of Context in comments for Refinery A compared to Refinery B. Results indicated an overall effect by phase (χ^2 (2) =365.23, $p < .001$; contingency coefficient = .324). Adjusted standardized residuals demonstrated that, compared to Refinery B, comments witch context were more frequent for Refinery A from Phase 1 to Phase 2 (19.1; 19.0% vs. 81.0%, respectively).

A Chi-square test of independence was calculated comparing the frequency of Explanation in comments for Refinery A compared to Refinery B. Results indicated an

overall effect by phase (χ^2 (2) =176.20, p < .001; contingency coefficient = .500). Adjusted standardized residuals demonstrated that, compared to Refinery B, comments with an explanation were more frequent for Refinery A from Phase 1 to Phase 2 (13.3; 37.6% vs. 62.4%, respectively).

A Chi-square test of independence was calculated comparing the frequency of Action in comments for Refinery A compared to Refinery B. Results indicated an overall effect by phase (χ^2 (2) =59.65, p < .001; contingency coefficient = .257). Adjusted standardized residuals demonstrated that, compared to Refinery B, comments with action were more frequent for Refinery A from Phase 1 to Phase 2 (7.7; 42.1% vs. 57.9%, respectively).

Figures 1-4 show an exploratory trend analysis in the form of time series cumulative graphs separated out by workgroup and nominal category. These graphs show changes in each nominal category within a contextual comment across phases. Each data point that raises the slope represents an occurrence of the contextual category targeted in a comment. The dotted lines represent changes in phases: A represents the baseline period, B represents the initial training of the trainers, and C represents the when the training was administered to the individual work groups. The solid celeration line starting at zero and processing through the cumulative sum at the end of baseline shows the expected slope based on the base line data.

Discussion

Results suggested that the behavioral training containing exemplars, guided practice, and feedback was effective in adapting employee written contextual comments within a Behavior Based Safety process. For the entire refinery, training was associated with increases in comments specific to Behavior, Context, Explanation, and Action within the Behavior

Based Safety observations. Conditional comments decreased across phases, which is considered desirable providing a greater focus on behaviors of individuals rather than the condition of equipment.

Comments that targeted a behavior increased as a result of the training for the refinery as a whole. This is demonstrated especially in the lab and construction 1 workgroups. Comments that provided context also increased for the refinery as a whole. The time series cumulative graphs for the lab and construction 1 workgroups demonstrated this increase with construction 1 having the most visually dramatic change. Explanations of the risk preset or mitigated by the behavior in comments went up for each of the workgroups: construction 1, lab, warehouse, and scaffolding as well as for the refinery as a whole. The scaffolding group did not include this information on a single comment before training but did demonstrate several comments with explanations of risk following the training. Comments that detailed what action was done on scene rose for the refinery as a whole, but these effects were only exemplified in the time series cumulative graph for the lab when broken down by workgroup. The overall rise in each of these dependent variables across the refinery demonstrates the efficacy of the training.

The increase in contextual comments could provide safety professionals with more information about surrounding context of the trending risks to make more informed intervention attempts to reduce the likelihood of injuries. The inclusion of a targeted behavior in a comment allows professionals to hone in on specific behaviors that are creating risk. Comments with context around the behavior help to provide information about environment that acts as a contingency with the behavior. In many cases the immediate environmental context determines if the behavior may be putting someone at risk. Likewise,

the explanation of risks present or mitigated as a result of the behavior describes why the behavior is safe or creating risk in that specific environment. Contextual and explanatory information helps to eliminate wasteful operation-wide interventions and can help safety professionals to target interventions on behavior in the precise environment associated with the risk.

The description of the action that was taken on scene informs safety professionals that the feedback interaction as well as an intervention on unsafe behavior is actually occurring on scene. Further, having the observer write this description acts as a built in prompt for the observer to provide reinforcement and exemplifies the strength of the process to safety professionals who read the comments later.

Conditional comments decreased following the training. This is desirable because Behavior Based Safety is built to proactively assess behaviors and their impact on safety metrics. Conditional comments, inherently, address the environment rather than a person's interaction with that environment. The condition or engineering downfalls of equipment are not the main focus of this process so the decline in these types of comments is desirable.

Training Efficacy

These results support previous research indicating that the use of guided practice, feedback, and exemplars (Brethower & Smalley,1998; Noe, 2013; Daniels & Bailey, 2014; Blanchard & Thacker, 2010) are effective in aiding skill development. It is also consistent with the finding that behavioral modeling facilitates skill transfer when trainees are allowed to create their own scenarios (Taylor, Russ-Eft, & Chan, 2005). Exemplified in the increases across phases for all dependent variables in contextual comments. Although results were in line with previous research, the methodology could be improved by pairing the training with

consequences, using a stimulus response chain, adding other antecedents, taking into account the past experiences of trainees, keeping the benefits of training salient to the trainees, learning about the individual differences of trainees, assessing the individual skill levels of the trainees, and gathering pertinent information about the organizational culture.

Training is an antecedent-based intervention. Alone, training does not provide consequences for targeted behaviors. Consequences following the behavior of contextual comment writing could have been added to help create stronger and lasting effects on behavior (Sulzer- Azaroff, & Mayer, 2013). Initial changes in behavior are likely proximal to the training event, but the transfer and maintenance of these behaviors across situations – outside of training – is unlikely without any reinforcement (Kazdin, 2012; Sulzer- Azaroff, & Mayer, 2013). Reinforcement plays a key role in creating lasting change by strengthening the relationship between a stimulus and a response, especially complex behaviors such as writing in context (Sulzer- Azaroff, & Mayer, 2013). Reinforcement is appropriate when attempting to increase low frequency behaviors or establishing new behaviors (Kazdin, 2012). Similarly, feedback could have been used after the training to provide information to the performers about their performance and increase subsequent performance. Feedback is an effective consequence that has been shown to help increase (e.g. Dagen, Aalavosius, & Harshbarger, 2009; Brethower & Smalley,1998; Noe, 2013; Daniels & Bailey, 2014; Blanchard & Thacker, 2010). No consequences were added in this study to shape or maintain the desired behavior thereby limiting the effects of the training initially and over the long term.

Additionally, no stimulus-response chaining was used in the intervention. Stimulus response chains are sequences that include discriminative stimuli and responses in which the

last response is followed by a reinforcer (Martin & Pear, 1978). Each new response sets the occasion for the next response in the sequence and therefore represents a discriminate stimulus: prompting the next behavior in the succession when one is completed. The training could have benefited from linking each step in writing a contextual comment together in a stimulus response chain to elicit more complete contextual comments. Creating stimulus-response chains may reduce the response cost; if the results were due to covariant effects within the dependent variables a response chain could help to counterbalance those negative affects.

Before the training, trainers should attempt to target the motivation levels of trainees because motivation is positively related to transfer (Noe, 2013). The benefits of the training should be made salient so that trainees are motivated (Dweck, 1986). Other antecedents could be used to help keep these benefits salient. Goal setting could also be used as an antecedent to help cultivate performance in contextual comment writing. Goals have shown to be linked with positive performance outcomes (Locke & Latham, 2002).

Motivation is also affected by the trainee's history. Trainers should note past experiences of the trainees so that the trainer can be aware of negative reactivity, and address the issue accordingly. People with negative training experiences will often think that all training ineffective which will affect the trainings effectiveness on that individual (Smith-Jentsch, Jentsch, Payne, & Salas, 1996). Trainers should attempt to gather as much info about the trainees when designing the training itself.

Grossman and Salas (2011) posit that many contextual factors play a role in facilitating the efficacy of training. These factors fall into three broad categories: trainee characteristics, trainee design, and the work environment. Links were found between the

outcomes of training and trainee characteristics like self-efficacy, motivation, cognitive ability, and perceived utility of the training. Within the design behavior modeling, error management, and a realistic training environment were found to effect training efficacy in terms of transfer. Within the work environment transfer climate, support, opportunities to perform, and follow-ups from managers were found to facilitate transfer of training. This information could have been integrated in the development of the training to bolster the results across nominal categories.

Individual differences play a role in the outcomes of training. The sample used in this study had ranging amounts of education, with most participants holding only a high school degree. This limits the writing skills that participants had coming in to the study. A meta analysis performed by Colquit, LePine, and Noe (2000) showed results suggesting that trainees are most likely to succeed in transferring skills learned in training if they have the appropriate level of prerequisite skills and abilities required by the training.

Beyond individual differences in skill, the broad organizational culture will also affect the effect of training. Organizational culture is an important element to account for when developing and assessing training. It is possible that some performers did not write full contextual comments and this influenced others to do the same. Trainees are often hesitant to apply the new skills when it goes against organizational norms (Grossman & Salas, 2011). It could be that the performers were not fully aware of the organizational benefits of contextual comment writing. Dachner, Saxton, Noe, and Keeton (2013) discuss the importance of linking the importance of the training to the broader organizational structure.

Limitations

Limitations of this study stem from the lack of control that was utilized and allowed by the host organization in this applied setting. Participants were not randomly assigned to groups and the comparison group (i.e., Refinery B) had some differences in population and applications of Behavior Based Safety that made them less equivalent to the experimental group. The experimental and control refineries had different employment settings and held different trainings for their employees throughout the year. The experimental group also had a different observation card with a structured comment rubric. Additionally, the variables could be influenced by one another; or an external variable that was not considered could be acting on all of them.

Inconsistency in the quantities of comments from workgroups over time limited our ability to interpret results. For example, the hole watch fire watch group and construction 2 only contributed comments during turnaround periods. Further the hole watch fire watch group was not renewed as a contracting workforce after the eighth month of data collection. Thus, their data ceased at that point. Construction 1 provided a steady stream of comments throughout the year, but other workgroups like the lab, scaffolding, and warehouse had weeks with hundreds of submitted comments followed by other weeks with none.

A final limitation is that the train the trainer system could have affected results. More explicitly, some trainers had more experience with training and the material that they had to train on with others. Additionally, some trainers are more popular within their workgroup than others. These combined affects can greatly affect training outcomes (Noe, 2013).

Future Research

Contextual comments are a new concept to research in the field of behavioral safety. The contingencies that manage the writing behaviors within contextual comment require

further study. Future research should seek to find antecedents and consequences that better shape contextual comment writing.

Research should also seek to find the organizational outcomes that are linked to contextual comment writing. Safety teams could use contextual comments to better understand the trends in behavioral data. The added information leads to better analysis, which in turn leads to better interventions. Efficacious interventions could lead to reductions in injury. This study was unable to assess this trend due to a lack of documentation in intervention planning and outcomes; but if that data were available a researcher could track outcome variables alongside contextual comments to demonstrate these relationships.

The development of a guided comment sections could prove to be an improvement in the contingencies related to the response cost of adding extra content to comments. A guided comments section would ask specific questions to provide a prompt to the writer. For example, if the rubric used in this study was developed into a guided comment sections it would have the following questions: What behavior was observed? What was the behavior done with or to? What was done on scene to correct unsafe behavior or reinforce safe behavior? How did the behavior propagate or mitigate risks of the task? Research should seek to differentiate between types of rubrics and prompts; eventually providing a framework for how to create the rubric or prompt that will work best for eliciting contextual comments in a Behavior Based Safety process.

Conclusion

The results of this study indicate that behavioral training containing exemplars, guided practice, and feedback can be used as an effective behavior modification strategy, but more research is needed to evaluate additional intervention strategies to increase contextual

comment writing. Creating a strong and salient rubric can help to shape the behavior of writing contextual comments. Contextual comments provide key information to safety professionals to more accurately pinpoint risk and also make better informed intervention attempts to manage that risk. The prevalence of these comments should lead to positive organizational outcomes such as better feedback, more targeted interventions, and eventually less injuries.

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Table 1.

Mean Percentage of Each Nominal Category Across Phases

Independent Variable	Phase	Refinery A	Refinery B
Behavior Targeted	Phase 1	18.7%	53.7%
	Phase 2	81.3%	46.3%
Context Given	Phase 1	19.0%	56.8%
	Phase 2	81.0%	43.2%
Explanation	Phase 1	37.6%	91.7%
	Phase 2	62.4%	8.3%
Action	Phase 1	42.1%	16.2%
	Phase 2	57.9%	83.8%

Note. This table shows the changes in each nominal category across phases for both the experimental group (Refinery A) and the control group (Refinery B).

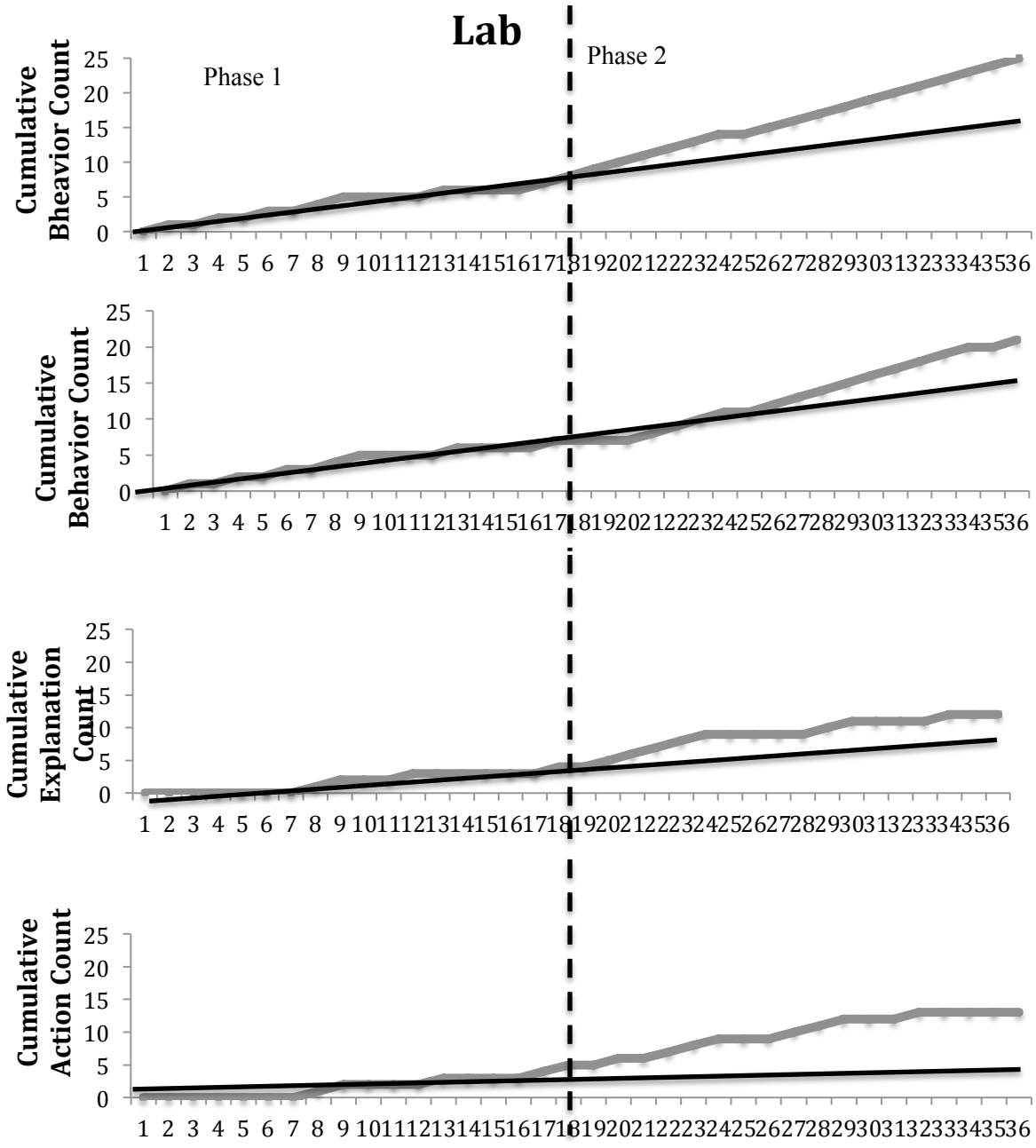

Figure 1. Time-series cumulative graph for the Lab Workgroup showing changes in each nominal category within a contextual comment across phases. Data points were added for each comment in serial order. If this contextual category was present the slope raised by one occurrence. Dotted lines represent changes in phases: A represents the baseline period, B represents the initial training of the trainers, and C represents the when the training was administered to the individual work groups. A solid Celeration Line was drawn starting at the zero point of the x and y axis and processing through the cumulative sum at the end of the baseline data. Celeration Lines show the expected slope of the data if baseline conditions persisted allowing an estimate of change associated with the intervention.

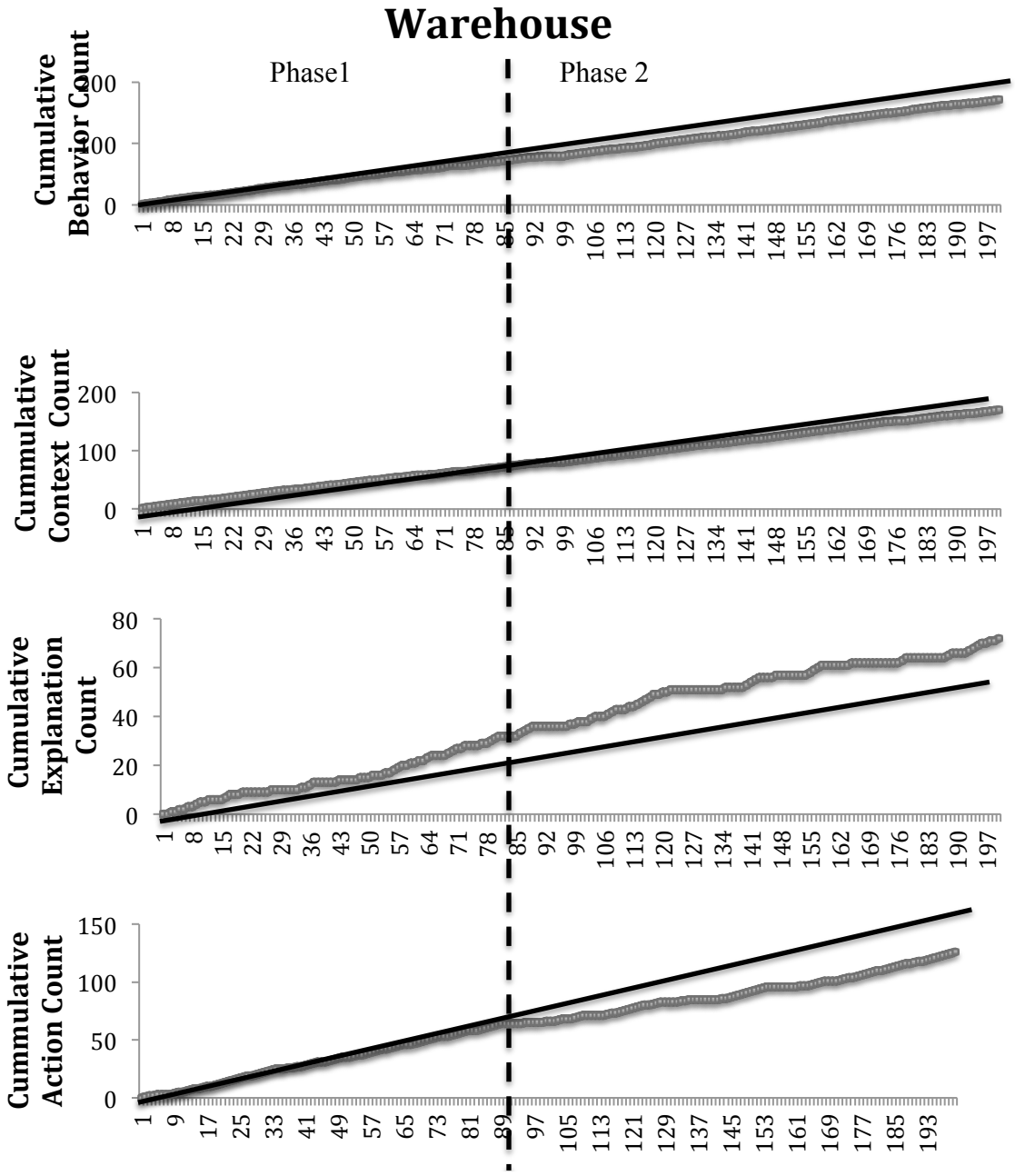

Figure 2. Time-series cumulative graph for the Warehouse showing changes in each nominal category within a contextual comment across phases. Each data point that raises the slope represents an occurrence of the contextual category targeted in a comment. The dotted lines represent changes in phases: A represents the baseline period, B represents the initial training of the trainers, and C represents the when the training was administered to the individual work groups. The solid celeration line starting at zero and processing through the cumulative sum at the end of baseline shows the expected slope based on the base line data.

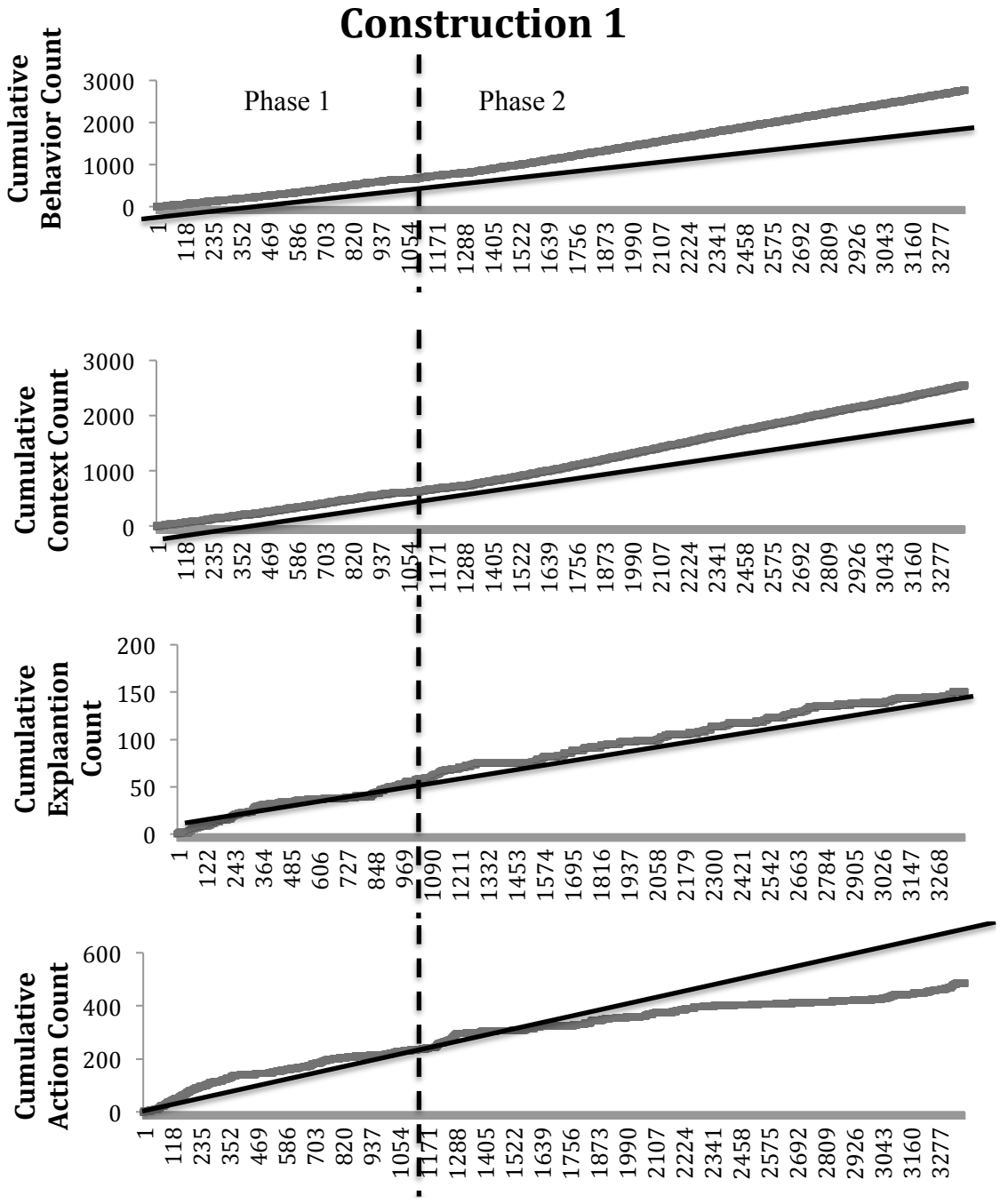

*Figure 3.*Time-series cumulative graph for Construction 1 showing changes in each nominal category within a contextual comment across phases. Each data point that raises the slope represents an occurrence of the contextual category targeted in a comment. The dotted lines represent changes in phases: A represents the baseline period, B represents the initial training of the trainers, and C represents the when the training was administered to the individual work groups. The solid celeration line starting at zero and processing through the cumulative sum at the end of baseline shows the expected slope based on the base line data.

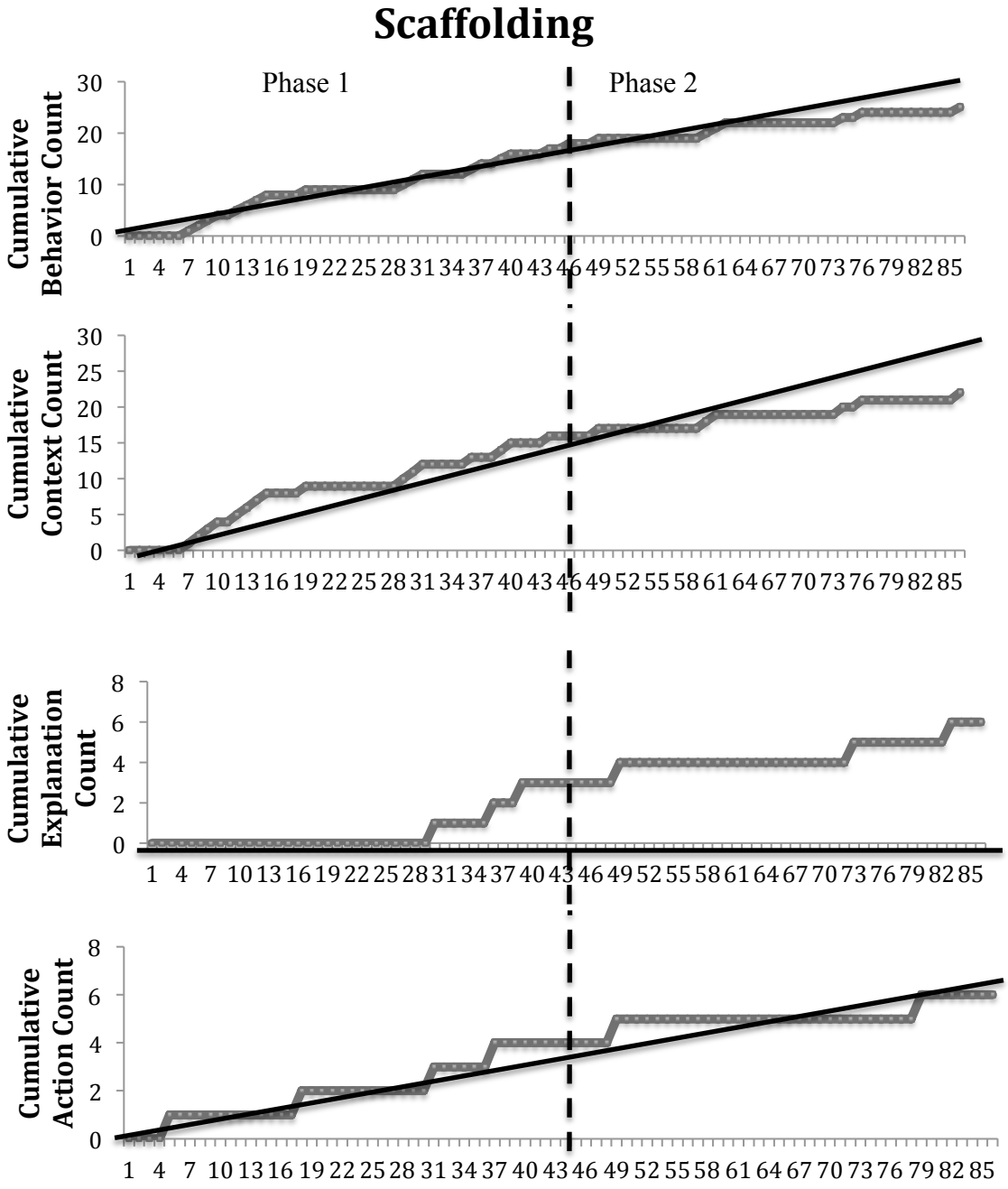

Figure 4. Time-series cumulative graph for the Scaffolding workgroup showing changes in each nominal category within a contextual comment across phases. Each data point that raises the slope represents an occurrence of the contextual category targeted in a comment. The dotted lines represent changes in phases: A represents the baseline period, B represents the initial training of the trainers, and C represents the when the training was administered to the individual work groups. The solid celeration line starting at zero and processing through the cumulative sum at the end of baseline shows the expected slope based on the base line data.

Appendix A

Memorandum of Agreement

August, 2014

Memorandum of Understanding between:

Danielle Kretschmer
Graduate Student, Department of Psychology
Appalachian State University
danielleкretschmer@gmail.com
775 771 5588 cell

Timothy D. Ludwig, Ph.D.
Professor, Department of Psychology
Appalachian State University
ludwigtd@appstate.edu
828 773 0986 cell

And

Marathon Petroleum Corporation
POC: Von Meeks
Safety Supervisor

Regarding:
ANALYSIS OF MARATHON AND CONTRACTOR COMMENTS FOR SIX WORKGROUPS ON PERFORMANCE CHECKLISTS FROM A DATABASE

Background:

Danielle Kretschmer was an intern for the summer of 2014 at Marathon Petroleum Corporation and gained experience with the use of their database. Upon completion of the internship a proposal was made to extensively analyze the data for a thesis and for benefit of Marathon Petroleum Corporation.

Marathon Petroleum Corporation uses a behavior checklist with a comments section when examining safe behaviors. Current research suggests that comments can be used to affect company safety outcomes. Danielle Krestchmer also designed, developed, and implemented training on contextual comment writing.

The comprehensive database of Marathon Petroleum Corporation will allow for an accurate and efficient evaluation of the training on contextual comment writing. By tracking the information in comments the efficacy of the training can be evidenced.

CGGV Data Requested:

1) Access to Marathon Petroleum Corporation's database and archival database through MARCH 2015.

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2) Interview data from targeted workgroups to examine current policies on each.

3) Demographic information for Marathon Petroleum Corporation groups.

4) Information on training sessions.

What will be done with the interviews and corporate data:

1) Descriptive analyses will be completed on the variance in safety metrics from January, 2014- March, 2015

2) The effect of the implementation of the training will be assessed by several time series graphs, multiple baseline graphs, and by a repeated measures ANOVA

3) Comments will also be evaluated qualitatively.

Benefits to TRW:

The anticipated benefits to Marathon Petroleum Corporation may include:

• The new training should increase quality, participation, and increased accuracy of the BBS process evidenced by trends in the data; Miss. Kretschmer and Dr. Ludwig will analyze the data in order to discover these potential trends.

• Overall efficacy of the BBS program at Marathon Petroleum Corporation will be analyzed through the baseline measure of the observation data and comments. Efficacy information on the BBS training will allow Marathon Petroleum Corporation to continually improve the process.

• The review of articles and publications in the beginning of the thesis will allow Miss. Kretschmer to provide valuable information of best practices of BBS around the world.

Confidentiality Agreement:

Marathon Petroleum Corporation would agree to:

- Implement a process to introduce the shortened checklist and associated training/instruction on Marathon Petroleum Corporation vessels.

- Provide Dr. Ludwig and Miss. Krestchmer with access to Marathon Petroleum Corporation's database and archival database

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- Allow Dr. Ludwig and Miss. Kretschmer to interview safety management within the operation of each targeted workgroup.

- Marathon Petroleum Corporation will make a reasonable effort to allow the publication of analyses arising from this project. Publication attributions could be:
    a) publishing actual results attributed to Marathon Petroleum Corporation,
    b) publishing actual results but make the source anonymous (not attributed to Marathon Petroleum Corporation), or
    c) adapting the actual results through transformations so that business-sensitive data cannot be discovered by the reader.

- Dr. Ludwig, Miss. Kretschmer, and Marathon Petroleum Corporation will agree on the most appropriate method of reporting the results. Results will be denied inclusion in the report when, in Marathon Petroleum Corporation's sole opinion, they could do damage to Marathon Petroleum Corporation.

Dr. Ludwig and Miss. Kretschmer agree to the following assurances:

- All Marathon Petroleum Corporation's data will be held as confidential until such time as reporting is authorized by Marathon Petroleum Corporation's points of contact. Data collected from Marathon Petroleum Corporation will not be distributed to anyone or entity other than Dr. Ludwig and Miss. Kretschmer unless otherwise authorized by Marathon Petroleum Corporation.

- All data will be secured in a locked room on a password protected computer.

- Marathon Petroleum Corporation will be able to review and make comments on any reports generated from this research. Dr. Ludwig and Miss. Kretschmer will present Von Meeks with the reports he anticipates will go into the publication(s). Dr. Ludwig and Miss. Kretschmer will not publish any reports bearing Marathon Petroleum Corporation's name, the name of any employees, or Marathon Petroleum Corporation data without the consent of Marathon Petroleum Corporation.

- If desired, Marathon Petroleum Corporation will be recognized on all reports generated.

- This research will be reviewed and approved by Appalachian State University's Institutional Review Board to assure the ethical conduct of this research.

Signatures:

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Von Meeks
Safety Supervisor
Marathon Petroleum Corporation

Timothy Ludwig, Ph.D.

Danielle Kretschmer
Appalachian State University

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Appendix B

IRB Approval

To: Danielle Kretschmer

CAMPUS MAIL

From: Dr. Lisa Curtin, Institutional Review Board Chairperson
Date: 11/18/2014
RE: Notice of IRB Exemption
Study #: 15-0132

Study Title: Assessing the Efficacy of Training Targeting Contextual Comments in Behavior Based Safety Observations

Exemption Category: (4) Collection or Study of Existing Data, If Public or Unable to Identify Subjects This study involves minimal risk and meets the exemption category cited above. In accordance with 45 CFR 46.101(b) and University policy and procedures, the research activities described in the study materials are exempt from further IRB review.

Study Change: Proposed changes to the study require further IRB review when the change involves:

- an external funding source,
- the potential for a conflict of interest,
- a change in location of the research (i.e., country, school system, off site location),
- the contact information for the Principal Investigator,
- the addition of non-Appalachian State University faculty, staff, or students to the research team, or
- the basis for the determination of exemption. Standard Operating Procedure #9 cites examples of changes which affect the basis of the determination of exemption on page 3.

Investigator Responsibilities: All individuals engaged in research with human participants are responsible for compliance with University policies and procedures, and IRB determinations. The Principal Investigator (PI), or Faculty Advisor if the PI is a student, is ultimately responsible for ensuring the protection of research participants; conducting sound ethical research that complies with federal regulations, University policy and procedures; and maintaining study records. The PI should review the IRB's list of PI responsibilities.

To Close the Study: When research procedures with human participants are completed, please send the Request for Closure of IRB Review form to irb@appstate.edu.

If you have any questions, please contact the Research Protections Office at (828) 262-2692 (Robin).

Best wishes with your research.

Websites for Information Cited Above

Note: If the link does not work, please copy and paste into your browser, or visit https://researchprotections.appstate.edu/human-subjects.

1. Standard Operating Procedure #9: http://researchprotections.appstate.edu/sites/researchprotections.appstate.edu/files/IRB20SOP920Exempt%20Review%20Determination.pdf

2. PI responsibilities: http://researchprotections.appstate.edu/sites/researchprotections.appstate.edu/files/PI20Responsibilities.pdf

3. IRB forms: http://researchprotections.appstate.edu/human-subjects/irb-forms

CC:
Timothy Ludwig, Psychology

Appendix C

Refinery A Observation Card

COMMENTS AND BARRIERS FOR OPPORTUNITY FOR IMPROVEMENT

nents:

Each Opportunity for Improvement must have a barrier associated with it:

Business System- Tangible things that can be easily corrected

Equipment/ Facility- Tangible things that cannot be easily corrected

Personal Factor- Emotional State, Frustration, Fatigue, Angry, Sad, Rushed

Culture- Resistant to Change

Personal Choice- Taking a Shortcut

Unsure of / Disagreement - Knowledge / Training

UNIT IN TURNAROUND: YES NO

OBSERVER: **YOUR WORKGROUP:**

DATE: **TIME:**

TYPE OF OBSERVATION: SELF PEER TO PEER

LOCATION:

WORKGROUP OBSERVED:

 # PEOPLE OBSERVED:

CONVERSATION BEFORE OBSERVIING: YES NO

TASK:

IF THIS IS A CONDITIONAL OBSERVATION, CIRCLE ONE OF THE FOLLOWING:

High Risk / High Frequency High Risk/ Low Frequency

Low Risk/ High Frequency Low Risk/ Low Frequency

IF CONDITIONAL ISSUE, HAS YOUR FOREMAN BEEN MADE AWARE OF IT? YES NO

BEHAVIOR: S (Safe) O (Opportunity for Improvement) C (Condition)

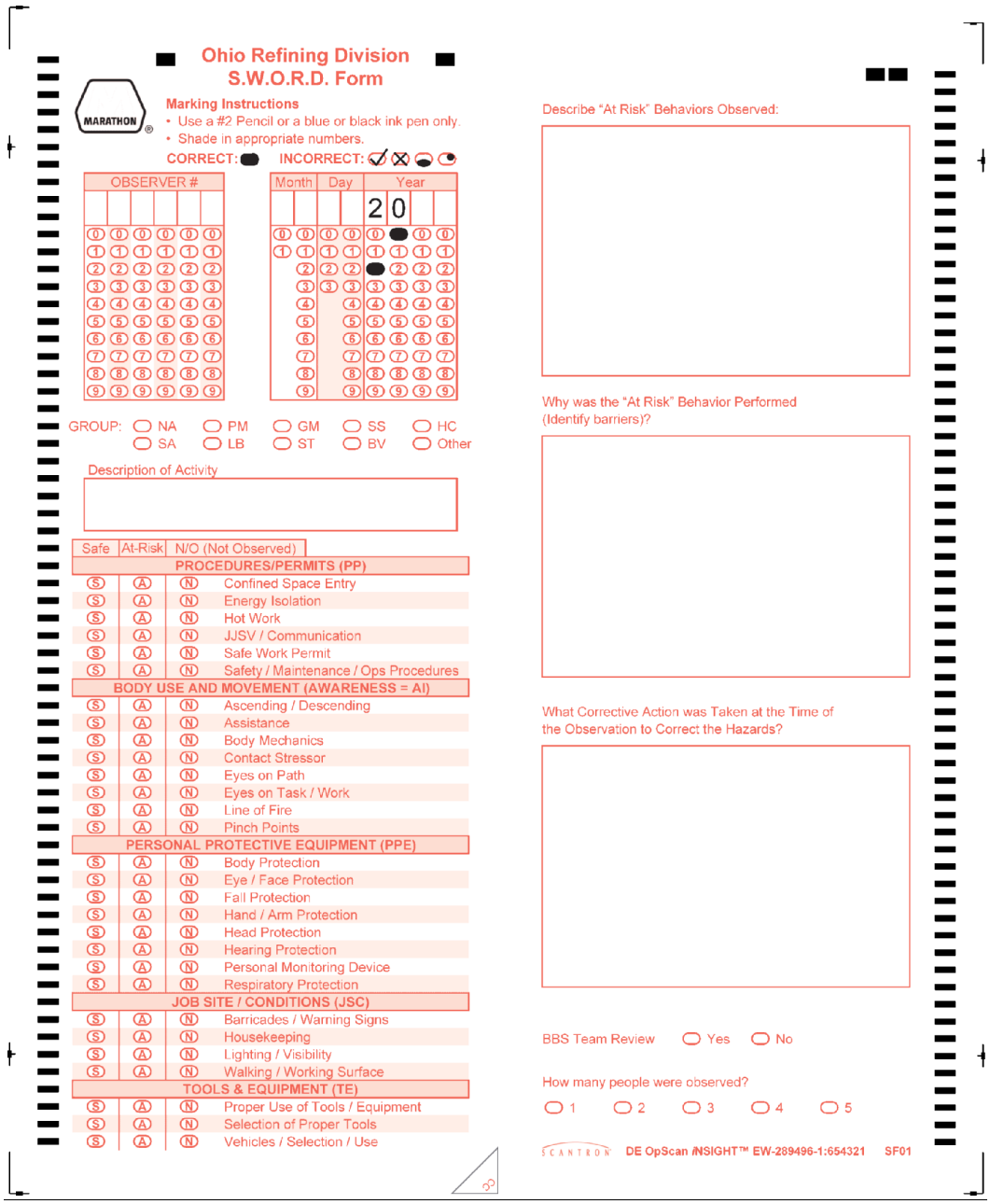
	PEOPLE	S	O	C
0.1	Ascending/Descending			
0.2	Carry/Moving			
0.3	Communication			
0.4	Eyes on Task			
0.5	Line of Fire			
0.6	Overextending			
0.7	Pace			
0.8	Pinch Points			
0.9	Push / Pull			
1.0	Twist / Turn			
	PROCEDURE	**S**	**O**	**C**
2.0	Confined Space Entry			
2.1	Energy Isolation LOTO			
2.2	Hot Work			
2.3	JSA / JHA Assessment			
2.4	Material Handling / Storage			
2.5	Permits			
2.6	Process Safety			
2.7	Sign / Labels			
	WORK ENVIRONMENT	**S**	**O**	**C**
3.9	Housekeeping			
4.0	Odor			
4.1	Proper Lighting			
4.2	Spotter			
4.3	Tripping Hazards			
4.4	Weather			

	PPE	S	O	C
1.1	Face Shield / Welding Shield			
1.2	Fall Protection			
1.3	Hand Protection			
1.4	Head Protection			
1.5	Hearing Protection			
1.6	Goggles / Glasses			
1.7	Personal Monitors			
1.8	Protective Clothing			
1.9	Respiratory Protection			
	TOOLS / EQUIPMENT	**S**	**O**	**C**
2.8	Barrier Tape / Barricades			
2.9	Condition			
3.0	Guards			
3.1	Grounding			
3.2	Hoses			
3.3	Obstructed Safety Equipment			
3.4	Process Equipment			
3.5	Proper Selection / Use			
3.6	Scaffold, Ladders, & Stairs			
3.7	Storage			
3.8	Transportation / Travel			

Comments & Barriers for all Opportunity for Improvement to be noted on back of page.

Appendix D

Refinery B Observation Card



Ohio Refining Division
S.W.O.R.D. Form

MARATHON

Marking Instructions
- Use a #2 Pencil or a blue or black ink pen only.
- Shade in appropriate numbers.

CORRECT: ● INCORRECT: ✓ ⊗ ◒ ◔

OBSERVER #

Month | Day | Year (20)

GROUP: NA PM GM SS HC SA LB ST BV Other

Description of Activity

Safe	At-Risk	N/O (Not Observed)	
			PROCEDURES/PERMITS (PP)
S	A	N	Confined Space Entry
S	A	N	Energy Isolation
S	A	N	Hot Work
S	A	N	JJSV / Communication
S	A	N	Safe Work Permit
S	A	N	Safety / Maintenance / Ops Procedures
			BODY USE AND MOVEMENT (AWARENESS = AI)
S	A	N	Ascending / Descending
S	A	N	Assistance
S	A	N	Body Mechanics
S	A	N	Contact Stressor
S	A	N	Eyes on Path
S	A	N	Eyes on Task / Work
S	A	N	Line of Fire
S	A	N	Pinch Points
			PERSONAL PROTECTIVE EQUIPMENT (PPE)
S	A	N	Body Protection
S	A	N	Eye / Face Protection
S	A	N	Fall Protection
S	A	N	Hand / Arm Protection
S	A	N	Head Protection
S	A	N	Hearing Protection
S	A	N	Personal Monitoring Device
S	A	N	Respiratory Protection
			JOB SITE / CONDITIONS (JSC)
S	A	N	Barricades / Warning Signs
S	A	N	Housekeeping
S	A	N	Lighting / Visibility
S	A	N	Walking / Working Surface
			TOOLS & EQUIPMENT (TE)
S	A	N	Proper Use of Tools / Equipment
S	A	N	Selection of Proper Tools
S	A	N	Vehicles / Selection / Use

Describe "At Risk" Behaviors Observed:

Why was the "At Risk" Behavior Performed (Identify barriers)?

What Corrective Action was Taken at the Time of the Observation to Correct the Hazards?

BBS Team Review ○ Yes ○ No

How many people were observed?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

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Vita

Danielle completed her Bachelors in psychology with an emphasis in experimental behavior analysis at the Univeristy of Nevada, Reno. Whilst persuing her Master's degree at Appalchian State she accrued a range of consulting experinece in social media, branding, action research, market/consumer research, and change management. She is the current president of the Society for Human Resource Management. Danielle has presented her research at international conferences. She has three presentations for conferences accepted for 2014-2015. Danielle plans to persue a consulting career upon graduation and is looking forward to entering the workforce.