THE COST OF PARTICIPATION: REDUCING RESPONSE EFFORT TO INCREASE PARTICIPATION AND QUALITY IN PEER-TO-PEER OBSERVATIONS

A Thesis
by
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FOREWORD

This thesis is written in accordance with the style of the *Publication Manual of the American Psychological Association (6th Edition)* as required by the Department of Psychology at Appalachian State University.

ABSTRACT

THE COST OF PARTICIPATION: REDUCING RESPONSE EFFORT TO INCREASE PARTICIPATION AND QUALITY IN PEER-TO-PEER OBSERVATIONS. (August 2012)

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Behavior-based safety (BBS) systems have shown to be effective in decreasing injury rates in industry. Typical BBS systems use a peer-to-peer observation via a critical behavior checklist (CBC) to measure the rates of safe and at-risk behavior for observed employees. A key feature of these programs is quality participation. The current study sought to test if using a shorter CBC with a few behaviors (5-8) would increase quality participation in BBS systems. No such increases were observed. Instead, results indicated that many employees did not utilize the new eight-behavior CBC. Interviews with managers on each vessel revealed that implementation methods on each vessel varied considerably. Furthermore, many employees relied on memory, rather than using a CBC. The implications of inconsistent implementation and memory reliance are discussed.

DEDICATION

I dedicate this to my fiancée, Jennifer Jenkins. Her continued support through my graduate school career has helped me succeed through this experience.

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First, I would like to acknowledge my thesis chairman, Dr. Timothy Ludwig, for his continual advice and guidance through this project. I would also like to thank my thesis committee, Dr. Shawn Bergman and Dr. Stan Aeschleman, and my research assistant, Andrew Borgione.

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The U.S. Bureau of Labor Statistics (2011) reported 4,547 work-related deaths in 2010 in the U.S. These fatalities indicated a rate of 3.5 deaths for every 100,000 full-time equivalent U.S. workers. Although the number of fatalities has not significantly changed since 2009 (4,551 work-related deaths), total lost-time injuries have steadily decreased since 2003. In addition to the social implications of severe worker injuries and deaths, many organizations may experience the increasing monetary costs related to injuries in the workplace. The Liberty Mutual Research Institute of Safety (2010) estimated the U.S. cost of injuries to be $53.42 billion in 2010, an increase of over 40% since 1998 ($37.1 billion increase). Most of these were direct costs, such as when injured employees' medical expenses were billed to the employer. Indirect costs, such as administrative time costs, increased insurance rates, lost production time, and damaged reputations, may be four times the price of direct costs (Safety Management Group, 2011). The National Safety Council (2011) estimated the combined total of direct and indirect costs to be $183 billion in 2010. They also estimated an average cost of $1.29 million per death and $61,800 per nonfatal disabling injury. These costs may escalate for uninsured employees.

The moral concerns and increasing financial costs of injuries illustrate a need for organizations to develop improvements to safety in the workplace. Many organizational safety improvements over the past decade (U.S. Bureau of Labor Statistics, 2011) can be attributed to maturing safety management systems such as incident analyses and hazard identification (Vinodkumar & Bhasi, 2010).

Safety management systems refer to the policies, procedures, and activities implemented to promote and maintain safety. For example, reporting of minor injuries and other incidents by workers allows companies to analyze risks and develop safer workplaces, processes, and practices (McSween, 1995; Sulzer-Azaroff & Austin, 2000). Traditionally, these systems focused on the use of punishment for at-risk behavior and substantial rewards for an absence of injuries. Despite admirable intentions, traditional systems may exacerbate safety issues. By overusing punishment, employees may begin to avoid the person in charge and have contempt for the process itself (McSween, 1995). Similarly, zero-injury incentives may reduce reporting behaviors if the reporting of an incident would result in voiding the reward for themselves and their peers (Agnew & Daniels, 2010; McSween, 1995). Both incentive and disincentive programs can actually discourage employees from reporting their injuries or other incidents such as close calls or witnessing others' at-risk behaviors (Geller, 1996; Geller, 2005a; McSween, 1995).

Another example of safety management systems is the incident analysis process that analyzes the events surrounding injuries in order to provide information about the causes of the incident. Unfortunately, these analyses track low frequency events (Geller, 1996). Without large numbers of incident analyses, it becomes challenging to establish trends to prevent future incidents. Also, incident analysis focuses solely on outcome measures, which refer to a response to events *after* they occur and not prevention *before* they occur (Agnew & Daniels, 2010).

In contrast, a preventative or leading indicator approach to safety focuses on changing the behaviors of workers and leaders towards establishing safer practices. Behavior refers to "*acts* or *actions* by individuals that can be *observed by others*" (Geller, 1996, p. 115, emphasis in original). When safety managers focus on safe behavior, or any behavior that positively impacts safety (e.g., wearing a safety belt or maintaining three points of contact while descending stairs), substantial decreases in injuries can occur (Agnew & Daniels, 2010).

The link between injuries and at-risk behavior has been widely studied. Reber and Wallin (1983) published one of the first studies reporting a significant negative correlation between at-risk behaviors and recordable injury rates. McSween (1995) cites one company's internal injury analyses that discovered behaviors as a primary cause of 80% - 90% of injuries. Myers, McSween, Medina, Rost, and Alvero (2010) conducted a similar analysis and found behaviors to be the leading cause of 95% of the injuries. This clear link of behavior to injuries illustrates a need for companies to focus their attention on safe behaviors.

Components of Behavior-Based Safety

Behavior-Based Safety (BBS) is an empirically validated system of maintaining safe behavior in the workplace and is based on the work of B. F. Skinner and W. Edwards Deming (Geller, 2005a). Variations of BBS have been shown to be effective in improving safe behavior (e.g., Fante, Gravina, Betz, & Austin, 2010; Grindle, Dickinson, & Boettcher, 2000; Hermann, Ibarra, & Hopkins, 2010; Komaki, Barwick, & Scott, 1978; Ludwig, Biggs, Wagner, & Geller, 2002; Ludwig & Geller, 1997, 1999, 2000; Stephens & Ludwig, 2005; Sulzer-Azaroff & Austin, 2000).

Variations of BBS usually contain peer-to-peer observations and feedback. In this method, employees observe each other's safe and at-risk behavior while on the job and record the results on a behavioral checklist. Observers then discuss the results with the employee and provide praise for safe behaviors and corrective feedback for at-risk behaviors. Behavioral checklists are then collected and analyzed to identify and correct the causes of at-risk behaviors. Peer-to-peer observations and feedback provide key advantages because they allow for individualized immediate feedback, which has been shown to generate the greatest amount of behavior change (Daniels & Daniels, 2006; Ludwig, Geller, & Clarke, 2010).

Cooper (2006) examined an employee-led safety program in a paper mill company that utilized peer-to-peer observations. Safety project teams were formed and instructed to organize the behavioral checklist, recruit observers, set goals, and provide group-level feedback to employees. The most important safety behaviors targeted by the checklist included simple behaviors (e.g., holding hand rail) and "footprints" which referred to leftover conditions that could cause safety issues (e.g., uncoiled hose on the ground). The results indicated an increase in the frequency of safe behaviors recorded on the checklist from an initial level of 49.3% to approximately 70%.

Components of the Peer-to-Peer Observation Process

Sulzer-Azaroff and Austin (2000) outlined the basic elements of BBS, which work directly into the peer-to-peer feedback process and are rooted in the basics of behavioral science. These steps include

- pinpointing behaviors,
- measuring behaviors,

- providing performance feedback, and
- reinforcing progress.

Pinpointing behaviors. Safety professionals need to first identify and define which behaviors the peer-to-peer observation process will examine. Pinpointing can be used by identifying specific, observable, and measurable behaviors which lead to safety outcomes (Agnew & Daniels, 2010; Geller, 1996; McSween, 1995). To identify key behaviors that are indeed correlated with possible injuries, safety managers should brainstorm and describe the conditions that cause hazards and behaviors that put employees at-risk as well as examine past incident analyses for behavioral connections.

Geller (2005b) recommended applying the "dead man's" test for targeting behaviors. This means that if a dead man can perform the action (e.g., failed to bend correctly) then the pinpointed behavior is not a behavior and should not be targeted. Applying this simple test allows a safety professional to identify directly observable behavior, thus leading to concrete measurements. Geller (1996) further recommended using the active term "at-risk" instead of the non-active term "unsafe." However, safety professionals should not focus primarily on at-risk behaviors. Pinpointing active safe behaviors also helps communicate with employees what a person *should do* instead of telling them *what not to do* (McSween, 1995).

Measuring behaviors. After pinpointing key behaviors correlated with injuries, behaviors have to be measured frequently and accurately (Agnew & Daniels, 2010; Geller, 1996, 2005b; McSween, 1995). The peer-to-peer observation method allows for collection of safety behavior data through employee observation (Cooper, 2009).

Based on their systematic review of the literature, Boyce and Geller (2001) advocated for the use of employee observations, as opposed to researcher observations. With this process, employees typically observe other employees while performing work. Observers watch the employee's behavior and use the performance checklist to note whether the employee performed the pinpointed safe and at-risk behaviors. Geller (1996, 2005b) refers to this as a critical behavior checklist (CBC) because it specifically targets the most important behaviors influencing safety. A CBC involves simple check boxes labeled "safe" and "at-risk." The observer uses these checkboxes to record the employee's safety performance. The CBC also allots space for further comments and elaboration (Geller, 1996; Geller, 2005b; McSween, 1995).

After collecting the data, the frequency of the behaviors is calculated. This can be done using a simple percentage of safe behaviors typically referred to as "percent safe." Typically this number is calculated by dividing the number of safely performed behaviors by the number of total behaviors observed. The percent safe information is then provided to employees as group-level feedback (Cooper, 2006; Geller, 1996).

Providing performance feedback. Observers provide immediate feedback following the observation session. Researchers frequently report the robust improvement of safe behaviors due to behavioral feedback (e.g., Fox & Sulzer-Azaroff, 1989; Komaki et al., 1978; Rhoton, 1980; Ludwig et al., 2010, Ludwig & Geller, 2000). Feedback provides information about a group or individual's performance (Agnew & Daniels, 2010; Ludwig et al., 2010). In the field of safety, simple injury rates feedback (Komaki et al., 1978) may not be the type of feedback that influences employees to change their behavior. Instead, performance feedback focusing on pinpointed safe and at-risk behaviors tends to be the most effective because it specifies the behaviors to change (Agnew & Daniels, 2010; Geller, 1996; Geller, 2005b; McSween, 1995).

In their seminal study, Komaki et al. (1978) pinpointed safe behaviors in a food manufacturing plant. Behaviors such as proper cutting technique (cut with one hand, hold object above the cut with the other hand) and the use of two people when moving conveyors were operationally defined and managers collaborated with employees to set a 90% goal for each behavior. The researchers then provided frequent behavioral feedback (three to four times a week) on the percentage of safe behaviors. After their intervention, safe behaviors increased from 70% to 99%.

Komaki et al. (1978) attributed the effectiveness of feedback to positive reinforcement, which refers to a stimulus provided after a behavior that causes the behavior to increase. Locke (1980) criticized this interpretation by claiming that the feedback cannot, by itself, serve as a reinforcer because it only provides information about progress towards a goal. More recent behavior analytic literature considers feedback as an antecedent as well as a consequence in the traditional antecedent-behavior-consequence model of behavior (Agnew & Daniels, 2010; Mayer, Sulzer-Azaroff, & Wallace, 2012). Agnew and Daniels (2010) suggested that feedback needs to describe specific behavior the employee can directly control. Feedback provides information, usually with oral communication, written text, or graphic data, to groups or individuals based on recent performance and can serve as a prompt to direct the desirable behavior (Ludwig & Geller, 2000). Additionally, positive feedback can serve as social praise and, thus, function as a reinforcer (Geller, 2005b).

Within peer-to-peer feedback systems, observers discuss the employee's performance directly after the behavior occurs. This allows for immediate feedback which has been shown to be effective in many situations (Agnew & Daniels, 2010; Daniels & Daniels, 2006; Geller, 1996; Ludwig et al., 2010). For example, Goomas and Ludwig (2009) utilized electronic performance monitoring to set goals and provide immediate feedback to employees to significantly increase distribution production in a warehouse setting.

The peer observation process also has a demonstrated effect on those volunteering as observers. Alvero and Austin (2004) and Alvero, Rost, and Austin (2008) showed that subjects who observed proper lifting behaviors in others increased their own proper knee bending and back posture when lifting. This finding is consistent with Ludwig and Geller (1999), who asked pizza deliverers to record the license plate numbers of other drivers on community roads whom they witnessed using safety belts. The deliverers increased their own belt use by 32% while participating in this community program. Ludwig and Geller elaborated further on this effect by distinguishing between “agents” and “targets.” While participants (people being observed) are the targets of change, the agents of change (people recording license plates) are involved in the intervention. In a peer-to-peer feedback process, employees constantly function as both participants and agents of change, therefore leading to a higher emphasis on safe behavior.

Group aggregated feedback has been associated with changes in individual behavior but does not provide specific information to individual employees. Feedback is more effective when provided at the individual level (Daniels & Daniels, 2006). Ludwig et al. (2010) implemented group feedback in two pizza delivery stores and then added individual feedback in a second phase of the study. Drivers who initially improved their turn signal use in the group feedback phase did not continue to improve in the individual feedback phase. In contrast, those who did not improve in the initial group feedback stage showed substantial improvement in the individual feedback stage. These findings suggest that individualized feedback may be required to influence certain segments of a population who are unaffected by group-level feedback.

Reinforcing progress. Once the process has been initiated, managers should reinforce the progress of the program. Geller (1996) recommended strengthening the feedback process by using visual feedback via charts. Feedback charts usually display group behavioral trends (e.g., group wide percent safe) to employees each day, week, or month, and inform employees on how they performed (Geller, 1996; McSween, 1995). For example, if a safety manager displayed high percent safe data for proper lifting technique (e.g., bending from the knees, using two hands, asking for help) for the entire group, then this may be a reinforcer for the safe behavior. Furthermore, the process should remain focused on the reinforcing of safe behavior as opposed to punishing at-risk behavior (Geller, 1996; Mayer et al., 2012; McSween, 1995). Additionally, managers can use this temporal trend of specific behaviors to chart progress and fluctuations in safety performance. It may also lead to pro-safety interventions such as training, increased observations of the behavior, and emphasis in safety meetings (McSween, 1995).

Management behaviors also reinforce the process. Without involvement of the management, BBS initiatives will likely fail (Geller, 1996; McSween, 1995). Employees need guidance and direction at first or they may see it as “just another unenforced rule” from management and will likely stop participating in the process. For example, Cooper (2006) examined the effect of managerial support on overall safety performance, such as percent safe behaviors. He found that managerial support positively correlated with the overall percent safe of the group.

Graphically displayed data also allow for evidence that the BBS process is progressing as designed and is being monitored by employees and management. In addition to reinforcing safe behavior, group feedback also reinforces participation in peer observations (Geller, 2002). Because of the immediate and contingent nature of the one-on-one feedback during an observation, it represents the most important part of the process. Low quality observations do not inform employees about their safety behaviors which leads to less overall feedback (Dagen, Alavosius, & Harshbarger, in press). Process feedback may not only increase voluntary participation but it may also motivate employees to create more comprehensive CBCs for further analysis. In addition, more employees may actively seek to be observed and to receive feedback.

Participation and Quality in BBS Observations

The success of BBS programs depends on participation in the observation process (Geller, 2002) because it increases the frequency of the individualized peer-to-peer feedback and provides more data to be analyzed (Cooper, 2006). Indeed, Cooper (2009) conducted a meta-analysis on design factors of BBS systems and found that the most behavior change occurs with daily or intermittent (two to three times a week) observations as opposed to weekly observations. If more employees participate in the BBS process, then more observations occur, more feedback is provided, more data is available for analysis, and the ability to reduce injuries is maximized. Myers et al. (2010) found a negative correlation between participation in BBS programs and worker compensation claims, meaning that as participation increases, worker compensation claims decrease.

High-quality observations allow for more accurate analysis. Quality observations have been operationally defined as the frequency of comments written on the CBC and the number of words in each comment (Dagen et al., in press). More frequent and detailed comments allow observers to better elaborate on the observed behaviors. Quality observations can also refer to how often the observer noted at-risk behavior. Minimal indications of at-risk behavior could demonstrate fake reporting (also known as "pencil-whipping") by the observer (Cooper, 2006). Without high-quality observations, the one-on-one feedback will not reflect accurate conditions and the effects of the process may be mitigated.

Dagen et al. (in press) strengthened participation and quality of observations by delivering feedback to employees in three areas of a petroleum refinery on the number of observations conducted over the previous week. Employees were required to conduct behavioral observations on their fellow employees, but many employees did not participate in the process. Observations also lacked quality, which the authors defined as the number of observations with comments and the number of words for each comment. During weekly safety meetings the safety coordinator delivered feedback on observation counts, praised employees for improving participation that week, and addressed comments listed on observation cards. Their results showed substantial increases in employee participation during the intervention with the three areas of the refinery showing 448%, 233%, and 33% increases over baseline. Significant increases in comments also occurred during the feedback intervention.

Limiting the Cost of Participation

The personal interaction between peers is usually described as reinforcing enough to increase future interactions and can be self-sustaining (Cooper, 2006). However, many companies report having challenges getting employees to sample the observation and feedback process the first few times (Ludwig et al., 2002). This would suggest that, initially, the immediate negative consequences of participation (e.g., lost time at work) are stronger than the immediate positive consequences of participation (e.g., informative peer interactions) (Agnew & Daniels, 2010; Daniels & Daniels, 2006). Many punishing consequences are present when employees engage in observations. For example, untrained employees may experience awkward communication during the immediate feedback step in the observation process. To address all of these issues, observers need proper training in order to perform successful observations. The training of observers usually includes basic communication skills and proper methods for delivering constructive feedback. Training should also teach observers to focus more on the employee's safe behavior (Geller, 1996, 2005b; McSween, 1995). A lack of emphasis on positive feedback could lead to confrontational feedback sessions.

Alternatively, the act of doing an observation and providing feedback may represent a response cost (Mayer et al., 2012) that may hinder the employee's participation in BBS. The loss of time to engage in other activities may serve as another punisher of participation and quality. In addition to conducting observations, employees have many other tasks to perform while at work. Taking time from the day to conduct an observation can increase the likelihood of a missed deadline and a boss's criticism. While safety observations can lead to a safer workplace and fewer incidents, these consequences are not immediate and, therefore, are less effective (Agnew & Daniels, 2010; Daniels & Daniels, 2006). The punishing consequence of lost time for conducting an observation is more powerful because it is immediate.

A CBC with a large number of behavioral categories increases the amount of time taken to complete the observation. Consequently, reducing the amount of time and effort the CBC requires will reduce the punishing response costs and potentially lead to an increase in quality participation, especially when other reinforcing consequences are in place (e.g., good feedback session, praise from safety managers, points for reward system). Because the behavior requires less effort, employees may be less likely to rush through the observation, resulting in higher quality.

Based on this assumption, shortening the CBC could reduce the cost to participate in the program thus increasing the likelihood of completing a CBC. Indeed, Geller (1996) argued that a longer CBC would discourage participation in the process. McSween (1995) advised shortening the CBC by only targeting behaviors which directly correlate with safety outcomes, occur frequently, and are easily observed. Many have advocated for the use of shorter CBCs (Daniels & Daniels, 2006; Geller, 1996; Geller, 2005b; McSween, 1995) yet there is a paucity of empirical investigation in behavioral safety research focusing on CBC length.

Geller (2002) argued that employees use a cost benefit approach when deciding whether to participate in the BBS process. Geller refers to the motivational theory of outcome expectancy (Vroom, 1964) which suggests that, in order to increase effort, employees must believe that their effort will lead to improved performance, their performance will lead to positive outcomes, and these outcomes will be desirable and valued by the employee. If participating in an observation requires a high amount of effort, then employees will be less likely to engage in the behavior.

Survey development literature has demonstrated that length is a factor related to response rate (e.g., participation on surveys) and quality of completion within business settings. Yammarino, Skinner, and Childers (1991) conducted a meta-analysis of 115 studies and found that shorter surveys significantly increased the response rate on surveys. Increased effort to complete a survey among respondents may interfere with their likelihood to complete surveys (Bednar & Westphal, 2006; Greer, Chuchinprakarn, & Seshadri, 2000). Greer et al. (2000) sent a survey to employees in different work settings and asked them how likely they would be to fill out a survey with varying numbers of pages and questions. Their results indicated that respondents significantly preferred the shorter length surveys of five questions. In a more experimental design, Bednar and Westphal (2006) sent three questionnaires to business executives and found the length of the survey significantly predicted the number of responses to the survey, with the shortest version (7 minute completion time) performing the best over longer versions (10 and 17 minutes). The authors also found that higher quality (length of responses by participants) responding occurred with the shorter surveys. They theorized that longer surveys cause employees to rush through completion, which would reduce quality and even facilitate illusory observations. Galesic and Bosnjak (2009) tested the effects of an internet survey length on participation in the survey and quality of responses (length of responses). Longer tests of 20 and 30 minutes led to less participation in the survey and less completion of the survey than shorter tests of 10 minutes. Moreover, longer tests led to faster and shorter responses for questions towards the end of the survey. Respondents seem to not want to start longer surveys, and if they do, they finish them quickly without consideration for quality.

Miller's (1956) well-known research on the capacity of our working memory found that humans can only hold 7 plus or minus 2 chunks of information at one time. His seminal work has been verified many times by others (Kareev, 2000; Shiffrin & Nosofsky, 1994). This 7 plus or minus 2 finding suggests that observing 7 plus or minus 2 behaviors would prove easier because of working memory capacity. While conducting an observation, the observer needs to remember behaviors listed on the CBC while watching his or her peer employee. Because employees have a limited working memory capacity, it is unlikely that each behavior will be reviewed with the same quality. Additionally, attending to a number of behaviors beyond the limits of human capacity would require increased effort such as looking frequently at the CBC which further reduces the likelihood of the participation.

Based on the research supporting higher response rates and higher response quality, the current study's purpose was to examine the effect of a shortened CBC on participation in peer-to-peer observations and on the overall quality of the CBC. Originally, the host company used a long, 18-behavior CBC for observations. During the intervention, a new, eight-behavior version of the CBC was introduced to the employees. The shortened CBC should require less effort for completion; thus, making it less punishing and allowing more time for quality reporting. Participation (i.e., the number of cards turned in and the percentage of employees turning in cards) and quality (e.g., number of words on comments, number of at-risk behaviors identified) were expected to increase due to the reduction of required effort and the increased specificity of the shortened CBC.

Method

Participants and Setting

This study examined the impact of a shortened CBC intervention using 191 off-shore employees working for a geophysical exploration company on three separate seagoing vessels. The company gathered marine floor geological information in order to locate potential off-shore oil for client companies. Seagoing vessels trailed streamers (long cables) just under the ocean surface. Sonar emitting machines, called "guns," were attached to the streamers and shot sonar waves to the ocean floor that would penetrate the sea floor and bounce back to the streamers. After processing the gun and streamer information, the resulting maps would be sold to oil companies in order to find potential places to drill.

Each employee on every vessel had a specific job positions and varying tasks associated with each role. Employee tasks were divided into two categories: seismic and maritime. Seismic employees maintained and organized the guns and collected and organized seismic data. Maritime crew employees were involved in the general upkeep of the vessel such as propulsion, navigation, meal preparation, and sanitation. See Table 1 for more detailed task descriptions. This study was approved by Appalachian State University's Institutional Review Board (Appendix A).

Vessels

Three target vessels (i.e., Vessels A, B, and C) received the experimental intervention, which was the implementation of the shortened CBC. They were selected via stratified sampling on the basis of overall safety performance in order to include high performance (Vessel B), average performance (Vessel A), and low performance (Vessel C). On-shore health, safety, environment (HSE) managers based these standards on the performance of preventative activities such as the rate of hazards reported, rate of safety performance observations (i.e., “leading indicators”), and counts of safety incidents after they occurred (i.e., “outcome measures”) including rates of incidents and quality of incident analyses (i.e., thoroughness of the causal analysis of injuries).

All operational and BBS processes were similar on all the vessels investigated in this study. Each vessel towed similar numbers of streamers, which also meant that the average number of people on each vessel was similar. Two of the vessels, Vessels A and C, were comprised of four rotating crews who overlapped with each other. Each crew worked for approximately five weeks, but the rotations were staggered. Vessel B was comprised of two working crews who rotated and did not overlap. At the conclusion of a five week trip, Vessel B would dock and a new crew would board.

Baseline BBS Process

The host company began instituting its BBS system approximately two years and eleven months before the intervention occurred. A committee of safety managers collaborated with a behavioral safety consulting company to pinpoint 18 behaviors to include on the CBC and to develop the overall process. These original 18 behaviors were selected through a causal analysis of the past 25 injuries from each vessel participating in the BBS process (Table 2).

A group of trainers implemented the baseline BBS process by conducting one-day training on all the five week shifts of each vessel. By providing training to each shift, they were able to train every employee on the process. Trainers taught the importance of assessing safety behaviors and providing behavioral feedback to peers. Then, they displayed company statistics on the causal factors of incidents. Trainers explained the process of behavioral observation and had employees complete an observation while watching a video. Finally, trainers ended with an in-depth description of the recognition process and an analysis of the data. Following training, employees and on-board HSE managers received supplemental material. This supplemental material, along with on-the-job training, allowed for training of new employees hired after the original vessel-wide training. On each vessel, an eight-person steering committee was assigned to manage the BBS process which included encouraging the observation process, collecting data, compiling of incident reports, heading crew-wide safety meetings, coordinating celebrations and rewards, and handling safety suggestions.

The main focus of the BBS process included voluntary peer-to-peer observation and feedback which required employees to serve as observers of peer behaviors. Employee observers were instructed to ask employees for permission before observing. After receiving permission, observers assessed employee's safe and at-risk behaviors for approximately ten minutes. Then, the observers would record their findings on an 8.5 by 11 inch paper CBC with 18 pinpointed behaviors (see Appendix B). The observer would rate each behavior as "excellent" (safe) or "concern" (at-risk). The CBC included demographic information such as name of the observer, date, time, location (vessel and area), and the task observed. Recording of the observer's name allowed for individual tracking of the observers, however, the observee's name was never recorded. The bottom of the CBC included a section for comments (e.g., positive observations, concerns, and further suggestions) and definitions of each behavior were also included on the back of the page (see Table 2).

After completion of the observation, the observers discussed the employee's behavior by citing specific examples. Observers were instructed to provide mostly praise for safe behaviors as opposed to mostly focusing on corrective feedback for at-risk behaviors. After each observation, employees could enter their own data into the data management system.

Employees were required to complete one observation during each five week shift, but were encouraged to complete more. No punishers occurred if employees failed to meet the goal. However, a point system was instituted to reinforce various participatory behaviors including submission of quality observations, participation in the steering committee, completion of a quality hazard report, and completion of any improvement suggestions. Employees redeemed their points at the end of their shifts for various prizes of their own choice including backpacks, food, or donations to charity. Additionally, from time to time the steering committee subjectively selected the employee with the highest quality observation by checking for full completion and examining comments. These employees were recognized for their accomplishments and given an award. The award generally consisted of backpacks or other items for use on the vessels.

Dependent Variables

Study variables were transcribed from an archive gathered from software used by the company to record and analyze BBS and other safety data. The system allowed for input of many events such as behavior observations, injuries, and near misses. Any employee on a vessel could conduct observations, and could also input his or her observation into the data collection software. Input of the data usually occurred within a few days of the recorded event. Once the steering committee entered the data, the software allowed for retrieval of different reports based on the specified time period.

For the purposes of this study, data were transferred from the company's database to a separate database that included each employee's name from each shift on all three vessels based on vessel manifests from their voyages. These manifests did not include maritime employees, so they were not included in the overall analysis. In order to ensure confidentiality, employee names were coded into confidential identification numbers on the research database. At the end of the project, all documents containing employee names were destroyed and access to the company database was stopped.

Participation. The primary dependent variable for this study was the amount of participation in the peer-to-peer observation and feedback process. These data were calculated by counting the number of observation cards turned in per employee over each of their five week shifts. Additionally, participation was assessed as the percentage of those who performed at least one observation (percent participation).

Quality. The quality of observations on observation cards constituted a second dependent variable. Based on Dagen et al.'s (in press) scoring scheme, quality was measured as the average number of words written in the comments. The comments included all of the words written on the comments section of the observation card. Comments were assessed manually by reviewing the comments on each observation over the study period and noting the number of words in the comments.

Dagen et al. (in press) defined an additional measure of quality as the percent of at-risk behaviors (which the company labeled as "concern") identified by employees. The data collection software of the company allowed for a report to be generated which listed the number of times behaviors were listed as safe and at-risk.

Inter-rater reliability. In order to assess the reliability of the data collection process, this study used an inter-rater method. The reliability of participation and quality variable transformations were assessed on 37.5% of CBC transformations via two independent researchers (primary and secondary). The two researchers did not collaborate during the transformations. The reliability data were calculated by correlating the data from each of the spreadsheets gathered by each researcher. Correlations above .80 were considered reliable. Results of the reliability check showed a 1.0 correlation for the number of observations, and a .99 correlation for the number of words in the comments. Only the primary transformer's data was used for further analysis.

Experimental Design

The baseline BBS process utilized an 18-behavior CBC to track employee behavior. The intervention of this study changed the CBC to a shorter, eight-behavior form. The impact of the new, shorter CBC on crew participation and the quality of observations were assessed on three experimental vessels using a within groups design. The baseline and intervention phases consisted of two full shift rotations for the various crews. Due to the differing rotation schedules for each vessel, a natural multiple baseline occurred when each vessel received the intervention.

The length of data collection varied by individual vessel. On average, pre-intervention variables were collected from archival data 20 weeks before implementation of each vessel's intervention. Vessels A and C received the intervention first, and Vessel B received the intervention eight days after Vessels A and C. Data were collected for approximately 20 weeks after the onset of the intervention. Vessel A was examined for 268 days (38 weeks, 2 days), Vessel B was examined for 255 days (36 weeks, 3 days), and Vessel C was examined for 275 days (39 weeks, 2 days).

Intervention

Steering committees on each vessel were required to conduct a causal analysis of any event associated with a recordable injury and to select a contributing behavior from the 18-behavior CBC. These incident reports on 3.5 years of recordable injuries for all marine vessels in the fleet were analyzed by the on-shore HSE manager and by members of the steering committees. If the steering committees did not complete a report on the recordable injury, then a post-hoc causal analysis was conducted. For each report, all contributing safe and at-risk behaviors (e.g., improper body mechanics, failure to maintain three points of contact) were identified and recorded into a spreadsheet. Behaviors were then ranked based on the total number of injuries by summing their rankings per year and dividing by the number of years (four; half-year counted as one). The eight behaviors with the highest overall rankings (see Table 3) were then used in the shortened CBC.

On the new CBC, definitions of each behavior were moved to the front of the sheet and comment blanks were moved to the back (Appendix C). The CBC was physically reduced to one third of a standard 8.5 by 11 inch sheet of paper. Three columns were added in between the behaviors and the corresponding definitions. The first column (FEEDBACK) was for employees to note whether they wrote any comments about that specific behaviors checked. The next two columns (EXCELLENT and CONCERNS) were for the employees to check if the observed behavior was safe (excellent) or at-risk (concern).

The corporate marine HSE manager sent an email to the on-board HSE manager of each vessel (Vessels A, B, and C) at the start of a five week shift. The email informed on-board HSE managers that they had been selected to try the new CBC. It described the general reasoning for the reduction of the number of behaviors (e.g., human memory storage capacity). A brief clarification for how to use the new CBC was included in the email. To prevent the exclusion of potentially important behaviors, the email did inform employees to note behaviors, other than the targeted eight, if necessary. The point system and one-per-shift requirements for observation participation were not mentioned. Upon receiving the email (Appendix D), HSE managers were told to remove the old CBCs from the bins and to replace them with the new eight-behavior CBCs. While the HSE managers encouraged the use of the new CBC, the company's database system, where the employees would enter the data, could not be changed to reflect the new CBC. Therefore, the input screen for the database still listed all of the original 18 behaviors.

The implementation of the new CBC was confirmed by the vessels via email after the CBCs were replaced. Confirmation from Vessel A came two days, Vessel B came seven days, and Vessel C came four days after the initial email. To ensure every crew received the intervention, another email was sent during the next rotation on each vessel. On Vessel A and C this occurred 2.5 weeks after their first intervention, and on Vessel B this occurred 5 weeks after their first intervention.

Results

A total of 191 employees were present in the database. Because the crew manifest did not list maritime employees, they were excluded from the analysis. For individually tracked variables, a listwise deletion method was used. This method ensured that the analysis included only employees present in all four phases. After deletion, the dataset included 112 participants who were present in all four phases of the analysis including 37 from Vessel A, 34 from Vessel B, and 41 from Vessel C. Throughout the entire collection process, employees completed a total of 945 observations including 381 from Vessel A, 230 from Vessel B, and 334 from Vessel C.

Each phase of the analysis included one full rotation on a vessel. A full rotation meant that all workers of every shift rotated through their five week schedule. For example, Baseline 1 on Vessels A and C included all four of their shifts (i.e., shift A, B, C, D). For Vessel B, Baseline 1 included their two shifts (i.e., shift A, B). The other phases (i.e., Baseline 2, Post-intervention 1, Post-intervention 2) included a full rotation as well.

Participation

The average observations per employee were calculated by counting the number of observations for each employee and dividing by the total number of employees. If an employee's name was on the voyage manifest but no CBC observations contained the name of the employee, then the employee was assumed to have completed no observations for that rotation.

Initial analysis compared mean-level changes from baseline to intervention. Overall, the mean number of observations per person decreased from 2.12 (*SD* = 1.43) to 2.10 (*SD* = 1.58). Results varied for each vessel (see Figure 1). The mean number of observations on Vessel A showed little change in the mean number of observations between baseline, 2.58 (*SD* = 1.91), and intervention, 2.57 (*SD* = 1.99). The mean number of observations for Vessel B decreased between baseline, 2.03 (*SD* = .91), and intervention, 1.35 (*SD* = .75). This change represented a 33.50% decrease in the mean number of observations. The mean number of observations for Vessel C showed an increase in the mean number of observations between baseline, 1.77 (*SD* = 1.18), to intervention, 2.30 (*SD* = 1.48). This change represented a 29.94% increase from baseline.

To further assess the change in the average number of observations per person through the baseline and intervention phases, a mixed 4 (within: Baseline 1, Baseline 2, Post-intervention 1, Post-intervention 2) x 3 (between: Vessels A, B, and C) factorial ANOVA was used. There was no significant main effect for phase, $F(3, 327) = 2.39$, $p = .069$.

To examine the differences between vessels for each phase, the interaction between the two was examined. This interaction between vessel and phase was significant, $F(6, 327) = 4.72$, $p < .001$. This means that the phase of the study had different effects on each of the vessels. Within-group contrasts showed a significant interaction between vessel and phase when comparing Baseline 1 to Baseline 2, $F(2, 109) = 4.19$, $p = .018$. Figure 1 shows that this significant effect reflects a difference between Vessel B's Baseline 1 (*M* = 2.41, *SD*=1.33) and Baseline 2 (*M* = 1.65, *SD* = 0.85). This interaction most likely resulted from the difference between Vessel A's Baseline 1 (*M* = 2.84, *SD* = 2.14) and Baseline 2 (*M* = 2.32, *SD* = 2.00) There was no significant interaction when comparing Baseline 2 to Post-intervention 1, $F(2, 109) = 3.79$, $p = .163$, nor was there a significant interaction when comparing Post-intervention 1 to Post-intervention 2, $F(2, 109) = .728$, $p = .774$.

To assess the overall percentage of participation, reports were compiled for each five week rotation and employees were counted to see how many employees performed at least one observation per rotation. Percentages of observations were aggregated by phase (Baseline 1, Baseline 2, Post-intervention 1, Post-intervention 2), dividing the number of employees who performed at least one observation by the total number of employees required to observe, and then multiplying by 100. Overall, these results showed no changes from baseline to intervention. The overall participation percentage decreased from 83.48% at baseline to 80.80% after intervention, representing a 3.21% decrease. The participation percentage varied considerably by vessel as expected because of the stratification based on performance (Figure 2). Vessel A's participation percentage decreased from 77.03% at baseline to 74.32% after intervention, representing a 3.51% decrease. Vessel B's participation percentage decreased from 95.59% at baseline to 85.29% after the intervention, representing a 10.77% decrease. Vessel C increased from 79.27% in baseline to 82.93% during the intervention, representing a 4.62% increase.

Quality

The average number of words was calculated by counting the total number of words in the comments section and then dividing by the total number of observations with comments for each employee over a rotation. If employees did not write any comments, their entry was recorded as a zero and it was included in the overall average. If employees did not perform any observations, their comments were listed as zeros.

Initial analyses examined mean-level changes in the number of words in the comments sections. Overall, the results showed no significant changes. The overall number of words in the comments section decreased from 32.49 (*SD* = 25.98) to 31.89 (*SD* = 31.04). The change in number of words varied significantly between vessels (Figure 3). For employees on Vessel A, the number of words in the comments section showed a decrease from baseline to intervention, decreasing from 26.00 words (*SD* = 19.90) to 20.65 words (*SD* = 16.03). This represents a 20.58% decrease. For Vessel B, the number of words in the comments section increased from 52.15 words (*SD* = 26.97) at baseline to 56.30 words (*SD* = 41.85) during the intervention, representing a 9.88% increase. For Vessel C, the number of words in the comments section decreased from 22.03 words (*SD* = 20.92) at baseline to 21.80 words (*SD* = 16.42).

To further assess the change in the average number of words in the comments section through the baseline to intervention phases, a mixed 4 (within: Baseline 1, Baseline 2, Post-intervention 1, Post-intervention 2) x 3 (between: Vessels A, B, and C) factorial ANOVA was used. Although a between vessels analysis was not the target of the current study, the mean-level examination indicated substantial differences between each vessel. Thus they were added to the analysis.

There was no significant main effect for phase, $F(3, 327) = 0.30$, $p = .828$, meaning that when vessels were aggregated there was no difference between any of the phases. To examine the difference between the vessels for each phase the interaction between vessel and phase was examined. This interaction was not significant, $F(6, 327) = 2.06$, $p = .058$. However, within groups contrasts showed a significant interaction between vessel and phase when comparing Baseline 1 to Baseline 2, $F(2, 109) = 4.11$, $p = .019$. Figure 3 shows that this interaction could reflect the large increase in number of words between Vessel B's Baseline 1 (M = 44.77, SD = 27.93) and Baseline 2 (M = 59.54, SD = 42.09). There was no significant interaction when comparing Baseline 2 to Post-intervention 1, $F(2, 109) = .06$, $p = .946$, nor was there a significant interaction when comparing Post-intervention 1 to Post-intervention 2, $F(2, 109) = .47$, $p = .624$.

The at-risk percentage was calculated by dividing the total number of at-risk behaviors identified by the total number of behaviors observed (i.e., safe and at-risk behaviors) and multiplying by 100. These numbers were collected as an aggregated group number across phases (Baseline 1, Baseline 2, Post-intervention 1, Post-intervention 2) and were not tracked individually. The percentage of at-risk behaviors identified was calculated for each behavior present on the new, shortened CBC. These percentages were then aggregated so a total could be assessed. The results showed no real trends for this percentage (Figure 4). On each vessel, the percentage of at-risk behaviors remained low throughout each phase of the experiment. The percentage of behaviors identified as at-risk on Vessel A decreased from 6.61% to 5.88% from baseline (aggregated Baseline 1 and 2) to intervention (aggregated Intervention 1 and 2), representing an 11.12% decrease. The percentage of behaviors identified as at-risk on Vessel B increased from 7.64% to 8.52%, representing an 11.38% increase. The percentage of behaviors identified as at-risk on Vessel C increased from 2.85% to 3.11%, representing a 9.28% increase.

Manipulation Check

The intervention email explicitly instructed HSE managers on each vessel to remove the original CBC and replace it with the new one. If the managers replaced their old CBC with the new, shortened CBC as instructed, then the percentage of the eight new CBC behaviors should have increased substantially in the post-intervention phases. Conversely, the percentage of the 10 behaviors that were on the old CBC but not on the new one should be substantially lower in the post-intervention phases because those behaviors were no longer on the checklists. All 18 behaviors were still listed on the input screen for the database, so it was still possible for employees to report behaviors that were not on the new CBC.

Percentages of new CBC and old CBC behaviors were calculated by dividing the number of times a behavior was identified by total number of behaviors identified and multiplying by 100. For example, if “stays clear of sharp objects” was identified 5 times, and the total number of behaviors identified was 100, then this would indicate a 5% identification percentage for “stays clear of sharp objects.”

These percentages for each behavior were then grouped into (a) those that were on the new CBC, and (b) those only on the old CBC. Then, the percentages were aggregated across phases (Baseline 1, Baseline 2, Post-intervention 1, Post-intervention 2). Maritime and company employees could not be separated in this analysis. Figure 5 shows a graphic representation of this result.

Then new CBC behaviors on Vessel A showed a slight decrease. Overall, the percentage of Vessel A decreased from 62.05% at baseline to 57.98% after the intervention. This represents a 7.79% decrease. The percentage of the new CBC behaviors for Vessel B increased after the intervention from 55.73% to 74.86% after the intervention, indicating a 34.33% increase. Vessel C showed no change in the percentage of new CBC behaviors identified, increasing from 55.56% at baseline to 57.84% after the intervention. This represents a 4.10% increase.

Discussion

This study examined the manipulation of the CBC length and how it relates to participation in a peer-to-peer observation system. It was expected that the shortened CBC would be completely integrated into the workforce on the target vessels and would increase participation and quality in the process. The manipulation check demonstrated an increase in the identification of new CBC behaviors in only one of the vessels. Furthermore, the overall analysis showed no major differences in participation (i.e., number of observations, participation percentage) or quality (i.e., number of words in comments, percent of at-risk behaviors identified) across baseline and intervention phases.

Individual Vessel Analysis

The results of the manipulation check on Vessel A indicated no increase in the identification of new CBC behaviors. This suggests that employees on Vessel A may not have used the new CBC even though the manager confirmed the new CBC replaced the old checklists. If the shorter checklist was not used, participation and quality would not be expected to change. Neither the number of observations nor the participation percentage changed after the intervention. After the intervention, the number of comments decreased by 20%. However, baseline comments had already been decreasing so this may have been a continuation of a trend.

The results of the manipulation check on Vessel B indicated that the vessel substantially increased identification of new CBC behaviors, indicating potential use of the checklist among employees. However, neither participation nor quality increased. A possible ceiling effect may have limited the ability for some variables to increase. The percentage of participation on Vessel B was 91% throughout the process. Consistent high performance may have also impacted the number of words in the comments section and the at-risk percentage, which remained above average throughout each phase. Vessel B did not perform above average in the number of observations. However, the substantial decrease in the number of observations on Vessel B during baseline may indicate the impact of another variable (e.g., changing location, new contract, management change).

The results of the manipulation check on Vessel C provided evidence that employees on the vessel may not have utilized the new CBC. Consequently, the results did not indicate significant changes after the intervention. Although there was a 30% increase in observations, this trend was not confirmed statistically. The percentage of employees performing an observation did not change. Quality also did not improve; neither the number of words in the comments section nor the number of at-risk behaviors changed significantly.

Differences in Implementation

The results also suggest that the implementation of the eight-behavior checklist intervention may not have been salient enough for employees to sample the new CBC and experience its potential positive outcomes. Only the employees on Vessel B substantially increased their identification of new CBC behaviors. Only Vessel B's HSE managers indicated that every employee was handed the new CBCs and that the CBC was discussed in face-to-face meetings.

In contrast, while managers on Vessels A and C verified that the new CBC was made available, their employees still recorded old CBC behaviors. Managers on Vessels A and C did send a mass email to all crew members regarding the new CBC, but they did not distribute or explain it. Without a formal introduction of the CBC, the employees never had the new CBC in their hands unless they retrieved it on their own. It is possible that some may not have known the new CBC even existed. Furthermore, the data management system continued to list all original 18 behaviors. This could further contribute to the unfamiliarity of the new CBC.

Geller (2002) noted that if employees do not know how to perform a new behavior (e.g., using a new CBC), they will be less likely to perform it. He suggested using hands-on training and demonstrations to educate employees on the targeted process. In this case, the implementation of the CBC should have been more pervasive and employees should have received uniform introduction and training instruction to allow for widespread distribution of the new CBC and knowledge of its benefits.

For example, HSE managers could have been equipped with a new training video to demonstrate the use of the new CBC. Managers on Vessel B received feedback from employees that the current DVD still outlined the procedure for the original 18-behavior CBC. After employees watched this DVD, they were told to disregard the instructions, and adhere to the new CBC. Such inconsistencies in instructions can cause confusion about the proper procedure for observations, and, according to Geller (2002), could hinder the use of the new CBC. A new DVD regarding the new CBC may have decreased this confusion about the process.

Similarly, concerns about keeping all 18 behaviors on the data collection system were discussed during the design of the intervention, but it was concluded that maintaining the previously established data collection software would not be a problem. However, HSE managers expressed struggles with employee compliance of limiting their identification of old CBC behaviors. This suggests that all the systems supporting the BBS process should be adapted before introduction of a new initiative like the CBC.

Because of the unclear communication, the absence of training on the new CBC, and the lack of consistency on the computer entry screen, employees may have never retrieved a physical CBC and used it. Therefore, they were not able experience the benefits of the new CBC. Ludwig et al. (2002) referred to this as “sampling the contingency,” meaning that individuals need to perform the behavior first in order to experience the reinforcers. Instead, employees still received continued reinforcement (via points toward the company prizes) for the use of the old checklist, and may not have acknowledged a need to change their behavior.

Reliance on Memory

The results of the manipulation check represent the most notable difference between the three vessels. Employees on Vessels A and C seemed not to use the new CBC while employees on Vessel B may have. To better understand these differences, HSE managers on each vessel were questioned via email about the results of the manipulation check. HSE managers on all three vessels indicated that many employees may not have been using any CBC (old or new) when conducting observations throughout the study. Instead, they stated that these employees relied on their “memory” (HSE Managers, Vessels A, B, C, personal communication). They suggested that employees have used the CBCs for so long that they have memorized the list. Employees may perform observations without cards and then input the information into the data collection software. During the intervention the data collection software still included the original 18 behaviors, thus employees were still able to record behaviors from the old CBC.

Regardless of CBC length, the use of memory poses broader issues in the behavioral data collection process. For example, the amount of time that passes between the observing and the recording of behaviors in the data collection system could impact the accuracy of the memory. This decay is most prevalent directly after an event occurs and quickly levels off (Copeland, Radvansky, & Goodwin, 2009; Kassin, Tubb, Hosch, & Memon, 2001; Wixted & Ebbesen, 1991). For behavioral safety observations, this trend suggests that employees using memory may forget vital information before recording the observed behavior, especially information for comments. Increased delay between the observation and the recording of the information increases the likelihood of retroactive interference, which refers to the phenomenon of newly learned information inhibiting a person's ability to remember older information (Eakin & Smith, 2012). For example, an observer walking over to a computer to input recently observed behaviors may witness another employee engaging in at-risk or safe behavior. This new information could interfere with the observer's memory of the original observation, thus decreasing the accuracy.

Similarly, the observer's recall ability would also be subject to the serial positioning effect. Specifically, this refers to the more accurate memory of items at the beginning of a series (primacy effect) and at the end of the series (recency effect; Healy, Havas, & Parker, 2000). For a behavioral observation, this means that observers remember events at the beginning and at the end of the observation, and would struggle to remember events occurring in the middle. The difficulty in remembering events in the middle of the observation could lead to observers "filling in blanks" by referring to their overall impression of the peer employee's safety patterns (i.e., the halo effect; Nisbett & Wilson, 1977).

The recording errors resulting from faulty memory could hinder the steering committee's ability to assess behavioral trends. Steering committees could still analyze data, but the conclusions drawn from the analyses would be suspect. Without a clear understanding of behavioral trends, the steering committee may make inaccurate decisions regarding safety.

Memory reliance could also greatly affect the impact of the behavioral observation process. Observers recording information on their CBC can reference their notes while providing the critical feedback to their peers at the end of an observation. When observers use memory, they may forget important information from the observation and may not discuss this in the feedback session. Without the specific feedback, employees do not have the opportunity to focus on and improve their safe behavior or correct at-risk behavior.

Memory reliance may also create a trend of observers not actually completing a true observation. When the BBS process was first initiated, employees probably used the original 18-behavior CBC. The cumbersome nature of observing 18 behaviors resulted in a high response effort for the behavior. Observers could learn to reduce response effort by relying solely on "memory" of the 18 behaviors without the use of the arduous CBC.

After a few experiences of not using a CBC, observers would quickly learn that they do not have to complete an observation card when entering information into the data management system. This could lead to two potential eventualities. First, observers may no longer conduct a formal observation and simply use their memory of a recent experience with another employee. Second, observers may resort to using a composite memory of many peers' behavior over a few days and enter a single observation into the data management system. In this case, observers would not use feedback and would rely solely on group performance. In both situations, the recorded information would be highly subject to memory deterioration and bias, as well as, a halo effect, where they would rely on their general impressions instead of actual behavior (Nisbett & Wilson, 1977). Also, no one receives feedback in these situations, negating the most important step of the observation process. Both potential outcomes, however, are reinforced by the system because they greatly reduce the response effort required to receive credit for an observation. Observers then receive points towards the reward system of the company.

This deterioration of the observation process can lead to the even more detrimental effect of pencil-whipping, when observers fabricate observation data. In this case, observers would enter observations into the data management system without having performed a single observation. This method could greatly hinder the validity of the BBS process; however, it has not been widely researched in behavioral safety.

Limitations

It is important to note two potential limitations of the research design: (a) the length of baseline measurement, and (b) the lack of control groups. The short measure of baseline hindered establishment of consistent patterns in behavior. This was especially evident in Vessel B. However, while a longer baseline assessment would better establish behavior trends, it would also create attrition in the sample of employees. The current company frequently rotated positions; therefore, few employees would have been present in every phase of the study and most would have been cut from the data analysis.

The original design of this study did include the use of three control vessels matched on the performance stratification of the three target vessels. The control vessels would have provided a comparison to a group that did not receive the intervention. The overall analysis of the target vessels did not show a significant change from baseline to intervention for any of the independent variables. Therefore, the analysis of control group data may not have provided added value to the following explanation of the data. For this reason, the control groups were not included in the current analysis.

Areas for Future Research

Because many employees may have relied on memory, instead of using a CBC, a manipulation of the CBC may not have made a difference. A more systematic analysis of policies and practices on the targeted vessels may have revealed that employees were not using the old CBCs. Thus, future researchers should verify that employees are using the existing checklist through short anonymous surveys and interviews. Ensuring the use of checklists will also help mitigate the potential issues of pencil-whipping.

Improper implementation of the new CBC represented another limitation of this study. Future researchers should make unilateral changes so that policies and procedures do not conflict with each other (Burke, 2002; Kotter, 1995). For example, if researchers manipulate a CBC, they should also manipulate the data management system to match the CBC change. This would help reduce confusion and inconsistency of the directions. Also any training material should mirror the procedure of the new CBC.

In this study, managers did not provide employees on the vessels with uniform methods of introduction and training of the new CBC, which could have caused the substantial differences in the results of the manipulation check. Future studies should ensure consistent implementation of a new CBC. For example, the old CBC should be discarded and completely replaced by the new version. Next, employees should be formally introduced to the new CBC and educated on how to use it. Actual demonstrations and practice would help further employee skills before they begin to use the new CBC. This process would also allow employees to sample the contingency, resulting in increased adoption of the change (Ludwig et al., 2002).

Conclusion

The current study examined the effect of a shortened CBC on the participation and quality of a peer observation process. The results and communication with the vessels indicated the widespread use of memory reliance as opposed to CBCs. Memory reliance demonstrates a major issue for peer-to-peer observation. It can greatly attenuate the validity of the procedure by reducing one-on-one feedback and leading to potential pencil-whipping. To decrease memory reliance, safety professionals could frequently adapt their CBCs in order to change behavioral trends. Also, requiring observers to give their completed CBCs to the members of the steering committee would provide a simple validity check of the CBCs.

Without the use of CBCs, changes in quality participation would not be expected. Before studying the manipulation of CBCs, researchers must control for the memory reliance in observation processes. Researchers should then guarantee uniform and effective implementation, including communication and training, of a new CBC. Once researchers control for these issues, then further analysis of CBC manipulation can occur.

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Table 1

Employee Positions with Descriptions

Position	Description
Mechanic and Gun mechanic	Responsible for picking up, deploying and troubleshooting the sound source. Also responsible for the lifting equipment (crane operations), straps and ropes for equipment towed in the water.
Observer	Responsible for the acquisition of the streamer data and for maintaining the data recording streamers (cables).
Engineer or Electrician	These two positions may be broken into two on larger vessels. The engineer is responsible for the engines (propulsion), generators, water treatment, sewage system, etc. The electrician is responsible for electrical equipment, lighting, wiring, etc.
Processing	Responsible for the processing of the seismic data. They will help out with streamer deployment or retrieval, loading of groceries, etc.
Deck hand	Responsible for maintenance of the vessel, painting, making sure winches for the maritime side are working correctly. They are involved in resupply of the vessel, fuel, groceries, on some vessels are the crane operator.
Navigator	Responsible for the exact positioning of the vessel. They are also responsible for the positioning of the tailbuoys, cable levelers (birds), compasses. They will be involved in the deployment, retrieval, and maintenance of the streamers. They will also be the people that will have to work aloft (at height) on navigation antennas.
Catering and galley staff	Involved in preparing crew meals and are responsible for cleaning around the vessel.
Client representative	They represent the client for the current job. They do minimal physical work, and are mainly responsible for insuring the quality of the data meets the defined standards.
Deck officers	They are the officers that stand watch on the bridge. They rank from Chief Officer, First Officer, Second Officer, and Third Officer. The Chief Officer is generally the safety officer on board for the maritime crew. The officers are over the deck crew and will spend some time working on deck daily and are the ones over resupply (fuel, groceries, etc.).

Table 2

Behaviors on 18-Behavior Critical Behavior Checklist with Definitions

Behavior	Definition
Body mechanics when lifting, carrying, reaching, or pulling	Legs bent, natural body curve, turn with whole body, not waist, and load close to body. Leverage from arms or legs, not back, not from extended reach. Push rather than pull whenever possible.
Maintain three points of contact	Hand on rungs or bars, feet on rungs. One hand and two feet or two hand and one foot on ladder or stairs. Use handrails, swing bars, all steps, and ladder runs.
Eyes on work or path	Watch hands engaged in tasks. Face and head generally pointed in the direction of travel. Not walking while looking up or reading. Walking forward whenever possible.
Pace of work or movement	Working or walking at a pace that allows planned response.
Obtain assistance	Obtain assistance when necessary to avoid strain or other risk, e.g., when lifting heavy or awkward load.
Clear of pinch points	Keep body parts from places where they might be severely cut.
Clear of sharp edges	Keep body parts from places where they might be severely cut.
Clear of "line of fire"	Work or stand out of the path of equipment that might shift, relieve pressure, move, or fall. Stay clear of ropes and equipment under tension.
Clear of hot surfaces or materials	Keep body parts from places where they might be burned. Use protective blanket when appropriate.
Selection of tools and equipment	Select designated tools and equipment for each task. Avoid substituting one tool for another, e.g., wrench for a hammer. Avoid modifying tools and equipment, e.g., using a cheater bar. Winches and reels are used for picking up and deploying equipment, cranes and winches used for hoisting and lowering loads.

Table 2 continued

Behavior	Definition
Condition of tools and equipment	Use tools and equipment with guards securely in place. Use tools in working condition, e.g., electrical cords free of fraying or splicing, wooden handles free of cracks, hammerheads free of flattening.
Standard personal protective equipment	Use hearing, eye, face protection (glasses with side shields, goggles, face shield), hard hats, steel toed, non-slip shoes, etc. in areas designated. Wear Kevlar gloves when using cutting tools. Wear designated gloves when handling solvents and other chemicals or when doing welding and electrical work, etc.
Other personal protective equipment	Wear protective clothing designated for the task (e.g., chemical suits, slicker suits, rubber boots, overalls, dedicated suits with neck seals for small boat operations in cold weather, etc.). Wear clothing that will not get caught in rotating.
Work areas free of slip and trip hazards	Remove spills and clutter from walkways and workstations.
Permit to work	This should be in place and officer on watch informed prior to working aloft or over the side, commencing hot work, working on energized systems, in enclosed spaces, in small boat operations and crane operations.
Lock-out tag-out	Block the flow of energy from a power source to a piece of equipment and keeping it locked.
Communications	When working with others, inform them of potential hazards through a common system of signals, symbols, language, or behavior.
Equipment deenergized	Equipment of all types of power (including mechanical, hydraulic, thermal, electrical, and compressed gas, water or air) needs to be deenergized. Drain lines that may be under pressure, and shut down lines before repair.
Ventilation	Maximize the circulation of air as to avoid heat exhaustion or exposure to fumes

Table 3

Behaviors on Eight-Behavior Critical Behavior Checklist with Definitions and Overall Rankings (numbers rank the behaviors on frequency of their frequency of occurrence in the causal analysis)

Ranking	Behavior	Definition
1	Standard personal protective equipment for task	Individual(s) are wearing standard personal protective equipment for the task and any additional personal protective equipment identified during the pre-job risk assessment.
2	Clear of sharp edges	All body parts are clear of places where they might be cut or cut off.
3	Work areas free of slip and trip hazards	Work area clear of spills and clutter in walkways and work stations.
4	Body mechanics - lift, carry, reach and pull	Legs bent, natural body curve, turn with whole body, not waist and load close to body. Leverage from arms or legs, not back, not from extended reach. Push rather than pull whenever possible.
5	Clear of pinch points	Body parts are clear of places where they might be pinched, e.g., when freeing jammed equipment or frozen bolts. Fingers clear of doors, lids and covers.
6	Obtain assistance	Obtain assistance when necessary to avoid strain or other risk, e.g., when lifting heavy or awkward loads.
7	Eyes on work or path	Watch hands engaged in tasks. Face and head generally pointed in the direction of travel. Not walking while looking up or reading. Walking forward whenever possible.
8	Selection of tools and equipment	Select designated tools and equipment for task and used as designed. Avoid substituting one tool for another, and avoid modifying tools and equipment.

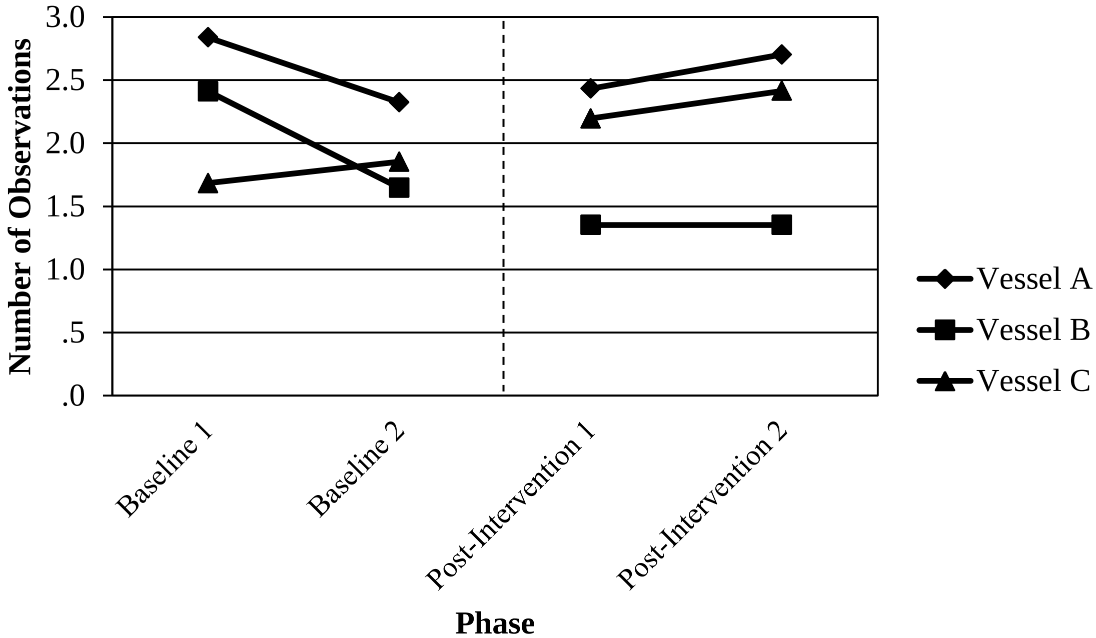

Figure 1. This figure shows the average number of observations per person separated by vessel. The dotted line represents the intervention.

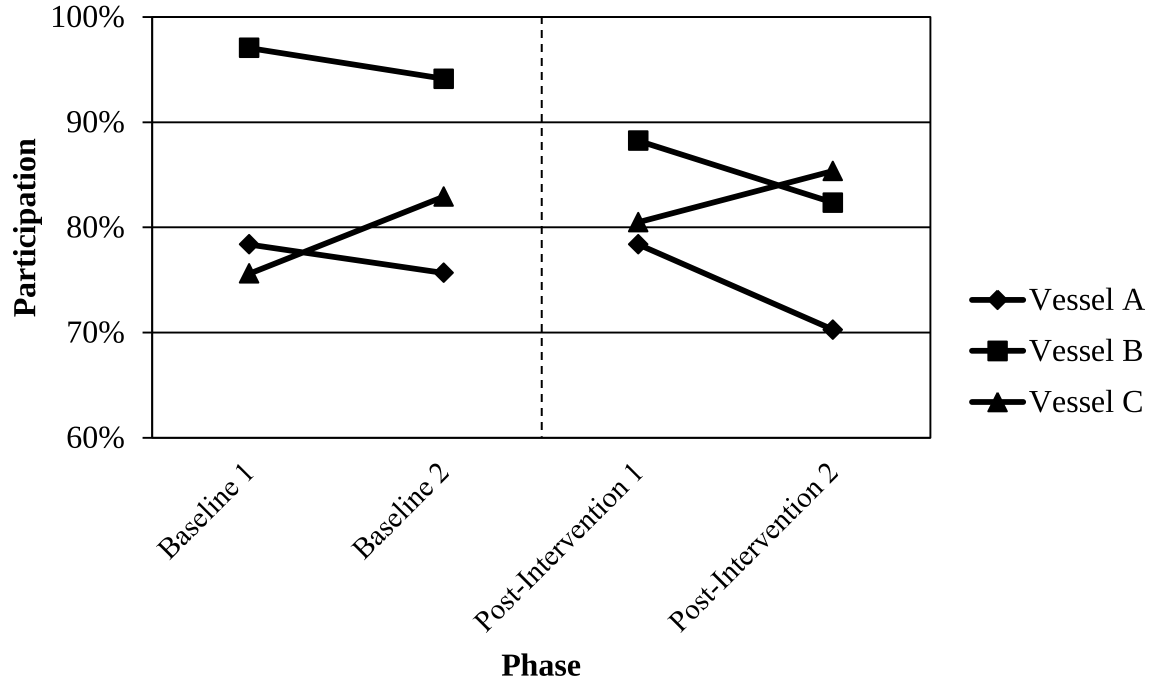

Figure 2. This figure shows the participation percentage for each vessel. The vertical dotted-line illustrates when the intervention occurred.

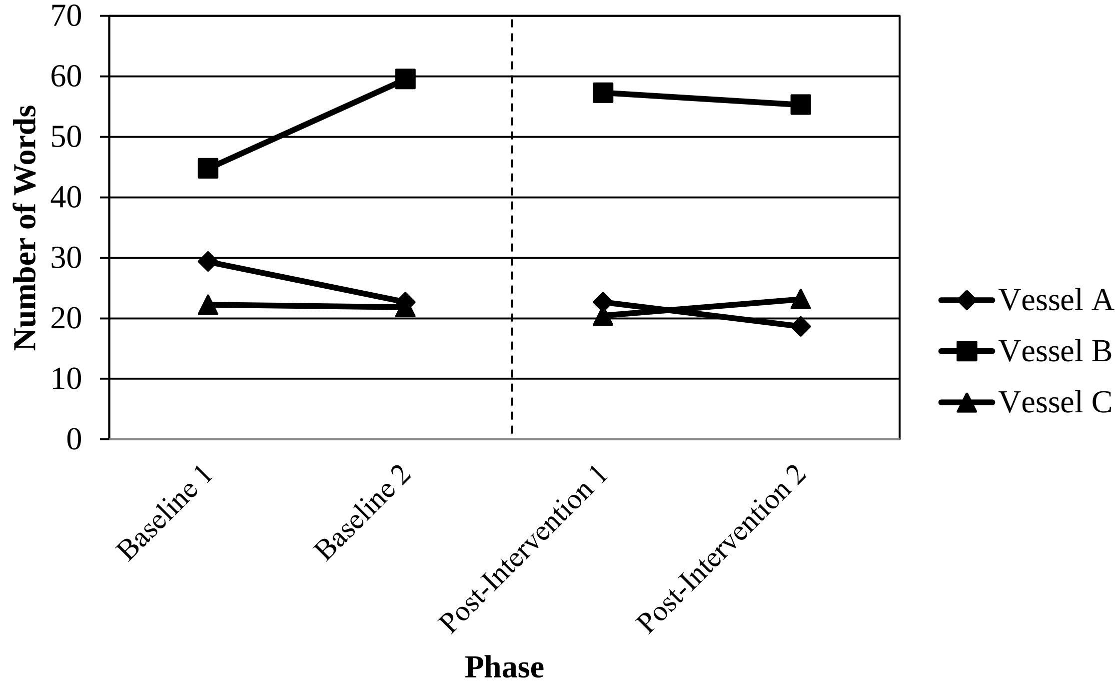

Figure 3. The figure shows the number of words on comments per person separated by Vessel. The dotted line represents the intervention.

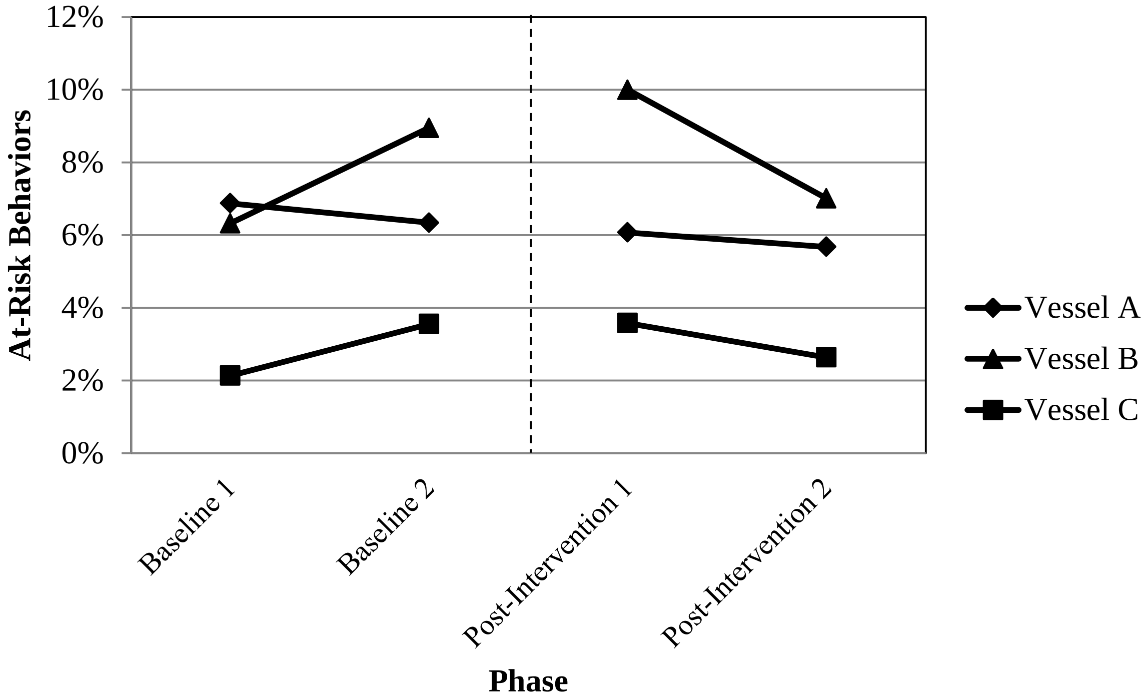

Figure 4. This figure shows the percentage of at-risk behaviors identified for each vessel throughout each phase. The vertical dotted-line illustrates when the intervention occurred.

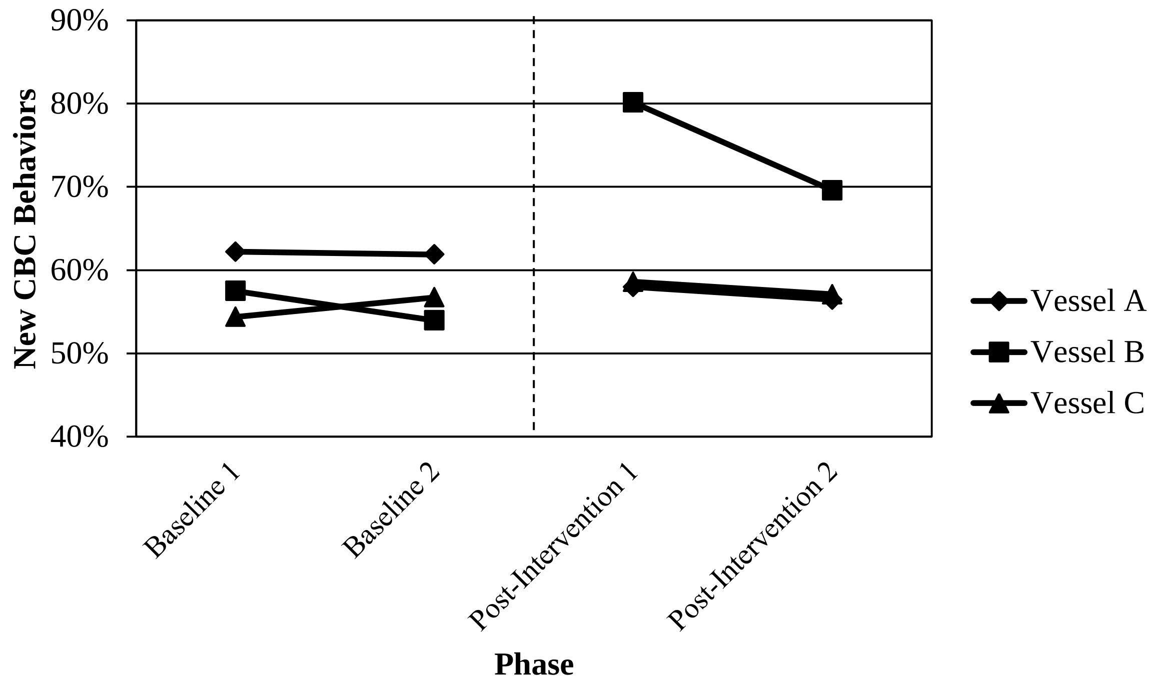

Figure 5. This figure shows the percentage of the new critical behavior checklist behaviors identified for each vessel throughout each phase. The vertical dotted-line illustrates when the intervention occurred.

Appendix A

IRB Approval Notice.

To: Michael Boitnott

Psychology

From: Dr. Stan Aeschleman, Institutional Review Board Chairperson

Date: 1/11/2012

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)

Study #: 12-0136

Study Title: THE COST OF PARTICIPATION: REDUCING RESPONSE EFFORT TO INCREASE PARTICIPATION AND QUALITY IN PEER-TO-PEER OBSERVATIONS

Submission Type: Initial

Expedited Category: (5) Research Involving Pre-existing Data, or Materials To Be Collected Solely for Nonresearch Purposes

Approval Date: 1/11/2012

Expiration Date of Approval: 1/09/2013

This submission has been approved by the Institutional Review Board for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Appendix B

Original critical behavior checklist from the company.

TASK OBSERVATION PROCESS

Observer's Name:		Date:		Time (local):	

Location of Observation: (vessel and area)		Task Observed:	

1. **Observations**: *1. Ask permission of individual(s) being observed to conduct observation. 2. Check if excellent or concern. 3. Note positive observations and concerns. 4. Show the form to individual(s) being observed. 5. Discuss what was done well and any concerns. 6. Are there any recommendations to improve safety on board?*

Body Position/Ergonomics	Excellent	Concern	Personal Protective Equipment (PPE)	Excellent	Concern
Body mechanics when lifting, carrying, reaching or pulling			Standard Personal Protective Equipment for task		
Maintain 3 points of contact			Other PPE		
Eyes on work or path			Work Conditions/Housekeeping		
Pace of work or movement			Work areas free of slip and trip hazards		
Obtain assistance			Permit to work and Lock-out Tag-out		
Clear of pinch points			Communication		
Clear of sharp edges			Equipment de-energized		
Clear of "line of fire"			Ventilation		
Clear of hot surfaces or materials			Tools & Equipment		
			Selection of tools and equipment		
			Condition of tools and equipment		

2. **Feedback**:

Positive observations

Concerns

Suggestions/Additional Comments Related to Task Observed

3. **Action points**:

Proposed actions	Immediate Action taken (Y/N)	Long term action to enter PRISM (Y/N)
1.		
2.		

Appendix C

Intervention critical behavior checklist.

Front

TASK OBSERVATION PROCESS CHECKLIST

Observer Name	Date	Time (local)
Location of Observation	Task Observed	Data input to Prism? YES / NO

Nbr BEHAVIOR	✓	✓	✓	
01 Standard PPE for task	F	E	C	Individual(s) are wearing standard personal protective equipment (PPE) for the task and any additional PPE identified during the pre-job risk assessment.
02 Clear of sharp edges	E	X	O	All body parts are clear of places where they might be cut or cut off.
03 Work areas free of slip and trip hazards	E	C	N	Work area clear of spills and clutter in walkways and work stations.
04 Body mechanics - lift, carry, reach and pull	D	E L	C	Legs bent, natural body curve, turn with whole body, not waist and load close to body. Leverage from arms or legs, not back, not from extended reach. Push rather than pull whenever possible.
05 Clear of pinch points	B	L	E	Body parts are clear of places where they might be pinched, e.g. when freeing jammed equipment or frozen bolts. Fingers clear of doors, lids and covers.
06 Obtain assistance	A	E	R	Obtain assistance when necessary to avoid strain or other risk, e.g. when lifting heavy or awkward loads.
07 Eyes on work or path	C	N	N	Watch hands engaged in tasks. Face and head generally pointed in the direction of travel. Not walking while looking up or reading. Walking forward whenever possible.
08 Selection of tools and equipment	K	T	S	Select designated tools and equipment for task and used as designed.. Avoid substituting one tool for another, and avoid modifying tools and equipment.

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TASK OBSERVATION PROCESS COMMENTS

Nbr	Positive Observations or Concerns

Nbr	Positive Observations or Concerns

Nbr	Positive Observations or Concerns

Nbr	Action Points

Appendix D

Email notifying vessels of the intervention. Certain words have been removed to protect confidentiality.

Hello,

I hope that you are settling in after crew break and that all is well.

Your vessel has been selected for a beta test of the TOP short checklist. The eight behaviors on the TOP short checklist are the top eight behaviors that were root causes to [redacted] injuries over the past three and a half years. The checklist is the result of analysis of the recordable injuries on our vessels since XX-XX-XXXX.

Why are we narrowing the behaviors to eight? The human brain is capable of remembering seven pieces of information plus or minus two. Focusing on the top eight behaviors should allow our crew members to keep the checklist in their mind when they are not conducting an observation, thus increasing awareness.

We will still enter the observations into the standard form in the data collection software. If the TOP short checklist is well received, we will adjust the checklist on an annual basis based on injury data. You can still write down a behavior not on the form, please provide comments about what you observed. You will notice the definitions are on the front side by the behaviors, this is to reduce the variance in our understanding of the behaviors. The comments portion has moved to the back of the sheet, so please be sure to flip the sheet over to make your comments.

In hopes that I am clearly communicating, I have attached the directions below for conducting an observation.

When conducting an observation:

1. Ask permission of individual(s) being observed to conduct an observation.

2. Check if excellent or concern. Check the feedback column for the behaviors that you will be commenting on.

3. Note the positive observations and concerns (on the backside).

4. Show the form to the individual(s) being observed.

5. Discuss what was done well and any concerns.

6. Ask the individual(s) if they have any recommendations to improve safety on board?

We will be getting your feedback throughout the beta test and the data will be analyzed for improvements moving forward. [redacted]

Please replace your old checklists with the new ones and would you confirm when you are using the new checklist e-mailing myself and [redacted]? I will send e-mails to each rotation right after crew break until we cycle through the entire crew.

VITA

Michael Keith Boitnott was born and raised in Midlothian, Virginia. After graduating from Monacan High School, he attended James Madison University in pursuit of a Bachelor of Science in Psychology. While at James Madison University, he was a member and served as President of Sigma Nu Fraternity. He was also a member of many clubs including Psi Chi honors society and the Omicron Delta Kappa honors society. He presented research at the Virginia Psychological Association and served as a Teaching Assistant for Psychological Statistics during his final year.

After graduating in May 2010, he enrolled at Appalachian State University to pursue a Master’s degree in Industrial/Organizational Psychology and Human Resource Management. While at Appalachian State, he served as a Graduate Teaching Instructor and presented research at the Organizational Behavior Management Network Conference in Tampa, Florida and at the Southeastern Association for Behavior Analysis in Charlotte, North Carolina. He received his Master of Arts in August 2012 and began work in human resources following graduation.