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Development of a Safety Decision-Making Scenario to Measure Worker Safety in Agriculture

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Keywords
Decision-making, Grain bin, Management, Safety at work

Disciplines
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Safety hazards in agricultural production and handling represent a perennial concern for workers, management, and other agricultural professionals (BLS, 2012). Specifically, personnel who work at commercial grain-handling facilities contend with a wide variety of safety issues spanning several safety standards and guidelines. Other safety challenges of agricultural handling facilities include the management of a large number of seasonal and temporary workers and the intense pressure for high productivity during the busy spring and fall seasons (Brandon, 2009; Chapman and Husberg, 2008; Lehtola et al., 2008). Previous research conducted with grain-handling personnel (Freeman et al., 1998; Roberts and Field, 2010) and the number of incidents recorded annually at grain-handling facilities establish that managing personnel safety at a commercial grain elevator is a challenge (Laviana, 2010).

In hazardous industries, safety programs and the management of personnel are especially important (Das et al., 2008; Evans et al., 2005). Furthermore, in such industries, the success of safety programs depends on team-oriented employees who can spot potential issues and correct them promptly (Das et al., 2008). Employee decisions constitute a major portion of these actions in both positive and negative ways. Consequently, the deci-

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sion-making patterns of employees have the potential to work in favor of or against organizational safety management processes (Keren et al., 2009).

This study examines the process that workers used to make a decision choice in a safety decision-making task within a commercial grain-handling facility. Using the process-tracing method of decision analysis, employees completed computer simulations that measured their decisions in a given scenario along with the dimensions (factors) they used to make their decisions. Understanding the factors that influence each employee's choice of a safe decision is an important component of improving safety interventions and training for workers. When employees make safe decisions, both the workers and the organization see the benefits (Goetsch, 2008), but no improvement in safety can be realized if employees do not make positive safety-oriented decisions on the job.

Human Factors in Safety

Humans are an important component of high-reliability organizations. High-reliability organizations have been defined as those in which safety is a critical component of operations (Cox et al., 2006). This is in part due to the intrinsic hazards of these organizations. Failure in safety systems at this level could lead to high-level property damage, injury, or loss of life (Cox et al., 2006). Examples from the literature include aviation, biotechnology, offshore drilling, nuclear energy, and rail operations.

Even in organizations that do not present the potential for catastrophic hazards, McLain and Jarrell (2007) noted that high production and technology demands can often result in mental and physical environments that threaten organizational safety. Multiple demands on a worker's time, together with a lack of control over work tasks, can blur behavior expectations for workers. Although management requires workers to be both safe and productive, sometimes these two priorities are incompatible, given the work environment (McLain and Jarrell, 2007).

Cox et al. (2006) failed to include agricultural handling facilities in their list of high-reliability work environments, even though the commercial grain-handling industry has no shortage of safety hazards and the pressure for high productivity is generally high (Chapman and Husberg, 2008). Personnel at commercial grain-handling facilities deal with a wide variety of safety hazards, including confined spaces, excessive noise, and chemical, biological, petroleum, and electrical dangers (Lehtola et al., 2008; OSHA, 1988, 2004; Rains, 2004; Roberts and Field, 2010). Agricultural worksites also include the dangerous combination of large numbers of inexperienced workers along with a powerful pressure for high productivity during certain times of the year (Brandon, 2009; Chapman and Husberg, 2008; Lehtola et al., 2008).

On any given day, multiple hazards are presented to workers in the agricultural handling industry. These dangers are well known by workers (Walker, 2010), yet incidents still occur, and the injury and fatality rates in this industry are significantly higher than the average injury and fatality rates across all industries (BLS, 2012).

Safety Perceptions and Safety Behavior

One potential indicator of future safety behavior is the safety perceptions of workers. First defined as safety climate by Zohar (1980, 2008), this measure examines the relative importance of safety when compared with other business goals, as perceived by employees. Das et al. (2008) also noted that safety climate has a significant perceptual component. This means employees recognize and construe information or episodes differently, and management and supervisors may have little control over these perceptions. Keren et al. (2009) reiterated this, stating that employees do not respond directly to workplace incidents but perceive and interpret events that occur in their work environment before taking action. Therefore, when analyzing an incident, researchers and managers are limited to analysis after the fact, which is subject to a great deal of bias (Dekker, 2002).

Although post-incident analysis provides valuable information, understanding factors that predict or characterize unsafe employee behaviors before they occur would be an even better tool for managers and supervisors. Two main approaches to explaining the safety behavior of workers have been explored by researchers. First, researchers have attempted to explain the ways in which employees violate safety rules, and the environmental and personal factors that may contribute to unsafe behavior (Hofmann et al., 1995). The second perspective tries to predict employee behavior by identifying predicting factors and creating predictive models (Mullen, 2004). Neither approach provides a complete answer, but they both help to explain why workers routinely violate the long-held assumption of self-preservation in the workplace (Maslow, 1970).

Zohar and Erev (2007) cited a flawed weighting of hazards by the employee and the delayed and uncertain occurrence of negative outcomes resulting from not following safety procedures as major contributors to irresponsible behavior. Worker attitudes may be conveyed as a failure to wear protective gear, to follow safety procedures, or to complete required training (Hofmann et al., 1995; Kouabenan, 2009; Reason et al., 1998). Workers with negative attitudes toward safety are hypothesized to behave differently in safety-intensive situations compared to those with more positive attitudes (Zohar, 2008).

The second perspective of inquiry, a better understanding of factors that predict workplace accidents, is also a high priority for researchers. Mullen's (2004) qualitative work identified several factors that helped predict unsafe behaviors. Some of these include role overload, performance versus safety, peer pressure, and avoidance of negative consequences. The first two factors address a common theme in the safety literature: the continual conflict between safety and productivity (Kouabenan, 2009; McClain and Jarrell, 2007). Additionally, although peer pressure can be positive or negative, negative peer pressure is typically highlighted in the literature (Keren et al., 2009; Mullen, 2004).

Mullen (2004) also mentioned a factor that is especially prevalent in high-reliability industries, which are defined as industries where safety is of utmost importance; this factor is the worker's "image." Several interviewees reported taking unsafe risks to impress either supervisors or co-workers for the purpose of securing a promotion or gaining status within the organization or work group (Choudhry and Fang, 2008; Mullen, 2004). Zohar and Erev (2007) suggested that supervisors and management can either encourage or discourage these types of behaviors, but they must actively provide observation and feedback.

Dekker (2002) took a different approach, focusing on behavior after the accident occurs. Because many accidents are the result of human error, it is important to understand why people acted the way they did, rather than attempting to judge their behavior after the accident. Dekker (2002) pointed out that hindsight adds bias and, along with the pressure to find a "fall guy" after a fatal incident or serious injury, works against the process of learning the mindset of the victim during his or her ordeal. Instead, Dekker (2002) suggested that investigators focus less on the mistake and more on learning from the mistake. Instead of asking why the employee made the fatal error, he advises investigators to understand why the employee felt his or her actions were positive in that context. Even given all of these lines of research, prediction of employee safety decision-making and resulting behavior remains difficult. Decision-making analysis helps address some of the weaknesses of tools such as safety climate and predictive modeling.

Theories Grounding Safety Decision-Making

Several psychological theories have been offered to explain a worker's decision-making process in a risky environment, such as a grain-handling facility. Three theories were used to guide the experimental design and decision-making scenario used in this work: the Theory of Planned Behavior, the Expected Utility Theory, and the Prospect Theory.

Murphy (2003) discussed Azjen and Fishbein's (1969) Theory of Planned Behavior as it applies to an agricultural safety setting. The model involves four steps: assessing the problem, identification of risks (hazards), evaluating what works in addressing the problem, and a final implementation step. Murphy (2003) linked the approach to traditional models developed in the public health sector, where the overriding goal is behavior change. The approach goes beyond a one-time decision. The theory also posits that behavioral intentions immediately precede behavior. People will pursue their intended action if the behavior leads to a desirable outcome, if others value the behavior, and if necessary resources and opportunities are available to support the behavior (Ajzen and Fishbein 1969).

Fogarty and Shaw (2010) also examined safety violations using the Theory of Planned Behavior and argued that the subjective norms of a workplace and perceived behavioral control play a role in the intention of a person to follow or not to follow safety procedures. Using this perspective, several factors play a role in the decision-making scenario examined in the present research. The decision scenario in this work examines the influence of social norms on the intention of employees to openly violate safety procedures when prompted by a supervisor. The employees' willingness to disregard safety procedures would be classified as an intentional violation. However, even if the employee had safe intentions, subjective norms such as the expectations of supervisors might play a role in the employee's ease or difficulty in violating safety procedures.

Traditionally, a fundamental basis for risky decision-making has been the Expected Utility Theory (EUT), which posits that, when people make risky decisions, they weigh several options and the likelihood of each occurring (Newell et al., 2007; Zohar and Erev, 2007). The option with the highest "utility" to the decision-maker is selected as the final choice. Based on the EUT, safe behavior should be the preferred choice. However, Zohar and Erev (2007) demonstrated that decision biases create a paradox whereby "careless behavior prevails during many routine jobs, making safe behavior an ongoing managerial challenge" (Zohar and Erev, 2007). In the decision-making scenario, the choice of a safe decision is not straightforward. In addition to questions on the perceived utility of routine safety decisions noted by Zohar and Erev (2007), information accessibility (Sharps and Martin, 2002) and cognitive distortions (Tversky and Wakker, 1995) could derail the employee's intention to make a safe decision, violating both the EUT and the long-held assumption that self-preservation outweighs other motivations (Maslow, 1970).

The Prospect Theory (PT) challenges the fundamental postulation of the EUT by suggesting that people tend to overweight low probabilities and underweight higher probabilities, which is an example of the "distortions" introduced under the framework of the EUT (Tversky and Wakker, 1995). The PT also states that risk-averse behavior is more common when a person stands to gain, while those who perceive that they have nothing to lose seek greater risk in their behavior. According to Newell et al. (2007), actual probabilities are often ignored by decision-makers who underestimate common outcomes and overestimate rare outcomes. Additionally, Kahneman and Tversky (1979) demonstrated that decision-makers can be more affected by decision outcomes that have a lower probability of actually occurring but more impact rather than by outcomes that have a greater chance of happening but a lower or uncertain impact. Both the EUT and PT imply that people are more sensitive to risk than to uncertainty.

The implications of all three theories play an important role in the decision-making scenario in this work. The employees are faced with both risk and uncertainty: they know that violating the safety procedure is risky to their personal safety, but a fatality is less of a certainty than the possibility of the supervisor's displeasure with them. Given the choice between these two alternatives, it would not be unexpected from the perspective of the EUT and PT that an employee would choose to please the supervisor and do the work quickly, rather than take the time to perform the task safely. The role of organizational norms (highlighted by the supervisor's request for the employee to disregard safety procedures) as discussed in the Theory of Planned Behavior also grounded this work.

Keren et al. (2009) established a framework for examining the relationship between safety climate and safety decision-making, where the decision-making process reflects proximate behavior. The concept of safety decision-making is defined by processes that are thought to play a role in the safety-related decisions that employees make on the job, which are termed dimensions. Mills (2007, p. 4) defined safety decision-making as "the process of selecting a safe alternative through information acquisition based on safety training, personal beliefs, values, previous experience, and accessible safety information." This definition is taken from decision theories and models in use for nearly 50 years and of interest to researchers since Aristotle's time (Buchanan and O'Connell, 2006). The focus of this work is the creation of a safety decision-making scenario for use in a commercial grain-handling facility.

In the decision-making scenario examined in this work, the risks are well known to the employee, yet the degree of cost versus benefit and the priority of each is not completely clear. This was by design rather than by accident. The decision-making scenario was written to test how employees would respond to conflict in their cost/benefit analysis as well as in their assessment of priority, as identified in decision-making theories reviewed by Amendola (2001) and Murphy (2003). In this case, the benefits of safe behavior and the support of peers may not outweigh the costs of lower productivity or disapproval from the supervisor. Therefore, the intended behavior outlined by the Theory of Planned Behavior may not lead to a desirable outcome as modeled.

Measuring Employee Decision-Making

In this study, the decision-making scenario was presented to employees using the decision process tracing methodology. Decision process tracing is an approach used to capture direct cognitive processes by evaluating the information that an individual uses to form a judgment and the sequence in which the information is examined (Ford et al., 1989). Other key processes recorded include: the number of alternatives viewed, the time needed to make a choice, and the final decision. A key advantage of process tracing is that it addresses the intervening steps between information acquisition and decision choice, which is considered a fundamental component of decision-making analysis (Mintz, 2004).

Decision process tracing has several advantages over self-reported questionnaires, which depend on recall ability and researcher observation of work behavior, which is cross-sectional at best and may have serious bias related to the Hawthorne effect and other effects. Decision process tracing also has benefits that are not realized with structural modeling. The process tracing method focuses on the processes that humans use to analyze and gather information in preparation to making a decision, while structural modeling emphasizes the final choice (Ford et al., 1989). Mintz (2004) added another advantage of process tracing: the ability to isolate decision rules and models used in the decision-making process, as well as test the association of situational and personal factors with the decision process and the final decision choice. The data collected from process tracing can then be used to infer information on the decision-making process used by employees as they made a choice (Ford et al., 1989; Keren et al., 2009; Payne et al., 1993).

This research is significant in that it attempts to increase the level of understanding of the orientation toward safety in a decision-making task in an agricultural materials handling environment. A second goal of this research is to measure the proportion of employees who make a safe decision choice even when presented with a scenario that discourages a safe decision. This research is the first attempt to measure decision choice and decision orientation within an agricultural work environment. This research utilizes the methodology first employed by Keren et al. (2009) to establish a method to measure the orientation toward safety in decision-making tasks, and examines the process within a work environment that has been characterized multiple times as one of the most dangerous occupational sectors (BLS, 2012; Chapman and Husberg, 2008).

The safety decision scenario was created based on a fundamental safety concern in all work environments: the failure to follow standard operating procedures (SOPs) (Keren et al., 2009; Zohar and Erev, 2007). The scenario was selected to reflect the response of an employee when presented with a potential shortcut opportunity. The dilemma presented is one that occurs commonly in the grain-handling industry, i.e., the bridging of out-of-condition grain as it is unloaded from a storage container to a transportation vehicle (Brandon, 2009; Freeman et al., 1998; Kingman and Field, 2005). This bridging blocks the flow and slows or stops the grain from moving.

The decision-making scenario and decision dimensions were developed and critiqued by a panel of experts in grain elevator operations using a modified Delphi method (Linstone and Turoff, 2002). Weighted scores for each matrix square were assigned by the same panel of experts. The assigned values represented the utility of the decision choice in terms of safety within each dimension. The scenario was pilot-tested on a small group with a moderate knowledge of grain elevator operations. Slight modifications were made to improve the clarity of the decision scenario as a result of the pilot tests.

Using the information contained in the matrix squares, employees viewed the information and then selected a decision choice. The information presented to the employees in the decision-making scenario was not intended to represent the entire spectrum of factors that could influence their decision. Instead, the scenario focused on the factors most likely to influence the decision of an employee according to both published literature and expert opinion. Each of the dimensions included in the scenario has been identified in previous research as important in safety decision-making and safety behavior (Walker, 2010; Keren et al., 2009; Choudhry and Fang, 2008; Zohar, 2008; McLain and Jarrell, 2007; Seo, 2005; Mullen, 2004; Prussia et al., 2003). The text of the decision simulation was presented as follows:

You and a co-worker are emptying a bin and working to fill a waiting truck. Your supervisor walks by to check on your progress and notices that the flow of grain to the truck has slowed. Your supervisor suggests keeping the auger running while someone gets inside the bin to release the blockage and keep the grain flowing. You are surprised because your organization normally follows the grain safety handling standard administered by OSHA, which require lock out / tag out of the bin before entry. You need to decide what to do next. You have the following four options:

1. Enter the bin
2. Follow the entrance procedure
3. Confront the supervisor and follow the procedure
4. Follow the procedure and report the supervisor

These four factors could impact your decision:

1. Safety
2. Productivity
3. Supervisor's opinion of you
4. Peer pressure

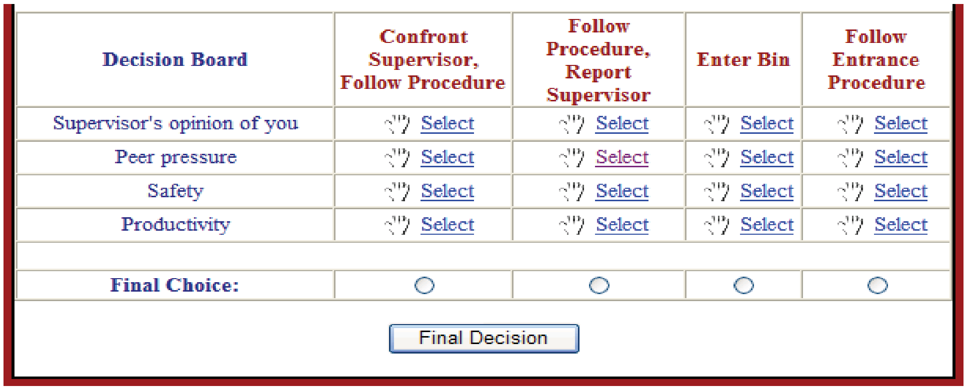
When you are ready, follow the steps below in order to initiate and complete the simulation.

The software platform used was Decision Mind, a computerized decision-making simulation tool (Mintz, 2004). The decision structure was presented in a matrix format, as shown in table 1, with a set of decision alternatives and a set of dimensions. The alternatives define the decision choices (C) available to the participant, and information is gathered by viewing the dimensions (D). Each square of the matrix provides an evaluation of a given choice on a given dimension. The participant is asked to choose one alternative based on the information acquired from the dimensions. Each square on the matrix is also assigned a utility value on a scale from -10 to +10, with -10 indicating a negative evaluation from a safety perspective and +10 indicating a positive evaluation. The utility values represent the evaluation of the safety orientation of the decision choice within a specific dimension.

The decision-making simulations were presented electronically. The sequences of the

Table 1. Decision Mind decision simulation matrix.

	Choices			
Dimensions	C_1: Confront Supervisor, Follow Procedure	C_2: Follow Procedure, Report Supervisor	C_3: Enter Bin	C_4: Follow Procedure
D_1: Supervisor's opinion	-8	-2	+7	0
D_2: Peer pressure	+4	+1	-6	+4
D_3: Safety	+3	+10	-10	0
D_4: Productivity	-7	+4	+10	-4



Decision Board	Confront Supervisor, Follow Procedure	Follow Procedure, Report Supervisor	Enter Bin	Follow Entrance Procedure
Supervisor's opinion of you	Select	Select	Select	Select
Peer pressure	Select	Select	Select	Select
Safety	Select	Select	Select	Select
Productivity	Select	Select	Select	Select
Final Choice:	○	○	○	○

Figure 1. Decision-making matrix as viewed by research participant.

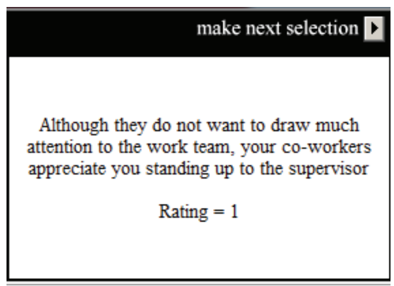


Figure 2. Decision choice outcome for the Report Supervisor choice in the Peer Pressure dimension.

decision choices and dimensions were randomized for each participant. A screen shot of the decision-making matrix as seen by a participant is shown in figure 1. When participants clicked on "select," a pop-up window appeared identifying the potential outcome of the decision choice with respect to that dimension. In figure 1, the highlighted square is for the decision choice of following the correct safety procedure but reporting the supervisor's behavior from a peer pressure perspective. Figure 2 shows the pop-up window that would have appeared to the participant.

Calculations

To provide a way to quantitatively present the information gathering process completed by participants, Keren et al. (2006) introduced the search index. This measurement calculates the ratio between the number of times the squares of one dimension were viewed as compared with the other dimensions. In this study, four dimensions were measured: safety, productivity, supervisor opinion, and peer pressure. Accordingly, the search indices are the safety search index (S_SI), productivity search index (P_SI), supervisor opinion search index (SO_SI), and peer pressure search index (PP_SI). The calculations are shown below:

$$\mathrm{S\_SI} = \frac{N_{safety}}{\frac{1}{n}\sum_{i=1,\, i \neq N}^{n} {}_{i-safety}} \tag{1}$$

where N_{safety} is the number of times safety squares were viewed, and $N_{i\text{-}safety}$ is the number of times squares other than safety were viewed.

$$\mathrm{P\_SI} = \frac{N_{Productivity}}{\frac{1}{n}\sum_{i=1,\, i \neq N_{i-productivity}}^{n}} \tag{2}$$

where $N_{productivity}$ is the number of times productivity squares were viewed, and $N_{i\text{-}productivity}$ is the number of times squares other than productivity were viewed.

$$\mathrm{SO\_SI} = \frac{N_{SO}}{\frac{1}{n}\sum_{i=1,\, i \neq N_{i-SO}}^{n}} \tag{3}$$

where N_{SO} is the number of times supervisor's opinion squares were viewed, and $N_{i\text{-}SO}$ is the number of times squares other than supervisor opinion were viewed.

$$\mathrm{PP\_SI} = \frac{N_{PP}}{\frac{1}{n}\sum_{i=1,\, i \neq N_{i-PP}}^{n}} \tag{4}$$

where N_{PP} is the number of times peer pressure squares were viewed, and $N_{i\text{-}PP}$ is the number of times squares other than peer pressure were viewed.

Values less than one represent a dimension of less importance as compared with the other dimensions. Values greater than one represent a dimension of greater importance in relation to the other dimensions. Values of one indicate that the dimension plays no more importance than any other dimension; therefore, one is designated the "ultimate mean." The dimension most affiliated with safety in this decision-making scenario is the safety dimension. Participants who viewed safety dimension information at a higher frequency were assumed to be considering safety as a prioritized source of information in their decision-making process.

The focus of this work was the process that grain elevator employees used to make a decision choice in a safety-oriented decision task. Accordingly, data were collected to answer the following research questions:

1. Given a safety decision-making task, what decision choice is selected by grain elevator employees?
2. What information do employees use to select a decision choice in a safety decision task in a grain elevator environment?
3. Do employees emphasize safety at a higher level than the ultimate mean in their decision-making process?

The decision-making simulation was presented to the study participants with the choices and dimensions of the decision task in random order. The participants completed the decision-making simulation as their work schedules permitted. For classification purposes, the participants were given identification numbers. No personal identifiers were linked with the identification numbers to eliminate the possibility of tracking specific participant responses.

The participants were employees of three grain-handling facilities located in the upper Midwestern U.S. Employees who would be subject to safety-related decisions in their daily jobs were offered the opportunity to participate in the study. Of the 410 invitations, 197 responded. Of these 197, 160 provided usable data, for a response rate of 39%.

All employees were drawn from grain-handling organizations that volunteered for the study. Although only three grain-handling companies made up the sample, the service area of these three companies covered nearly one-third of the state's area. Additionally, the grain-handling capacities of all three companies were large, varying between 18 million and 217 million bushels per year. Approximately three-quarters of the data are from one facility, with the other two facilities providing the remainder of the data. However, when tested individually, the facilities showed no significant differences in their decision choices or decision-making processes.

Results

The sample consisted of 142 males and 18 females, for a total sample size of 160. Data were gathered over a two-week period in early spring. The participant ages ranged from below 21 to over 61, with the most common response being 41 to 50 years of age. Two groups of employees made up the largest portion of the sample: those with less than three years on the job (38.5%), and those who had been with the organization more than ten years (34%). Nearly all (98%) had completed high school, with over half (62%) completing at least two years of college.

Results were calculated using SPSS (ver. 18.0, SPSS, Inc., Chicago, Ill.). Information from the safety decision-making simulation contained two important data points: the final decision choice, and information about the decision-making process. The decision-making process is represented by the search index values, which reflect the information acquired by participants for each dimension as compared with the other three dimensions. A value of one for a particular dimension indicates that no emphasis was given to that dimension above the other dimensions and therefore represents the ultimate mean, or benchmark value. A paired-sample t-test was performed on each search index to compare its value with the ultimate mean. Results of the t-tests for each index are presented in table 2. The safety dimension was significantly higher than the ultimate mean of one. The supervisor's opinion, productivity, and peer pressure dimensions were not significantly different from the ultimate mean of one.

The second data point contained within the decision-making simulation was the distribution of decision choices. These results are shown in figure 3. The numbers above each bar in the graph represent the utility value of that decision choice in the safety dimension. The decision choice made by the greatest number of participants was to confront the supervisor and to perform the task safely, although similar numbers of workers chose to follow the safety procedure or report the supervisor to management.

Table 3 displays the distribution of decision choices by participant age, gender, and education level. Percentages indicate the proportion of participants in a specific demographic category (e.g., male, over 60, or high school graduate) who made a specific decision. Not all participants completed the demographic information, so the sample sizes may differ across categories.

Table 2. Results of t-tests for information emphasis within a safety decision-making task (n = 160).

Search Index	Mean	SD	t-Score	p-Level
Safety	1.34	1.40	3.29	0.001
Productivity	0.967	0.866	-0.526	0.600
Supervisor's opinion	1.13	1.32	1.28	0.201
Peer pressure	0.978	0.911	-0.318	0.751

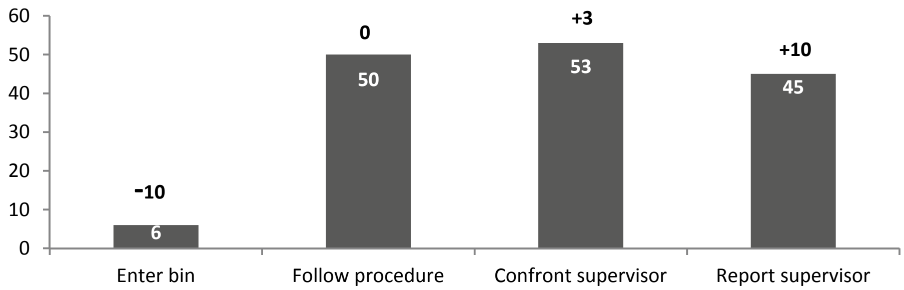


Figure 3. Distribution of frequency of decision choices in a safety decision-making task (n = 161).

Table 3. Distribution of gender, age, and education in decision choices.

		Enter Bin (N = 6)	Follow Procedure (N = 51)	Confront Supervisor (N = 54)	Report Supervisor (N = 46)
Gender	Male	6 (100%)	44 (86%)	42 (78%)	29 (63%)
	Female	0 (0%)	7 (14%)	12 (22%)	17 (37%)
Age	Under 21	0 (0%)	0 (0%)	2 (4%)	2 (4%)
	21-30	3 (50%)	12 (24%)	4 (7%)	11 (24%)
	31-40	0 (0%)	7 (14%)	9 (17%)	7 (15%)
	41-50	1 (17%)	14 (27%)	21 (39%)	14 (30%)
	51-60	2 (33%)	12 (23%)	17 (31%)	11 (24%)
	Over 60	0 (0%)	6 (12%)	1 (2%)	1 (2%)
Education	High school or less	0 (0%)	3 (6%)	1 (2%)	0 (0%)
	High school	2 (33%)	19 (37%)	17 (31%)	15 (33%)
	2-year degree	1 (17%)	13 (25%)	14 (26%)	11 (24%)
	2 to 4 years of college	2 (33%)	5 (10%)	12 (22%)	15 (33%)
	4-year degree	1 (17%)	10 (20%)	9 (17%)	5 (11%)
	Graduate degree	0 (0%)	1 (2%)	1 (2%)	0 (0%)

Discussion

Several significant findings emerged from this study. The first research question asked about the decision choices made by the employees. Four alternatives were offered. With the exception of the small number (n = 6) who chose to enter the bin, the frequency distributions of the other three options were nearly equal, as shown in figure 3. There were no discernable demographic patterns for the choices, as shown in table 3. No demographic group was more likely than any another group to select a given choice.

The second question, which is discussed in more depth later, asked about the information that the employees used to make their decision choices. When considering the employees' choices, it is important to note that no one choice was superior from all perspectives. Entering the bin is clearly not safe and is therefore a negative choice from a safety perspective, but this choice could potentially be evaluated more positively in terms of productivity and supervisor opinion. As expected, few employees chose to enter the bin, the most unsafe option. However, the fact that any of the participants made this choice further supports the continuing importance of studying employees' safety behavior (Brown et al., 2000; Hudson, 2009). Even when hazards are presented very clearly, employees can still make unsafe decisions (Walker, 2010).

The other three alternatives presented in the decision-making scenario, while safer than entering the bin, are not equal in terms of worker safety. Choosing to follow the correct procedure does not include the issue of the supervisor asking the worker to break the SOP; therefore, it does not address the root cause of the problem. Confronting the supervisor, while a safe individual decision, could have negative implications for future safety outcomes, especially considering that facility safety is often dependent on teamwork and psychological safety, i.e., the freedom of workers to correct mistakes or incorrect orders (Das et al., 2008; Edmondson, 1996; Kath et al., 2010). Upsetting the supervisor or threatening the power structure of the work group has potentially negative implications. Additionally, this choice could negatively impact the trust between the supervisor and the employee, leading to future unsafe behaviors performed in retaliation by the employee (Davis et al., 2000).

The fourth choice, i.e., following the procedure but reporting the supervisor to management, has the best potential to improve safety outcomes across the entire organization (Keren et al., 2009; Edmondson, 1996). This action is an example of what Vredenburgh (2002) termed proactive practices and what Edmondson (1996) referred to as "psychological safety," and both of these are indicators of a safer workplace. If supervisors are advising workers to take safety shortcuts, this is a fact that a proactive management should be aware of, but employees must also feel comfortable reporting such behavior to management. Furthermore, if employees report unsafe behavior by supervisors to management, then management should take action to prevent such behavior from recurring. If management took no action on the employee's complaint, then the decision by the employee to report the supervisor would likely not recur, in part because of the lack of management response to the problem (Zohar, 2000; Zohar and Luria, 2005).

The second research question asked about the information that the employees used to make their decision choices. To determine this information, the search index method was used, as introduced by Keren et al. (2006). Search indices for the four dimensions (safety, productivity, supervisor opinion, and peer pressure) were compared with an ultimate mean of one. A search index equaling one indicated that no higher emphasis was placed on a given dimension. Of the four dimensions, only safety was viewed by employees significantly more often than the ultimate mean. Therefore, the third research question, which asked if the safety dimension was prioritized by employees at a higher level than the other dimensions, can be answered positively. In addition, none of the other dimensions (productivity, supervisor's opinion, and peer pressure) showed a significant difference from the ultimate mean; therefore, a conclusion can be made that none of these dimensions was prioritized by the employees at a higher or lower level than the other two dimensions in this decision-making scenario.

This lack of emphasis on the non-safety dimensions was unexpected for several reasons. In this study, peer pressure was presented to the employees in positive terms through the information that popped up when the employees clicked on decision matrix squares (e.g., fig. 2). The participants in this study seemed to defy Mullen's (2004) conclusion that peer pressure can serve as an indirect discouragement to safety by way of the employee's "image." It seems reasonable that positive peer pressure would prevent employees from taking unsafe risks to impress supervisors or co-workers, as reported by Choudhry and Fang (2008). Zohar and Erev (2007) suggested that behaviors such as these can be encouraged or discouraged depending on the behavior of management.

Keren et al. (2009) reported peer pressure as a significant dimension in the decision-making tasks of manufacturing employees. Two factors could have impacted the difference in results in this study. First, the decision-making scenario used by Keren et al. (2009) positioned peer pressure as a negative influence on safety rather than as a positive influence, as was the case in this study. Second, strong support of safety by management might encourage employees to challenge the unsafe work practices of their peers (Zohar, 2008), reflecting an environment of "psychological safety" observed by Edmondson (1996) or of "proactive practices" noted by Vredenburgh (2002). Employees who believe that they will be supported by management may be more likely to address unsafe work behaviors directly, rather than follow along with unsafe behavior. Finally, the lack of emphasis in the peer pressure dimension by the participants in this study suggests that positive peer pressure plays a lesser role than negative peer pressure in the employee decision-making process (Keren et al., 2009).

The lack of significant emphasis on the supervisor's opinion was also unexpected. The supervisor's request to put production concerns ahead of safety concerns aligns with the scenario described by Zohar and Luria (2005). The implication of the situation described by Zohar and Luria (2005) was that when employees are faced with competing demands, they will choose the behavior that is perceived to be the highest priority. If the supervisor places following orders ahead of safety considerations, this indirectly communicates to the employee that safety should not be the employee's primary consideration. The fact that the participants in this study were able to disregard the supervisor's opinion and complete the decision-making task safely was unexpected, based on both previous research and theoretical basis (Zohar and Luria, 2005, Zohar and Erev, 2007).

The data suggest that, in this case, safety considerations overcame the desire to please the supervisor, but the potential conflict in employees' minds as they made their decision choice warrants further investigation in a similar decision-making scenario. One reason for this outcome could be the potential bias in employees' perceptions, i.e., that they should view the safety dimension because they knew it was the safest option. Although the employees were not told that the study was a safety-focused experiment, the design of the decision-making scenario could have led them to believe this.

The final dimension considered as part of the decision-making scenario was productivity. McLain and Jarrell (2007) noted that productivity can negatively impact safety, but that was not the case in this study. The reason for this is unknown, but it may be related to the well-known dangers of grain-handling facilities, which are routinely acknowledged by employees (Walker, 2010). Knowing that safety is an integral part of the job in a hazardous workplace (Chapman and Husberg, 2008) may limit the willingness of employees to consider faster but less safe methods of performing their duties. Or, as posited by the Theory of Planned Behavior, social norms and expectations may influence employees to make work decisions based on safety rather than speed (Fogarty and Shaw, 2010). A second theoretical basis might be that employees see little to gain from risky behavior, so they opt out of unsafe decisions, per the Prospect Theory (Tversky and Wakker, 1995).

Conclusions and Limitations

Several limitations concerning this research should be noted. First, the small sample size limits the ability to generalize the data to a larger population. In addition, the data collection process was unfamiliar to the participants, leading to possible measurement error. Both of these biases may have affected the results. Additionally, data were collected from only one industry, using cross-sectional data collection techniques, in only one region of the U.S. A larger, more heterogeneous sample would substantially strengthen the conclusions of this study. Related to this, the participants were drawn from a group of organizations that volunteered for the study. This introduces potential for selection bias.

Another potential bias related to the sample is the data collection process. Employees completed the decision-making scenario as their work schedules allowed. The researchers were not on-site while data were collected; therefore, no information was gathered on the times and days of data collection. Nor was any information gathered on how much time employees were allocated to complete the decision-making scenario. It is unknown whether the participants were salaried or hourly employees; this could have impacted the way they responded to the decision-making scenario. Finally, no data were collected on whether the participants had experienced a previous safety incident. Although their safety training background was known, no significant relationship was found between safety training and participant responses.

Other limitations involve the decision-making scenario. The scenario involved one situation presented from one perspective (i.e., safety, with a positive peer pressure emphasis). The scenario was not designed to include every possible dimension of the decision, nor did it include specific details. This was the first attempt to use the process tracing method and Decision Mind to collect decision-making data from grain-handling employees. For this reason, the decision-making scenario was fairly simple. The employees' responses may be different for different scenarios, limiting the applicability of the results to other safety situations, even within the same work environment.

Finally, it is important to acknowledge that the employees' responses were hypothetical. While the employees stated that their choices represented what they would do in the given conditions, the difference between what employees say they will do and what they actually do is well documented by behavioral theory (Murphy, 2003). We acknowledge the potential error that these limitations bring to the conclusions of this study.

This research was the first to examine safety decision-making in a grain-handling environment. The conclusions have raised many questions that could be addressed with additional empirical evidence. To better study the wide variety of safety decisions faced by grain-handling employees, alternate decision-making scenarios should be developed and tested. Additionally, the emphasis of peer pressure in the decision-making process warrants additional investigation and perhaps comparison of positive peer pressure with negative peer pressure. Additional work concerning the search dimensions of interest (i.e., safety, productivity, supervisor's opinion, and peer pressure) would also be useful. Some of these dimensions have theoretical linkages to safety outcomes, especially productivity (McLain and Jarrell, 2007). Finally, a duplicate design with a wider population and more diversity in gender, occupation, and workplace hazards would add to the existing body of knowledge.

Even with the limitations and additional questions noted above, it is clear that researchers still have much to understand about the process that employees use to make safety decisions. The decision-making process as it unfolds in a hazardous work environment also has many unanswered questions. A better understanding of the decision-making process would provide a better grounding for employee training and safety interventions. For managers and supervisors, understanding, acknowledging, and addressing the dimensions of safety decision-making in a meaningful way is an essential part of managing occupational safety.

Workplace safety decision-making has many contributing factors. In a hazardous work environment, safe work practices can make the difference between going home at the end of the day and ending the day injured or killed. For better or worse, worker behavior is always precipitated by a decision-making process. A better understanding of the factors that affect the decision-making process for safety-related tasks has potential benefits for workers and for those who manage the safety of workers in agricultural environments.

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