Safety Science 118 (2019) 453–465

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/safety

# Are employee surveys biased? Impression management as a response bias in workplace safety constructs

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ARTICLE INFO

*Keywords:*
Workplace safety
Method bias
Impression management
Socially desirable responding
Unlikely virtues

ABSTRACT

Safety researchers often rely on employee surveys, which are susceptible to impression management. The *purpose* of this investigation was to estimate the prevalence of impression management in self-report measures of workplace safety constructs in three distinct samples. Results from an initial sample of research laboratory personnel indicated that impression management accounted for 28% of the variance in the relationships among safety constructs. In a second sample of research laboratory personnel, impression management was significantly related to safety constructs even after controlling for personality trait variance and accounted for more variance (35%) in the safety construct relationships than what was found in the first sample. A third sample of oil and gas personnel provided less support for the biasing effect of impression management, accounting for 11% of the variance in safety construct relationships. Overall, these data suggest that impression management accounts for up to one-third of the variance in workplace safety construct relationships. Safety researchers should seek to replicate these findings, examine interventions to reduce the prevalence and impact of impression management, and identify alternative sources or methods of assessment.

## 1. Introduction

The ultimate goal of workplace safety research is to reduce injuries and fatalities on the job. Safety surveys that measure various safety-related constructs, including safety climate (Zohar, 1980), safety motivation and knowledge (Griffin and Neal, 2000), safety participation and compliance (Griffin and Neal, 2000), and outcome indices (e.g., injuries, incidents, and near misses) are the primary way that researchers gather relevant safety data. They are also used extensively in industry. It is quite common to administer self-report measures of both safety predictors and outcomes in the same survey, which introduces the possibility that method biases prevalent in self-report measures contaminate relationships among safety constructs (Podsakoff et al., 2012).

The impetus for the current investigation is the continued reliance by safety researchers and practitioners on self-report workplace safety surveys. Despite evidence that employees frequently underreport injuries (Probst, 2015; Probst and Estrada, 2010), researchers have not directly examined the possibility that employees portray the workplace as safer than it really is on safety surveys. Correspondingly, the current investigation strives to answer the following question: Are employee safety surveys biased? In this study, we focus on one potential biasing variable, impression management, defined as conscious attempts at exaggerating positive attributes and ignoring negative attributes (Connelly and Chang, 2016; Paulhus, 1984). The *purpose* of this study is to estimate the prevalence of impression management as a method bias in safety surveys based on the extent to which impression management contaminates self-reports of various workplace safety constructs and relationships among them.

### 1.1. Workplace safety

Most extant safety frameworks (Beus et al., 2016; Christian et al., 2009; Griffin and Neal, 2000) propose that safety outcomes (e.g., injuries) are a function of individual and situational factors that influence safety-related behavior. Safety behavior includes both compliance (i.e., behaviors in line with stated safety policies) and participation (i.e., intentional efforts to improve safety; Griffin and Neal, 2000). Safety behavior is in turn directly related to outcome indices. These frameworks guided decisions concerning which variables to include in the current research studies.

This investigation focuses on three proximal and distal predictors of safety behavior and outcomes: safety knowledge, safety climate, and perceived job risk. Extending job performance theory to safety in the workplace, safety knowledge is one of three central antecedents of safety behavior (i.e., safety knowledge, motivation, and skills), defined

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https://doi.org/10.1016/j.ssci.2019.05.051
Received 1 October 2018; Received in revised form 27 April 2019; Accepted 28 May 2019

as the degree of awareness of safe behavior, procedures, and equipment (Griffin and Neal, 2000). Safety climate is defined as shared perceptions of safety policies, practices, and procedures, or the priority of safety relative to other organizational considerations (Zohar, 1980, 2003, 2010). A final safety-related predictor examined in this investigation is perceptions of job risk or harm, including the degree of exposure to hazardous situations and physical danger on the job (Jermier et al., 1989).

Safety researchers often obtain self-reports of various safety-related constructs and measure these constructs concurrently. In their meta-analysis of the safety literature, Christian et al. (2009) found that 92% of studies examining workplace accidents and injuries at the individual level of analysis used self-report data, whereas 8% were medical or OSHA records. Similarly, 97% of studies measuring safety performance/behavior at the individual level of analysis did so using self-reports. Many other perceptual safety predictors and criteria are typically and appropriately measured using self-reports (e.g., safety climate, perceived risk, safety attitudes). Sixty-one percent (55 out of 90) of the studies identified by Christian et al. (2009) measured both safety predictors and criteria using self-reports. The prevalent use of self-reports is understandable given the practical advantages as well as the challenges (e.g., legal constraints, concerns from management and institutional review boards) associated with gaining access to alternative sources of safety data, such as organizational records or supervisor/peer ratings of safety behavior.

### 1.2. Impression management as a method bias

There is an extensive research literature examining biases in self-report, Likert-based survey measures of various psychological constructs, many of which are likely to also be prevalent in workplace safety surveys (Schwarz, 1999). These method biases result from: (1) respondents (e.g., consistency motif, leniency bias, and social desirability), (2) item characteristics and placement (e.g., item social desirability, item priming effects), or (3) the context of the measurement setting (e.g., predictor and criterion measured at the same location and at the same time; Podsakoff et al., 2012). Moreover, self-report safety measures rely on accurate comprehension and recall, which can be unduly influenced by various factors including for instance the saliency of recent events and the context of the measurement setting (Schwarz, 1999; Tourangeau et al., 2000).

Socially desirable responding, the tendency of respondents to exaggerate positive attributes and downplay negative attributes (Connelly and Chang, 2016; Paulhus, 1984), is proposed as a specific source of bias in self-report measures of safety constructs. Social desirability is commonly conceptualized as a two-dimensional construct consisting of (1) positively-biased responding that is self-deceptive and (2) conscious attempts at dishonesty (i.e., impression management; Paulhus, 1984). From a practical standpoint, impression management, rather than self-deception, is most concerning and therefore the focus of this study. However, recent research suggests that measures of impression management assess both dishonesty and substantive personality traits (e.g., Borkenau and Ostendorf, 1992; Christiansen et al., 1994; McCrae and Costa, 1983), so we also attempt to examine the influence of impression management independent of this substantive variance.

#### 1.2.1. Theoretical explanations

Our theoretical rationale for impression management as a method bias in self-report measures relies on Edwards's (1957) original description of social desirability, in combination with more recent conceptualizations of socially desirable behavior (i.e., Baumeister, 1982) and impression management as a method bias (Podsakoff et al., 2012). Specifically, impression management is not universally applicable in all self-reports (Moorman and Podsakoff, 1992), but is more likely to act as a biasing variable when people are *motivated* to respond in a socially acceptable manner because survey items can be perceived as having salient social consequences (Edwards, 1957; Podsakoff et al., 2012; Sudman and Bradburn, 1982). For example, employees might be hesitant to disagree with the following safety behavior item: "I carry out my work in a safe manner." Relatedly, impression management serves two broad purposes: to secure rewards and/or avoid negative consequences (Baumeister, 1982; Podsakoff et al., 2012; Stone, 1989).

#### 1.2.2. Previous research on method bias in the safety literature

Few safety researchers have directly examined method bias in the workplace safety literature (for an exception, see Beus, 2012); however, many have commented on and examined it indirectly. For example, Christian et al. (2009) assessed criterion source (i.e., self-reports, supervisor ratings, objective data) as a moderator of the relationships between safety climate and behavior and outcomes. They did not find any significant differences in effect size estimates across criterion sources and concluded that method bias "may not be a major concern in the safety domain" (p. 1122). However, they only assessed method variance among safety climate, safety behavior, and outcomes, relatively few primary studies utilized supervisor ratings or objective data for comparison purposes, and they did not identify or assess a specific source of method bias that might be relevant in measures of safety.

Nahrgang et al.'s (2011) treatment of method bias in another recent meta-analysis of workplace safety is reflective of many safety studies; that is, method biases are often presented as potential limitations, but the nature and degree of their effects are not directly assessed. Nahrgang et al. (2011) briefly acknowledged the potential influence of method variance in their discussion, "most workplace safety research has involved evaluating all of the factors from the employee's perspective…thus, the studies suffer from common method bias that potentially inflated the relationships between constructs" (p. 17).

Analogous research in the driving behavior and accident literature (Harrison, 2010; af Wåhlberg et al., 2010) and research on injury underreporting (Probst et al., 2013; Probst and Estrada, 2010) suggests that impression management might be a concern when collecting self-reports of safety constructs. Results from studies in the driving behavior literature generally indicate that impression management and/or social desirability is significantly associated with self-reported driving behavior and accidents; however, controlling for social desirability in the relationships among self-reports does not consistently support its biasing effect (af Wåhlberg et al., 2010; Barraclough et al., 2014; Harrison, 2010; Lajunen and Summala, 2003). Relatedly, there is consistent evidence that employees underreport the number of injuries that they experience at work, with research suggesting that between 50% and 70% of injuries experienced by employees are not reported to their organization (Probst, 2015; Probst et al., 2013; Probst and Estrada, 2010).

#### 1.2.3. Motivation to impression manage on self-report measures of safety

Impression management is expected to be prevalent in self-report measures of safety constructs because of the salient social consequences associated with responding and additional costs to providing unfavorable responses. Most organizations and especially those in high-risk industries focus heavily on maintaining high levels of safety, which might in turn motivate employees to provide socially desirable responses on safety measures, regardless of their true perceptions and behavior. Research has shown that employees are fearful of the negative consequences sometimes associated with reporting injuries and they explicitly underreport in order to avoid them (Probst, 2015; Probst and Estrada, 2010).

In much the same way, safety surveys often have consequences for employees especially when the results reflect problems with safety attitudes or behavior. For instance, management might react to a safety survey that identifies deficiencies in employees' safety knowledge and behavior by instituting more onerous oversight and after hours training. Accordingly, safety surveys are argued to be susceptible to positive biases, including impression management, such that employees are

motivated to provide socially desirable responses instead of answering honestly, which is practically very easy to do (for example, strongly agreeing with all safety compliance items). Using three safety surveys, the degree to which impression management contaminates self-report measures of perceived job risk, and safety knowledge, climate, behavior, and outcomes is estimated based on (1) the relationships between impression management and self-report measures and (2) the amount of variance in the relationships among safety constructs attributable to impression management.

**Hypothesis 1:.** *Impression management will be* (*a*) *positively related to self-reports of safety knowledge, climate, participation, and compliance, and* (*b*) *negatively related to self-reports of perceived job risk, and injuries, incidents, and near misses.*

**Hypothesis 2:.** *Accounting for impression management in self-reports of safety constructs will lead to reductions in the relationships among safety constructs.*

## 2. Method – Study 1

This study was part of a larger assessment of safety climate at a public research university in the United States using a sample of research laboratory personnel. Due in part to continuous changes in laboratory personnel including undergraduate students, the university does not keep a record of all of the individuals who work in this environment. Therefore, a recruitment e-mail was sent to a distribution list of all faculty, staff, and students (~65,000) asking them to complete an online laboratory safety survey. The recruitment e-mail was concurrently sent to people who completed laboratory safety training in the previous two years (1841) and all principal investigators (1897).[1] Some people received multiple recruitment emails because they were included on more than one of these distribution lists.

Seven hundred forty-six laboratory personnel responded to the survey.[2] The majority of respondents were graduate students (229, 37%), followed by undergraduate students (183, 30%), research scientists and associates (123, 20%), post-doctoral researchers (28, 5%), laboratory managers (25, 4%), and principal investigators (23, 4%). Respondent sex (329 [53%] female; 287 [47%] male), race (377 [64%] White; 16 [3%] Black; 126 [21%] Asian; 72 [12%] Hispanic), and age ($M$ = 31, $SD$ = 13.24) were also requested. Respondents worked in various types of laboratories, including biological (219, 29%), animal biological (212, 28%), human subjects/computer (126, 17%), chemical (124, 17%), and mechanical/electrical (65, 9%). To incentivize participation, respondents were given the option to provide their name and email address *after* they completed the survey in a separate survey link, in order to be included in a raffle for one of five $100 gift cards.

### 2.1. Measures

#### 2.1.1. Safety climate

Nine items from Beus et al. (2019) 30-item safety climate measure were used in the current study. The nine-item measure included one item from each of five safety climate dimensions (safety communication, co-worker safety practices, safety training, safety involvement, safety rewards) and two items from the management commitment and safety equipment and housekeeping dimensions. The nine items were identified based on factor loadings from Beus et al. (2019). Items were responded to on a five-point agreement scale (1 = strongly disagree, 5 = strongly agree).

#### 2.1.2. Safety knowledge, compliance, and participation

Respondents completed slightly modified versions of Griffin and Neal's (2000) four-item measures of safety knowledge (e.g., "I know how to perform my job in the lab in a safe manner."), compliance (e.g., "I carry out my work in the lab in a safe manner."), and participation (e.g., "I promote safety within the laboratory."). Items were completed using a five-point agreement scale (1 = strongly disagree, 5 = strongly agree).

#### 2.1.3. Perceived job risk and safety outcomes

Respondents completed a three-item measure of perceived job risk (e.g., "I encounter personally hazardous situations while in the laboratory;" 1 = almost always untrue, 5 = almost always true; Jermier et al., 1989). Respondents also provided safety incident data regarding the number of injuries, incidents, and near misses that they experienced in the last 12 months.

#### 2.1.4. Impression management

Four items were selected from Paulhus's (1991) 20-item Balanced Inventory of Desirable Responding. These items were selected based on a review of Paulhus's (1991) full measure and an assessment of those items that were most relevant and best representative of the full measure (Table 1). Items were completed using a five-point accuracy scale (1 = very inaccurate, 5 = very accurate). Ideally this survey would have included Paulhus's (1991) full 20-item measure. However, as is often the case in survey research, we had to balance construct validity with survey length and concerns about respondent fatigue and for these reasons only a subset of Paulhus's (1991) measure was included.

## 3. Results

Hypotheses were examined using confirmatory factor analysis following Williams and McGonagle's (2016) data analytic technique by estimating impression management as a latent method factor along with an unmeasured latent method factor (see Tables 2–4). Data analysis was conducted using STATA 14.2 (StataCorp, 2015). All models were evaluated and compared based on Chi-square values and common fit indices (i.e., Comparative Fit Index [CFI], Tucker-Lewis Index [TLI], and Root Mean Square Error of Approximation [RMSEA]; Kline, 2011). Typical cutoffs for a model with adequate fit are RMSEA less than 0.06 and CFI and TLI greater than 0.90 (Hu and Bentler, 1999).

The measurement model was first estimated by linking each safety construct and impression management to their respective indicators, which provided good model fit [$\chi^2$ (413) = 1310.28, $p < .05$; RMSEA = 0.057; CFI = 0.937; TLI = 0.929]. Next, the baseline model was established by linking the latent impression management factor to the safety construct indicators, followed by an unmeasured latent method factor (Williams and McGonagle, 2016). Finally, impression management and the unmeasured method factor were made orthogonal to the latent safety construct indicators (i.e., constrained to 0). Fit statistics for the baseline model suggested that it provided adequate fit [$\chi^2$ (454) = 1438.88, $p < .05$; RMSEA = 0.057; CFI = 0.931; TLI = 0.929].

The presence and equality of method effects was then examined. First, the impression management method factor loadings that were constrained to zero in the baseline model were freely estimated. A comparison of this model to the baseline model provided support for impression management as a method factor [$\Delta\chi^2$ (27) = 150.00, $p < .05$]. Second, factor loadings for the unmeasured method factor were freely estimated and a comparison of this model to the previous model (Model 3 vs. Model 4) provided support for the presence of an unmeasured method factor [$\Delta\chi^2$ (27) = 223.48, $p < .05$]. Two subsequent models were estimated wherein the method factor loadings were constrained to be equal among the indicators of each latent safety

[1] The recruitment e-mail for 387 people from this list was returned as undeliverable and 12 people replied indicating that they were not laboratory personnel.

[2] We are unable to provide an accurate response rate of who responded relative to who was eligible to respond (lab personnel) as the number of lab personnel is unknown.

**Table 1**
Impression management and unlikely virtues items used in Study 1, Study 2, and Study 3.

| Study 1 – Paulhus (1991) | Study 2 – Blasberg et al. (2014) | Study 3 – Weekley (2006) |
|---|---|---|
| 1. I believe there is never an excuse for lying. | 1. I have done unsafe things that I don't tell other people about. (R) | 1. I have never broken a traffic law. |
| 2. I always admit it when I make a mistake. | 2. I don't gossip about other people's business. | 2. I have never done something I believed was wrong. |
| 3. I rarely overindulge. | 3. There have been occasions when I have taken advantage of someone. (R) | 3. I have never done something I wasn't supposed to do. |
| 4. I have sometimes had to tell a lie. (R) | 4. I have said something bad about a friend behind their back. (R) | 4. I have never done something I wished I wouldn't have. |
| | 5. I never cover up my mistakes. | 5. I have never lost my temper. |

*Note.* R = reverse coded items.

**Table 2**
Study 1 – Descriptive statistics and inter-correlations.

| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| 1. Perceived job risk | 1.69 | 0.82 | (0.87) | | | | | | |
| 2. Safety knowledge | 4.46 | 0.58 | −0.07 | (0.92) | | | | | |
| 3. Safety climate | 4.16 | 0.76 | −0.20* | 0.47* | (0.95) | | | | |
| 4. Safety compliance | 4.40 | 0.63 | −0.19* | 0.75* | 0.54* | (0.93) | | | |
| 5. Safety participation | 4.12 | 0.69 | 0.02 | 0.63* | 0.52* | 0.62* | (0.89) | | |
| 6. Safety outcomes[a] | 1.43 | 3.83 | 0.22* | −0.06 | −0.20* | −0.15* | −0.05 | – | |
| 7. Impression management | 4.10 | 0.68 | −0.08* | 0.28* | 0.31* | 0.28* | 0.31* | −0.10* | (0.63) |

*Note.* $n = 757$. Coefficient alphas appear on the diagonal.
[a] Combined self-reports of injuries, incidents, and near misses.
* $p < .05$, two-tailed.

**Table 3**
Study 1 – Model 4 standardized factor loadings.

| Measure and indicator | Substantive estimates | Substantive estimates$^2$ | Impression management estimates | Impression management estimates$^2$ | Unmeasured factor estimates | Unmeasured factor estimates$^2$ |
|---|---|---|---|---|---|---|
| Perceived job risk – item 1 | 0.76* | 0.58 | −0.09 | 0.01 | 0.16* | 0.03 |
| Perceived job risk – item 2 | 0.88* | 0.77 | −0.03 | 0.00 | 0.07 | 0.00 |
| Perceived job risk – item 3 | 0.84* | 0.71 | −0.06 | 0.00 | 0.10 | 0.01 |
| Safety knowledge – item 1 | 0.77* | 0.59 | 0.31* | 0.10 | −0.22* | 0.05 |
| Safety knowledge – item 2 | 0.80* | 0.64 | 0.33* | 0.11 | −0.15* | 0.02 |
| Safety knowledge – item 3 | 0.83* | 0.69 | 0.29* | 0.08 | 0.08 | 0.01 |
| Safety knowledge – item 4 | 0.82* | 0.67 | 0.32* | 0.10 | 0.03 | 0.00 |
| Safety climate – item 1 | 0.81* | 0.66 | 0.37* | 0.14 | −0.04 | 0.00 |
| Safety climate – item 2 | 0.82* | 0.67 | 0.36* | 0.13 | 0.00 | 0.00 |
| Safety climate – item 3 | 0.79* | 0.62 | 0.33* | 0.11 | 0.09 | 0.01 |
| Safety climate – item 4 | 0.76* | 0.58 | 0.31* | 0.10 | −0.07 | 0.00 |
| Safety climate – item 5 | 0.66* | 0.44 | 0.25* | 0.06 | −0.23* | 0.05 |
| Safety climate – item 6 | 0.69* | 0.48 | 0.27* | 0.07 | −0.19* | 0.04 |
| Safety climate – item 7 | 0.71* | 0.50 | 0.28* | 0.08 | −0.20* | 0.04 |
| Safety climate – item 8 | 0.79* | 0.62 | 0.34* | 0.12 | 0.12* | 0.01 |
| Safety climate – item 9 | 0.69* | 0.48 | 0.33* | 0.11 | 0.09 | 0.01 |
| Safety compliance – item 1 | 0.75* | 0.56 | 0.33* | 0.11 | −0.25* | 0.06 |
| Safety compliance – item 2 | 0.78* | 0.61 | 0.28* | 0.08 | −0.29* | 0.08 |
| Safety compliance – item 3 | 0.80* | 0.64 | 0.36* | 0.13 | −0.31* | 0.10 |
| Safety compliance – item 4 | 0.79* | 0.62 | 0.37* | 0.14 | −0.20* | 0.04 |
| Safety participation – item 1 | 0.73* | 0.53 | 0.39* | 0.15 | 0.00 | 0.00 |
| Safety participation – item 2 | 0.76* | 0.58 | 0.38* | 0.14 | 0.12* | 0.01 |
| Safety participation – item 3 | 0.72* | 0.52 | 0.27* | 0.07 | 0.04 | 0.00 |
| Safety participation – item 4 | 0.74* | 0.55 | 0.27* | 0.07 | 0.13* | 0.02 |
| Safety outcomes – injuries | 0.67* | 0.45 | −0.06 | 0.00 | 0.05 | 0.00 |
| Safety outcomes – incidents | 0.71* | 0.50 | −0.04 | 0.00 | 0.01 | 0.00 |
| Safety outcomes – near misses | 0.57* | 0.32 | −0.13* | 0.02 | 0.19* | 0.04 |

* $p < .05$, two-tailed.

construct, but they provided significantly worse fit compared to the unconstrained model [$\Delta\chi^2$ (21) = 55.36, $p < .05$; $\Delta\chi^2$ (21) = 42.30, $p < .05$].

Hypothesis 1a and 1b were tested based on the standardized method factor loadings from the final unconstrained model (Table 3). Hypothesis 1a was supported; that is, the impression management latent factor was significantly positively related to self-reported indicators of safety climate, knowledge, and participation and compliance. Impression management accounted for a similar amount of variance in measures of safety climate (12%), compliance (12%), participation (12%), and knowledge (11%). In comparison, the unmeasured method factor was only consistently and significantly associated with indicators of safety compliance. Hypothesis 1b was partially supported; impression management was significantly negatively related to near misses, but accounted for a minimal amount of the variance in indicators of safety outcomes (1%) and perceived job risk (0.4%).

Hypothesis 2 was examined by comparing the substantive factor correlations from the baseline model with the same correlations from

**Table 4**
Study 1 – Safety construct substantive impression management factor correlations.

| Substantive factor correlations | | | Baseline model | Model 3 | VRR (Baseline vs. Model 3) | Model 4 | VRR (Baseline vs. Model 4) |
|---|---|---|---|---|---|---|---|
| Perceived job risk | – | Safety knowledge | −0.08 | −0.06 | 44% | −0.08 | 0% |
| Perceived job risk | – | Safety climate | −0.21* | −0.20* | 9% | −0.17* | 34% |
| Perceived job risk | – | Safety compliance | −0.19* | −0.18* | 10% | −0.09 | 78% |
| Perceived job risk | – | Safety participation | 0.01 | 0.05 | 0% | 0.02 | 0% |
| Perceived job risk | – | Safety outcomes | 0.27* | 0.26* | 7% | 0.22* | 34% |
| Safety knowledge | – | Safety climate | 0.50* | 0.41* | 33% | 0.42* | 29% |
| Safety knowledge | – | Safety compliance | 0.80* | 0.77* | 7% | 0.87* | 0% |
| Safety knowledge | – | Safety participation | 0.68* | 0.62* | 17% | 0.63* | 14% |
| Safety knowledge | – | Safety outcomes | −0.09 | −0.04 | 80% | −0.06 | 56% |
| Safety climate | – | Safety compliance | 0.57* | 0.48* | 29% | 0.47* | 32% |
| Safety climate | – | Safety participation | 0.57* | 0.47* | 32% | 0.50* | 23% |
| Safety climate | – | Safety outcomes | −0.22* | −0.19* | 25% | −0.16* | 47% |
| Safety compliance | – | Safety participation | 0.67* | 0.61* | 17% | 0.74* | 0% |
| Safety compliance | – | Safety outcomes | −0.18* | −0.14* | 40% | −0.05 | 92% |
| Safety participation | – | Safety outcomes | −0.08 | −0.04 | 75% | −0.07 | 23% |
| Average VRR | | | – | – | 28% | – | 31% |

*Note.* VRR = variance reduction rate between correlations at the baseline model and model 3 and model 4.
* $p < .05$, two-tailed.

the unconstrained impression management model and the final unconstrained model (Table 4). Variance reduction rates (VRR) were computed for changes in these correlations, which provides an indication of the proportion of shared variance among safety constructs attributable to impression management and the combination of impression management and the unmeasured method factor (Chen and Spector, 1991). Hypothesis 2 was almost fully supported as all but one of the correlations were reduced when accounting for impression management (Baseline vs. Model 3; average VRR = 28%). The largest consistent changes between the baseline model and unconstrained impression management model were for factor correlations with safety climate (average VRR = 26%). These same relationships were altered slightly with the inclusion of an unmeasured method factor (Baseline vs. Model 4; overall average VRR = 31%). Hypothesis 2 was further examined by comparing the unconstrained models to the same models with factor correlations among safety constructs constrained to their baseline values. Both comparisons were significant [$\Delta\chi^2$ (15) = 230.00, $p < .05$; $\Delta\chi^2$ (15) = 27.49, $p < .05$], leading to the conclusion that the method effects significantly altered relationships among safety constructs. Relationships were most frequently reduced when accounting for the method factors.

## 4. Discussion – Study 1

The *purpose* of this investigation was to estimate the extent to which impression management contaminates self-report measures of safety constructs. The results generally supported the contention that employees provided positively-biased responses to the safety measures. The impression management method factor loadings were positive and significant for self-reports of safety climate, knowledge, and behavior and negative for self-reports of near misses. Accounting for impression management and the unmeasured method factor led to significant changes in the safety construct relationships (average VRR = 28% and 31%), and the largest reductions were for relationships with safety climate. However, in some cases correlations among safety constructs strengthened when accounting for the method factors, suggesting that they might act as suppressors in these relationships.

### 4.1. Impression management substance vs. style

An underlying assumption of Study 1 was that the impression management scale provided a valid assessment of response distortion. However, there is debate concerning the validity of impression management scales as assessments of intentional dishonesty. As noted earlier, recent research suggests that there are both substantive (i.e., personality) and style (i.e., dishonesty) components of impression management scales (e.g., Borkenau and Ostendorf, 1992; Christiansen et al., 1994; McCrae and Costa, 1983). In a recent meta-analysis, Connelly and Chang (2016) found evidence for both substance and style of impression management; however, personality factor variance (i.e., Alpha factor variance [conscientiousness, agreeableness, and emotional stability]) outweighed the response pattern variance, demonstrating further evidence for the need to covary out the substantive trait variance.

The focus of this research is on impression management as a method bias on self-reports of safety constructs, and thus not the personality trait variance associated with measures of impression management. However, Study 1 did not account or control for this substantive variance. In turn, the relationships between impression management and the self-reported safety constructs are likely due in part to personality trait variance. Indeed, Beus et al. (2015) meta-analysis indicates that conscientiousness, agreeableness, and emotional stability are positive correlates of safety perceptions and behavior. Thus, a second study was conducted to (1) further examine impression management as a method bias in self-reports of safety while (2) accounting for personality trait variance in impression management scales. A personality measure was administered to respondents and controlled for to more accurately estimate the degree to which self-report measures of safety constructs are susceptible to impression management as a response bias.

**Hypothesis 3:**. *Impression management will be significantly related to self-reports of perceived job risk, and safety knowledge, climate, behavior, and outcomes, when controlling for Alpha personality trait variance (conscientiousness, agreeableness, and emotional stability).*

## 5. Method – Study 2

In Study 2, a similar survey was distributed to all laboratory personnel at a different university located in Qatar. A recruitment e-mail was sent to all faculty, staff, and students at the university (532 people), which included a link to an online laboratory safety survey. No incentive was provided for participating and no personally identifying information was collected from participants. A total of 123 laboratory personnel responded.[3] Unfortunately, the university does not keep a

[3] Two hundred people clicked on the survey link. Of those, 61 people indicated that they were not laboratory personnel and an additional 16 people opened and/or clicked through the survey without responding.

record of the total number of research laboratory personnel. Most respondents were research scientists or post-doctoral researchers (43; 39%), followed by principal investigators (12; 11%), laboratory managers and coordinators (12; 11%), graduate students (3; 3%), faculty teaching in a laboratory (3; 3%), and one administrator (1%). Respondents primarily worked in two types of laboratories: chemical (55; 45%) and mechanical/electrical (39; 32%). Twenty-nine (24%) respondents indicated that they worked in an uncategorized laboratory.[4]

### 5.1. Measures

#### 5.1.1. Safety constructs

Respondents completed the same six self-report measures of safety constructs that were used in Study 1: safety climate, safety knowledge, safety compliance, safety participation, perceived job risk, and injuries, incidents, and near misses in the previous 12 months.

#### 5.1.2. Impression management

Respondents completed a five-item measure of impression management from the Bidimensional Impression Management Index (Table 1; Blasberg et al., 2014). Five items from the Communal Management subscale were selected based on an assessment of their quality and degree to which they represent the 10-item scale.[5] A subset of Blasberg et al.'s (2014) full measure was used because of concerns from management about survey length. Items were responded to on a five-point agreement scale (1 = strongly disagree, 5 = strongly agree).

#### 5.1.3. Personality

Conscientiousness, agreeableness, and emotional stability were assessed using six items from Gosling et al. (2003) 10-item personality measure. Four items from the 10-item measure assessing openness to experience and extraversion were not included in this study. Respondents were asked to indicate the degree to which adjectives were representative of them (i.e., Conscientiousness – "dependable, self-disciplined;" Agreeableness – "sympathetic, warm;" Emotional stability – "calm, emotionally stable"; 1 = strongly disagree, 7 = strongly agree) and combined to represent the Alpha personality factor. One conscientiousness item was dropped because it had a negative item-total correlation ("disorganized, careless" [reverse coded]). This was not surprising as it was the only reverse-scored personality item administered.

## 6. Results

Hypothesis 1a and 1b were tested based on the correlations between impression management and the safety constructs[6] (Table 5). Correlations were similar to those in Study 1 and, in many cases, stronger, providing partial support for Hypothesis 1a and 1b. Impression management was significantly related to perceived job risk ($r = -0.26$, $p < .05$), safety knowledge ($r = 0.33$, $p < .05$), compliance ($r = 0.30$, $p < .05$), and outcomes ($r = -0.25$, $p < .05$), but impression management was not significantly related to safety climate ($r = 0.21$, $p > .05$) and participation ($r = 0.20$, $p > .05$).

Hypothesis 2 was examined by comparing the zero-order correlations among the safety constructs to partial correlations of the same relationships controlling for impression management (Ganster et al., 1983). Hypothesis 2 was generally supported as most correlations were reduced when controlling for impression management, particularly relationships with safety outcomes (average VRR = 74%). Impression management accounted for an overall average of 35% of the variance in the relationships among safety constructs. However, some correlations strengthened when controlling for impression management, especially correlations with perceived job risk.

Hypothesis 3 was tested by comparing the zero-order correlations between impression management and safety constructs and partial correlations of the same relationships, while controlling for the Alpha personality factor (Table 6). VRR for these comparisons is the proportion of shared variance between impression management and each safety construct attributable to the Alpha personality factor (Chen and Spector, 1991). Hypothesis 3 was supported, as the significant zero-order correlations remained significant when controlling for the Alpha personality factor (average overall VRR = 12%).

## 7. Discussion – Study 2

Results from Study 2 provided further support for the impact of impression management on the relationships among self-reported safety constructs. Impression management accounted for a larger proportion of variance in the relationships among safety constructs (average VRR = 35%) than that observed in Study 1. Impression management had the largest consistent effect on correlations with safety outcomes, a particularly notable result considering relationships with safety outcomes are fundamental in the safety domain. A second consideration in Study 2 was the substance and style of the impression management scale. Alpha personality (conscientiousness, agreeableness, emotional stability) indeed accounted for some of the variance in the relationships between impression management and the self-report measures of safety (12%). However, correlations between impression management and safety constructs remained significant even when controlling for Alpha personality trait variance.

Two limitations inherent in Study 1 and Study 2 were addressed in a third study, specifically, score reliability and generalizability. First, the reliability of the scores from these first two samples especially for the impression management scale was concerning, but not altogether inconsistent with previous results (see Li and Bagger, 2006; Ones et al., 1996). Correspondingly, an unlikely virtues measure (i.e., "intentional efforts to avoid answering in a frank and honest manner" Ellingson et al., 1999, p. 158) was used in Study 3, which arguably provides a better assessment of response distortion (Ellingson et al., 1999; Hough et al., 1990; Levashina et al., 2014; Weekley, 2006).

The second limitation is generalizability, including in particular the specific work environment and the safety predictors assessed in the first two studies. Both Study 1 and Study 2 were conducted using university research laboratory personnel. These personnel are exposed to various risks, exemplified by recent fatalities at university labs (see Allen, 2014). However, Study 3 used a sample of personnel from a more hazardous industry, oil and gas. Additional self-report measures of safety constructs were also added to the survey, namely, risk propensity (i.e., the extent to which individuals are inclined to engage in risky behaviors; Griffin, 2012), safety communication (i.e., the timeliness, accuracy, and usefulness of safety information; Griffin, 2012; Nahrgang et al., 2011), and safety motivation ("an individual's willingness to exert effort to enact safety behaviors and the valence associated with those behaviors;" Neal and Griffin, 2006, p. 947).

## 8. Method – Study 3

A safety survey was distributed to personnel at an oil and gas company in Qatar, as part of a larger collaboration to examine the effectiveness of a safety communication workshop. All employees (~370) were invited to participate in the survey and 107 responded (29% response rate). Respondents were asked to report their employee

[4] Follow up discussion with university administrators suggested that most personnel who indicated working in an uncategorized laboratory were likely from physics laboratories, as this option was not explicitly listed on the survey.

[5] We contacted Dr. Paulhus about a shortened version of the Bidimensional Impression Management index, but he did not have a shortened version to share.

[6] Confirmatory factor analyses were not used in Study 2 because the sample size was insufficient for those types of analyses given the number of parameters to be estimated.

**Table 5**
Study 2 – Descriptive statistics, inter-correlations, and partial correlations controlling for impression management.

| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Personality (Alpha factor) | 5.39 | 0.84 | (0.63) | | | | | | | |
| 2. Perceived job risk | 2.05 | 1.00 | 0.00<br>0.08<br>[0%] | (0.84) | | | | | | |
| 3. Safety knowledge | 4.54 | 0.51 | 0.23*<br>0.15<br>[57%] | 0.05<br>0.15<br>[0%] | (0.90) | | | | | |
| 4. Safety climate | 4.39 | 0.66 | 0.00<br>−0.07<br>[0%] | −0.12<br>−0.02<br>[97%] | 0.66*<br>0.65*<br>[3%] | (0.94) | | | | |
| 5. Safety compliance | 4.46 | 0.50 | 0.21<br>0.15<br>[49%] | 0.11<br>0.18<br>[0%] | 0.86*<br>0.85*<br>[2%] | 0.48*<br>0.51*<br>[0%] | (0.89) | | | |
| 6. Safety participation | 4.43 | 0.55 | 0.11<br>0.06<br>[70%] | 0.09<br>0.17<br>[0%] | 0.79*<br>0.78*<br>[3%] | 0.61*<br>0.55*<br>[19%] | 0.69*<br>0.70*<br>[0%] | (0.85) | | |
| 7. Safety outcomes[a] | 0.52 | 1.17 | −0.09<br>−0.01<br>[99%] | 0.18<br>0.05<br>[92%] | −0.14<br>−0.07<br>[75%] | −0.28<br>−0.18<br>[59%] | −0.14<br>−0.11<br>[38%] | −0.15<br>−0.07<br>[78%] | – | |
| 8. Impression management | 3.81 | 0.66 | 0.33*<br>[0%] | −0.26*<br>[97%] | 0.33*<br>[3%] | 0.21<br>[19%] | 0.30*<br>[0%] | 0.20<br>[78%] | −0.25*<br>[38%] | (0.63) |

*Note.* $n = 123$. Zero-order correlations are followed by partial correlations controlling for impression management and variance reduction rates. Coefficient alphas appear on the diagonal.
[a] Combined self-reports of injuries, incidents, and near misses.
* $p < .05$, two-tailed.

**Table 6**
Study 2 – Zero-order correlations, partial correlations controlling for personality, and variance reduction rates.

| Safety-related correlate of impression management | Zero-order correlations | Partial correlations (controlling for Alpha personality) | VRR |
|---|---|---|---|
| 1. Perceived job risk | −0.26* | −0.27* | 0% |
| 2. Safety knowledge | 0.33* | 0.27* | 26% |
| 3. Safety climate | 0.21 | 0.23 | 0% |
| 4. Safety compliance | 0.30* | 0.25* | 20% |
| 5. Safety participation | 0.20 | 0.17 | 13% |
| 6. Safety outcomes | −0.25* | −0.23* | 13% |
| Average VRR | | | 12% |

*Note.* VRR = variance reduction rate.
* $p < .05$, two-tailed.

identification numbers at the start of the survey, which was used to identify those who participated in the workshop. A majority of employees provided their identifying information (96, 90%; see Tables 7 and 8). The typical respondent was male (101, 94%) and had no supervisory responsibility (72, 67%); however, some women (6, 6%), supervisors (17, 16%), and managers/senior managers (16, 15%) also completed the survey.[7] The sample was diverse in national origin with most respondents from India (44, 42%) and Pakistan (25, 24%).

### 8.1. Measures

#### 8.1.1. Safety constructs

Respondents completed five of the same self-report measures of safety constructs used in Study 1 and Study 2, including safety climate (Beus et al., 2019), safety knowledge (Griffin and Neal, 2000), safety compliance (Griffin and Neal, 2000), safety participation (Griffin and Neal, 2000), and injuries, incidents, and near misses in the previous 6 months. Respondents completed a similar measure of perceived job risk (Jermier et al., 1989) that included three additional items assessing the degree to which physical, administrative, and personal controls effectively mitigate risks. Additional self-reports included a three-item measure of risk propensity, a 12-item measure of safety communication adapted from organizational and safety-specific communication measures (Frone and Major, 1988; Griffin, 2012; O'Reilly, 1982; Parker et al., 2001), and a three-item measure of safety motivation (Griffin and Neal, 2000).

[7] The total percentage of respondents by position does not add up to 100% because some respondents chose not to report their position.

**Table 7**
Study 3 – Identified and anonymous subsample demographic information and differences.

| Demographic | Identified ($n = 96$) | Anonymous ($n = 11$) |
|---|---|---|
| Age *M* (*SD*) | 46.44 (7.92) | 51.40 (6.55) |
| *Level* | | |
| Employee | 64 (67%) | 8 (73%) |
| Supervisor | 16 (17%) | 1 (9%) |
| Manager | 11 (12%) | 2 (18%) |
| Senior manager | 3 (3%) | – |
| *National heritage* | | |
| Bangladesh | 4 (4%) | – |
| Burma | – | 1 (9%) |
| Egypt | 3 (3%) | – |
| India | 39 (41%) | 5 (46%) |
| Indonesia | 4 (4%) | 1 (9%) |
| Jordan | 4 (4%) | 1 (9%) |
| Malaysia | 4 (4%) | – |
| Pakistan | 22 (23%) | 3 (27%) |
| Philippines | 6 (6%) | – |
| Qatar | 8 (8%) | – |
| U.S. | 1 (1%) | – |
| *Sex* | | |
| Female | 91 (95%) | 47 (45%) |
| Male | 5 (5%) | 58 (55%) |
| Tenure *M* (*SD*) | 12.76 (6.53) | 13.58 (6.87) |

*Note.* The identified and anonymous subsamples were not significantly different in any of these demographic variables based on independent samples *t*-tests (age, tenure) and Wilcoxon-Mann-Whitney nonparametric tests (level, race, sex). Percentages do not always add up to 100% due to rounding.

#### 8.1.2. Unlikely virtues

Five items were selected from Weekley's (2006) 10-item unlikely virtues measure (see also Levashina et al., 2014; Table 1) and were

**Table 8**
Study 3 – Identified and anonymous subsample descriptive statistics and inter-correlations.

| | Identified vs. Anonymous | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9[a] | 10 |
| 1. Perceived job risk | 2.13 | 0.60 | | 0.01 | 0.22 | −0.13 | 0.25 | 0.30 | 0.16 | 0.73* | – | −0.12 |
| 2. Risk propensity | 1.87 | 1.10 | 0.11 | | −0.55 | −0.12 | −0.29 | −0.30 | −0.56 | −0.13 | – | −0.32 |
| 3. Safety communication | 4.12 | 0.29 | −0.24* | 0.06 | | 0.44 | 0.74* | 0.64* | 0.83* | 0.53 | – | 0.42 |
| 4. Safety knowledge | 4.50 | 0.58 | −0.26* | −0.15 | 0.33* | | 0.71* | 0.73* | 0.69* | 0.25 | – | 0.75* |
| 5. Safety motivation | 4.23 | 0.63 | −0.36* | −0.18 | 0.37* | 0.63* | | 0.98* | 0.78* | 0.53 | – | 0.65* |
| 6. Safety climate | 4.18 | 0.58 | −0.26* | −0.12 | 0.70* | 0.54* | 0.55* | | 0.73* | 0.52 | – | 0.70* |
| 7. Safety compliance | 4.48 | 0.73 | −0.23* | −0.25* | 0.34* | 0.62* | 0.71* | 0.64* | | 0.59 | – | 0.46 |
| 8. Safety participation | 4.13 | 0.77 | −0.09 | −0.15 | 0.37* | 0.44* | 0.69* | 0.47* | 0.65* | | – | 0.22 |
| 9. Safety outcomes[b] | 3.00 | 4.24 | −0.24 | −0.17* | 0.08 | 0.13 | 0.02 | 0.25 | 0.12 | −0.18 | | – |
| 10. Unlikely virtues | 3.28 | 1.37 | −0.03 | −0.05 | 0.20 | 0.37* | 0.34* | 0.28* | 0.39* | 0.35* | −0.02 | |
| *M* | | | 2.36 | 1.94 | 4.01 | 4.55 | 4.41 | 4.24 | 4.52 | 4.24 | 0.81 | 3.55 |
| *SD* | | | 0.66 | 0.99 | 0.53 | 0.51 | 0.47 | 0.55 | 0.55 | 0.62 | 2.20 | 0.83 |

*Note.* Identified $n = 96$, Anonymous $n = 11$. Identified subsample correlations are below the diagonal and anonymous subsample correlations are above the diagonal.
[a] Correlations with safety outcomes are not reported for the anonymous subsample because there were not enough reported outcomes to assess these relationships.
[b] Combined self-reports of injuries, incidents, and near misses.
* $p < .05$, two-tailed.

responded to on a 5-point agreement scale (1 = strongly disagree; 5 = strongly agree). Akin to the previous studies, an abbreviated version of the measure was used because of constraints with survey length and the need to balance research and organizational objectives.

## 9. Results

Hypothesis 1a and 1b were examined based on the correlations between the unlikely virtues measure and the self-report measures of safety constructs[8] (Table 9). Results provided partial support for Hypothesis 1. Unlikely virtues displayed significant positive relationships with safety knowledge ($r = 0.40$, $p < .05$), safety motivation ($r = 0.31$, $p < .05$), and safety compliance ($r = 0.30$, $p < .05$), and a smaller positive relationship with safety participation ($r = 0.28$, $p > .05$). Unlikely virtues displayed non-significant and minimal relationships with risk propensity ($r = -0.13$, $p > .05$), safety communication ($r = 0.03$, $p > .05$), perceived job risk ($r = -0.02$, $p > .05$), and safety outcomes ($r = -0.01$, $p > .05$).

Hypothesis 2 was tested by comparing the zero-order correlations among safety constructs to the same relationships controlling for unlikely virtues (Table 9). Hypothesis 2 was partially supported. Most of the relationships among safety constructs were reduced when accounting for unlikely virtues, but the unlikely virtues measure on average accounted for less variance in the relationships among safety constructs than that observed in Study 1 and Study 2 (overall average VRR = 11%). The largest consistent changes were for relationships with safety knowledge (average VRR = 24%), whereas the unlikely virtues measure accounted for no variance in relationships with safety outcomes.

### 9.1. Exploratory analysis: identified vs. anonymous data

Respondents in Study 3 were asked to provide identifying information at the beginning of the safety survey. This investigation thus offers an opportunity to assess differences in the magnitude and effect of impression management across identified and anonymous safety survey data. Safety researchers and practitioners typically attempt to alleviate concerns about social desirability on self-report measures by ensuring the anonymity of their data (c.f., Lajunen and Summala, 2003). The aforementioned theoretical rationale suggests that employees should be more motivated to provide positively biased responses when data are identifiable because of the added cost that their individual responses might become known.

This comparison is exploratory, however, because most respondents in Study 3 provided identifying information ($n = 96$), as compared to those who chose to remain anonymous ($n = 11$). Mean scores on the unlikely virtues measure were higher in the identified subsample ($M = 3.55$, $SD = 0.83$), compared to the anonymous subsample ($M = 3.28$, $SD = 1.37$), but these means were not significantly different [$d = 0.24$, $t(94) = -0.90$, $p > .05$]. Unfortunately, there were not enough respondents in the anonymous subsample to compute partial correlations. However, an analogous comparison given this constraint was the average VRR for the full sample compared to the identified subsample. If the unlikely virtues measure accounted for larger variability in the identified vs. anonymous data, then the average VRR should be larger after removing anonymous respondents (Table 9 vs. Table 10). Results from this comparison reflected the opposite. The average VRR was lower in the identified subsample ($M = 2\%$, $SD = 0.07\%$) compared to the full sample ($M = 11\%$, $SD = 15\%$), and this difference was significant [$t(35) = -2.72$, $p < .05$].

## 10. General discussion

Safety researchers have provided few direct estimates of method bias in self-report measures of safety constructs. This oversight is especially problematic considering they rely heavily on self-reports to measure safety predictors and criteria. The *purpose* of this three-study investigation was to estimate the extent to which impression management contaminates self-reports of safety constructs. Impression management and safety were examined using two samples of research laboratory personnel and a sample of oil and gas personnel, following common methodology in safety research. That is, both predictors and criteria were self-reported at a single time point.

The results from all three studies, but especially the first two, suggest that self-reports of safety are susceptible to dishonesty aimed at presenting an overly positive representation of safety. In Study 1, self-reports of safety knowledge, climate, and behavior appeared to be more susceptible to impression management compared to self-reports of perceived job risk and safety outcomes. Study 2 provided additional support for impression management as a method bias in self-reports of both safety predictors and outcomes. Further, relationships between impression management and safety constructs remained significant even when controlling for Alpha personality trait variance (conscientiousness, agreeableness, emotional stability).

Findings from Study 3 provided less support for the biasing effect of

[8] Confirmatory factor analyses were not used in Study 3 (like Study 2) because the sample size was insufficient for those types of analyses, given the number of parameters to be estimated.

**Table 9**
Study 3 – Descriptive statistics, inter-correlations, and partial correlations controlling for unlikely virtues.

| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Perceived job risk | 2.33 | 0.65 | (0.64) | | | | | | | | | |
| 2. Risk propensity | 1.94 | 0.99 | 0.34* | (0.74) | | | | | | | | |
| | | | 0.34* | | | | | | | | | |
| | | | [0%] | | | | | | | | | |
| 3. Safety communication | 4.02 | 0.51 | −0.29 | 0.06 | (0.90) | | | | | | | |
| | | | −0.32 | 0.06 | | | | | | | | |
| | | | [0%] | [0%] | | | | | | | | |
| 4. Safety knowledge | 4.55 | 0.51 | −0.28 | −0.20 | 0.20 | (0.88) | | | | | | |
| | | | −0.29* | −0.16 | 0.14 | | | | | | | |
| | | | [0%] | [36%] | [51%] | | | | | | | |
| 5. Safety motivation | 4.39 | 0.49 | 0.55* | −0.28 | 0.30 | 0.61* | (0.79) | | | | | |
| | | | 0.58* | −0.25 | 0.27 | 0.56* | | | | | | |
| | | | [0%] | [20%] | [19%] | [16%] | | | | | | |
| 6. Safety climate | 4.23 | 0.55 | −0.35* | −0.12 | 0.58* | 0.59* | 0.60* | (0.93) | | | | |
| | | | −0.35* | −0.09 | 0.57* | 0.56* | 0.57* | | | | | |
| | | | [0%] | [44%] | [3%] | [10%] | [10%] | | | | | |
| 7. Safety compliance | 4.51 | 0.57 | −0.26 | −0.39* | 0.32 | 0.55* | 0.73* | 0.72* | (0.94) | | | |
| | | | −0.27 | −0.37* | 0.30 | 0.50* | 0.70* | 0.70* | | | | |
| | | | [0%] | [10%] | [12%] | [17%] | [8%] | [5%] | | | | |
| 8. Safety participation | 4.23 | 0.63 | −0.01 | −0.25 | 0.30 | 0.25 | 0.62* | 0.45* | 0.62* | (0.86) | | |
| | | | −0.01 | −0.22 | 0.27 | 0.16 | 0.58* | 0.41* | 0.65* | | | |
| | | | [0%] | [23%] | [19%] | [59%] | [12%] | [17%] | [0%] | | | |
| 9. Safety outcomes[a] | 0.51 | 0.86 | −0.14 | −0.22 | 0.13 | −0.01 | 0.05 | −0.03 | 0.13 | −0.05 | – | |
| | | | −0.14 | −0.22 | 0.14 | −0.01 | 0.06 | −0.03 | 0.14 | −0.05 | | |
| | | | [0%] | [0%] | [0%] | [0%] | [0%] | [0%] | [0%] | [0%] | | |
| 10. Unlikely virtues | 3.52 | 0.89 | −0.02 | −0.13 | 0.18 | 0.40* | 0.31* | 0.22 | 0.30* | 0.28 | −0.01 | (0.91) |

*Note.* $n = 107$. Zero-order correlations are followed by partial correlations controlling for unlikely virtues and variance reduction rates. Coefficient alphas appear on the diagonal.

[a] Combined self-reports of injuries, incidents, and near misses.

* $p < .05$, two-tailed.

impression management on self-report measures of safety constructs (average VRR = 11%). However, the unlikely virtues measure did reflect more reliable scores as those observed in Study 1 and Study 2 and it was significantly related to safety knowledge, motivation, and compliance. Controlling for the unlikely virtues measure led to the largest reductions in relationships with safety knowledge. Further exploratory comparison of identified vs. anonymous respondents observed that mean scores on the unlikely virtues measure were not significantly different for the identified subsample compared to the anonymous subsample; however, unlikely virtues had a larger impact on relationships among safety constructs for the anonymous subsample.

### *10.1. Theoretical implications*

The argument for impression management as a biasing variable in self-reports of safety relied on the salient social consequences to responding and other costs to providing a less desirable response, including for instance negative reactions from management, remedial training, or overtime work. This rationale is consistent with early theorizing on social desirability and more recent discussion of impression management as a method bias (Baumeister, 1982; Leary and Kowalski, 1990; Podsakoff et al., 2012; Stone, 1989). This theoretical explanation was not directly examined in the current studies. Findings suggest that the influence of impression management on self-report measures of safety constructs depends on various factors (e.g., distinct safety constructs, the identifying approach, industry and/or safety salience) rather than the ubiquitous claim that impression management serves as a pervasive method bias.

The results of Study 1 and Study 3 suggest that impression management was most influential as a method bias in self-report measures of safety climate, knowledge, and behavior, compared to perceived risk and safety outcomes. These results might reflect the more concrete nature of these constructs based on actual experience with hazards and outcomes. Moreover, these findings are in line with Christian et al.'s (2009) conclusion that measurement biases are less of an issue for safety outcomes compared to safety behavior. These findings in combination with theoretical rationale suggest that the social consequences of responding are more strongly elicited by self-report measures of safety climate, knowledge, and behavior, compared to self-reports of perceived job risk and safety outcomes. Items in safety perception and behavior measures fittingly tend to be more personally (e.g., safety compliance – "I carry out my work in a safe manner.") and socially relevant (e.g., safety climate – "My coworkers always follow safety procedures.").

The results from Study 2, compared to findings from Study 1 and Study 3, suggest that assessments of job risk and outcomes are also susceptible to impression management. The Alpha personality factor generally accounted for a smaller portion of the variance in the relationships between impression management and perceived risk and safety outcomes, findings consistent with Beus et al.'s (2015) meta-analysis. The largest effects of impression management on the relationships among safety constructs were for relationships with perceived risk and safety outcomes. These results align with research on injury underreporting (Probst et al., 2013; Probst and Estrada, 2010) and suggest that employees may have been reluctant to report safety outcomes even when they were administered on an anonymous survey used for research purposes.

These results in combination apply more broadly to method bias in workplace safety research. Christian et al. (2009) provided one of the few assessments of method variance in the safety literature and concluded that "common method bias may not be a major concern in the safety domain" (p. 1122). This pronouncement, however, appears to be premature. The results of these studies highlight the need for safety researchers to acknowledge the potential influence of method bias and to assess the extent to which measurement conditions elicit particular biases.

#### *10.1.1. Industry differences and safety salience*

We used three samples in part to determine if the effect of impression management generalizes. However, results from Study 3 were

**Table 10**
Study 3 identified subsample – zero-order correlations, partial correlations, and variance reduction rates.

| | | | Zero-order correlations | Partial correlations (controlling for UV) | VRR |
|---|---|---|---|---|---|
| Perceived job risk | – | Risk propensity | 0.30 | 0.30 | 0% |
| Perceived job risk | – | Safety communication | −0.36 | −0.35 | 5% |
| Perceived job risk | – | Safety knowledge | −0.16 | −0.23 | 0% |
| Perceived job risk | – | Safety motivation | −0.54 | −0.59 | 0% |
| Perceived job risk | – | Safety climate | −0.35 | −0.37 | 0% |
| Perceived job risk | – | Safety compliance | −0.32 | −0.37 | 0% |
| Perceived job risk | – | Safety participation | −0.08 | −0.13 | 0% |
| Perceived job risk | – | Safety outcomes | −0.24 | −0.24 | 0% |
| Risk propensity | – | Safety communication | 0.18 | 0.19 | 0% |
| Risk propensity | – | Safety knowledge | −0.21 | −0.24 | 0% |
| Risk propensity | – | Safety motivation | −0.29 | −0.30 | 0% |
| Risk propensity | – | Safety climate | −0.10 | −0.10 | 0% |
| Risk propensity | – | Safety compliance | −0.32 | −0.34 | 0% |
| Risk propensity | – | Safety participation | −0.21 | −0.24 | 0% |
| Risk propensity | – | Safety outcomes | −0.17 | −0.17 | 0% |
| Safety communication | – | Safety knowledge | 0.04 | 0.07 | 0% |
| Safety communication | – | Safety motivation | 0.19 | 0.21 | 0% |
| Safety communication | – | Safety climate | 0.49 | 0.49 | 0% |
| Safety communication | – | Safety compliance | 0.21 | 0.23 | 0% |
| Safety communication | – | Safety participation | 0.07 | 0.09 | 0% |
| Safety communication | – | Safety outcomes | 0.06 | 0.05 | 31% |
| Safety knowledge | – | Safety motivation | 0.62 | 0.60 | 6% |
| Safety knowledge | – | Safety climate | 0.62 | 0.64 | 0% |
| Safety knowledge | – | Safety compliance | 0.71 | 0.69 | 6% |
| Safety knowledge | – | Safety participation | 0.43 | 0.37 | 26% |
| Safety knowledge | – | Safety outcomes | 0.13 | 0.15 | 0% |
| Safety motivation | – | Safety climate | 0.60 | 0.60 | 0% |
| Safety motivation | – | Safety compliance | 0.82 | 0.81 | 2% |
| Safety motivation | – | Safety participation | 0.70 | 0.69 | 3% |
| Safety motivation | – | Safety outcomes | 0.02 | 0.02 | 0% |
| Safety climate | – | Safety compliance | 0.72 | 0.72 | 0% |
| Safety climate | – | Safety participation | 0.42 | 0.42 | 0% |
| Safety climate | – | Safety outcomes | 0.25 | 0.25 | 0% |
| Safety compliance | – | Safety participation | 0.61 | 0.59 | 6% |
| Safety compliance | – | Safety outcomes | 0.12 | 0.13 | 0% |
| Safety participation | – | Safety outcomes | −0.18 | −0.18 | 0% |
| Average VRR | | | – | – | 2% |

*Note*. UV = unlikely virtues; VRR = variance reduction rate.
* $p < .05$, two-tailed.

inconsistent with the observed effect of impression management in Studies 1 and 2. One possible explanation is that these findings are due to industry differences and specifically the salience of safety. There are clear risks associated with research laboratories as exemplified by notable incidents; however, the risks of bodily harm and death in the oil and gas industry tend to be much more salient (National Academies of Sciences, Engineering, and Medicine, 2018). Given these differences, employees from the oil and gas industry as reflected in this investigation might have been more *motivated* to provide a candid and honest response to self-report measures of safety. This explanation, however, is in need of more rigorous assessment.

#### 10.1.2. Identified vs. anonymous responding

Theoretically, identified data are more susceptible to impression management than unidentified data because they introduce the possibility that employee responses can become known to their organization. However, exploratory findings from Study 3 suggest the opposite, which might reflect discrepancies in the motivation underlying providing identifying information in combination with the placement of the identifying questions. For instance, the anonymous subsample in Study 3 might have represented those respondents who were already concerned about possible recourse and in turn they were more likely to provide positively-biased responses. Further research is needed to understand and identify the motivations underlying why and under what conditions respondents are more likely to provide identifying information. Based on the social psychological theory of deindividuation (Postmes and Spears, 1998), anonymity likely contributes to lower personalization and less concern with crossing social boundaries (e.g., providing a negative assessment of management's commitment to safety) (Saari and Scherbaum, 2011).

### 10.2. Practical implications

Overall, the results suggest that under certain conditions employees provide positively biased responses to self-report measures of safety, which can in turn impact the observed relationships among safety variables. However, the strongest correlations between impression management and safety were moderate in magnitude and impression management typically had a small effect (Cohen, 1988) on the relationships among safety constructs. Thus, a reasonable question is the degree to which the observed effects of impression management are practically meaningful.

We argue that these findings are practically relevant especially within the context of workplace safety. Safety research is profoundly complex and numerous factors act in combination to influence safety incidents and injuries (Hofmann et al., 2017). Thus, even small changes in the relationships among safety constructs can have substantial impact on how they are understood and, more importantly, how they are used to predict and reduce outcomes. It is also noteworthy that impression management suppressed relationships in some cases; thus, accounting for impression management might strengthen theoretically important relationships. These results also have meaningful implications for organizations because positively biased responding on safety surveys can contribute to the incorrect assumption that an organization

is safer than it really is.

The results of Study 2 are particularly concerning and practically relevant as they suggest that employees in certain cases are likely to underreport the number of safety outcomes that they experience even when their survey responses are anonymous. However, these findings were not reflected in results from Study 1 and Study 3. Thus, it appears that impression management serves as a method bias among self-reports of safety outcomes only in particular situations. Further research is needed to explicate the conditions under which employees are more/less likely to provide honest responses to self-report measures of safety outcomes.

The results of this investigation concerning the effect of impression management on relationships among safety knowledge, climate, and behavior are especially problematic considering self-reports are often the only means to assess these constructs. For instance, researchers almost unanimously measure safety climate using self-report measures (Beus et al., 2010). The focus of the current investigation was not to eradicate self-reports of safety as in many cases it is best practice to use self-reports. However, safety researchers do rely extensively on employee reports and the results of this investigation give some credence to concerns about impression management.

#### 10.2.1. Alternative approaches, sources, and methods

A practical issue that follows from the results of this investigation is how safety researchers should heed concerns about method bias in their studies. One common practice to reduce the potential impact of positive biases in self-report measures is the use of anonymous vs. identifiable surveys. The exploratory results from Study 3 suggest that requesting identifying information prior to the administration of a safety survey might contribute to more honest responding for those who provide identifying information, but this approach might also heighten biased responding for those who choose to remain anonymous. Research on differences between identified and anonymous surveys is particularly impactful because safety researchers often need to collect identifying information to more appropriately and effectively assess group-level safety constructs (e.g., safety climate).

Another common practice is to have an independent third party (e.g., consulting firm or university research team) conduct the survey, similar to Study 3 in this investigation. This way, no one in the organization has access to the individual employees' responses. The third party collects survey responses, compiles the data, and disseminates findings. Further, results of the survey are conveyed in aggregated form, so individual responses cannot be associated with specific employees.

An alternative measurement approach might involve altering current items to reduce the degree to which they elicit socially desirable responding (e.g., shifting the referent or perspective; Huang et al., 2014; Wallace et al., 2016). For instance, the individual referent for the following safety behavior item from Griffin and Neal's (2000) measure—"I use the correct personal protective equipment for the task I am doing"—could be altered to the workgroup referent—"My workgroup uses the correct protective equipment for the tasks they are doing." A similar alteration might involve focusing more heavily on the broader system rather than individual perceptions and behavior.

The extant literature also provides some guidance concerning alternative sources and methods of assessing safety constructs beyond self-report measures; however, it is important to acknowledge that these alternatives often come with their own set of challenges and biases. The most common alternative source of safety information is from supervisors, which have primarily been applied to assess safety behavior (Christian et al., 2009). However, the accuracy of supervisor-ratings is dependent on whether or not supervisors observe that which they are asked to rate. There has also been some, but very limited, research that seeks to assess safety constructs using alternative methods of assessment beyond surveys (e.g., Burke et al., 2008). For instance, Burke et al. (2008) used subject-matter experts to rate safety climate based on descriptions of organizations. Another option is to triangulate, gathering multiple assessments of the same constructs (Mathison, 1988).

### 10.3. Limitations and future directions

As with any study, there are limitations of this investigation that should be addressed in future research to more sufficiently estimate the effects of method bias in self-reports of safety. For one, some researchers have questioned the validity of measures used to assess faking, including social desirability and impression management (Griffith and Peterson, 2008; Ones et al., 1996; Uziel, 2010). There is empirical evidence to support their contention (e.g., Connelly and Chang, 2016), so we accounted for the substance and style of impression management scales in Study 2. However, a multitrait-multimethod study would permit parsing construct and method effects and thus, an interesting avenue for future research involves assessing impression management as a method bias using both self-reports and informant ratings (e.g., supervisor ratings) of various safety constructs (see Connelly and Chang, 2016; Kenny and Kashy, 1992). Relatedly, social desirability consists of both self-deception and intentional dishonesty (i.e., impression management) and whereas impression management was the primary focus in this investigation, future research might also explore the degree to which safety surveys are influenced by self-deception.

Another limitation of this investigation was the low reliability of scores on the impression management and personality measures, which is understandable considering we used shortened versions of longer measures. Some relationships with these constructs were inconsistent with theoretical rationale and empirical findings in the safety literature. Specifically, the Alpha personality factor was unrelated to perceived risk and safety climate; these findings are at odds with multiple meta-analyses (Beus et al., 2015; Christian et al., 2009; Clarke, 2010). The unlikely virtues measure in Study 3 was used to address issues with reliability in the first two studies and was indeed associated with more reliable scores. However, the higher reliability observed in Study 3 was also coupled with appreciably lower observed impact of impression management.

Moreover, comparison of the identified and anonymous subsample from Study 3 was exploratory because there were too few respondents in the anonymous subsample for comparison purposes. This is typical of a field study with employees who must be given discretion, per ethical guidelines, over whether and how they respond. Findings from this comparison clearly warrant further research to more confidently reveal potential differences between respondents who provide identified information and those who choose to remain anonymous.

Interesting avenues for future research following from this discussion are to examine various method biases and the specific conditions under which they are more or less likely to be prevalent in safety research. Method effects result from respondents, item characteristics and placement, and the context of the measurement setting (Podsakoff et al., 2012). Impression management was presented as one specific source of method bias argued to be particularly relevant in the context of safety because of the salient social consequences associated with responding to safety surveys. However, the results of this study in combination with the broader method bias literature suggest that specific method biases are not universally applicable in self-reports of safety, but rather that their influence depends on various factors (e.g., identified vs. anonymous responding). For instance, there are likely to be particular situations and measurement settings that elicit negatively biased responding on self-reports of safety (e.g., to get a reaction from management). In addition, there are likely other situational and environmental factors that contribute to both positively and negatively biased responding (e.g., job insecurity, economic recession) and factors

that might limit the degree to which employees can provide insight into why they might engage in unsafe behavior (e.g., inadequate time, equipment, and resources).

## 11. Conclusion

This investigation offered a step towards better understanding the effect of method bias in safety research. Three studies estimated the degree to which impression management contaminated self-reports of safety constructs using anonymous and partially identified surveys. The results from Study 1 and Study 2 but to a lesser extent Study 3 suggest that employees provide positively biased self-reports of safety, which in turn contaminate estimates of the relationships among some safety constructs. Impression management does not appear to be a pervasive method bias in self-report measures of safety, but rather its influence may depend on additional considerations (e.g., safety salience). These findings stress the need for safety researchers to further examine method bias in safety surveys and to seek alternative means of assessing safety constructs as well as other practical solutions to limit biases.

## Acknowledgements

This work was supported by the Mary Kay O'Connor Process Safety Center at Texas A&M University. An earlier version of this paper was presented at the 31st Annual Conference of the Society for Industrial and Organizational Psychology in Anaheim, CA. We wish to thank Luc Vechot and Atif Mohammed Ashraf for their assistance with Study 3. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Declaration of Competing Interest

None.

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