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Cognitive failures in response to emotional contagion: Their effects on workplace accidents

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ABSTRACT

The purpose of this study was to examine contagion of positive and negative emotions among employees as an antecedent of cognitive failures and subsequent workplace accidents. Using emotional contagion theory and the neural model of emotion and cognition, we tested the proposition that higher contagion of anger (i.e., a negative emotion accompanied by dysfunctional cognition) would be associated with greater cognitive failures, whereas higher contagion of joy (i.e., a positive emotion accompanied by pleasant information processing, attention and positive cognition) would be associated with fewer cognitive failures. In turn, cognitive failures were predicted to be related to higher rates of subsequent workplace accidents. Using a two-wave lagged design, anonymous survey data collected from $N = 390$ working adults in the U.S. supported the hypothesized mediation model. Specifically, emotional contagion of anger positively predicted cognitive failures, whereas emotional contagion of joy negatively predicted cognitive failures. Furthermore, cognitive failures positively predicted experienced accidents and fully mediated the relationship between contagion of joy/anger and experienced accidents. These findings suggest that lapses in cognitive functioning may be prevented by positive emotions (and enhanced by negative emotions) that employees absorb during social interactions at work and represent a more proximal source of accidents in comparison to emotions. Theoretical and practical implications of these results are discussed in light of the globally rising rates of workplace accidents and related costs for safety.

1. Introduction

Cognitive failures can be defined as cognitive-based errors resulting from problems with memory, attention or action, and occurring in a simple task that a person should normally do without mistakes (Martin, 1983). Workplace cognitive failures are breakdowns in cognitive processing at work that previous research has found to be associated with safety accidents (Wadsworth et al., 2003; Wallace and Chen, 2005). While the association between cognitive processing and workplace accidents is well established, there is a dearth of information examining the role of emotions in the occurrence of cognitive-based human errors causing accidents at work. For example, some literature suggests an association between cognitive failures and emotion-related factors such as positive and negative affectivity, depression, worry, stress and anxiety (Mahoney and King, 1998; Payne and Schnapp, 2014; Robertson et al., 1997; Wagle et al., 1999), and subsequent workplace accidents (Wadsworth et al., 2003). Yet, no study has explored whether and to what extent basic discrete emotions exchanged among employees during their social interactions at work (i.e., emotional contagion) play a role in safety accidents resulting from inattention, distraction and mental errors.

The purpose of this research was to examine emotional contagion of positive and negative emotions among employees as an antecedent of cognitive failures and subsequent workplace accidents. Using emotional contagion theory (Hatfield et al., 1994) and the neural model of emotion and cognition (Izard and Malatesta, 1987; LeDoux, 2002), we test the proposition that higher contagion of anger (i.e., a negative emotion accompanied by dysfunctional cognition; Andrieş, 2011) will be associated with greater cognitive failures, whereas higher contagion of joy (i.e., a positive emotion accompanied by pleasant information processing, attention and positive cognition; Andrieş, 2011) will be associated with fewer cognitive failures. In turn, cognitive failures are predicted to be related to higher rates of workplace accidents. Fig. 1 presents an overview of our overarching conceptual model. Specifically, emotional contagion is the automatic and unintentional tendency of humans to absorb emotional cues of another individual, thus converging

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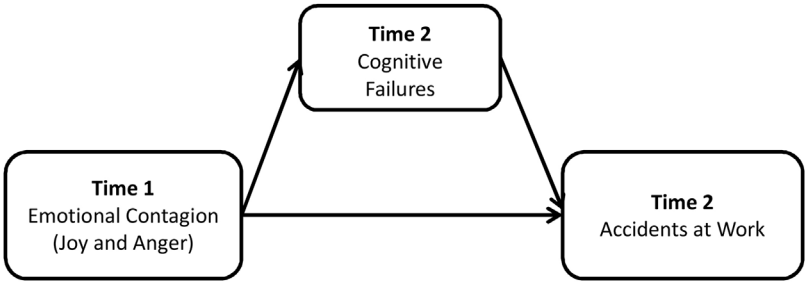

Fig. 1. Conceptual mediation model.

emotionally on the same affective experience (Hatfield et al., 1994). That is, the joy that employees involuntarily absorb while interacting with others at work (i.e., contagion of joy) makes them experience an optimal operating condition and helps them stay positive and pleasant in processing information (Andrieş, 2011; Seligman, 2002), thus being provided with greater energy required to complete an activity in a safe manner. Conversely, employees who are infected with anger from others (i.e., contagion of anger) may experience an unpleasant condition that induces perceived inability to control the course of events, negative thinking, and dysfunctional information processing (Andrieş, 2011), thus diminishing the resources to cope with attentive and safe completion of a task.

In testing these propositions, our study makes several important distinct contributions to the literature. First, we seek to understand the role of emotions in the emergence of cognitive lapses and potentially related unsafe behaviors. While emotional contagion occurs *below conscious recognition* because emotional cues activate the limbic system, the neocortex receives the emotional signal milliseconds thereafter thus *enabling the conscious awareness* of one's emotional exchanges with others (LeDoux, 2002). As such, individuals at work undergo implicit processes through which they are involuntarily and automatically "infected" by emotion of others that virally spread in large social communities (Hatfield et al., 2012). Notably, individuals are also able to manage the emotion they absorb from others by becoming *subsequently aware* of these aspects of emotional experiences at the workplace (Andrieş, 2011). As such, employees' experience of contagion at work and the possibility of becoming aware of socially absorbed emotions is an important first step to help employees improving their ability to manage their emotional resources so as to gaining emotional awareness and the ability to manage emotional experience (Brehm, 1999; Troth et al., 2017) that prevent interference with dysfunctional cognitive processing. Our current study represents the first to test whether employees impaired cognitive functioning that may result into work accidents is associated with emotions that they involuntarily absorb from others during social interactions at work. Although we study emotional contagion and not positive and negative affectivity, we mirror the study of Payne and Schnapp (2014) on positive and negative affectivity associated with problems with everyday functions and activities, and engage a similar balanced approach (i.e., consider both the positive and negative aspects of emotion-related factors) in order to examine the effects of contagion of a positive and a negative emotion (i.e., joy and anger) on employee cognitive failures and workplace accidents.

Our study also bridges the literatures in the often disparate fields of emotion, cognition, and occupational safety by examining the safety-related outcomes of the interplay between emotional contagion and cognitive failures within organizations. Given that emotion is a key factor in understanding the variation in behavior (Gutnik et al., 2006), our proposed conceptual model including the role of emotion, as well as its interplay with cognition, increases our ability to account for workplace accidents. In doing so, the current study goes beyond the study of affect-related factors that occur solely intrapsychically (e.g., anxiety) and focuses on emotion that is interpersonally induced (Barsade et al., 2009) during social interactions at work, (i.e., contagion of discrete basic emotions). This is consistent with Hatfield and colleague' (Hatfield et al., 2014) suggestion that during social interaction people's own emotions are more influenced by the non-verbal and unconscious clues of other rather than what they are really feeling. As such, understanding emotional contagion as an emotion-related factor with a strong social component as an antecedent of cognitive failures and subsequent safety outcomes may have crucial implications for the development of effective emotion management interventions at work. Specifically, we seek to evaluate how social interactions at work shape their emotional experience (Troth et al., 2017) potentially influencing the quality of their cognitive functioning and subsequent likelihood of experiencing accidents/injuries at work.

In the sections below, we review the literature and develop our hypotheses on the relationship between cognitive failures, workplace accidents and emotional contagion of positive and negative emotions.

2. Cognitive failures and workplace accidents

Employees often experience off-task thoughts or behaviors at work that are not intended (e.g., occasionally forgetting important work-related procedures or instructions, being distracted by co-workers, or throwing valuable documents away unintentionally). While on-task effort refers to enacting behavior that increases task completion and success (e.g., planning and execution of task strategies), off-task effort consists of engaging in task-irrelevant thoughts that inhibit successful task performance (Wallace and Chen, 2005). Building on Martin's (1983) definition of cognitive failures in everyday life as unintended execution lapses, Wallace and Chen (2005) conceptualize workplace cognitive failures as off-task cognitions and behaviors consisting of cognitively based errors that occur during the performance of a work-related task that the employee is normally successful in executing.

Workplace cognitive failures encompass three main areas of impaired cognitive functioning (Wallace and Chen, 2005): (a) memory (i.e., failures related to information retrieval), (b) attention (i.e., failures in perception), and (c) action (i.e., the performance of unintended actions, or action slips; Norman, 1981). Specifically, the memory component is defined as the unsuccessful recall of relevant and familiar work-related information. The attention dimension refers to a breakdown in employee perceptual and attentional focus on on-task (i.e. task-relevant) information while working. The action component consists of unsuccessful execution of appropriate on-task behaviors in an intended or purposeful manner.

The common thread of the three workplace cognitive failure dimensions is the departure from functional cognitive operation, which leads to unintended outcomes through these various off-task execution lapses (Broadbent et al., 1982). As such, the three dimensions combined in a higher order factor more fully captures the off-task cognitive processes that may lead to safety behaviors at work, and are likely to predict behavioral outcomes (e.g., safety) better than each specific component in isolation. "At best, such errors detract from effective job performance, but at worst they can result in disastrous accidents." (Wallace and Chen, 2005, p. 615). Indeed, cognitive failures have been shown to relate to safety-related outcomes, such as industrial and

transportation accidents (Hassanzadeh-Rangi et al., 2014; Wallace and Vodanovich, 2003), injuries across different occupational settings (Wallace and Chen, 2005), and near misses (Allahyari et al., 2014). Furthermore, a study from Bridger et al. (2012) suggests that employees with higher susceptibility to cognitive failures are approximately four times more likely to have an accident compared to accident-free controls.

Consistent with the above arguments, we expect to find the following:

Hypothesis 1. Cognitive failures positively predict experienced accidents.

While we expected to replicate these earlier findings reporting the effects of cognitive lapses on accidents experienced at work, the primary contribution to be made by the current study lies in investigating the contagion of positive and negative emotions that employees infect into each other while interacting at work as a predictor of such cognitive failures and subsequent accidents.

3. Emotional contagion at work as a predictor of cognitive failures and accidents

Off-task effort refers not only to errors due to task-irrelevant thoughts but also to negative feelings (e.g., anxiety), both of which may inhibit successful task performance (Wallace and Chen, 2005). While literature indicates that emotions can impair cognitive functioning, until recently, there has been little attempt to examine how discrete basic emotions (Ekman, 1999) experienced by employees at work can cause task errors and accidents. Indeed, some evidence suggest that cognitive failures are associated with worry and boredom (Robertson et al., 1997), which can affect control in executing intended action (Kanfer and Ackerman, 1996). In the current study we focus on basic discrete emotions (e.g., joy, anger) because they are caused by genetic heritage and play an adaptive function, thus being universal (i.e., manifested in all cultures; Ekman, 1999) and generating findings and knowledge that are largely applicable to different organizational contexts. Moreover, the prototypical features associated to each discrete basic emotion may help individuals to "call" their feelings and assign them to objects or specific causes (Brehm, 1999), thus gaining emotional awareness and the ability to manage emotional experience and behavior. We specifically examine the extent to which these discrete basic emotions that employees inevitably and unintentionally exchange among each other when interacting at work (i.e., emotional contagion) may lead to subsequent increases or decreases in cognitive failures and experienced accidents at work.

As noted above, during social interaction people's own emotions are more influenced by the others' non-verbal and unconscious clues (i.e., emotional contagion) than what people are really feeling (Hatfield et al., 2014). Furthermore, emotional contagion is of critical importance in understanding human cognition and behavior (Hatfield et al., 2009). Therefore, in the current study we account for the social sources of emotions that employees involuntarily absorb from others at work and thus focus on both unintended emotional (i.e., emotional contagion) and cognitive (i.e., cognitive failures) interference with task performance that may lead employees to jeopardize safety (i.e., accidents).

According to emotional contagion theory, people tend to mimic the facial, vocal, postural, and behavioral emotional cues "of those around them, and thereby "catch" others' emotions as a consequence of such facial, vocal, and postural feedback" (Hatfield et al., 1993; p.3). The simultaneous detection and reflection of the emotional cues of others occurs below conscious recognition and is enabled by the Mirror Neuron System mimicking the brain activation pattern underlying an emotional stimulus (Iacoboni, 2009; Rizzolatti and Sinigaglia, 2008). As such, emotional contagion refers to a nonconscious process through which humans automatically detect emotions of those with whom they relate, thus allowing absorption of the same emotion (Hatfield and Rapson, 1998). Thus, it refers to an individual experience of emotion that includes the interpersonal component of the feelings exchanged during social encounters (Hatfield et al., 1993). The contagion of emotions is activated involuntarily and automatically by involving the limbic system that is mainly associated with detecting biologically relevant cues including emotions expressed by peoples' faces and bodies (Prochazkova and Kret, 2017). Yet, the neocortex receives the emotional signal milliseconds thereafter thus *enabling the subsequent conscious awareness* of one's emotional exchanges with others (LeDoux, 2002). Consistently, it is possible to ask people to report their contagion experience on a survey (Petitta and Naughton, 2015), as is the method used in the present study. As such, emotional contagion involves "epidemic" spreading of emotions among all employees interacting at work (Hatfield et al., 2012; Petitta and Naughton, 2015).

As noted by Barsade and Gibson (2007), emotional contagion has an inherent social component; yet, it can be studied, and consistently operationalized, at the individual (e.g., being prone to catching other people's emotions, Hatfield et al., 1994), dyadic (e.g., emotional exchanges between: salespersons and customers, Pugh, 2001; teachers and students, Bakker, 2005), and group level (e.g., affect transfer among group members, Barsade, 2002). The current study utilizes an individual-level perspective of emotional contagion, understood as the individual's experience of feeling an emotion that s/he has absorbed from other people while interacting in the workplace. In doing so, we avoid measuring an individual general susceptibility to pick a mix of others' affective clues, such as emotions, feelings, moods (Hatfield and Rapson, 1998) and follow Doherty's (1997) suggestion to target the absorption of discrete basic emotions (e.g., joy, anger). Finally, we conceptualize emotional contagion at work as emotional exchanges that occur among employees and thus contextualized to work settings, rather than in general situations of an individual's life (Doherty, 1997; Hatfield and Rapson, 1998).

As noted above, emotional contagion is of critical importance in understanding human cognition and behavior (Hatfield et al., 2009). According to neural models of emotion and cognition (Izard, 1992; LeDoux, 2002), emotion can be activated by a thalamo-amygdala (subcortical) pathway that can operate independently of the neocortex and of cognition requiring cortical processing or integration (LeDoux, 1987). "This evidence is consistent with the notion of the ontogenetic primacy of emotions and the functioning of emotion feeling-motivational states in advance of cognitive development (Izard and Malatesta, 1987)." (Izard, 1992, p. 563). The relevance of the amygdala as the key to emotional experiences has also been consistently supported by neuroscience research (Armony and LeDoux, 1997; Prochazkova and Kret, 2017) suggesting that the basolateral nuclei of the amygdala attaches emotional significance to a stimulus. Next, the information from this region is subsequently sent to brain regions that are implicated in cognitive processing of emotional stimuli (e.g., the cingulate gyrus, temporal pole, the medial orbitofrontal cortex, and the medial prefrontal cortex). As such, employees' experience of contagion at work and the possibility of becoming aware of socially absorbed emotions is an important first step to develop the ability to manage one's own emotional experience and inhibit emotional states that may undermine action (Brehm, 1999; Kanfer and Heggested, 1997; Troth et al., 2017), thus strengthening task attention and preventing allocation of off-task effort (i.e., engaging in task-irrelevant thoughts and feelings of anxiety) and the likelihood of occurrence of workplace cognitive failure (i.e., off-task cognitions) and related safety breach behaviors such as workplace accidents (Wallace and Chen, 2005).

Taken together, our arguments from emotional contagion theory and neural literature on emotion and cognition provide an overarching framework for including emotions and their contagion among employees at the workplace as predictors of cognitive failures during task performance, and subsequent accidents. Specifically, we propose that contagion of negative emotions (e.g., anger) among employees may

interfere with their cognitive functioning and thus increase cognitive failures and related accidents at work. Conversely, contagion of positive emotions (e.g., joy) may support optimal cognitive functioning and thus prevent cognitive lapses and the likelihood of accidents.

As noted earlier, Payne and Schnapp (2014) conducted a study on the effects of both positive and negative affective experiences on cognitive failures in everyday functions. The authors found that positive affect dimensions such as joviality and cheerfulness were negatively related to distractibility and cognitive problems with memory errors and blunders. On the other hand, negative affective experiences like hostility were linked to increased errors on assessments for a variety of executive functions, including attention, working memory, and verbal fluency. Additional literature mainly skewed toward the study of the interfering effects of negative emotions on cognitive functioning suggests that fear, stress and disgust (Wallace and Chen, 2005) or worry and boredom (Robertson et al., 1997) or anger, frustration and anxiety (Gilboa et al., 2008; Simpson et al., 2005) may put individuals at a higher risk for engaging in off-task behaviors, and thus experiencing more accidents at work (Allahyari et al., 2014; Hassanzadeh-Rangi et al., 2014; Simpson et al., 2005; Wallace and Chen, 2005).

Indeed, literature suggests that negative emotions such as anger are associated with an unpleasant state that induces perceived inability to control the course of events, negative thinking, reduced capacity of discernment, and an information processing dysfunctionally sucked into unpleasant situations (Andrieş, 2011). Conversely, positive emotions such as joy are associated with optimal operating condition (Seligman, 2002), intellectual curiosity, sharpened attention and positive thoughts, and the experience of remaining positive and pleasant in processing information (Andrieş, 2011).

While no study has examined the effects of emotional contagion of anger on employee cognitive failures, we can speculate that employees who absorb anger from others during social interactions at work are likely to experience higher hindrance to their cognitive functioning and more perceptual, attentional, memory, and action-related mental lapses (Broadbent et al., 1982). Not only do negative emotions (i.e., anger) compromise employee cognitive processes by narrowing attention (Gilboa et al., 2008), but they also are associated with safety aversive behaviors and workplace accidents. For example, Dunbar (1993) found that anxiety was related to reductions in employee use of personal protective equipment. Similarly, Shoss and Probst (2012) suggest that negative emotions may narrow perceptual focus thus causing individuals to miss important performance-related cues and act without considering the consequences of their actions. In the current study, we expect a similar effect such that the contagion of anger will interfere with employees optimal mental processing and prevent them from completing a work task safely, thus leading them to experience more workplace accidents. Accordingly, we argue that contagion of joy will provide employees with the experience of a pleasant condition that contributes to sharpen their attention and improves cognitive functioning helping them to avoid safety hazards and experience less accidents.

Consistent with the above arguments, we predict the following:

Hypothesis 2. Emotional contagion of joy absorbed from others negatively predicts cognitive failures (2a), whereas emotional contagion of anger absorbed from others positively predicts cognitive failures (2b).

Hypothesis 3. Emotional contagion of joy absorbed from others negatively predicts experienced accidents (3a), both directly and indirectly via cognitive failures. Emotional contagion of anger absorbed from others positively predicts experienced accidents (3b), both directly and indirectly via cognitive failures.

4. Method

4.1. Participants and procedure

In order to test our hypotheses, we collected anonymous survey data via Qualtrics from a sample of U.S. adult workers. Due to the anonymity of the data and low risk to participants, the study was classified as exempt by the second author's Institutional Review Board (Protocol #: 15967). After providing participants with informed consent materials that explained the anonymous nature of the data collection and their rights as research participants, employees completed the on-line survey containing the research measures through Amazon's Mechanical Turk, an online human subjects' crowdsourcing platform. As recommended by Peer et al. (2014), we only recruited "high reputation" participants who had an established track record of providing high quality data to previous crowd-sourced tasks. Specifically, we required a minimum 90% prior approval rating across a minimum of 100 previously completed tasks. Moreover, we embedded multiple attention checks throughout each survey administration as an additional quality control.

Data were collected at two time points (baseline and a one-month follow-up). In order to incentivize continued participation at both times, participants were offered $4 for completing the survey at Time 1 (T1) and an additional $5 for completing the Time 2 (T2) survey. The sample consisted of $N = 390$ individuals. Fifty-six percent of respondents were male. The mean age of participants was 35.81 years ($SD = 10.7$). The average employee organizational tenure with the current employer was 5.6 years ($SD = 4.6$). Fifty-six percent of employees worked for a private company and 43.8% belonged to public organizations. The vast majority (75.6%) held a permanent position within their organization. Over half (62.9%) had been with their current employer for 5 or more years ($M = 5.61$ years; $SD = 4.63$), with a range from less than 1 year to 32 years. The average years of education from respondents was 14.69 (roughly corresponding to "some college"). Ninety-four percent of respondents were full-time workers and 100% of the sample worked in a position that exposed them to risk of injuries. The mean hours of work in a typical week was 41.1 ($SD = 8.4$). Seventy-seven percent of respondents worked during the day shift, 6.7% in swing shift, 4.6% in night shift, and 12.1% in rotating shifts. Finally, twenty-one different industry sectors were represented, with the largest numbers coming from health care (13.3%), retail trade (12.3%), manufacturing (10%), construction (8.7%), and transportation/warehousing (6.7%). The average household income from respondents was $62,311.92 ($SD = 37,079.12$), with a range from $716,600 to $20,000,000.

4.2. Measures

In order to reduce the problems associated with mono-method bias, we followed recommendations by Podsakoff et al. (2012) and introduced a 1-month temporal lag between our predictors of cognitive failures and accidents at work. Specifically, our conceptual antecedents (emotional contagion of joy and emotional contagion of anger) were measured at T1, whereas our subsequent outcomes (cognitive failures and accidents at work) were measured one month later at T2. Below is a description of measures used to provide data for the current analyses.

4.2.1. Emotional contagion

Emotional contagion from the perspective of basic and discrete emotions absorbed by the respondent (i.e., EC absorbed) at the workplace was measured by two subscales (i.e., joy absorbed and anger absorbed) of the Emotional Contagion at Work Scale (Petitta and Naughton, 2015). Previous findings support the empirical distinctiveness of contagion of the two discrete basic emotions assessed in this research, namely, joy and anger (Petitta and Naughton, 2015). The ECWS assesses emotional contagion by presenting respondents with items that represent different work-situated emotional experiences. The

sub-scale of joy absorbed by others (joy-absorbed) includes four items. A sample item is, "*Interacting with happy people makes me feel better when I am a little down*". The sub-scale of anger absorbed by others (anger-absorbed) includes five item. A sample item is, "*When someone is angry and raises their voice, I become irritated.*" Respondents were provided a prompt describing the emotional situation as the frame of reference and then were asked to indicate how frequently they experienced the described emotional situations using a 5-point Likert response scale, ranging from 1 (*Never*) to 5 (*Always*). Higher scores of "joy absorbed" and "anger absorbed" reflect greater levels of joy and anger being absorbed from others at work (i.e., greater absorption of emotional contagion).

4.2.2. Cognitive failures

We used the Workplace Cognitive Failure Scale, developed by Wallace and Chen (2005), to measure cognitively based errors that occur during the performance of a task that the person is normally successful in executing. Fifteen items measured three components of workplace cognitive failure. Five items measure the subscale of memory, which refers to information retrieval failures. A sample item subscale is: *Cannot remember what materials are required to complete a particular task?* Five items measure the subscale of attention, which refers to failures in perception. A sample is: *Day-dream when you ought to be listening to somebody?* Five items measure the subscale of action, which refers to performance of unintended actions. A sample item is: *Accidentally started or stopped the wrong machine?* Respondents were asked to indicate their agreement using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

4.2.3. Experienced accidents

Using a measure (Probst et al., 2013) adapted from Hayes et al. (1998), employees were asked to indicate how many safety accidents they *experienced and reported* to appropriate company officials (i.e., How many accidents did you experience and report to your supervisor in the last 12 months?) and how many accidents they had *experienced but were not reported* to appropriate company officials (i.e., How many accidents did you experience but NOT report to your supervisor in the last 12 months?) over the past 12 months. In order to ensure consistent interpretation of the question, we provided the following definition for the term *Accident*: An unplanned and uncontrolled event that led to: injury to persons, damage to property/plant/equipment, or some other loss to the company. Using these data, we could compute the total number of experienced accidents, both reported and not reported. Although the workplace accident variables were self-report in nature, previous studies do indicate that self-report measures of accidents and unsafe behaviors are related to independent observations of these variables (Lusk et al., 1995).

4.3. Analytical strategy

In order to maximize the reliability and parsimony of our structural equation model, item parcels were created for cognitive failures measure consisting with fifteen items. This factor was defined by three parcels in order to obtain less free parameters to estimate and to reduce the sources of sampling error (Little, 2013). Specifically, each parcel was created by averaging five items which were sequentially assigned based on the highest to lowest item-total corrected correlations (Little et al., 2013). In order to test our measurement model and evaluate the distinctiveness of the latent constructs of the present study, we performed an initial confirmatory factor analysis with MPlus 8 (Muthén and Muthén, 1998–2017) consisting of the hypothesized three latent variables (i.e., emotional contagion of joy, emotional contagion of anger and cognitive failures) and their respective item-level indicators. Consistent with literature suggestion (e.g., Arbuckle, 1996), we used a robust maximum likelihood estimator (MLR) and a full information maximum likelihood approach (FIML) to handle missing data, which is robust to violations of the assumption that data are missing completely at random (MCAR) and provides a full information modeling technique (i.e., uses all available data without listwise deletion).

Next, we tested two alternative versions of our substantive structural equation model. In the first model (Model 1), we hypothesized both direct and indirect (through cognitive failures) effects of emotional contagion on experienced accidents (i.e., partial mediation model). In the second model (Model 2), the direct effects were constrained to zero and cognitive failures fully mediated the relationship of emotional contagion with experienced accidents (i.e., total mediation model). Given that Model 1 is nested within Model 2, they were statistically compared by means of $\Delta\chi^2_{(\Delta df)}$ in order to determine the final model to retain. If $\Delta\chi^2$ is not significant for an alpha level of .01 (Scott-Lennox and Scott-Lennox, 1995), the more parsimonious model (i.e., the full mediation model or Model 2) should not be rejected. Finally, indirect effects were assessed considering the 95% confidence intervals (CI) around their estimates derived on 10,000 bootstrapped sample replications (MacKinnon et al., 2004).

5. Results

5.1. Test of measurement model

The model showed an excellent fit to the data: $\chi^2_{(df=51,\ N=390)} = 104.847$, $p < .001$, RMSEA = .052 (.038–.066), CFI = .971, TLI = .963, SRMR = .040., thus supporting the distinctiveness of the study latent variables.

5.2. Descriptive statistics and correlations

Table 1 presents the descriptive statistics, scale reliabilities, and intercorrelations among the study variables at the two time points. As shown in the diagonal, each study variable meets the criterion for internal consistency reliability, ranging from .83 to .91. Emotional contagion of joy (joy-contagion) measured at T1 was significantly and negatively correlated with cognitive failures measured at T2 ($r = -.19$, $p < .001$), but not significantly related to experienced accidents (measured at T2). Emotional contagion of anger (anger-contagion) measured at T1 was significantly and positively correlated with both T2 cognitive failures ($r = .41$, $p < .001$) and subsequent T2 experienced accidents ($r = .17$, $p < .01$). Moreover, higher levels of T2 cognitive failures were associated with increased T2 experienced accidents ($r = .23$, $p < .001$).

5.3. Test of structural model

The partial mediation model (Model 1)[1] examining the relationships

[1] We also tested two alternative models in order to assess whether the three separate components of cognitive failures and their possible interactions are better predictors of safety outcomes rather than the one factor structure. Specifically, the first alternative model (Model 1) included a three-factor cognitive failures structure, rather than the single factor defined by the three components of cognitive failures recommended by the literature (Wallace and Chen, 2005). The second model (Model 2) included three multiplicative terms among the three components of cognitive failures (i.e., memory × attention, attention × action, memory × action), which were added to Model 1 as independent predictors of experienced accidents. Moreover, interaction terms were posited as correlated with the three components of cognitive failures. Notably, neither Model 1 nor Model 2 are nested within our hypothesized model. Additionally, given that Model 2 was tested by using numerical integration, fit indices such as RMSEA, CFI, TLI, etc. are not calculable. Thus, in order to compare our hypothesized model with Model 1 and Model 2, we relied on three information criteria: AIC, BIC, and Sample-Size Adjusted BIC. Lower values of these indices indicate a better model. Information criteria for our hypothesized model was: AIC = 12,953.87, BIC = 13,120.45, Sample-Size

Table 1
Descriptive statistics.

Variable	*M*	SD	1	2	3	4
Emotional Contagion Joy (T1)	3.55	.96	*.83*			
Emotional Contagion Anger (T1)	2.31	.86	.05	*.86*		
Cognitive Failures (T2)	1.87	.64	−.19**	.41*	*.91*	
Accidents (T2)	1.68	2.89	.07	.17**	.23**	–

Cronbach's alpha reliability coefficients are on the diagonal.
* $p < .05$
** $p < .01$.

between emotional contagion of joy and emotional contagion of anger at T1 and subsequent cognitive failures at T2, which in turn predict workplace accidents (T2), showed a good fit to the data: $\chi^2_{(df=60,\ N=390)} = 115.255$, $p < .001$, RMSEA = .049 (.035–.062), CFI = .97, TLI = .96, SRMR = .038. Similarly, the full mediation model (Model 2) showed a good fit to the data: $\chi^2_{(df=62,\ N=390)} = 121.758$, $p < .001$, RMSEA = .050 (.037–.063), CFI = .97, TLI = .96, SRMR = .038. Given that the full mediation Model 2 was more parsimonious and was not worse than Model 1 ($\Delta\chi^2_{(2)} = 6.79$, $p = .033$), we concluded that Model 2 cannot be rejected and retained this as the final substantive model of the study. As can be seen (Fig. 2), and as predicted by Hypothesis 1, cognitive failures at T2 positively predicted experienced accidents at T2 (.25, $p < .001$). Moreover, emotional contagion of joy at T1 negatively predicted subsequent cognitive failures at T2 (−.23, $p < .001$). Similarly, emotional contagion of anger at T1 positively predicted subsequent cognitive failures at T2 (.49, $p < .001$). Together, these findings provide support for Hypothesis 2.

Finally, emotional contagion of joy (T1) exerted a negative indirect effect on experienced accidents (T2) through cognitive failures (T2) (−.058; CI −.091 to −.030) while emotional contagion of anger (T1) exerted a positive indirect effect on experience accidents (T2) through cognitive failures (.124; CI .069–.124). However, neither emotional contagion of anger nor joy exhibited direct effects on experienced accidents at Time 2, since the full mediation model (Model 2) did not result in worsening of model fit with respect to the partial mediation model (Model 1). Thus, partial support for Hypothesis 3 was found, suggesting cognitive failures completely mediate the effects of emotional contagion on experienced accidents. Overall, the model explained the 28% of cognitive failures variance and 7% of experienced accidents variance.

6. Discussion

Globally, surveillance statistics indicate that workers annually experience approximately 260 million occupational injuries and 350,000 fatalities due to work-related injuries (Hämäläinen et al., 2006). While the detrimental impact of negative emotions on employee cognitive failures (i.e., problems with memory, attention or action) and accidents at work has been previously documented, the current study is the first to specifically explore how the contagion of both positive and negative discrete basic emotions among employees may act as an explanatory mechanism of mental lapses that occur while performing a task and related accidents that employee may experience. Moreover, it is in line with literature suggesting that during social interaction people's own emotions are more influenced by the others' unconscious and non-verbal clues than by what people are really feeling (Hatfield et al., 2014), and provides initial support to the idea that emotional exchanges among employees can impact the flow of cognitive functioning (Carrigan and Barkus, 2016).

As such, the purpose of the current study was to examine the extent to which the contagion of anger vs. joy among employees at the workplace may prompt vs. prevent errors in cognitive functioning, thus increasing the likelihood of unsafe task performance and the occurrence of accidents. In doing so, we sought to gain a better understanding not only of the role of discrete basic emotions (both positive and negative) but also of the unwanted and unintentional nature of their absorption by individuals during social interactions at work (i.e., emotional contagion) in the emergence of involuntary cognitive lapses and task-irrelevant thoughts that inhibit successful task performance and may result into work accidents.

Our findings from a two-wave lagged design suggest that emotional contagion of anger may prompt failures related to attention, information retrieval, and the performance of unintended actions (i.e., cognitive failures), whereas emotional contagion of joy may prevent the occurrence of such mental lapses. In turn, cognitive failures may increase the experience of work accidents and fully mediate the relationship between contagion of joy/anger and accidents. That is, distracting off-task efforts may be reduced by positive emotional contagion at work (and, alternately, increased by contagion of negative emotions). As such, organizations may expect higher rates of accidents as a result of greater employee perceived inability to control the course of events, negative thinking, and reduced capacity of discernment caused by high levels of anger exchanged among employees, which interfere with correct task performance. Conversely, organizations may expect lower rates of accidents as a result of employee optimal operating condition, strengthened task attention and the employee experience of remaining positive and pleasant in processing information that is due to high exchanges of joyful emotional experience.

6.1. Theoretical implications

Our results have implications for the extant literature in the areas of workplace safety and emotional contagion. First, our study attempt to integrate emotional contagion theory with research on workplace safety. Specifically, we extended earlier research on cognitive failures showing a relationship between emotion-related factors and cognitive failures by reporting that contagion of both positive and negative emotions would be associated with subsequent mental lapses. That is, emotional contagion of anger among employees could raise the levels of employee errors and lapses in cognitive functioning, whereas contagion of joy would associate with fewer cognitive errors.

As such, it appears that emotions absorbed by employees through automatic and unwanted processes associated with social interaction at work could play a relevant role in the quality of cognitive functioning of employees and related likelihood of experiencing an accident. This comports with Hatfield's (Hatfield et al., 2014) assertion that during social life individuals' own emotions are more influenced by emotional clues unconsciously absorbed by others as compared to what they are really feeling. Furthermore, our results add to the growing relevance of positive psychology (Fredrickson, 2001) in the workplace stating that positive emotions are associated with optimal operating condition by reporting that emotional contagion of joy may prevent inattention, distraction and mental errors that lead to work accidents. As such, the current study goes beyond prior perspectives viewing emotion as a negative influence and hindrance to the cognitive process (Gutnik et al.,

(*footnote continued*)
Adjusted BIC = 12,987.18. Model 1 yielded the following fit indices and information criteria values: $\chi^2_{(df=56,\ N=390)} = 111.77$, $p < .001$, RMSEA = .051 (.037–.064), CFI = .972, TLI = .960, SRMR = .041, AIC = 12,954.51, BIC = 13,144.89, Sample-Size Adjusted BIC = 12,992.58. As can be seen, our substantive model showed lower information criteria values than those observed for Model 1. Furthermore, the three components of cognitive failures exerted no significant effect on experienced accidents. Finally, Model 2 showed higher information criteria values (AIC = 14,090.711, BIC = 14,388.17, Sample-Size Adjusted BIC = 14,150.20) in comparison to our hypothesized model. Thus, consistent with the literature suggesting that a single factor defined by the three components of cognitive failures is likely to predict safety outcomes better than each specific component in isolation (Wallace and Chen, 2005), we retained the hypothesized model.

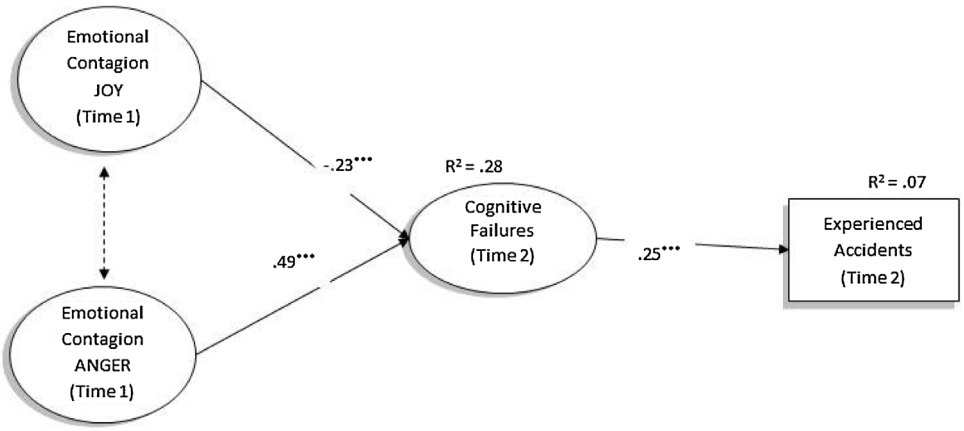

Fig. 2. Standardized structural coefficients for the structural model. *Note.* $^{***}p < 001$; dotted lines are statistically non-significant estimates.

2006), and the exclusive focus on accidents occurring due to negative emotions that tax attentional processes. Specifically, our study reports that the contagion of positive emotions (i.e., joy) may help in preventing safety breakdowns.

Second, not only would cognitive failures be affected by emotional contagion but they also would fully mediate the relationship between contagion and accidents. This finding is in line with literature on cognitive failures suggesting that workplace cognitive failure is likely to mediate the influences of more distal motivational/emotional factors (Kanfer and Heggested, 1997; Wallace and Chen, 2005). Similarly, we found that contagion of emotions is a more distal predictor of accidents. Moreover, our study results lend support to the Affective Primacy theory (Izard, 1991; LeDoux, 1998; Rizzolatti and Sinigaglia, 2008) suggesting that emotional responses are triggered prior to the information processing in the cortex. Thus, the current study informs safety research that employees accidents may be the result not only of impaired cognitive processing but also of unintentional and implicit absorption of emotions from other employees that may play a key role in the occurrence of accidents at work by shaping the quality of cognitive performance of employee.

Finally, we also extend previous theorizing about emotional contagion by incorporating cognitive failures and workplace accidents. While literature has established an interdependence of emotion and cognition in the emergence of emotional contagion (e.g., Hatfield et al., 2014; Prochazkova and Kret, 2017), the current study is the first to consider how unaware absorption of emotions (i.e., emotional contagion) at work may act as an explanatory mechanism of impairment/facilitation of cognitive functioning that underpins employee error-free and safe performance of a work task. Specifically, we found evidence that employee absorption of positive/negative emotions coupled with the quality of mental processes involved in task execution were jointly associated with the likelihood of subsequent unsafe outcomes (i.e., work accidents). In doing so, we consider the effects on safety of two involuntary and implicit processes of employee functioning: unaware contagion of emotions and involuntary mental lapses. It is recalled that individuals unconsciously catch other's emotional clues but subsequently become aware (i.e., the neural signal reaches the neocortex, which is associated with higher self-awareness brain function) of the emotional contagion they have experienced (and thus can report it by answering to a measurement scale).

6.2. Practical Implications

From a practical perspective, the results of this study have several implications. First, our finding that higher levels of workplace cognitive failures are associated with more work accidents may serve as a warning to organizations that employee distractibility allows irrelevant information to interfere with performance of a current activity (Bergman et al., 1995) and maintenance of goal-directed thinking (Carrigan and Barkus, 2016). On the one hand, greater cognitive failures are known to be associated with interpersonal and environmental stress (Collip et al., 2013; Gunthert et al., 1999) as well as problems whilst dealing with contextual time-pressures (e.g., production pressure) or chaotic surrounds (Kane et al., 2007). On the other hand, strict attentional focus is a cognitive management style rooted into individuals' control of action that serve to strengthen task attention and executive control in organizing and maintaining actions and thoughts according to ones' goals (Kanfer and Ackerman, 1996; Kiefer, 2012). As such, organizations may develop safety interventions aimed at reducing contextual triggers of distractibility and related slips in cognitive operation (e.g., noise, chaos, stress, workload fatigue, time pressure), as well as increase *mindful* safety practices, understood as the ability to be *aware* of critical factors in the environment and to act appropriately when dangers arise (Dahl and Kongsvik, 2018). In other words, organizations should not only intervene on fundamental features of safety (e.g., environment) but also send consistent visible signals that indicate to workers that safety is valued and prioritized, and that safety practices are supported and rewarded.

Second, and more importantly, our findings on how employee slips in cognitive functioning would be shaped by emotions that are socially exchanged at work calls for organizational attention to the social and relational environment wherein employees invest a substantial part of their emotional energies and thus contribute to the quality of their life and behavior at work (Andrieş, 2011). If emotional contagion and cognitive failures are involuntary processes, how can organizations intervene in order to capitalize on the benefits of contagion of joy while preventing negative effects of contagion of anger on lapses in cognitive functioning? The answer may yet lie in a combination of factors associated with individuals' emotional and cognitive functioning and the management of emotion- and cognition-related processes: (a) self-awareness, (b) self-regulation, and (c) self-control.

Effective emotion management requires knowledge about the nature of emotions (Andrieş, 2011; Troth et al., 2017), thus enabling to improve employees' ability to manage their emotional resources so as to adapt to job requirements and work to increase organizational effectiveness and safety. Specifically, employees self-awareness of emotional processes is the first step to recognize how one's own social interactions with people at work contribute to feelings of joy and anger as well as the mechanisms through which these emotions may cause one to experience distractibility, as opposed to optimal functioning, in cognitive control and possible subsequent accidents. Consistent with Gross's (1998) model of emotional regulation, this may help incumbents to develop copying skills by examining the conditions under which they reappraise their cognitions and subsequently regulate their emotions.

Additionally, involvement practices and participative decision-making that allow employees to develop sense-making and regain control may help in experiencing fewer negative emotions (Probst, 2005). As such, intervention programs might fruitfully provide management and employees with tools to help them augment the experience of absorption of joy, and conversely inhibit the experience of absorbing other's anger. For example, emotion management techniques such as mindfulness have been shown to be effective in alleviating the absorption of negative emotions by reducing rumination (Sander, 2013). This may help preventing work errors in that mind-wandering could serve as the catalyst for many of the most common types of failures (Carrigan and Barkus, 2016). Furthermore, mindful individuals are better equipped to avoid involuntary cognitive errors because they are more aware of both external environment as well as internal processes (Kelloway et al., 2017). Mindfulness practices may increase employee self-endorsed behavioral regulation and thus allow them to engage in safer and healthier behavior patterns (Brown and Ryan, 2003). Finally, mindfulness also applied to leaders in relation to safety management may enhance leaders' emotional and cognitive self-regulation thus facilitating the achievement of safety-related goals while also developing better-quality relationships with followers, which lead to increased safety performance (Kelloway et al., 2017). Overall, successful emotion management interventions rely on organization's authentic respect for the emotional experience of employees at work, on emotional behavior of the leader, and on employee participation in trainings on emotional skills development that should always be optional and not required (Andrieş, 2011).

6.3. Strengths, limitations, and future perspectives

Although this study makes several contributions to the extant literature, its findings also warrant further investigation. First, although drawing from a broadly diverse sample of workers employed within a wide variety of industry sectors throughout the United States, the current research relies on self-report data from a convenience sample. Therefore, an arguable limitation might be that our findings have been affected by self-selection biases in the kinds of employees that agreed to participate. As such, replication of our effects in additional cultural contexts either than the U.S. would be useful. Moreover, one may argue that the use of MTurk workers as a sampling strategy may raise questions regarding the generalizability of the findings and concerns about data quality. A study of the representativeness of MTurk workers (Paolacci et al., 2010) suggests that MTurk workers tend to be younger, more likely to be female, have higher education levels, but have fairly similar levels of household income compared to the overall U.S. workforce. A comparison of our sample demographics to the U.S. workforce indicates that our sample was quite representative based on gender (44% female vs. 46.9% in the population), but was slightly younger (35.81 years old vs. a median age of 41 in the US workforce), and had on average 2.6 years education more than the population (14.7 vs. 12.1 years). Thus, our current results should be interpreted in light of these caveats. Finally, literature suggests that data obtained by MTurk workers tend to be as equally valid as data obtained from other sources (e.g., college student samples, job applicants) as long as steps are taken to ensure data quality (Barger and Sinar, 2011; Behrend et al., 2011; Buhrmester et al., 2011). Consistently, the current study recruited only "high reputation" participants who had an established track record of providing high quality data to previous crowd-sourced tasks (Peer et al., 2014) and embedded multiple attention checks throughout each survey administration as an additional quality control. As such, we followed best practices in the use of MTurk sampling strategy in order to obtain quality data.

Second, while the likelihood of common method variance is minimized by the cross-lagged data used in the current research that introduce temporal distance between our predictors and outcomes, future studies where the predictors are measured at Time 1, mediators are measured at Time 2, and outcomes are measured at Time 3 would be ideal for testing longitudinal hypotheses. Additionally, longitudinal design using latent growth curve models could examine within-person processes (i.e., cognitive failures).

Furthermore, while our study outcome (i.e. workplace accidents) was self-report in nature and thus potentially biased by respondents' social desirability, previous studies do indicate that self-report measures of accidents are related to independent observations of these variables (Lusk et al., 1995). As such, it is less likely that the results of the current study were affected by this factor. Nonetheless, we recommend that, when possible, researchers collect data from multiple sources (e.g., supervisors or organizational records) to overcome the potential problems caused by common method variance. Finally, a more experimental approach in the future studies may complement and expand upon the current correlational results. While experimentally manipulating emotions in the workplace poses ethical and practical challenges, such studies could be done in a laboratory setting to evaluate their impact on safety-related behaviors using a similar experimental safety paradigm as Probst (2002).

Third, future research can delineate the influence of contagion of additional discrete emotions. Given that literature (Gilboa et al., 2008; Wallace and Chen, 2005) suggests that negative emotions (e.g., worry, anxiety) increase the number of accidents experienced by employees, future studies may consider the impact of contagion of other discrete emotions (e.g., sadness, fear) on employee cognitive functioning and subsequent flawless and safe task performance.

Finally, future studies might also extend the current findings by examining other safety-related outcomes of the interplay between emotional contagion and cognitive failures beyond experienced accidents. For example, future research might consider accident underreporting, near misses as well as actual experiences of workplace injuries.

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