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'The canary in the coal mine': A multi-level analysis of the role of hope in managing safety performance of underground miners

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ABSTRACT

Coal mining is one of the most dangerous occupations in China despite the enforcement of stringent industry regulations and investments in modern safety equipment. In recent years, the majority of accidents in coal mining have been attributed to human errors. This study offers new insights into combatting coal mining accidents by focusing on 'soft' human factors from the perspective of coal miners. We draw from positive psychology to argue that hope and team reflexivity play critical roles in transforming management commitment to safety into desired safety outcomes. We test our model using multi-level analysis on a sample ($n = 487$) of underground miners in 98 coal mining sites in China. The results show that hope mediates the influence of management commitment to safety on miners' behaviors towards both safety compliance and safety participation. Team reflexivity, as a team-level property, is found to positively moderate the association between management commitment to safety and miners' hope. We discuss the implications of our findings that hope can be the 'the canary in the coal mine' in predicting safety behavior of coal miners.

1. Introduction

Underground coal mining is infamously known as one of the most dangerous occupations in China with frequent accidents from suffocation, gas poisoning, roof collapse, rock burst, outbursts, and gas explosions (He and Song, 2012). According to China's State Administration of Coal Mine Safety (2019), there were 170 accidents in Chinese coal mines involving 316 fatalities in 2019. The high incidence of accidents is in spite of stringent workplace safety regulations by the government since 2000 (Shi, 2009), the closure of a large number of illegal underground mines (MOHRSS, 2018), and investment in technology upgrade for controlling, detecting and eliminating hazards (Jiang, 2018). The root causes of these fatalities – e.g., 80% to 90% of accidents in relation to coal-dust explosions, blasting, haulage and hoisting equipments – are reported to be due to human errors rather than defective equipments and technology (Meng and Li, 2012; Zhu et al., 2018).

Consistent with the broader workplace safety literature where accidents are linked to human errors (Hale et al., 2010; Swuste et al., 2012), the role of human factors in relation to accidents in coal mining has likewise generated increasing interest from researchers. Among human factors that have been explored (e.g., stress, Leung et al., 2012), management commitment to safety (MCS) is the most frequently occurring theme (Hofmann et al., 2017; Zohar, 2010). While a consensus is yet to evolve on the expressions of MCS, it is generally expressed as workers' perceptions of management's concerns and attitudes towards safety issues

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(Huang et al., 2012; O'Toole, 2002; Zohar, 2010). An implicit assumption underlying this line of research is that positive safety cues from management fosters desired employee behaviors (Avolio et al., 2004; Eid et al., 2012; Vinodkumar and Bhasi, 2010). Indeed, MCS has been linked as its own or as part of safety climate to safety performance (Christian et al., 2009; DeJoy et al., 2010). In this literature, safety performance includes both safety compliance, a type of task behaviors associated with safe work practices (e.g. complying with safety rules and regulations), and safety participation, a type of contextual voluntary behaviors supporting an organization's overall safety (e.g., attending safety meetings voluntarily and promoting safety programs therein) (Griffin and Neal, 2000).

Despite knowledge of the importance of MCS, research on the mechanisms that transform it into safety performance, i.e. how to support this process, remains theoretically underspecified (Bamel et al., 2020). Since the primary goal of safety research is to provide guidance for improving safety in organizations, it requires not only knowledge about contributing factors to safety performance, but also how this influence occurs (Vinodkumar and Bhasi, 2010). To date, a small amount of research has examined safety knowledge (Huang et al., 2006; Huang et al., 2012), role definition (Chmiel et al., 2017) and communication (Fernández-Muñiz et al., 2012) in explaining the influence of management commitment to safety in reducing injury incidences and promoting safety behaviors. Notwithstanding their contributions, these studies mainly concern workers' deficiencies in safety competency and motivations while overlooking positive responses to organizational contexts such as MCS. While workers can sense the emphasis placed on safety by management, they might not necessarily act, respond, or behave in ways that fulfill such a management concern. The nature of underground coal mining as dirty, risky and physically unpleasant may block workers' motivations, making positive outlook and forward-looking pathways especially important (Wicks, 2002). Therefore, the available competency and motivation-based perspective is insufficient in explaining the positive psychological mechanism that transforms MCS into safety behavior of miners (see Stajkovic and Luthans, 1998). This is likely to explain why Vinodkumar and Bhasi (2010) failed to find a mediated relationship between management commitment to safety and safety behavior via safety knowledge or motivation. Relatedly, research on the boundary conditions of the MCS-safety performance link also remains underdeveloped, thereby limiting our understanding for fostering desired safety behaviors (Bamel et al., 2020).

The objective of this study is therefore to address the above-mentioned limitations by developing and testing a theoretically-based conceptual model which explicitly considers the underlying mechanism and boundary condition of the relationship between MCS and safety behavior of underground coal miners. We draw from theory of hope (Snyder, 1994; Snyder, Harris, et al., 1991a) to argue that the psychological processes captured in the concept of hope provides positive, useful resources, especially in stressful work environments, for influencing safety behavior. Essentially, MCS captures workers' interpretation of contextual cues on safety-related matters (Christian et al., 2009), a goal-oriented pursuit enshrined in the cognitive conceptualization of hope. In other words, we focus specifically on hope, as compared to other positive psychology concepts, because of its explicit focus on goal, agency and pathways (Snyder, 2002). We further draw from the theory of hope to argue that team reflexivity, a regulatory process in which team members reflect upon experience or observations, communicate and adapt the team's objectives and strategies to situations (West, 2000), moderates the MCS-hope relationship. Fig. 1 summarizes our research model in a multi-level fashion. We follow previous conceptualization of MCS (Zohar, 2010) by focusing on front-line team leaders as they assume an important role in setting work atmosphere and safety climate (Flin et al., 2000).

This study makes several contributions as follows. First, it enriches safety research of coal miners by bringing 'soft' human factor to the forefront with a multi-level view of how MCS influences safety performance. Second, it provides empirical evidence for the role of hope as a mediator of the MCS-safety performance relationship. The specific focus on hope overcomes the limitations of previous conceptualizations that treat hope as part of a composite measure along with resilience, optimism and self-efficacy as psychological capital (Eid et al., 2012), which may produce confounding results (Dawkins et al., 2013). Third, our study sharpens understandings of safety performance by offering fresh insights into the role of team reflexivity as the contingency factor underlying the influence of MCS on hope. Our moderated-mediation conceptual model thus provides a more nuanced understanding of how and when MCS predicts miners' safety behavior. Last, with the study conducted in the context of high incidence of fatalities in China's coal mining sector, it has practical implications for informing the design of safety interventions.

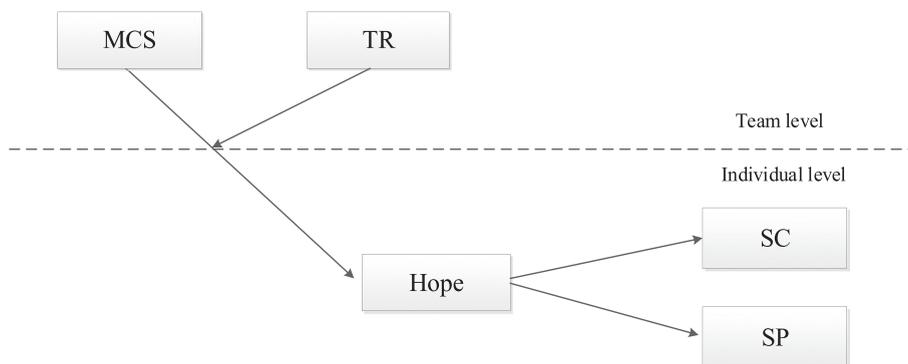


Fig. 1. Conceptual multi-level model of MCS on safety performance

MCS: Management commitment to safety; TR: Team reflexivity; SC: Safety compliance; SP: Safety participation.

Table 1
Summary table of hope and related constructs.

	Hope	Optimism	Self-efficacy
Meaning	the self-agency and the pathways regarding goals	the belief that good things will happen, by luck or by internal striving	the perceived capacity to act
Time perspective	future oriented	future oriented	temporal
Components	willpower (personal agency of specific goals) waypower (goal-related pathways)	positive expectations of future outcomes broadly	outcome expectancy based on specific situational contingencies
Scope	cross-situational, enduring, or situational goal-directed thoughts, or all three	general expectations	situation-specific (e.g. task) goals
Motivational state	will-do (the intention to be willful)		can-do (the capacity to act)
Signals	experience, resourcefulness	trusting on good luck	

2. Theoretical background and hypotheses

2.1. Theory of hope

Theory of hope (Snyder, 1994, 2000) is an emerging theory in positive psychology that explains positive human development from the perspective of hope as an important psychological resource. Designed originally to explain people's behavior in making excuses for mistakes and failure (Mehlman and Snyder, 1985), Snyder et al. (2000) identified a cognitive concept of hope as capturing people's desire to seek goals. Within this theory, the concept of hope has evolved and refined. In particular, Snyder et al., 1991b define hope as “a positive motivational state that is based on an interactively derived sense of successful (a) agency (goal directed energy) and (b) pathways (planning to meet goals).” As Snyder refines the nature of goal that lays the cognitive anchor of hope theory, the trilogy of goals, pathways, and agency are explicitly incorporated in the concept of hope, which Snyder (2005, p. 73) later defines as “the perceived capability to (1) develop workable goals; (2) find routes to those goals (pathway thinking); and (3) become motivated to use those pathways (agency thinking)”.

A commonly-raised concern about hope theory is its overlap with other seemingly-related cognitive-based positive psychology constructs. In several theoretical and empirical studies undertaken by Snyder, colleagues and others, they have provided evidence on how and why hope is distinct (Table 1). Empirically, Shorey, Snyder, Rand, Hockemeyer and Feldman (2002, p. 325) note that “hope has been found to predict subjective well-being even after controlling for the variance due to self-efficacy and optimism”. A recent meta-analysis similarly shows that hope is empirically distinguishable from generalized self-efficacy, optimism, affect and self-esteem (Alarcon et al., 2013). Hope also goes beyond self-efficacy in predicting well-being and the two have different factor structures (Magaletta and Oliver, 1999).

Conceptually although hope and optimism both reflect positive expectations about one's future (Alarcon et al., 2013), optimism concerns more broadly future outcomes in general while hope is more about personal agency of specific goals (Bryant and Cvangros, 2004). Also as Juntunen and Wettersten (2006, p. 95) note: “Snyder et al. (2000) argued that hope theory is more future oriented than Seligman's (1991) theory of optimism and attends more fully to both the self-agency and the pathways regarding goals than does Scheier and Carver's (1987) model of optimism (which is defined as the belief that good things will happen, by luck or by internal striving)”. In other words, hope is a more specific description of the cognitive process involved in determining behavior (Snyder, 1995).

An important difference between hope and self-efficacy is represented by the auxiliary verb “can” and “will” respectively (Snyder, 2000, p. 2582). The efficacy expectancy in self-efficacy bears some resemblance to agency thought in hope, with the former emphasizing the perceived capacity to act (“can”) and the latter the intention to act (“will”). Also the outcome expectancy in self-efficacy is based on specific situational contingencies (e.g. available resources for a specific task) whereas pathways thought in hope is on the self-analysis of overall capabilities to produce initial and alternate routes to goals (Kang et al., 2015; Snyder, 2002). In addition, the goal in self-efficacy is situation-specific, but in hope it may be enduring, cross-situational, and situational, or all three (Snyder, 2002). So, research has also found hope to positively predict self-efficacy beliefs (Juntunen and Wettersten, 2006) and occupational self-efficacy beliefs (Valero et al., 2015). In sum, it is the interactive process of goal-related pathway (i.e. waypower) and agency (i.e. willpower) that represents Snyder's (1994) unique contribution to positive psychological assessment (Rand and Cheavens, 2009).

2.2. The mediating role of hope in the MCS-safety performance link

Drawing from theory of hope, we develop a mediation model where the influence of management commitment to safety on safety performance is explained via hope. Safety performance refers to work behaviors pertaining to organizational safety and is generally operationalized in two forms where safety compliance concerns core in-role safety tasks and safety participation concerns voluntary participation and extra-role behaviors (Griffin and Neal, 2000). We argue that hope transforms the effect of management commitment to safety on safety performance of coal miners by providing them with goal-related cognitive thinking represented by willpower and waypower (Snyder, 2002).

The first step in unpacking our mediation model is to propose the relationship between MCS and hope. MCS refers to the emphasis accorded by management to safety as an integral part of the production system, rather than a mere technical part (Zohar, 1980).

While in some studies for practical interests it has been expressed as the high status given to safety officers or corrective actions against nonfulfillment of safety practices, the general practice is to treat MCS as employee perceptions of management attitudes towards safety (Zohar, 1980). When management is perceived by workers to emphasize and support safety standards, it creates a benchmark through which workers develop cues concerning the expectations of their behavior and performance towards attaining safety standards (Hon et al., 2014). The contextual cues obtained from MCS provide a clear picture to workers regarding what goals they strive for. In the theory of hope, goals are cognitive representations that individuals desire to get, do, create or experience (Snyder, Harris, et al., 1991a). Goals are the anchors of the theory of hope (Snyder et al., 2000). The goals that generate positive expectations for goal attainment need to be attainable and be of importance (Snyder et al., 2002a).

Hope can not only transfer MCS from a distal blueprint to proximal goals as mentioned above, but also to goal-related cognitive thinking of willpower and waypower. According to the theory of hope, 'hope is instilled through prolonged interactions with consistently hopeful and responsive actors' (Avolio et al., 2004, p. 809). When management sends clear signals through their actions towards safety standards and provides directions to pursue for attaining safety goals, MCS helps to nurture valuable personal resources (e.g., a sense of security, trust and support; Rego et al., 2012) that are conducive to effective functioning (c.f. Hobfoll et al., 2018). A supportive environment is important as safety often requires managing competing demands between output productivity and safety, which is not an easy undertaking. In terms of willpower, miners who sense management support feel that management stands beside them, and are thus more able to focus on goal-related endeavors and envision a positive future (Rego et al., 2014). In terms of waypower, by knowing that management is willing to offer necessary support to assist in dealing with safety issues, miners are more likely to believe they have the knowledge and skills necessary to find alternative pathways in the pursuit of safety-related goals (Griffin and Neal, 2000). An enhanced ability to recover from adversity and failure is possible.

Second, drawing from hope theory, we further argue that hope facilitates cognitive processes that enable the enactment of safety performance. Safety behavior requires some level of internal, sustaining force that pushes individuals to persevere in the face of adversity. Hope may be an empowering way of thinking (Snyder, 1994). Specifically, the willpower component of hope leads hopeful people (e.g. 'I will finish this', Snyder et al., 2000, p. 749) to move along the imagined route to pursue goals. Hope is a positive psychological resource that provides desired behavioral, attitudinal, and performance outcomes, including, but not limited to, in-role behavior (Bouckenoghe et al., 2015), organization citizenship behavior (Youssef and Luthans, 2007), work satisfaction (Luthans et al., 2007), and adaptive performance (Reivich and Shatte, 2002).

Meanwhile, hopeful miners generate more strategies to achieve a goal and find more solutions when faced with obstacles, meaning that they will have more means with which to enact safety behaviors. Because hope enables self-belief in goal achievement and outcome expectancy of available strategies for goal achievements (Snyder, 2002), hopeful miners are adept at finding alternative ways to reach their goals regardless of whether their working responsibilities are specified or not. Hope provides goal-directed pathways and has been shown to encourage employee well-being outcomes (e.g., Halama, 2010). The two components of hope are iterative such that development in one associates with increases in the other (Snyder, 2002). The combined effects mean that hope help initiate and sustain action towards goals, as well as enable adaptive management of obstacles that might interfere with goal pursuit (Snyder et al., 2002b).

Given the complexities involved in safety issues, when miners undertake safety compliance and safety participation, it is likely that they experience setbacks, frustrations, and ambiguity. This is particularly the case with underground miners whose task complexity can be unpredictable until they get underground, whose desire for income with more output may be incompatible with efforts required for safety behavior, or whose interpersonal conflicts with team members may lead them cut corners. In this situation, positive psychology is needed (Chen and Chen, 2014). The theory of hope has long argued that hope is a predictor of individuals' behaviors, especially in challenging and uncertain situation (Snyder, 2002). Hope entails a sense of control over possible future events (Luthans et al., 2007) and shifts the temporal focus from the present to the future with a positive expectation (Madrid et al., 2018). This means workers have cognitive resources (Hobfoll et al., 2018) that are necessary to not only fulfill core safety requirements when facing challenges (safety compliance), but also engage adaptively in voluntary activities that are not formally prescribed by job descriptions (safety participation) (Wang et al., 2018). Equipped with the willpower to move towards one's goal and the waypower to generate pathways for goal pursuits, miners with a high level of hope have intrinsic motivation to participate in organizational rules (Rego et al., 2012) and engage in discretionary, proactive behaviors (Madrid et al., 2018).

In sum, people consult a range of options for either undertaking safety behavior or not. This choice is influenced not only by the perceived context that affects the salience of selecting a particular behavioral option, but also by the expectancies of their capabilities, chances, and pathways in successfully achieving certain goals. In this sense miners' hope serves as cognitive resources that are necessary to transform the influence of management commitment to safety into safety behavior.

Hypothesis 1. Miners' hope mediates the relationship between management commitment to safety and (a) safety compliance, and (b) safety participation.

2.3. The moderating role of team reflexivity

Next, we explain the role of team reflexivity as a contingency factor underlying the MCS-hope association. Because hope can be malleable and vary across individuals (Snyder, 2002), we theorize that factors that stimulate teams to enhance shared understanding of the work environment will moderate the MCS-hope relationship. As a team regulatory process, team reflexivity encompasses reflection, planning and adaptation, which promotes awareness of the teams' strategies, goals as well as the procedures used to achieve these goals (Reiter-Palmon et al., 2018).

Collective reflection on team's objectives, strategies and processes can lead team members to clarify and reconcile differences (West et al., 1997). The resulting shared understanding overcomes issues such as different interpretations and sense-making of MCS among miners that might obstruct the positive influence of MCS on hope. A lack of shared understanding can lead to divergent views about the benefit of MCS for them. So, by raising and discussing the various interpretations, team reflexivity helps the team to reach a consensus that better elucidates the positive influence of management commitment to safety on hope. Also regularly meeting and reviewing team objectives and strategies increase the opportunity for team members to sense each other's willpower, making hope to be contagious.

The pathway thinking of hope entails contemplating multiple plausible routes when considering how to achieve desired goals vis-a-vis potential obstacles (Reichard et al., 2013). Team reflexivity entails motivations to systematically process information (De Dreu, 2007). This means the team does not simply follow a habitual routine, but discusses and reflects a process through which miners become aware of their own and others' strategies, enlarging the pool of alternatives. In contrast, when teams do not reflect, they are unlikely to seek and consider alternative ways to approach their work. Also when team members hold different interpretations without realizing or reconciling this, it is likely to result in coordination conflicts, dampening the influence of management commitment to safety on hope.

In the context of underground coal mining, miners are typically organized in teams that can vary between 10 and 30 miners depending on the specific tasks involved and the specialty of the team. Teams usually meet before and after each sortie to debrief and reflect on how things went and how they can be improved in the future. These team meetings are an important part of team capacity building ("*ban zu jian she*") in which a structured approach is undertaken that typically involves roll call, explanation of the sortie, and allocation of tasks (Hou, 2003; Li, 2008). In these meetings, team leader on duty checks every team member's readiness for work (e.g., work certificate, well-being, relationships with other team members, family issues), opens up discussions, and asks team members to repeat their understandings of tasks (Hou, 2003). As such, team reflexivity encompasses planning and adaptation in which team members contemplate and develop plans for achieving desired goals (West, 2000), a self-regulatory process that gauges team members' capability in undertaking certain behaviors and evaluating collective competencies against team's and workplace's standards (Bandura, 1986). Through these regulatory processes, miners are motivated to better align management intentions and desired collective performance goals, such as to improve workplace safety with their own capability, in a more hopeful state. As such we propose that team reflexivity, which encourages miners to focus on team goals and outcomes, will positively affect the extent to which MCS influences miners' hope for achieving desired safety:

Hypothesis 2. Team reflexivity moderates the relationship between management commitment to safety and miners' hope such that the relationship is stronger when team reflexivity is higher (vs. lower).

Integrating the above reasoning for the mediation (Hypothesis 1) and moderation (Hypothesis 2) relationships, we further propose a moderated mediation relationship.

Hypothesis 3. Team reflexivity moderates the indirect relationship between management commitment to safety and miners' safety performance such that the relationship is stronger when team reflexivity is higher (vs. lower).

3. Method

3.1. Sample and procedure

We test our hypotheses using multi-level data from coal-mining enterprises in the Ningxia and Inner Mongolia Autonomous Regions, two of China's largest coal-producing provinces (SACMS, 2016). To minimize the risks of common method variance (Podsakoff et al., 2003), data were collected from two sources, namely underground coal miners and team leaders.

One of the authors sought permission from the mining industry executives for undertaking the study. Once access to participating mining sites was secured, we developed and pilot tested a self-administered questionnaire with a sample of 10 coal miners and 5 team leaders to ensure the correct usage of industry concepts and terminologies and that technical, academic and psychological concepts were not confusing and clearly understood by miners. The finalized questionnaire was then administered on site to underground coal miners by one of the authors. Teams of miners were handed a survey package containing two sealed and pre-paid reply envelopes: one marked as 'miner survey' and the other as 'team leader' survey. Each envelope contained a plain language statement (in Chinese), a consent form and the self-administered questionnaire. The plain language statement explained that the purpose of the research project was for improving mining safety and assured miners and their team leaders that participation was completely voluntary, confidential, and that the data would be used for research purposes only. They were informed that feedback to management would be provided in an aggregate form with no particular participant being identified. One of the authors was also available on site to answer any question in relation to the study and the questionnaire from participants.

The envelope marked as 'miner survey' contained the questionnaire that assessed miners' perception of management commitment to safety, hope and team reflexivity. The plain language statement also instructed participating miners to hand over the second envelope marked as 'team leader' to their team leaders who rated safety behavior through a number of items. These approaches helped address common method bias and alleviated social desirability effects by protecting the confidentiality of responses (DeVellis, 2003). The questionnaires for miners and team leaders were marked by a four-digit code for response matching purposes only. It took participating miners approximately 20 mins to read the statements and complete the questionnaire, a timeframe deemed sufficient from the pilot testing.

Of the 1290 questionnaires initially distributed, 588 were returned. After data cleaning and excluding incomplete questionnaires, a total of 487 questionnaires with input from 98 team leaders were retained for data analysis, representing a response rate of 37.8%. We undertook two tests to understand our data (Armstrong and Overton, 1977). First we conducted independent sample *t*-test to compare selected demographic variables for the retained ($n = 487$) and excluded ($n = 101$) samples. The results showed no significant differences in age and education between the two samples. Second, we compared early (first 10% of respondents) and late (last 10% of respondents) survey respondents as a way of testing non-response bias (Rogelberg and Stanton, 2007). Results of independent sample *t*-test showed no significant differences across age, education and focal variables included in the data analysis.

The characteristics of the sample used for model testing ($n = 487$) are as follows: 6.6% were younger than 30 years old, 44.6% were between 30 and 40, 28.5% were between 40 and 50, and 20.3% were older than 50. In addition, 24.6% attended junior college or vocational education institutes, and 42.5% attended high school or technical secondary school, and 32.9% attended below high school. All participants were men.

3.2. Measures

The measures used in the study were adapted from existing scales in the literature. To ensure face validity, the wordings of some of the items used were revised to fit the specific context of the mining sector in China. All measures were originally written in English and translated into Chinese through the back-translation procedure (Brislin, 1986). We used a 7-point Likert scale ranging from 1, “strongly disagree,” to 7, “strongly agree”, unless indicated otherwise to measure our items.

Management commitment to safety was measured with Zohar and Luria's (2005) four-item scale, a measure of employees' perception of the extent to which management is committed to safety through their actions and behavior. Survey participants were asked to respond to the questions: ‘To what extent do you perceive management is committed to the following (a) making sure we follow all the safety rules, (b) prioritizing safety procedures when we are working under pressure, (c) discussing safety issues throughout the work week, and (d) ensuring we receive all the equipment needed to do the job safely’. Cronbach's alpha is 0.92.

Safety behavior was operationalized and measured by two constructs, namely safety compliance and safety participation, a common practice in safety research (Guo et al., 2018; Neal and Griffin, 2006). Safety compliance is measured by five items, with the first four taken from the four-item scale developed by Neal et al. (2000), namely, ‘using the correct safety procedures for carrying out job’, ‘using all the necessary safety equipment to do job’, ‘ensuring the highest levels of safety when carrying out job’ and ‘carrying out job in a safe manner’. Feedback from the senior management team and survey participants revealed the importance of the frequency that safety compliance activities were undertaken. Therefore, we added one item from Hon et al.'s (2014) two-item scale which assesses ‘always following all of the safety procedures for the job performed’. Cronbach's alpha is 0.94. Safety participation, an extra-role measure of safety performance, is measured by the four-item scale developed by Neal et al. (2000), including ‘voluntarily carrying out tasks or activities that help to improve workplace safety’, ‘helping coworkers when they are working under risky or hazardous conditions’, ‘promoting the safety program within the organization’, and ‘putting in extra effort to improve the safety of the workplace’. Cronbach's alpha is 0.91.

Hope was measured by the six-item state hope scale developed by Snyder et al. (1996) and adapted for the mining context. This state hope scale has been widely used in the context of work. Items included “There are lots of ways to overcome safety issues in mines” (waypower); “I energetically pursue safety goals” (willpower); “I see myself as being pretty successful on safety issues (willpower); ‘I am meeting the goals that I have set for myself’ (willpower); “I can think of many ways to reach my current safety goals” (waypower); and “If I should find myself in a jam, I could think of many ways to get out of it” (waypower). Cronbach's alpha is 0.95.

Team reflexivity was measured by the six-item scale developed by Swift and West (1998). Sample items include “My co-workers and I often review our objectives” and “My co-workers and I regularly discuss whether we are working effectively”. Cronbach's alpha is 0.93.

Control variables. We included participants' age (0 = under 30; 1 = between 30 and 40; 2 = between 40 and 50; 3 = over 50) and education (0 = below high school; 1 = high school or technical secondary school; 2 = junior college or vocational education) to control for any confounding effects they might have with key variables and relationships under study (e.g. Guo et al., 2018).

4. Results

4.1. Analytical strategy

Before aggregating individual level perceptions of MCS and team reflexivity to the team level, we first assessed the non-independence of the data, which supported data aggregation: MCS: ICC(1) = 0.29, ICC(2) = 0.67, Rwg = 0.96 and team reflexivity: ICC(1) = 0.55, ICC(2) = 0.86, Rwg = 0.91. Therefore these two variables are treated as the between-subjects level (i.e. level 2). Further, because of the nested nature of our data (98 team leaders rated 487 miners), we further assessed hope and safety behavior, which also showed a relatively high level of non-independence: hope: ICC(1) = 0.30, ICC(2) = 0.68, Rwg = 0.97, safety compliance: ICC(1) = 0.37, ICC(2) = 0.75, Rwg = 0.97, safety participation: ICC(1) = 0.26, ICC(2) = 0.63, Rwg = 0.96. Following Bliese (2000) and LeBreton and Senter (2008), we therefore undertook random coefficient modeling in MPlus v7 and set up a two-level model which explicitly accounts for the nested nature of our data.

Table 2
Descriptive statistics.

Variables	Mean	SD	α	1	2	3	4	5	6	7
1. Age	1.63	0.88	–							
2. Education	0.92	0.75	–	–0.05						
3.MCS	4.22	0.76	0.92	0.08	–0.07					
4.Hope	4.17	0.83	0.95	–0.03	0.03	0.29**				
5.TR	4.22	0.89	0.93	–0.05	0.01	–0.22**	0.07			
6. SC	4.24	0.78	0.94	0.06	–0.05	0.29**	0.29**	–0.01		
7.SP	4.23	0.74	0.91	–0.06	0.01	0.24**	0.23**	0.01	0.28**	

MCS: Management commitment to safety; TR: Team reflexivity; SC: Safety compliance; SP: Safety participation. Age: 0 = under 30; 1 = between 30 and 40; 2 = between 40 and 50; 3 = over 50. Education: 0 = below high school; 1 = high school or technical secondary school; 2 = junior college or vocational education.

** $p < .01$.

4.2. Measurement model

The descriptive statistics of the study variables, including mean, standard deviation, and correlations are summarized in Table 2. To test hypotheses, we undertook a two-stage analytical procedure recommended in the literature (Kline, 2015). First, confirmatory factor analysis (CFA) was conducted to provide support for the issues related to uni-dimensionality, validity and reliability, through a series of tests comparing the theoretical measurement model against sample data. The five-factor model, including MCS, hope, team reflexivity, safety compliance and safety participation, showed acceptable fit with data: $\chi^2(265) = 409.05$, $\chi^2/df = 1.54$, RMSEA = 0.03, CFI = 0.99, TLI = 0.98, SRMR = 0.02 and performed better than alternative models, including the four-factor model where safety compliance and safety participation were combined: $\chi^2(269) = 1459.17$, $\chi^2/df = 5.42$, RMSEA = 0.10, CFI = 0.89, TLI = 0.88, SRMR = 0.09; or the three-factor model where MCS and hope were combined and safety compliance and safety participation were combined: $\chi^2(272) = 2760.81$, $\chi^2/df = 10.15$, RMSEA = 0.14, CFI = 0.77, TLI = 0.74, SRMR = 0.14; or the two-factor model where safety compliance, safety participation and team reflexivity were combined and MCS and hope were combined: $\chi^2(274) = 5381.67$, $\chi^2/df = 19.64$, RMSEA = 0.20, CFI = 0.52, TLI = 0.47, SRMR = 0.21; or the one-factor model: $\chi^2(275) = 7417.69$, $\chi^2/df = 26.97$, RMSEA = 0.23, CFI = 0.33, TLI = 0.27, SRMR = 0.23.

4.3. Hypothesis testing

We then proceeded to test our hypotheses simultaneously by adding the mediator, miners' hope, and the moderator, team reflexivity, in the model. The results showed a good model fit: $\chi^2(6) = 12.97$, $\chi^2/df = 2.16$, RMSEA = 0.05, CFI = 0.97, TLI = 0.89, SRMR within = 0.02, SRMR between = 0.03. As summarized in Table 3, the unstandardized path coefficients between MCS and hope ($B = 0.86$, $se = 0.08$, $p = .00$). The associations between hope and (a) safety compliance ($B = 0.73$, $se = 0.19$, $p = .00$) and (b) safety participation ($B = 0.53$, $se = 0.17$, $p = .00$) were both statistically significant. The indirect effects of MCS on safety compliance and safety participation through hope were .63 ($se = 0.18$, $p = .00$, 95%CI [0.29, 0.97]) and 0.46 ($se = 0.14$, $p = .00$, 95%CI [0.18, 0.73]), respectively. Therefore, H1 is supported.

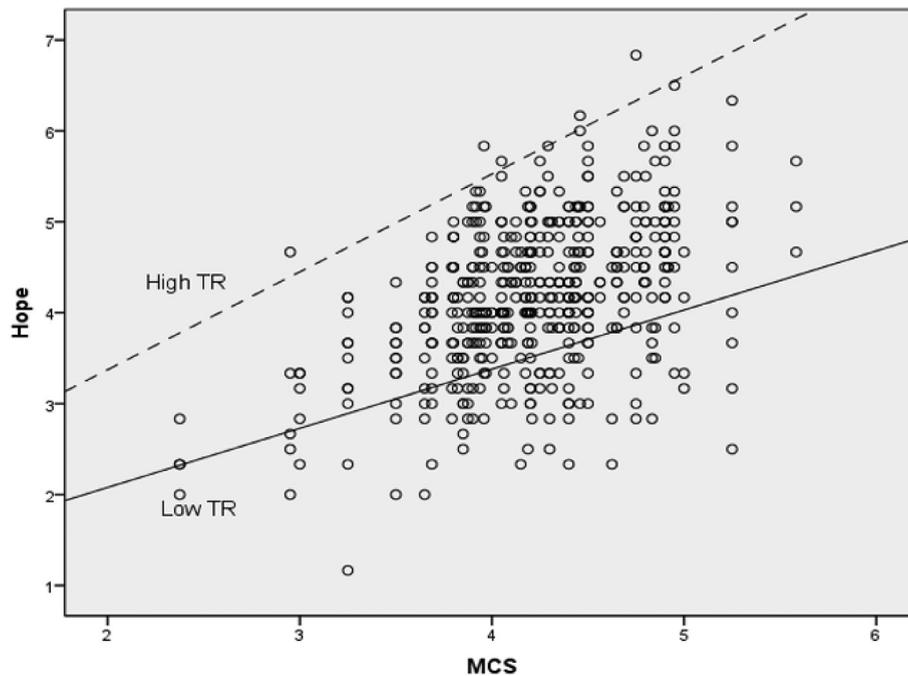
Next, the test of the hypothesized moderation relationships shows that the interaction term (Team reflexivity * MCS) was positively and statistically significantly related with hope ($B = 0.30$, $se = 0.10$, $p = .00$, 95% CI = [0.11, 0.49]), supporting H2. The scatter plot in Fig. 2 that illustrates the nature of this interaction and its fit with our data also confirms our statistical results that the influence of MCS on hope is contingent on team reflexivity. Fig. 2 shows that the rate of change of hope for high team reflexivity ($B = 1.13$, $p = .00$) is substantially higher than for low team reflexivity ($B = 0.60$, $p = .00$) confirming the significant moderating

Table 3
Unstandardized coefficient, standard errors and 95% confidence intervals of study results.

	Model 1: Hope			Model 2: Safety Compliance			Model 3: Safety Participation		
	B (se)	p	95% CI	B (se)	p	95% CI	B (se)	p	95% CI
Within level									
Age				0.06 (0.04)	0.10	[–0.01, 0.13]	–0.05 (0.04)	0.16	[–0.12, 0.02]
Education				–0.03 (0.04)	0.52	[–0.11, 0.06]	0.00 (0.04)	0.99	[–0.08, 0.08]
Between level									
Hope				0.73** (0.19)	0.00	[0.36, 1.10]	0.53** (0.17)	0.00	[0.20, 0.86]
MCS	0.86** (0.08)	0.00	[0.72, 1.01]	0.18 (0.16)	0.29	[–0.15, 0.50]	0.08 (0.16)	0.65	[–0.25, 0.40]
TR	0.31** (0.05)	0.00	[0.21, 0.42]						
MCS*TR	0.30** (0.10)	0.00	[0.11, 0.49]						

MCS: Management commitment to safety; TR: Team reflexivity.

** $p < .01$.



MCS: Management commitment to safety; TR: Team reflexivity

Fig. 2. The moderating role of team reflexivity on the influence of MCS on hope.

role of team reflexivity on the association between MCS-hope. Further, the mediated moderation index for the indirect path from MCS to (a) safety compliance (index = 0.22, $p = .00$; 95% CI = [0.09, 0.35]) and (b) safety participation (index = 0.16, $p = .05$; 95% CI = [0.00, 0.32]) via the moderation of team reflexivity were both significant, supporting [Hypothesis 3](#).

5. Discussion

This research was motivated by the search for a theoretically-based managerially-relevant solution to complement existing efforts for reducing accidents and fatalities in China's coal mining sector. We take a positive psychology perspective to investigate the role that human factors can play in achieving desired safety performance outcomes for underground miners. Based on the experience of a sample of 487 underground coal miners in 98 coal mining sites, our findings show that miners' hope mediates the influence of MCS on both in-role (safety compliance) and extra-role (safety participation) safety related behavior. In other words, MCS influences miners' safety behaviors by instilling hope, a positive state of psychological resources in miners that involves an overall perception of goal-directed determination and pathways to meet safety goals. The role of hope in transforming management commitment to safety into improved safety performance is also found to be contingent on team reflexivity, a team regulatory process that promotes awareness of the teams' strategies, goals as well as the procedures used to achieve these goals ([Reiter-Palmon et al., 2018](#)). The findings suggest that miners' hope could be the canary that provides valuable cues about the incidence of accidents in mining.

5.1. Theoretical contribution

The study makes a theoretical contribution by enriching our understanding of the underlying mechanisms that transform MCS into safety outcomes. First, the consideration of hope from the perspective of positive psychology adds to a small but growing research stream that investigates 'soft' human factors. This investigation complements the stream of safety research that focuses on technology based safety interventions. Second, our study avoids the pitfalls of existing theoretical and conceptual contentions of the positive influence of psychological capital on safety outcomes (i.e., [Eid et al., 2012](#)) by focusing specifically on hope. The use of a composite measure of psychological capital by [Eid et al. \(2012\)](#) provides insufficient or even inaccurate information about different psychological capital profiles and risks producing confounding results that have different theoretical implications ([Dawkins et al., 2013](#)). For instance, two employees may have similar composite scores of psychological capital and yet have very different profiles for the individual dimensions of psychological capital. For this reason, there are increasing calls for examining specific component of psychological capital in relation to particular outcomes and the contingencies under which they occur ([Dawkins et al., 2013](#)), which we have addressed in this study.

We also go beyond [Eid et al. \(2012\)](#) who focus on safety climate in their conceptual work, a concept that has limited consensus on

its constituents (Huang et al., 2006). Grouping various components by practical interests can mask theoretically distinct relationships. For instance, the effect of safety climate on safety performance might be due to positive thinking of hope, or due to fear of disciplinary action, or the loss of valued incentives (c.f. Beus et al., 2010). Thus, our focus specifically on MCS, as management attitudes towards safety, enables a finer-grained understanding of how MCS works in the safety domain.

Third, another contribution of this study is the explicit consideration of team reflexivity as a boundary condition underlying the association between management commitment to safety and safety behavior. This study is among the first to link thought processes to safety behaviors in managing the high prevalence of accidents in China's mining industry through the perspective of team reflexivity alongside hope. By so doing, the empirically tested mediated moderation model responds to the call from Zohar (2010) for more research into understanding how and when safety behaviors are motivated. The findings show that team reflexivity is an important team-level regulatory process that works in tandem with management commitment to safety to bring about desired psychological state and safety behaviors of workers.

Although our main focus on team reflexivity is as a moderator, we note its negative and statistically significant correlation with MCS (-0.22). This seemingly counterintuitive finding opens up opportunities for further enquiry into this all too often neglected variable in safety research. Team reflexivity denotes collectively processing meta-level issues that reflect on past experiences or observations in undertaking tasks and adapting team objectives, procedures and strategies, rather than just task specific information (Pieterse et al., 2011). Research argues that as team has a natural tendency to limit reflexivity and resort to customary routines, team reflexivity needs to be facilitated by team training or team leadership for such cognitive activities (West, 1996; Schippers et al., 2008). Given the default tendency of using habitual routine, this means without stimuli to boost reflexivity abilities, teams are inclined to not carefully consider their approaches because management commitment to safety has already provided a clear guideline. Therefore, although on the surface MCS and team reflexivity might be expected to be positively correlated as MCS provides a consistent and clear message about safety issues for the team to discuss, the nature of this association is more complex and deserve further enquiry.

To the extent MCS concerns management as the active agent in emphasizing safety issues, our findings suggest team, as the active agent in team reflexivity, can reinforce the positive influence of MCS by facilitating interactive processes for active planning, attention to team objectives and possessing inventory of environmental cues. In the mining context that is regulated with prescribed rules and procedures, work teams are not allowed to autonomously intervene, making team reflexivity a necessary but not sufficient condition for safety performance. This implies that team reflexivity is of necessity and acts a moderator (strengthening factor) of the influence of management commitment to safety on hope in the context of this study.

In a nutshell, this research provides a “hopeful” way out for organizations to promote commitment to safety among management because doing so enhances the state of hope in miners, an occupational group known for limited career prosperity. During our pilot test and fieldwork, miners often made comments on their previous state as “*sui bian ba, jiu zhe yang ba*” (just leave as it is) when they failed to sense management commitment to safety. By contrast, miners made heartfelt comments that they now believed they were able to retire alive or uninjured and that they looked forward to starting a family, bringing up children or spending time with wives after retirement. The change in positive psychology was promoted by the observation and sense of MCS, particularly behavioral managerial commitment as measured in our study, in providing cues for goals, creating sense of security and trust, and enhancing knowledge and skills. These positive, forward-looking, and pathway-like thinking help create meaning in their work and keep underground miners motivated to comply with prescribed rules and adaptively achieve safety objectives with initiatives.

5.2. Practical implications

This study also has several practical implications. First, a key finding of the study is about the importance of hope as a silent factor which can bring about positive changes in miners' safety behavior and reduce mining accidents. Therefore, effective training programs that help miners to develop hope should help in reducing workplace accidents. For instance, intervention programs can set up opportunities for miners to experience success that is linked to their positive belief in implementing multiple pathways as contingency plans. Additionally, training could also emphasize that miners should not relate safety obstacles to the self and instead encourage miners to formulate plans, sustain positive outlook as a team (Ciarrochi et al., 2016) and positively think of their sustainable careers (De Vos et al., 2020). In light of hope theory (Snyder, 2002), as coal mining enterprises seeking to promote hope in underground miners, they can teach miners that the hope-associated goal is not always about reaching a positive goal (e.g. wanting to get recognized for good safety performance). It can also be ‘repair-oriented’ (Lazarus, 1999) in which miners have the desire to deter the occurrence of negative outcomes (e.g., wanting to retire without getting injured).

Second, for programs which focus on the development of hope to be effective in fostering safety behaviors, the study also highlights the importance of employee perception of management's commitment to safety and their demonstration of an understanding of safety issues. Thus, it is important that MCS is clearly articulated and communicated to miners. To this end, focus on safeguarding procedural justice which has been found to influence employee perception of organizational support in China (Zhang et al., 2012) is a possible strategy in highlighting MCS. Similarly, research on impression management also suggests that frequent communication (O'Sullivan, 2010) about safety issues can play an important role in articulating management's commitment to and their understanding of safety issues.

Third, mining enterprises could use role modeling in developing miners' hope (Snyder, 2000) by identifying and promoting miners who are passionate about safety and providing recognition and incentives to role models. Additionally they can also develop structured coaching and mentoring programs between miners who score highly on hope and those who do not. Furthermore, mining enterprises could promote a workplace culture where miners feel comfortable to discuss safety issues openly with their team leaders

and peers without fear of reprisal. Our findings highlight the importance of team reflexivity as a contingent factor underlying the association between management commitment to safety and hope. A workplace culture based on trust and openness to different views and opinions may be critical in ensuring the success of intervention programs that target miners' mental and psychological state for improving safety behavior.

5.3. Limitations and future research opportunities

We acknowledge several limitations in this research, which provide avenues for future studies. The first limitation relates to issues of causality due to the cross-sectional nature of the study design. We therefore recommend future research to take an experimental or longitudinal design to address potential causality issues. Second, an interesting and unexpected finding is the non-significance of the association between team reflexivity and both safety participation and safety compliance. While this association is not directly relevant to the present theoretical model, it stimulates our curiosity as to the reasons behind this. Team reflexivity involves team deliberation about what went wrong and what can be improved. Unless these are provided as a feedback to management, team reflexivity is unlikely to directly influence safety outcomes. Some underlying processes may be at play in connecting miners' reflective activities with management that transform team reflexivity into desired performance outcomes. While theorizing and investigating possible mediators of the process is beyond the scope of this study, we urge future research to explore this line of enquiry.

Third, we took a positive psychology tradition to investigate how hope transforms the influence of management commitment to safety on miners' safety performance. Nonetheless, we acknowledge a possibility that with management emphasizing safety issues, employees might fear of being punished for not adhering to safety standards. This possibility suggests the need to investigate how MCS encompasses corrective actions for unsafe activities that might subsequently influence employee cognitive and affective responses to safety issues. Fourth, while we focus on MCS, we acknowledge that co-workers may also play a role, with emerging research advocating co-workers' commitment as a missing link in safety research (e.g. [Brondino et al., 2012](#); [Schwatka and Rosecrance, 2016](#)). Although the use of team reflexivity may to some extent capture the role of co-workers in influencing miners' responses to the influence of MCS, we recommend future research to extend our model by explicitly considering the role of co-workers in influencing miner's safety behavior.

5.4. Conclusion

This study makes a timely contribution to the ongoing debate of how to reduce the high incidence of accidents and fatalities in China's underground coal mining industry. We focus on the often neglected role of thought processes of frontline miners from a positive psychology perspective of hope and how it influences safety behavior of miners. Our finding that hope may well be the canary in the coal mine that alerts management to the incidence of accidents provides new insights and avenues into safety behavior management that may supplement existing efforts in combatting mining accidents in China.

CRedit authorship contribution statement

Xinfeng Ye: Conceptualization, Methodology, Investigation, Project administration, Resources. **Shuang Ren:** Conceptualization, Writing - original draft, Writing - review & editing. **Doren Chadee:** Conceptualization, Writing - original draft, Writing - review & editing. **Zhining Wang:** Formal analysis, Software, Visualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- Alarcon, G. M., Bowling, N. A., & Khazon, S. (2013). Great expectations: A meta-analytic examination of optimism and hope. *Personality and Individual Differences*, 54(7), 821–827.
- Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, 14(3), 396–402.
- Avolio, B. J., Gardner, W. L., Walumbwa, F. O., Luthans, F., & May, D. R. (2004). Unlocking the mask: A look at the process by which authentic leaders impact follower attitudes and behaviors. *Leadership Quarterly*, 15(6), 801–823.

- Bamel, U. K., Pandey, R., & Gupta, A. (2020). Safety climate: Systematic literature network analysis of 38 years (1980-2018) of research. *Accident Analysis and Prevention*, 135, Article 105387.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Upper Saddle River, NJ: Prentice Hall.
- Beus, J. M., Payne, S. C., Bergman, M. E., & Arthur Jr, W. (2010). Safety climate and injuries: An examination of theoretical and empirical relationships. *Journal of Applied Psychology*, 95(4), 713-727.
- Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: implications for data aggregation and analysis. In K. J. Klein, & S. W. J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (pp. 349-381). San Francisco: Jossey-Bass.
- Bouckenoghe, D., Zafar, A., & Raja, U. (2015). How ethical leadership shapes employees' job performance: The mediating roles of goal congruence and psychological capital. *Journal of Business Ethics*, 129(2), 251-264.
- Brislin, R. W. (1986). The wording and translation of research instruments. In W. J. Lonner, & J. W. Berry (Eds.), *Field methods in cross-cultural research and methodology series* (pp. 137-164). Beverly Hills, CA: Sage Publications.
- Bronдино, M., Silva, S. A., & Pasini, M. (2012). Multilevel approach to organizational and group safety climate and safety performance: Co-workers as the missing link. *Safety Science*, 50(9), 1847-1856.
- Bryant, F. B., & Cvengros, J. A. (2004). Distinguishing hope and optimism: Two sides of a coin, or two separate coins? *Journal of Social and Clinical Psychology*, 23(2), 273-302.
- Chen, C. F., & Chen, S. C. (2014). Measuring the effects of safety management system practices, morality leadership and self-efficacy on pilots' safety behaviors: Safety motivation as a mediator. *Safety Science*, 62, 376-385.
- China's State Administration of Coal Mine Safety (2019). Integrated information system for coal mine safety production. Accessed: 24 Sep 2019. From <https://zhxx.chinacoal-safety.gov.cn:8282/mj/a/login>.
- Chmiel, N., Laurent, J., & Hansez, I. (2017). Employee perspectives on safety citizenship behaviors and safety violations. *Safety Science*, 93, 96-107.
- Christian, M. S., Bradley, J. C., Wallace, J. C., & Burke, M. J. (2009). Workplace safety: A meta-analysis of the roles of person and situation factors. *Journal of Applied Psychology*, 94(5), 1103-1127.
- Ciarrochi, J., Atkins, P. W., Hayes, L. L., Sahlra, B. K., & Parker, P. (2016). Contextual positive psychology: Policy recommendations for implementing positive psychology into schools. *Frontiers in Psychology*, 7, 1-16.
- Dawkins, S., Martin, A., Scott, J., & Sanderson, K. (2013). Building on the positives: A psychometric review and critical analysis of the construct of psychological capital. *Journal of Occupational and Organizational Psychology*, 86(3), 348-370.
- De Dreu, C. K. (2007). Cooperative outcome interdependence, task reflexivity, and team effectiveness: A motivated information processing perspective. *Journal of Applied Psychology*, 92(3), 628-638.
- De Vos, A., Van der Heijden, B. I. J. M., & Akkermans, J. (2020). Sustainable careers: Towards a conceptual model. *Journal of Vocational Behavior*. <https://doi.org/10.1016/j.jvb.2018.06.011>.
- DeJoy, D. M., Della, L. J., Vandenberg, R. J., & Wilson, M. G. (2010). Making work safer: Testing a model of social exchange and safety management. *Journal of Safety Research*, 41(2), 163-171.
- DeVellis, R. F. (2003). *Factor analysis. Scale development, theory and applications* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Eid, J., Mearns, K., Larsson, G., Laberg, J. C., & Johnsen, B. H. (2012). Leadership, psychological capital and safety research: Conceptual issues and future research questions. *Safety Science*, 50(1), 55-61.
- Fernández-Muñiz, B., Montes-Peón, J. M., & Vázquez-Ordás, C. J. (2012). Safety climate in OHSAS 18001-certified organisations: Antecedents and consequences of safety behaviour. *Accident Analysis and Prevention*, 45, 745-758.
- Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: Identifying the common features. *Safety Science*, 34, 177-192.
- Griffin, M. A., & Neal, A. (2000). Perceptions of safety at work: A framework for linking safety climate to safety performance, knowledge, and motivation. *Journal of Occupational Health Psychology*, 5(3), 347-358.
- Guo, B. H., Yiu, T. W., & González, V. A. (2018). Does company size matter? Validation of an integrative model of safety behavior across small and large construction companies. *Journal of Safety Research*, 64, 73-81.
- Halama, P. (2010). Hope as a mediator between personality traits and life satisfaction. *Studia Psychologica*, 52(4), 309-314.
- Hale, A. R., Guldenmund, F. W., Van Loenhout, P. L. C. H., & Oh, J. I. H. (2010). Evaluating safety management and culture interventions to improve safety: Effective intervention strategies. *Safety Science*, 48(8), 1026-1035.
- He, S., & Song, L. (2012). Status and future tasks of coal mining safety in China. *Safety Science*, 50(4), 894-898.
- Hobfoll, S. E., Halbesleben, J., Neveu, J. P., & Westman, M. (2018). Conservation of resources in the organizational context: The reality of resources and their consequences. *Annual Review of Organizational Psychology and Organizational Behavior*, 5, 103-128.
- Hofmann, D. A., Burke, M. J., & Zohar, D. (2017). 100 years of occupational safety research: From basic protections and work analysis to a multilevel view of workplace safety and risk. *Journal of Applied Psychology*, 102(3), 375-388.
- Hon, C. K., Chan, A. P., & Yam, M. C. (2014). Relationships between safety climate and safety performance of building repair, maintenance, minor alteration, and addition (RMAA) works. *Safety Science*, 65, 10-19.
- Hou, Y. (2003). Meikuang banqianhui "qibu gongzuofa" (in Chinese). *Coal Mine Modernization*, 0129, 129.
- Huang, Y. H., Ho, M., Smith, G. S., & Chen, P. Y. (2006). Safety climate and self-reported injury: Assessing the mediating role of employee safety control. *Accident Analysis and Prevention*, 38(3), 425-433.
- Huang, Y. H., Verma, S. K., Chang, W. R., Courtney, T. K., Lombardi, D. A., Brennan, M. J., & Perry, M. J. (2012). Management commitment to safety vs. employee perceived safety training and association with future injury. *Accident Analysis and Prevention*, 47, 94-101.
- Jiang, P. (2018). *Report of development tendency and investment strategic decisions on China coal industry (2018-2023)*. Forward Business Info Co. Ltd.
- Juntunen, C. L., & Wettersten, K. B. (2006). Work hope: Development and initial validation of a measure. *Journal of Counseling Psychology*, 53(1), 94-106.
- Kang, H. J., Chai, D. S., & McLean, G. N. (2015). An intersectionality and hope-based career development model for female international marriage immigrants in Korea. *Human Resource Development International*, 18(5), 538-555.
- Kline, R. B. (2015). *Principles and practice of structural equation modeling*. New York: Guilford publications.
- Lazarus, R. S. (1999). Hope: An emotion and a vital coping resource against despair. *Social Research*, 66, 665-669.
- LeBreton, J. M., & Senter, J. L. (2008). Answers to 20 questions about interrater reliability and interrater agreement. *Organizational Research Methods*, 11(4), 815-852.
- Leung, M. Y., Chan, I. Y. S., & Yu, J. (2012). Preventing construction worker injury incidents through the management of personal stress and organizational stressors. *Accident Analysis and Prevention*, 48, 156-166.
- Li, R. (2008). Qiantan meikuang banzujianshe gongzuo (in Chinese). *Coal Engineering*, 6, 23-24.
- Luthans, F., Avolio, B. J., Avey, J. B., & Norman, S. M. (2007). Positive psychological capital: Measurement and relationship with performance and satisfaction. *Personnel Psychology*, 60(3), 541-572.
- Madrid, H. P., Diaz, M. T., Leka, S., Leiva, P. I., & Barros, E. (2018). A finer grained approach to psychological capital and work performance. *Journal of Business and Psychology*, 33, 461-477.
- Magaletta, P. R., & Oliver, J. M. (1999). The hope construct, will, and ways: Their relations with self-efficacy, optimism, and general well-being. *Journal of Clinical Psychology*, 55(5), 539-551.
- Mehlman, R. C., & Snyder, C. R. (1985). Excuse theory: A test of the self-protective role of attributions. *Journal of Personality and Social Psychology*, 49(4), 994-1001.
- Meng, X. F., & Li, X. C. (2012). *Construction and implementation guide on risk pre-control management system of safety in coal mine*. Xuzhou: China University of Mining and Technology Press.
- MOHRSS (2018). State council's opinion on the coal industry's efforts to address overcapacity and poverty. Accessed: 24 Sep 2020. From http://www.mohrss.gov.cn/sybx/SYBXShengcewenjian/SYBXSGuojiZhengce/201804/t20180418_292572.html.
- Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and

- group levels. *Journal of Applied Psychology*, 91(4), 946–953.
- Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. *Safety Science*, 34(1–3), 99–109.
- O'Sullivan, P. B. (2010). What you don't know won't hurt me: Impression management functions of communication channels in relationships. *Human Communication Research*, 26(3), 403–431.
- O'Toole, M. (2002). The relationship between employees' perceptions of safety and organizational culture. *Journal of Safety Research*, 33(2), 231–243.
- Pieterse, A. N., Van Knippenberg, D., & van Ginkel, W. P. (2011). Diversity in goal orientation, team reflexivity, and team performance. *Organizational Behavior and Human Decision Processes*, 114(2), 153–164.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903.
- Rand, K. L., & Cheavens, J. S. (2009). Hope theory. In C. R. Snyder, & S. J. Lopez (Eds.). *Oxford handbook of positive psychology* (pp. 323–333). New York: Oxford University Press.
- Rego, A., Sousa, F., Marques, C., & Cunha, M. P. (2014). Hope and positive affect mediating the authentic leadership and creativity relationship. *Journal of Business Research*, 67(2), 200–210.
- Rego, A., Sousa, F., Marques, C., & Cunha, M. P. E. (2012). Retail employees' self-efficacy and hope predicting their positive affect and creativity. *European Journal of Work and Organizational Psychology*, 21(6), 923–945.
- Reichard, R. J., Avey, J. B., Lopez, S., & Dollwet, M. (2013). Having the will and finding the way: A review and meta-analysis of hope at work. *Journal of Positive Psychology*, 8(4), 292–304.
- Reiter-Palmon, R., Kennel, V., Allen, J., & Jones, K. J. (2018). Good catch! Using interdisciplinary teams and team reflexivity to improve patient safety. *Group and Organization Management*, 43(3), 414–439.
- Reivich, K., & Shatte, A. (2002). *The resilience factor: 7 essential skills for overcoming life's inevitable obstacles*. New York, NY: Broadway Books.
- Rogelberg, S. G., & Stanton, J. M. (2007). Introduction: Understanding and dealing with organizational survey nonresponse. *Organizational Research Methods*, 10, 195–209.
- SACMS (State Administration of Coal Mine Safety) (2016). *The China coal industry statistics yearbook 2015*. Beijing, CHN: China Coal Industry Publishing House.
- Scheier, M. E., & Carver, C. S. (1987). Dispositional optimism and physical well-being: The influence of generalized outcome expectancies on health. *Journal of Personality*, 55(2), 169–210.
- Schippers, M. C., Den Hartog, D. N., Koopman, P. L., & Van Knippenberg, D. (2008). The role of transformational leadership in enhancing team reflexivity. *Human Relations*, 61(11), 1593–1616.
- Schwatka, N. V., & Rosecrance, J. C. (2016). Safety climate and safety behaviors in the construction industry: The importance of co-workers commitment to safety. *Work*, 54(2), 401–413.
- Seligman, M. E. P. (1991). *Learned optimism*. New York: Knopf.
- Shi, X. (2009). Have government regulations improved workplace safety?: A test of the asynchronous regulatory effects in China's coal industry, 1995–2006. *Journal of Safety Research*, 40(3), 207–213.
- Shorey, H. S., Snyder, C. R., Rand, K. L., Hockemeyer, J. R., & Feldman, D. B. (2002). Somewhere over the rainbow: Hope theory weathers its first decade-authors' response. *Psychological Inquiry*, 13(4), 322–331.
- Snyder, C. R. (1994). *The psychology of hope: You can get there from here*. New York: Free Press.
- Snyder, C. R. (1995). Conceptualizing, measuring, and nurturing hope. *Journal of Counseling and Development*, 73(3), 355–360.
- Snyder, C. R. (2000). *Handbook of hope: Theory, measures, and applications*. San Diego: Academic press.
- Snyder, C. R. (2002). Hope theory: Rainbows in the mind. *Psychological Inquiry*, 13(4), 249–275.
- Snyder, C. R. (2005). Teaching: The lessons of hope. *Journal of Social and Clinical Psychology*, 24(1), 72–84.
- Snyder, C. R., Harris, C., Anderson, J. R., Holleran, S. A., Irving, L. M., Sigmon, S. T., et al. (1991a). The will and the ways: Development and validation of an individual-differences measure of hope. *Journal of Personality and Social Psychology*, 60(4), 570–585.
- Snyder, C. R., Iardi, S. S., Cheavens, J., Michael, S. T., Yamhure, L., & Simpson, S. (2000). The role of hope in cognitive-behavior therapies. *Cognitive Therapy and Research*, 24(6), 747–762.
- Snyder, C. R., Irving, L. M., & Anderson, J. R. (1991b). Hope and health. In C. R. Snyder, & D. R. Forsyth (Eds.). *Handbook of social and clinical psychology* (pp. 285–305). Elmsford, NY: Pergamon.
- Snyder, C. R., Rand, K. L., King, E., Feldman, D., & Taylor, J. (2002a). "False" hope. *Journal of Clinical Psychology*, 58, 1003–1022.
- Snyder, C. R., Rand, K. L., & Sigmon, D. R. (2002b). Hope theory: A member of the positive psychology family. In C. R. Snyder, & S. Lopez (Eds.). *Handbook of positive psychology* (pp. 257–276). Oxford, UK: Oxford University Press.
- Snyder, C. R., Simpson, S. C., Ybasco, F. C., Borders, T. F., Babyak, M. A., & Higgins, R. L. (1996). Development and validation of the state hope scale. *Journal of Personality and Social Psychology*, 70(2), 321–335.
- Stajkovic, A. D., & Luthans, F. (1998). Social cognitive theory and self-efficacy: Go beyond traditional motivational and behavioral approaches. *Organizational Dynamics*, 26(4), 62–74.
- Swift, T. A., & West, M. A. (1998). *Reflexivity and group processes: Research and practice*. Sheffield, U.K: University of Sheffield.
- Swuste, P., Frijters, A., & Guldenmund, F. (2012). Is it possible to influence safety in the building sector?: A literature review extending from 1980 until the present. *Safety Science*, 50(5), 1333–1343.
- Valero, D., Hirschi, A., & Strauss, K. (2015). Hope in adolescent careers: Mediating effects of work motivation on career outcomes in Swiss apprentices. *Journal of Career Development*, 42(5), 381–395.
- Vinodkumar, M. N., & Bhasi, M. (2010). Safety management practices and safety behaviour: Assessing the mediating role of safety knowledge and motivation. *Accident Analysis and Prevention*, 42(6), 2082–2093.
- Wang, D., Wang, X., & Xia, N. (2018). How safety-related stress affects workers' safety behavior: The moderating role of psychological capital. *Safety Science*, 103, 247–259.
- West, M., Garrod, S., & Carletta, J. (1997). Group decision-making and effectiveness: Unexplored boundaries. In C. L. Cooper, & S. E. Jackson (Eds.). *Creating tomorrow's organizations: A handbook for future research in organizational behavior*. Chichester: Wiley.
- West, M. A. (1996). Reflexivity and work group effectiveness: A conceptual integration. In M. A. West (Ed.). *Handbook of work group psychology* (pp. 555–579). Chichester: John Wiley & Sons Ltd.
- West, M. A. (2000). Reflexivity, revolution and innovation in work teams. *Advances in interdisciplinary studies of work teams*. Vol. 5. *Advances in interdisciplinary studies of work teams* (pp. 1–29). Greenwich: JAI Press.
- Wicks, D. (2002). Institutional bases of identity construction and reproduction: The case of underground coal mining. *Gender, Work and Organization*, 9(3), 308–335.
- Youssef, C. M., & Luthans, F. (2007). Positive organizational behavior in the workplace the impact of hope, optimism, and resilience. *Journal of Management*, 33(5), 774–800.
- Zhang, Y., Farh, J. L., & Wang, H. (2012). Organizational antecedents of employee perceived organizational support in China: A grounded investigation. *International Journal of Human Resource Management*, 23(2), 422–446.
- Zhu, L., Wensheng, L., Yang, P., Wang, Z., & Wang, K. (2018). Statistical analysis and occurrence laws of coal mine accidents of China from 2007 to 2016. *Safety in Coal Mines*, 49(7), 237–240.
- Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology*, 65(1), 96–102.
- Zohar, D. (2010). Thirty years of safety climate research: Reflections and future directions. *Accident Analysis and Prevention*, 42(5), 1517–1522.
- Zohar, D., & Luria, G. (2005). A multilevel model of safety climate: Cross-level relationships between organization and group-level climates. *Journal of Applied Psychology*, 90(4), 616–628.