The psychological mechanism of construction workers’ safety participation: The social identity theory perspective

ABSTRACT

Introduction: Safety participation has gained increasing attention as an important dimension of workers' safety behaviors. Although previous studies attempted to identify factors affecting workers’ safety participation, only a few studies paid attention to the psychological mechanisms behind it. Therefore, this study aimed to develop and test a research model that explains how management factors are implicated in workers' safety participation. Specifically, this study focused on project-based organizations (e.g., construction projects) because employee psychological mechanisms may have a unique nature in such transient employment. Method: The hypotheses in the research model of the psychological mechanism of construction workers' safety participation are tested using survey data from 261 construction workers. Results: The results indicated that construction workers' safety participation is influenced by project identification after controlling the shared variance of safety compliance. Project identification also mediates the effects of transformational leadership and communication climate on safety participation. Practical Applications: This study offers researchers and practitioners an explanation of how management factors influence construction workers' safety behaviors and clarifies the role of project identification play in explaining the effects of management factors on safety compliance and safety participation.

Keywords: Construction Safety, Safety Participation, Project Identification, Transformational Leadership, Communication Climate, Psychological Mechanism
1. Introduction

The construction industry has been characterized by consistently high occupational accident and fatal injury rates across the globe. In 2018, for example, the U.S. construction industry reported 1,038 fatal occupational injuries, which accounted for more than 19% of total U.S. occupational deaths (ILO 2020). The construction industry recorded 16.2 fatal occupational injuries per 100,000 workers in 2018, whereas, for the same period, the overall national average rate was only 5.2 occupational fatalities per 100,000 workers (ILO 2020). An additional 77,500 construction workers suffered nonfatal occupational injuries and illnesses in the same year. In another example, the Korean construction industry reported 517 occupational fatal injuries in 2019, accounting for more than 25% of the total work-related deaths in the same period (KOSIS 2020). Its injury rate was 1.9 times higher than the all-industry rate of 1.08 fatalities per 100,000 workers (KOSIS 2020). Although the construction industry has seen significant advances in technologies and management practices, occupational accident statistics indicate that construction workers are still exposed to higher risk than other occupations.

Construction accidents tend to occur when unsafe work conditions coincide with the unsafe behaviors of workers (Lee et al. 2021). Traditional safety management practices primarily rely on individual-oriented formal controls, such as penalties, to regulate workers' unsafe behaviors (Törner and Pousette 2009; Choi and Lee 2017). However, the factors affecting safety behaviors have recently been focused upon to determine better ways to improve workers’ safety behaviors instead of blaming workers. For example, many previous studies have demonstrated associations between construction workers' safety behaviors and
individual factors such as personality (Hasanzadeh et al. 2019, Sun et al. 2020), job type (Glendon and Litherland 2001, Choudhry and Fang 2008), age (Fung and Tam 2013, Shuang et al. 2019), safety knowledge (Fung and Tam 2013, Hasanzadeh et al. 2017), and job experience (Cooper and Phillips 2004). In addition, other studies have empirically supported the effects of management factors such as leadership (Sheehan et al. 2016, Grill et al. 2017), supervisors (Gillen et al. 2002, Fang et al. 2015), communication (Siu et al. 2004, Kines et al. 2010a), training (Lingard 2002, Namian et al. 2016), group norms (Fugas et al. 2011, Choi et al. 2017a), and safety climate (Jiang et al. 2010, Fugas et al. 2012) on safety behaviors.

More recently, researchers have paid attention to the psychological mechanisms behind worker safety behavior. Fang et al. (2016) proposed the Cognitive Model of Construction Workers' Unsafe Behaviors (CM-CWUB) that entails "obtaining information, understanding information, perceiving responses, selecting responses, and taking actions" to identify root causes of workers' unsafe behaviors (p. 1). Choi and Lee (2017) developed an agent-based model of the socio-cognitive process underlying construction workers' unsafe behaviors that integrates cognitive processes, social influence, and site risk. Liang et al. (2018) developed a hybrid model that incorporates system dynamics and agent-based modeling to understand the social contagion effects of safety violations within a construction crew. Zhang et al. (2019) also developed an agent-based model of construction workers' unsafe behaviors to understand worker-management interaction's impact on construction workers' safety behaviors. Ye et al. (2020) developed an agent-based model of workers' safety behavior that integrates individual cognitive factors (i.e., safety awareness, experience, safety knowledge, safety attitude, and perceived safety norms) and organizational factors
(i.e., safety communication, safety training, and social groups).

Although previous studies have contributed significantly to extending the understanding of the psychological mechanisms of construction workers' safety behaviors, they have mainly focused on safety compliance (i.e., workers' compliance with safety rules and procedures). Previous studies have conceptualized safety behaviors comprising two dimensions that distinguish in-role and extra-role behaviors: safety compliance and safety participation (Clarke 2006, Neal and Griffin 2006). Safety compliance is defined as "adhering to safety procedure and carrying out work in a safe manner" (i.e., in-role safety behavior), whereas safety participation refers to "helping coworkers, promoting the safety program within the workplace and demonstrating initiative and putting efforts into improving safety in the workplace" (i.e., extra-role safety behavior) (Neal et al. 2000, pp. 101). Further, previous studies developed a model of the psychological mechanism of construction workers' safety compliance, but these models are limited to understanding the intrinsic psychological mechanisms of construction workers' safety participation (Xia et al., 2021). In addition, previous studies on safety participation have explored external factors that affect safety participation, such as safety climate (Griffin and Neal 2000), safety knowledge (Vinodkumar and Bhasi 2010), stress (Wang et al. 2020), leadership (Clarke and Ward 2006; Griffin and Hu 2013), and organizational support (Curcuruto and Griffin 2017), but their insights are limited in their understanding of the psychological mechanisms connecting these management factors to workers' safety participation (Liu et al. 2020). Furthermore, workers' safety participation in construction projects has been relatively unexplored compared to other organizational settings. Moreover, the psychological mechanisms underlying construction
workers' safety participation may not be the same in long-term organizations because of temporary and contract employment in construction projects. Consequently, the psychological mechanism of construction workers' safety participation is an aspect yet to be explored in detail.

With this background, this study aimed to investigate the psychological mechanism underlying the link between management factors (i.e., transformational leadership, communication climate) and safety participation. Considering that workers' safety participation is beyond their job requirements (i.e., extra-role behaviors), safety participation requires additional motives compared to safety compliance (i.e., in-role behaviors). The positive experience of workers in the work environment motivates them to engage in extra-role behaviors. Thus, transformational leadership and communication climate were included in the model to represent workers' interactions with management at construction sites. Transformational leadership refers to "the leader inspiring their followers to adopt the vision of the organization as if they were their own and focus their energy toward the achievement of collective goals" (Moriano et al., 2014, p.106). As transformational leaders motivate employees to move beyond achieving their immediate goals and pursue collective goals, employees are encouraged to engage in extra-role behaviors in an organization. Further, communication climate is defined as "the perception of employees with regard to the quality of the mutual relations and the communication in an organization" (Bartels et al., 2007, p. 177). Because a positive communication climate aids the workers in believing that their extra-role behaviors result in changes in an organization, workers with a more positive communication climate are more willing to engage in safety participation. In addition, this
study applied Social Identity Theory (SIT) and introduced project identification to the research model to link management factors and safety participation. Social identity is defined as "an individual’s awareness or knowledge that he/she belongs to certain groups together with some emotional and value significance to him/her of this group membership” (Tajfel, 1972, p. 292) SIT states that an individual's identification with a group is an important mechanism that motivates extra-role behaviors in the group; that is, people who strongly identify with a group or organization are more likely to exert extra effort into improving the performance of the group or organization. Similarly, construction workers' project identification has been introduced in the research model as an antecedent of safety participation which is a type of extra-role behavior in the safety context. Although previous studies have found the conducive effect of project identification on construction workers' safety compliance (Andersen et al. 2015, Choi et al. 2017b, Andersen et al. 2018), to our knowledge, no previous study has specifically examined the relationship between project identification and safety participation. Furthermore, the nature of project identification and its role in the psychological mechanisms underlying safety participation in construction projects may be unique compared with those of long-term organizations because construction workers are temporarily hired for a specific project. Due to the complex and transient nature of construction employment, it is not yet obvious how management factors translate into worker safety participation with the help of project identification. Therefore, this study contributes to the body of safety knowledge by expanding our understanding of the psychological mechanism of safety participation in a construction project, which is one type of project-based organization.
2. Theories and Hypotheses

In this study, a research model of the psychological mechanism behind construction workers' safety participation is proposed, based on related theories; it is tested in an attempt to fill the aforementioned knowledge gaps. Figure 1 illustrates the research model. The following describes the research model: construction workers' project identification has a positive impact on safety participation after controlling the effect of safety compliance on safety participation; project identification mediates the relationship between transformational leadership and safety participation; the communication climate effect on safety participation is mediated by project identification. The next sections discuss the research model’s hypotheses in detail.

![Research Model of the Psychological Mechanism Underlying Construction Workers’ Safety Participation](image-url)
2.1 Project identification, safety compliance, and safety participation

Safety participation refers to “employees’ extra-role participation in safety activities, such as actively participating in safety meetings, enthusiastically helping colleagues to complete safety tasks, and proactively giving safety recommendations” (Liu et al. 2019, p. 375).

Considering that safety participation is beyond workers’ formal responsibility for safety (i.e., safety compliance - conforming safety rules and procedures), safety participation would be understood as Organizational Citizenship Behavior (OCB) in the safety context (Hofmann et al. 2003, Jiang et al. 2010, Fugas et al. 2012). OCB refers to “individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and in the aggregate promotes the organization's efficient and effective functioning” (Organ 1988, p. 4). In this respect, safety participation has been called Safety Citizenship Behavior in previous studies (Hofmann et al. 2003, Jiang et al. 2017). SIT provides a theoretical foundation for the underlying psychological mechanism that motivates employees’ OCB.

Social identity is defined as "the part of an individual's self-concept, which derives from his knowledge of his or her membership of a social group together with emotional significance attached to that membership" (Tajfel, 1972, p. 292). Employing SIT, researchers have conceptualized organizational identification as a specific form of social identity, defining it as a "perception of oneness with or belongingness to an organization," (Ashforth and Mael 1989, p. 21; Mael and Ashforth 1992, p. 104) to understand the psychological mechanism of organization of the behaviors of the members. According to SIT, if an individual strongly identifies with a group, they internalize the group goals as personal values and exert more effort into achieving the group goal (i.e., internalization, Hogg and Smith 2007). Similarly,
employees with more salient organizational identification may exert extra effort (i.e., OCB) to improve the performance of the organization (Haslam et al. 2000, Van Knippenberg 2000, Riketta and Dick 2005). Previous studies have identified the effects of organizational identification on employees' extra-role behaviors (Van Dick et al. 2006, Tufan and Wendt 2020, Haslam et al. 2014). However, examining the internalization process of organizational goals would be worthwhile in the context of project-based organizations. Despite the relatively short life of a project-based organization, employees can still develop group norms or a shared perception of organizational goals that affect their behaviors (Gillen et al. 2002; Lingard et al. 2011; Ahn et al. 2014). Similarly, previous studies have found the role of project identification, defined as workers' perception of belongingness to their project, in different behavioral contexts such as safety compliance (Choi and Lee 2017, Anderson et al. 2018), turnover and work engagement (Ding et al. 2017), and intra-and inter-organizational tasks (Fang and Zhang 2021) in project-based organizations. Therefore, project identification, may motivate construction workers to become involved in extra-role safety behaviors beyond those of safety compliance (i.e., safety participation). Therefore, it is hypothesized that project identification can predict the safety participation of construction workers.

Safety compliance is included in the research model as an antecedent of safety participation to control the shared variance effects between safety compliance and safety participation in examining project identification’s impacts on safety participation (i.e., a control variable). While workers' safety participation is identified as extra-role behaviors in the safety context, they may overlap with in-role job requirements (Moorman et al. 1993,
Deluga 1995, Ishak and Alam 2009). Extra-role and in-role behaviors can be seen as distinct constructs, but their perceptual boundaries may vary across employees depending on their perceptions of job requirements (Morrison 1994). In other words, measures of extra-role behaviors may, in part, also assess in-role behaviors (Schnake 1991, Walz and Niehoff 2000).

In this respect, Williams and Anderson (1991) suggested that in-role behavior must be "included and used as a control variable so as to isolate variance in OCB measures that are not associated with the performance of in-role behaviors" (p. 614). Similarly, the possibility of overlaps between safety participation and safety compliance may not be eliminated. In this sense, previous studies have repeatedly reported significant correlations between safety compliance and safety participation, and they have correlated safety compliance with safety participation (Griffin and Neal 2000, Neal and Griffin 2006, Vinodkumar and Bhasi 2010, Griffin and Hu 2013, Hoffmeister et al. 2014, Barbaranelli et al. 2015, Guo et al. 2016).

Furthermore, safety compliance is also influenced by workers' project identification. According to SIT, when a specific group membership becomes salient to an individual's self-concept, people tend to assimilate their self-concept into their group prototype (Bergami and Bagozzi 2000, Hogg and Terry 2000). Prototypes are a fuzzy set of attributes associated with the description and prescription of exemplary group behaviors (Terry et al. 1999). Individuals' perception of the group prototype is revealed in their perception of group norms, defined as the shared perception of normal and acceptable group behaviors (Ellemers et al. 2004, Hogg and Reid 2006). Therefore, when an individual strongly identifies with specific group membership, he/she tends to internalize and comply with its norms (i.e., norm internalization process) (Ashforth and Mael 1989, Ellemers et al. 2004). Construction
workers, who have a salient project identification, are more likely to internalize project-level rules and procedures and comply with them. Considering that project-level safety rules and procedures are relatively strict compared with norms in the workgroup, project identification may positively impact safety compliance (Choi et al. 2017b). Previous studies have identified the role of project identification in construction workers' safety compliance (Andersen et al. 2015, Choi et al. 2017a, Andersen et al. 2018, Ye et al. 2020). Based on these notions, it is hypothesized that project identification predicts construction worker's safety compliance.

2.2 Transformational leadership, communication climate, and safety participation

Employees’ interaction with management has a significant impact on their selection of behaviors in an organization. Worker safety behaviors are influenced by work conditions (e.g., environment and tasks, etc.) and interaction with management (Fang et al. 2015). Because safety participation involves voluntary activities beyond in-role safety requirements (i.e., safety compliance), interaction with organizational leaders plays a pivotal role in motivating workers' safety participation. In the same vein, leadership style has received increasing attention in safety studies. Specifically, transformational leadership has been found to affect workers' safety behaviors, including safety participation (Christian et al. 2009, Clarke 2013, Griffin and Hu 2013). Transformational leadership refers to leader behaviors that inspire followers to adopt organizational goals and interests, moving them beyond their immediate self-interest to achieve collective goals (Bass and Bass Bernard 1985, Moriano et al. 2014, Buil et al. 2019). Transformational leaders recognize employee needs and motivate them to unite and pursue higher goals to produce positive organizational changes.
Employees’ interaction with transformational leaders makes them internalize organizational visions and goals and perform beyond in-role requirements and expectations to achieve organizational goals (Ding et al. 2017). The effects of transformational leadership on OCB have been empirically proved by previous studies (Podsakoff et al. 1990, Wang et al. 2005, Cho and Dansereau 2010, Humphrey 2012, López-Domínguez et al. 2013). Clarke (2013) identified the positive effects of transformational leadership on workers’ safety participation based on a meta-analytic path analysis of 103 previous studies in the safety context.

Another management factor included in the research model is communication climate. Effective internal communication is generally recognized to be essential to a successful organization. The communication climate is a facet of the psychological climate, defined as an individual’s perception and interpretation of the work environment's communication regarding its psychological meaning and significance (Rogers 1987, Smidts et al. 2001). A positive communication climate embraces supportiveness, openness and candor, confidence and credibility, participative decision making, and trust (Dennis 1974, Bartels et al. 2007). Since extra-role behaviors are beyond in-role requirements, effective organizational information communication would be crucial for encouraging employees' OCB. Effective communication improves employee's self-efficacy in extra-role behaviors. A positive communication climate gives employees faith that his/her extra-role behaviors can create a real contribution to an organization. For example, if management pays more attention to employee voices, they are more likely to make suggestions to improve organizational performance. While transformational leadership is related to the content of employee
interactions with management, the communication climate reveals the manner of interaction with management in an organization. Previous studies have empirically demonstrated the role of communication climate in promoting OCB in an organization (Abu Bakar and McCann 2015, Chan and Lai 2017). Furthermore, safety researchers and practitioners have gradually recognized the significance of communication for improving safety performance (Cigularov et al. 2010, Kines et al. 2010b, Huang et al. 2018), including safety participation (Mashi et al. 2020). For example, if workers feel comfortable discussing safety issues, they will put more effort into providing work safety suggestions.

Communication is generally a path for performing leadership in an organization. Transformational leaders may exert increased efforts to facilitate the formation of a positive communication climate to inspire collective goals among their subordinates. In addition, employees may perceive a more positive communication climate if transformational leaders maintain close interactions with them and genuinely care about their needs (Neff and Cirin 1999). Men (2014) demonstrated a positive relationship between transformational leadership and internal communications in medium-sized and large corporations in the U.S. In addition, Zohar and Tenne-Gazit (2008) also showed the positive effects of transformational leadership in strengthening friendly communications in an organization. Therefore, the research model includes a path from transformational leadership to a communication climate.

2.3 The mediating role of project identification

It has been argued that transformational leadership positively impacts workers' behaviors by promoting organizational identification (Tse and Chiu 2014, Ding et al. 2017). As mentioned,
transformational leaders are more focused on collective identity and organizational goals and visions. According to the social identity of leadership theory (Hogg 2001), employee interaction with transformational leaders fosters employees' psychological needs for self-esteem and self-enhancement as organizational members. A positive psychological experience in an organization leads to emotional attachment with it, which leads organizational identification to become salient to an employee’s self-concept (Walumbwa et al. 2008). Kark et al. (2003) and Cregan et al. (2009) found empirical evidence of transformational leadership’s positive effect on employees' organizational identification. Transformational leaders enable employees to internalize organizational visions and goals associated with self-fulfillment and esteem through organizational identification. Accordingly, subordinates, who strongly identify with the organization, tend to fully engage with their work role and are motivated to participate in proactive behaviors to improve organizational performance. Safety performance is one of the critical criteria evaluating the performance of construction projects. Based on these notions, it is hypothesized that construction worker's project identification mediates the relationship between transformational leadership and safety participation.

Several previous studies have empirically demonstrated the role of communication climate in organizational identification (Scott et al. 1999, Bartels et al. 2007, Bartels et al. 2010, Neill Marlene et al. 2019). Management with a constructive communication climate pays more attention to employee's voices in an organization. Also, employees may have more opportunities to create and share their ideas while discussing organizational issues and participating in the decision-making process. This may facilitate employees’ feelings of
ownership because they feel involved with the organization (Nakra 2006). Also, employees may feel greater control in the organization through proactive participation. These processes may enhance employees' self-worth and fulfillment, strengthening their organizational identification (Bartels et al. 2006).

Moreover, open communication with management may foster employees' self-esteem because they perceive that they are taken seriously (Smidts et al. 2001). Organization-based self-esteem is one of the critical dimensions of organizational identification (Bergami and Bagozzi 2000). Accordingly, employees in a positive communication climate are more likely to recognize themselves as significant organization members. The salient organizational identification driven by a constructive communication climate may also motivate employees to devote themselves to work and perform beyond job requirements to accomplish organizational goals and visions. Based on earlier results, it is hypothesized that construction workers’ project identification mediates the relationship between communication climate and safety participation.

3. Methods

3.1 Sample and procedure

A survey questionnaire was designed and administered to collect data in this study. The surveys were conducted at four construction sites from September to October 2019. Sites A and C were residential building construction projects, and the survey was conducted in September 2019. Sites B and D were commercial building construction projects, and data were collected in October 2019. Projects A and B’s general contractor was the same
company, and another general contractor carried out Projects C and D. Before data collection, the Institutional Review Board (IRB) of the authors’ institute approved the survey instruments and procedures. The surveys took place in a conference room of each project during regular safety training sessions to avoid interrupting participants’ ongoing tasks. Owing to the limited space available in the conference rooms at the construction sites, the research team administered surveys multiple times in each project. For example, the research team collected data from Site C, the largest project with regard to sample size, for four days. This grouping of respondents made it possible to secure ample space to ensure the confidentiality of participants’ respondents. One week before the data collection, a research team member explained the survey’s purpose and procedures to each project's forepersons and supervisors during their weekly meetings, and the forepersons and supervisors verbally advertised this study to their crews. The workers in each project voluntarily participated in the survey at the end of regular safety training sessions. Before administering the survey, a research team member (i.e., the survey administrator) provided a brief explanation regarding the purpose, procedure, and potential risk of the survey to the workers. Project participants who did not participate in the survey were prohibited from entering the conference room to prevent unforeseen effects on the response. Questions about personal identification were not included in the questionnaire to guarantee the responses’ anonymity. For example, an item regarding participants’ gender was excluded during the IRB process because female workers could be specified at a construction site. After questionnaires were filled out, survey administrators immediately collected the completed questionnaires to ensure confidentiality. The survey took approximately 20 minutes to complete.
The total sample size was 261; there were 43 respondents from Site A, 53 from Site B, 88 from Site C, and 77 from Site D. All participants were field workers (78.5%, 205 workers) or forepersons (21.5%, 56 workers) in the projects. Of these, 131 participants (50.2%) worked on residential building projects, and 130 participants (49.8%) were from commercial building projects. Ninety-six participants (36.8%) worked for the first general contractor, and 165 workers (63.2%) were from another general contractor. The sample includes various types of trade workers employed by subcontractors, including concrete workers, rebar workers, electricians, plumbers, and HVAC workers. The average age of the participants is 48.72, with standard deviations (S.D.) of 10.39. Of the participants, 20.7% are younger than 40 years old, 28.7% were between 41 and 50 years old, 41.8% are between 51 and 60 years old, and 8.4% were older than 60. The average years of participant job experience is 12.84 (SD = 9.91). Approximately 33% of the participants have less than five years of job experience, 33.6% have between five to 15 years of job experience, and 46.4% have more than 15 years of job experience. Approximately half of the participants (52.5%) had worked on the current project for less than three months, 23.9% had between three and six months of project tenure, and 23.6 worked on the current project for more than six months.

### Table 1. Participant Demographic Information

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 30 y</td>
<td>20</td>
<td>7.7</td>
</tr>
<tr>
<td>31 – 40 y</td>
<td>34</td>
<td>13.0</td>
</tr>
<tr>
<td>41 – 50 y</td>
<td>76</td>
<td>28.7</td>
</tr>
<tr>
<td>51 – 60 y</td>
<td>109</td>
<td>41.8</td>
</tr>
<tr>
<td>≥ 60 y</td>
<td>22</td>
<td>8.4</td>
</tr>
</tbody>
</table>
### Job experience

<table>
<thead>
<tr>
<th>Experience</th>
<th>Count</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 2 y</td>
<td>44</td>
<td>16.9</td>
</tr>
<tr>
<td>2 – 5 y</td>
<td>42</td>
<td>16.1</td>
</tr>
<tr>
<td>6 – 10 y</td>
<td>50</td>
<td>22.1</td>
</tr>
<tr>
<td>11 – 15 y</td>
<td>30</td>
<td>11.5</td>
</tr>
<tr>
<td>16 – 20 y</td>
<td>51</td>
<td>29.5</td>
</tr>
<tr>
<td>≥ 16 y</td>
<td>44</td>
<td>16.9</td>
</tr>
</tbody>
</table>

### Job title

<table>
<thead>
<tr>
<th>Title</th>
<th>Count</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreman</td>
<td>56</td>
<td>21.5</td>
</tr>
<tr>
<td>Worker</td>
<td>205</td>
<td>78.5</td>
</tr>
</tbody>
</table>

### 3.2 Measures

This study adopted prior validated measurements and modified them to the context of construction projects. For example, the measures of communication climate adopted from Postmes (2001) was changed from "Management of this organization pays attention to employees’ suggestions" (p. 246) to "Management of this project pays attention to employees’ suggestions". Before completing the draft questionnaire, several pilot studies were conducted to improve the measurements and instructions. All constructs were measured using a 7-point Likert scale ranging from -3 (strongly disagree) to 3 (strongly agree). In the first section, respondents were asked to provide their perception of transformational leadership, communication climate, and project identification. The second section contained measurements of safety compliance and safety participation. The third section included questions on the respondents' information, including age, job experience, job title, and tenure at the current project.

#### 3.2.1 Transformational leadership and communication climate

Transformational leadership has been conceptualized as a four-dimensional construct,
including idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Hoffmeister et al. 2014, Ding et al. 2017). The four items from Bass and Avolio (1994) were used to measure each dimension of transformational leadership. One example included, "Managers on this project talk enthusiastically about what needs to be accomplished." (Inspirational motivation). Communication climate was measured by three items from Smidts et al. (2001) and Postmes (2001) that reference employees’ work-related communication experience. An example of the items measuring communication climate is "Management of this project pays attention to employees’ suggestions." Cronbach's alpha was 0.89 for transformational leadership and 0.92 for the communication climate.

3.2.3 Project identification

SIT researchers have empirically validated a three-dimensional model of social identity (e.g., ethnicity, religion, gender, fans of a sports team, and family) that consists of cognitive (i.e., knowledge of membership), affective (i.e., emotional significance of membership), and evaluative dimension (i.e., the value of membership) (Ellemers et al. 1999, Bagozzi and Lee 2002, Cameron 2004). In addition to the three-dimensional model, recent studies have suggested a fourth dimension called the behavioral dimension (i.e., behavior supportive of the group). While SIT scholars have successfully developed a comprehensive conceptualization of social identification, the multi-dimensional nature of organizational identification and its impact on employees’ behavior has not been well investigated. Although a few previous studies proposed a multi-dimensional organizational identification.
model, empirical studies scrutinizing this model in relation to project-based organizations like construction projects are still tenuous. This study adopted established measures from previous studies (Mael and Ashforth 1992, Bergami and Bagozzi 2000, Jackson 2002, Van Dick et al. 2004, Johnson et al. 2012) for the four dimensions to develop a comprehensive conceptualization of project identification and to measure the salience of construction workers’ project identification. Sample items included: “being a member of this project is an important part of who I am” (cognitive dimension), “I am happy to be a member of this project” (affective dimension), “I am a valuable member of this project” (evaluative dimension),” and “This project’s successes are my successes” (behavioral dimension).

3.2.4 Safety compliance and safety participation

Safety compliance was assessed using three items from Neal et al. (2000) and Neal and Griffin (2006). The respondents were asked to provide their performance of compliance with safety rules and procedures during work at the current site. One example included: “I use all the necessary safety equipment (e.g., personal protective equipment) to do my job.” Cronbach's alpha shows good reliability of the scales (0.90). Three items from Neal et al. (2000) and Griffin and Neal (2000) were also used to measure safety participation. The items were designed to evaluate the respondent's propensity to engage in activities beyond their role to improve the project's safety performance. An example was "I voluntarily carry out tasks or activities that help improve workplace safety," and Cronbach's alpha for safety participation was 0.80.
3.3 Data analysis

As the first step in data analysis, an Exploratory Factor Analysis (EFA) was conducted to develop a multi-dimensional model of construction workers’ project identification because the multi-dimensional nature of organizational identification with project-based organizations (e.g., construction project) had not been investigated in prior studies. Based on this model, the measures’ adequacy was tested by Confirmatory Factor Analysis (CFA). The CFA was evaluated by RMSEA (Root Mean Square Error of Approximate), CFI (Comparative Fit Index), NNFI (Non-Normed Fit Index), and SRMR (Standardized Root Mean Square Residual). Factor loadings, composite, reliability, and average variance extracted from the measures were calculated to assess the convergent validity. Discriminant validity was evaluated by checking whether the correlation coefficients among the latent variables were significantly less than 1.00 (Bagozzi and Yi 2012). A 95% confidence interval of each correlation coefficient was estimated to check whether the confidence intervals included 1.00. Finally, the psychological mechanism of construction participation was investigated (i.e., the hypothesized relationship between the latent variables) using the Structural Equation Model (SEM). RMSEA, CFI, NNFI, and SRMR were also used to evaluate the SEM’s fitness.

4. Results

4.1 Measurement model assessment

EFA was employed to develop a comprehensive conceptualization of construction workers’ project identification. Before performing EFA, the Kaiser-Meyer-Olkin (KMO) test and
Bartlett’s test of sphericity were carried out to examine the applicability of the data for EFA. The KMO measure of sampling adequacy was 0.96, which exceeded the acceptable level of 0.8 (Zhang et al. 2016), and Bartlett’s test of sphericity was also significant ($\chi^2 (66) = 2931.45, p < 0.01$). Accordingly, the data were considered suitable for the EFA. The Velicer (1976)’s Minimum Average Partial test and comparative data technique proposed by Ruscio and Roche (2012) were combined to determine the appropriate number of factors. Based on procedures presented by Courtney and Gordon (2013), the MAP test and comparative data technique were conducted using SPSS 25. The MAP result indicated that the minimum squared average partial correlation of 0.040 was achieved for a two-factor model. Also, the comparative data technique revealed that moving from one factor to two factors provided statistically significant improvement ($p < 0.001$), while moving from two to three factors provided non-significant improvement ($p = 0.998$). Therefore, a two-dimensional model was selected as the final model of the project identification. Principal axis factoring with direct oblimin rotation, which is widely applied with high correlation among the factors, was used to determine project identification's underlying dimensions (Wan et al. 2015). To enhance the interpretability of the factors, the cut-off factor loading of 0.45 was used to exclude the weak indicators of common factors. The EFA result indicated that Factor 1 accounted for 64.4% of the total variance with a satisfactory reliability ($\alpha = 0.94$), and six items intended to measure the cognitive and affective dimensions of project identification were loaded on Factor 1 (i.e., the cognitive and affective dimension). Factor 2 accounted for 4.8% of the total variance with 0.91 of Cronbach’s alpha. Four items measuring the evaluative and behavioral dimension of project identification were loaded on Factor 2 (i.e., the evaluative and
Based on the project identification's two-dimensional model, CFA was conducted to assess the measurements' adequacy in this study. To examine the reliability of each construct in the research model, the Cronbach’s alpha test was conducted. As shown in Table 2, the values of Cronbach’s alpha range from 0.80 (safety participation) to 0.94 (cognitive and affective project identification), which is above the acceptable threshold of 0.70 (Hair et al. 2006). In addition, a confirmatory factor analysis (CFA) was conducted by using AMOS 26 (IBM) to assess the convergent and discriminant validity of the constructs. A CFA model with six latent variables (i.e., transformational leadership, communication climate, cognitive & affective project identification, evaluative & behavioral project identification, safety compliance, and safety participation) and 22 measures was built. Three manifest variables were excluded in the CFA model because the factor loadings are lower than 0.5, a threshold suggested by Hair et al. (2006). To assess CFA model fit, the following thresholds were applied in this study: RMSEA ≤ 0.07, CFI ≥ 0.90, NNFI ≥ 0.90, SRMR ≤ 0.07 (Hu and Bentler 1999, Bagozzi and Yi 2012). The goodness of fit indices for the CFA model met the above criteria: RMSEA ≤ 0.069, CFI ≥ 0.94, NNFI ≥ 0.92, and SRMR ≤ 0.057. Convergent validity was assessed by factor loading, composite reliability, and average variance extracted. To establish the convergent validity, factor loadings for all manifest variables should be greater than 0.5, and the value of composite reliability should be greater than 0.5 (Bagozzi and Yi 1988, Hair et al. 2006). Also, a value of 0.5 or greater is recommended for the average variance extracted. As shown in Table 2, all factor loadings exceed the threshold of 0.50, and composite reliability ranges from 0.83 to 0.94. The average variance extracted ranges from
0.62 to 0.79, which are greater than the recommended threshold. Convergent validity, therefore, is established in this study. The 95% confidence intervals for all correlation coefficients in the CFA model are constructed to examine the discriminant validity. All the confidence intervals did not include 1.00, which indicates that the correlation among all the constructs was significantly less than 1.00. Therefore, this study also achieved discriminant validity.

### Table 2. Reliability and Convergent Validity of the CFA

<table>
<thead>
<tr>
<th>Construct</th>
<th>Indicator</th>
<th>Factor Loading</th>
<th>Error Variance</th>
<th>Reliability (α)</th>
<th>Composite Reliability</th>
<th>Average Variance Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational Leadership</td>
<td>TL1</td>
<td>0.83</td>
<td>0.32</td>
<td>0.89</td>
<td>0.88</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>TL2</td>
<td>0.84</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TL3</td>
<td>0.87</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication Climate</td>
<td>CC1</td>
<td>0.84</td>
<td>0.29</td>
<td>0.92</td>
<td>0.92</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>CC2</td>
<td>0.91</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CC3</td>
<td>0.91</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive &amp; Affective Project Identification</td>
<td>CAP1</td>
<td>0.74</td>
<td>0.46</td>
<td>0.94</td>
<td>0.94</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>CAP2</td>
<td>0.77</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAP3</td>
<td>0.92</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAP4</td>
<td>0.92</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAP5</td>
<td>0.93</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAP6</td>
<td>0.86</td>
<td>0.26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluative &amp; Behavioral Project Identification</td>
<td>EBP1</td>
<td>0.83</td>
<td>0.31</td>
<td>0.91</td>
<td>0.91</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>EBP2</td>
<td>0.84</td>
<td>0.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EBP3</td>
<td>0.83</td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EBP4</td>
<td>0.87</td>
<td>0.24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Compliance</td>
<td>SC1</td>
<td>0.93</td>
<td>0.14</td>
<td>0.92</td>
<td>0.92</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>SC2</td>
<td>0.94</td>
<td>0.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SC3</td>
<td>0.80</td>
<td>0.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Participation</td>
<td>SP1</td>
<td>0.64</td>
<td>0.59</td>
<td>0.80</td>
<td>0.83</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>SP2</td>
<td>0.83</td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SP3</td>
<td>0.87</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: N = 261
4.2 Descriptive statistics

Table 3 represents the mean, standard deviation, and intercorrelation coefficients of the variables in this study and demographic variables (i.e., project type, company, forepersons, age, and project tenure). Table 3 shows that construction workers' project identification has a significant correlation with transformational leadership ($r = 0.78$, $p < 0.01$) and communication climate ($r = 0.79$, $p < 0.01$). It indicates that workers who perceive more transformational leadership and positive communication climate tend to have salient project identity. However, there was no significant correlation found between project tenure and project identification. Previous studies have shown that short-term tenure in an organization does not inhibit promoting an individual's organizational identification (Akerlof and Kranton 2005; Peters et al. 2013; Ramsey et al. 2013). In addition, previous studies on construction workers' project identification have shown that workers’ tenure in the current project is not a significant barrier to increasing their project identification (Choi et al. 2017a, b). Thus, certain workers may have salient project identification, even if they spent a relatively short time in the current project. Moreover, strong correlations between transformational leadership and project identification and between communication climate and project identification imply that transformational leadership and communication climate may promote workers' project identification even if workers do not spend a long time in the current project. A significant correlation is found between project identification and safety participation ($r = 0.42$, $p < 0.01$) and between project identification and safety compliance ($r=0.53$, $p < 0.01$). It implies that workers who more strongly identify with their project tend to follow the safety rules and procedures and put more extra effort into improving safety at their job site. Besides, a strong
positive correlation between safety compliance and safety participation ($r = 0.85$, $p < 0.01$) justifies the necessity of controlling the share variance of safety compliance to predict safety participation.

Also, several significant correlations are found between demographic variables and constructs in the research model. First, project type (i.e., office building vs. residential building) significant correlates with transformational leadership ($r = -0.23$, $p < 0.001$), project identification ($r = -0.14$, $p = 0.029$) and safety participation ($r = -0.15$, $p = 0.018$). At office building projects, workers perceived more transformational leadership and project identity and followed safety rules and procedures in their work. Besides, a significant correlation between company and safety compliance ($r = 0.14$, $p = 0.035$) indicates that workers for the second general contractor (Projects C and D) show better safety compliance. Furthermore, the foreperson shows significant correlations with project identification ($r = 0.15$, $p = 0.023$) and safety participation ($r = 0.15$, $p = 0.026$), and there is a significant correlation between age and project identification ($r = 0.20$, $p = 0.003$). It indicates that forepersons and older workers tend to perceive more salient project identity. Also, forepersons tend to put more additional effort into safety improvement in their projects. As such, demographic variables that significantly correlate with either project identification, safety compliance, or safety participation were included in the SEM model as control variables and excluded if the control variable's regression coefficient was not significant.
Table 3. Descriptive Statistics and Correlation Matrix

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-.082</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.058</td>
<td>-.046</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-.100</td>
<td>.095</td>
<td>.111</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>.062</td>
<td>.094</td>
<td>.029</td>
<td>.065</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>-.106</td>
<td>-.041</td>
<td>.179**</td>
<td>.495**</td>
<td>.139*</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>-.231**</td>
<td>-.042</td>
<td>.103</td>
<td>.127</td>
<td>.032</td>
<td>.025</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>-.081</td>
<td>-.069</td>
<td>.092</td>
<td>.067</td>
<td>.048</td>
<td>.011</td>
<td>.845**</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>-.142*</td>
<td>-.052</td>
<td>.148*</td>
<td>.196**</td>
<td>.053</td>
<td>.103</td>
<td>.777**</td>
<td>.792**</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>-.154*</td>
<td>.137*</td>
<td>.069</td>
<td>.041</td>
<td>-.060</td>
<td>.019</td>
<td>.414**</td>
<td>.347**</td>
<td>.424**</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>-.116</td>
<td>.108</td>
<td>.150*</td>
<td>.075</td>
<td>-.011</td>
<td>.056</td>
<td>.410**</td>
<td>.434**</td>
<td>.528**</td>
<td>.853**</td>
<td>1.000</td>
</tr>
</tbody>
</table>

| Mean      | 0.63  | 0.501 | 0.21  | 48.72 | 12.836| 13.218| 0.567 | 0.268 | 0.403 | 1.388 | 1.105 |
| SD        | 0.483 | 0.501 | 0.411 | 10.39 | 9.905 | 9.741 | 1.256 | 1.26  | 1.118 | 1.139 | 1.028 |

Notes: N = 261 *p < 0.05, **p < 0.01, SD = standard deviation, 1. Project type, 2. General contractor, 3. Foremen, 4. Age, 5. Project tenure, 6. Job experience 7. Transformational leadership, 8. Communication climate, 9. Project identification, 10. Safety compliance, 11. Safety participation
4.4 Structural model assessment

To clarify the psychological mechanism of construction workers' safety participation, SEM analysis was conducted using the same latent and measurement variables in the CFA model. Figure 2 shows the results of the path analysis of SEM. The structural model achieved an adequate statistical model fit: $\chi^2 = 566.75$, df = 237, $p < 0.001$, RMSEA $\leq 0.07$, CFI $\geq 0.94$, NNFI $\geq 0.93$, and SRMR $\leq 0.07$. In Figure 2, solid lines demonstrate significant path coefficients, and dotted lines indicate non-significant path coefficients in the model. As shown in Figure 1, workers' project identification is a significant predictor of safety participation ($\beta = 0.26$, $p = 0.003$) after controlling the effects of shared variance between safety compliance and safety participation. The result supports the hypothesis regarding the positive effects of project identification on workers' safety participation. Also, the path coefficient of safety compliance is significant ($\beta = 0.80$, $p < 0.001$), justifying the incorporation of safety compliance to control the shared variance between safety participation in examining the influence of project identification on safety participation. The path coefficient between project identification and safety compliance is also significant ($\beta = 0.30$, $p = 0.009$), supporting the hypothesis of project identification effects on safety compliance. The three positive significant path coefficients (project identification (independent variable) $\rightarrow$ safety participation (dependent variable), project identification (independent variable) $\rightarrow$ safety compliance (dependent variable), and safety compliance (mediator) $\rightarrow$ safety participation (dependent variable)) imply that the effects of project identification on safety participation are partially mediated by safety compliance. 23% of the
variance in safety compliance is explained by the combined effects of transformational leadership, communication climate, project identification, and a control variable (i.e., company). In addition, independent variables and mediators (i.e., transformational leadership, communication climate, project identification, and safety compliance) explain 78% of the variance in safety participation, which is considerably higher than other similar types of studies. This is primarily because of the strong correlation between safety participation and safety compliance. As mentioned above, previous studies did not include safety compliance as a control variable in predicting safety participation, despite fuzziness in perceptual boundaries between safety compliance and safety participation. Thus, to overcome the limitations of the previous studies, this study considers safety compliance a control variable in predicting safety participation by including a path from safety compliance to safety participation. Consequently, the percentage of variance in safety participation accounted for by the model is higher than in previous safety participation studies. If the model excludes the path from safety compliance and safety participation and renders them correlated, similar to models in previous studies, it explains only 17% of the variance in safety participation.

The path analysis results demonstrate a significant path coefficient between transformational leadership and project identification ($\beta = 0.35, p = 0.001$). The result supports the hypothesis on the effects of transformational leadership on project identification. Besides, while the path coefficient between transformational leadership and safety compliance is significant ($\beta = 0.30, p = 0.045$), the path coefficient between transformational leadership and safety participation is not significant. It implies that the project identification
(mediator) partially mediates the relationship between transformational leadership (independent variable) and safety compliance (dependent variable) and fully mediates the relationship between transformational leadership (independent variable) and safety participation (dependent variable). The results also show that communication climate is a significant predictor of project identification ($\beta = 0.49, p < 0.001$), supporting the hypothesis on the influence of communication climate on project identification. However, the direct effects of communication climate on safety compliance and safety participation are not statistically significant. Therefore, project identification fully mediates the effect of communication climate on safety compliance and safety participation. In addition, transformational leadership, communication climate, and a control variable (i.e., age) account for 67 percent of the variance in project identification.
5. Discussion

5.1 Theoretical and practical applications

This study developed and tested a theoretical model to examine the psychological mechanism of construction workers’ safety participation. This study adds support to the growing evidence on the role of the socio-cognitive process in worker safety behaviors. It was found that workers’ project identification would mediate the effects of transformational leadership and communication climate on their safety compliance and safety participation. This knowledge of the mediation effect is significant because it allows an understanding of the psychological dynamics through which management factors (i.e., transformational leadership,
communication climate) influence safety behaviors (i.e., safety compliance and safety participation) and reduce occupational accidents at construction sites. Previous studies focused on the direct effects of management factors on workers' safety behaviors. This study extends our understanding of safety behaviors by examining the psychological mechanisms driving the link between management factors and safety behaviors. Specifically, understanding safety participation's psychological mechanics is crucial in construction safety given the uncertainty and complexity of construction site work. In this sense, this study found the effects of management factors on safety participation independent from safety compliance because, in the research model, safety compliance was incorporated as an antecedent of safety participation. Although previous studies on safety participation or safety citizenship behaviors included safety compliance in their research model (Griffin and Neal 2000, Barbaranelli et al. 2015, Guo et al. 2016), they may not have controlled the shared variance between safety participation and safety compliance as they only allowed safety participation and safety compliance to be correlated (not employed as antecedents). For example, the path coefficient between project identification and safety participation changes from 0.26 to 0.50 if the shared variance was not controlled in the model. Therefore, previous study findings on safety participation factors could be overestimated due to the shared variance between safety compliance and safety participation. In the same vein, previous studies on OCB contended that in-role behaviors should be a control variable in predicting OCB (Williams and Anderson 1991, Walz and Niehoff 2000).

Furthermore, this study contributes to existing safety research by examining project identification's role in promoting construction workers' safety participation. Although
previous studies in organizational behaviors found that employees' organizational identification could be a psychological driver to facilitate their extra-role actions (Haslam et al. 2000, Van Knippenberg 2000, Riketta and Dick 2005; Humperhy 2012; Demir 2015; Wu et al. 2016), it has not been investigated in the context of safety behaviors. Furthermore, most previous studies on organizational identification focused on traditional and long-term organizations where the interactions between employees and organizations are assumed to be stable and continuous. However, the transient nature of employment in project-based organizations (e.g., construction projects) makes it challenging to apply findings from previous studies to project-based organizations directly. Even the few studies investigating the role of project identification in shaping employee's vocational behaviors only focused on improving in-role behaviors such as work engagement, turnover, and safety compliance (Walumbwa et al. 2011, Choi et al. 2017b, Ding et al. 2017). As such, the effects of project identification on construction workers' safety participation in this study advance our knowledge of organizational identification and safety participation. Considering many industries are increasingly adopting the project-based organization model, study findings may have impactful implications for a broad array of project-based organizations.

Besides, this study extends previous findings on the applicability of transformational leadership and communication climate in different behavioral and organizational contexts by examining leadership and communication behaviors in the context of safety participation in project-based organizations (i.e., construction projects). In line with prior studies examining the relationships between transformational leadership and safety behaviors and between communication climate and safety behaviors in long-term organizations, this study confirms
that a transformational leadership and communication climate still affects employees' safety participation and safety compliance in project-based organization settings. Specifically, respondents who perceived higher transformational leadership levels and a positive communication climate are more likely to perform their tasks more safely and put more extra effort into improving safety at their work. As safety compliance and safety participation are essential predictors of safety performance at construction sites, this study suggests that construction site managers should develop transformational leadership. It also provides an important criterion for selecting construction managers and implementing training programs to help them develop an effective leadership style. Construction projects are not favorable conditions for developing transformational leadership. However, recent studies, including this study, have consistently observed the role of transformational leadership in improving construction safety. Consequently, several studies have proposed practical guidance to promote transformational leadership in construction projects. Grill et al. (2019) found that intellectual stimulation is the most frequently observed transformational leadership behavior among construction managers. In practice, intellectual stimulation can be practiced in an interactive problem-solving process. For example, construction managers can practice intellectual stimulation by encouraging workers to become active participants in the problem-solving process. Thus, a positive communication climate would be helpful in developing intellectual stimulation in construction projects. Further, Aga et al. (2014) showed that team building activities can aid in the development of transformational leadership in project-based organizations. Furthermore, this study's findings suggest that managers at construction sites should focus on cultivating a more attractive communication climate. Construction managers
should provide each worker with adequate information and opportunities to speak out and get involved with the decision-making process.

This study contributes to the body of research on organizational identification studies by exploring the multi-dimensional nature of organizational identification in a project-based organization. The existing studies on organizational identification heavily focused on the cognitive aspect of organizational identification (i.e., perception of oneness with or belongingness to an organization) to distinguish it from organizational commitment (Johnson et al. 2012). As a result, little attention was given to the multidimensionality of organizational identification. Social identity scholars have successfully developed a comprehensive conceptualization of social identification with groups (e.g., based on ethnicity, religion, gender, sports team fans, and family), including cognitive (i.e., knowledge of membership), affective (i.e., the emotional significance of membership), and evaluative dimensions (i.e., the value of membership) (Ellemers et al. 1999, Bagozzi and Lee 2002). However, the multi-dimensional nature of organizational identification and its impact on employees' behavior has not been well investigated. A comprehensive conceptualization would be essential for an in-depth understanding of organizational identification because each dimension could be differently associated with its antecedents and consequences (Bergami and Bagozzi 2000, Johnson et al. 2012). Although a few previous studies proposed a multi-dimensional organizational identification model, to the best of the authors' knowledge, no studies focused on project-based organizations. The short-term tenure, along with transactional employment relationships in project-based organizations, may not have the same impact on each dimension of employees' organizational identification. Therefore, the two-dimensional
model identified by EFA in this study extends theories on organizational identification by developing a comprehensive conceptualization of organizational identification in project-based organizations.

5.2 Limitations

Although this study contributes to advancing our understanding of the psychological mechanism of construction workers' safety participation, several limitations should be acknowledged. First, this study's cross-sectional research design may be limited to explain dynamic relationships among the constructs. Specifically, it is difficult to investigate reciprocal determinism's ramification, which refers to the bidirectional influence between variables in cross-sectional studies. Although cross-sectional research design has been widely adopted in safety research, longitudinal studies could clarify the causal relationships. Second, since a self-reported questionnaire measures this study's manifest variables, it may induce the possibility that common method bias dilutes the results' theoretical significance. Due to the concerns about the common method bias, this study followed Podsakoff et al. (2003)'s single unmeasured latent factor method factor to test whether the bias would explain the relationship among the study constructs. Specifically, an additional, unmeasured latent method factor was added to the CFA model. Then, all manifest variables were allowed to load on their theoretical latent variable and method factor. The factor loadings and correlation coefficients among the latent variables remain virtually unchanged after including the method factor. The results indicated that the common method bias might not attenuate the significance of this study's findings. Furthermore, Christian et al. (2009) has suggested that
"common method bias may not be a major concern in safety domain" (p. 1122) based on the meta-analysis results of 90 studies.

6. Conclusion

This study incorporated transformational leadership, communication climate, and project identification to build and test a research model regarding construction workers' safety participation. The results of hypothesis testing suggest that (1) project identification has a positive impact on safety participation after controlling the effects of safety compliance, (2) project identification mediates the relationship between transformational leadership and safety participation, and (3) project identification mediates the influence of communication climate on safety participation. These findings deepened and extended prior research on safety behaviors and organizational identification by clarifying the mechanism that underlies the link between management factors and safety participation. Also, the study results suggest new directions for safety management in project-based organizations. Since the behavioral changes driven by organizational identification involve a process of genuine internalization, improving safety participation as well as safety compliance through project identification would be more durable and cost-effective compared with management reliance on formal approaches such as regulations and penalties. Therefore, cultivating transformational leadership and a positive communication climate to promote workers' project identification would be effective approaches to complement formal control limitations in safety management.

Appendix A. Measurement Items in this Study
### Construct | Indicator | Item
--- | --- | ---
Transformational Leadership | TL1 | Managers on this project emphasize the importance of having a collective sense of mission.
 | TL2 | Managers on this project talk enthusiastically about what needs to be accomplished.
 | TL3 | Managers on this project reexamine critical assumptions to question whether they are appropriate.
Communication Climate | CC1 | Managers on this project are open and honest towards me.
 | CC2 | Managers on this project pay attention to employees’ suggestions.
 | CC3 | In this project, I have ample opportunity to have my say.
Cognitive & Affective Project Identification | CAP1 | Being a member of this project is an important part of who I am.
 | CAP2 | My self-image overlaps with this project’s image.
 | CAP3 | I am happy to be a member of this project.
 | CAP4 | I feel a strong sense of belonging to this project.
 | CAP5 | I like being a member of this project.
 | CAP6 | To me, being a member of this project is an important source of self-esteem.
Evaluative & Behavioral Project Identification | EBP1 | I am a valuable member of this project.
 | EBP2 | I am an important member of this project.
 | EBP3 | Members of this project can always count on each other.
Safety Compliance | SC1 | I use the correct safety procedures for carrying out my job.
 | SC2 | I ensure the highest levels of safety when I carry out my job.
 | SC3 | I use all the necessary safety equipment (e.g., personal protective equipment) to do my job.
Safety Participation | SP1 | I voluntarily carry out tasks or activities that help to improve workplace safety.
 | SP2 | I help my coworkers when they are working under risky or hazardous conditions.
 | SP3 | I promote the safety program within this project.

**References**


Aga, D. A., Noorderhaven, N., & Vallejo, B. (2016). Transformational leadership and
doi:https://doi.org/10.1016/j.ijproman.2016.02.012

Journal of Economic perspectives, 9-32.


of safety climate. Accident Analysis & Prevention 77, 35-44.


Chan, S.H.J., Lai, H.Y.I., 2017. Understanding the link between communication


Courtney, M., Gordon, R., 2013. Determining the number of factors to retain in efa: Using the spss r-menu v2 0 to make more judicious estimations. Practical Assessment, Research, and Evaluation 18 (1), 8.


Dennis, H.S., 1974. A theoretical and empirical study of managerial communication climate in complex organizations. Purdue University.


Hoffmeister, K., Gibbons, A.M., Johnson, S.K., Cigularov, K.P., Chen,


from the perspective of ethnic minority employees. European Management Journal 38 (1), 179-190.


