Architecture Image Studies
AIS Scientific Journal

Vol.6, Issue 4, pp.58-68, 2025
DOI: https://doi.org/10.62754/ais.v6i4.396

https://journals.ap2.pt/index.php/ais/index

Organizational Cultural Influence on the Relationship Between Safety Perception and Behavior in Construction Workers

Hoon-Hee Kim[1], Byung-Chan Min[2]

Abstract

This study empirically investigates the influence of safety perception factors on construction workers' actual safety behavior. Based on survey data from 225 workers, an ordinary least squares (OLS) multiple regression showed that perceived coworker cooperation (A9; $\beta = 0.30$, $p < 0.001$), supervisor emphasis on safety (A8; $\beta = 0.15$, $p = 0.001$), and recognition of minor hazards (A6; $\beta = 0.15$, $p = 0.010$) significantly and positively predicted the average safety behavior score (B_avg), whereas other perception items, including A2 and A7, were not statistically significant ($p > 0.05$). The model explained a substantial proportion of variance ($R^2 = 0.79$; adjusted $R^2 = 0.78$), and five-fold cross-validation indicated robust generalizability (mean $R^2 = 0.75 \pm 0.05$). All responses were collected anonymously, and a self-administered five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) was used. Mediation analysis further suggested that A6 exerted an indirect effect via A9 (indirect = 0.24, ≈37.4% of the total effect; standardized coefficients with bootstrap 95% confidence intervals reported). These findings provide empirical evidence that organizational culture facilitates the transition from perception to behavior and support a shift from hardware-centered control toward collaboration-oriented culture and value-based education to promote voluntary safety behavior.

Keywords: *Construction safety, Safety behavior, Organizational culture, Multiple regression analysis, Safety perception, Mediation effect.*

Introduction

The construction industry, despite its significant contribution to national economies and high employment inducement coefficients, continues to be classified as one of the most hazardous industrial sectors due to its persistently high rate of occupational accidents [1]. In South Korea in particular, more than half of all fatal industrial accidents occur in construction, underscoring the structural nature of the issue, which cannot be addressed solely through technical improvements or one-off safety training programs [2].

While physical measures such as the provision of personal protective equipment (PPE) and the installation of safety signage are regularly implemented on sites, unsafe worker behavior remains prevalent. This persistent gap contributes to the ongoing risk of serious accidents, revealing the limitations of relying solely on physical interventions [3]. Rather than viewing unsafe behavior merely as individual rule violations, there is growing recognition that such behavior is influenced by deeper cognitive structures and organizational culture.

Earlier studies predominantly emphasized procedural and regulatory approaches or the physical work environment when analyzing safety performance [4]. However, recent empirical research has highlighted the significance of qualitative factors, such as workers' safety perceptions, interpersonal interactions, leadership expression styles, and psychological safety, in shaping safety behavior [5–7]. Zohar emphasized the importance of aligning organizational safety climate and worker behavior [4], while Edmondson highlighted psychological safety as a key factor that encourages proactive actions

[1] Department of Industrial & Management Engineering, Hanbat National University, Korea. Email: clyuhun@nate.com; ORCID: 13394820
[2] Department of Industrial & Management Engineering, Hanbat National University, Korea. Email: bcmin@hanbat.ac.kr; ORCID: 11382373 (Corresponding Author).

[8]. Although interest in the role of organizational culture in shaping safety has grown in the Korean context, rigorous structural and quantitative analyses remain limited [9,10].

To address this gap, the present study aims to quantitatively analyze the structural relationship between construction workers' safety perceptions (A1–A9) and their actual safety behaviors (B1–B9). This research is guided by the following questions:

- **RQ1**: Which safety perception factors exert a significant structural influence on actual safety behavior?
- **RQ2**: Do organizational culture and leadership-related perception factors (A6, A8, A9) significantly enhance the predictive power of behavioral models?

This study offers four key contributions. First, it extends previous correlational studies by applying multiple regression modeling to examine the explanatory power of organizational culture in a structural context [11]. Second, it categorizes safety perception factors into domains such as individual responsibility, institutional systems, leadership, and peer interaction, shifting the focus from formal safety measures (e.g., training attendance or PPE provision) to workers' actual attitudes and beliefs [5]. Third, it draws on empirical data from 225 domestic construction workers to offer practical insights for developing safety management strategies grounded in organizational culture. Fourth, by comparing the behavioral impact of various multidimensional perception factors, the study provides a quantitative foundation for prioritizing future safety intervention strategies, thereby enhancing its policy application.

Reducing industrial accidents on construction sites cannot be achieved through isolated campaigns or the mere distribution of protective equipment [2]. The key to fostering safe behavior lies in internalized worker perceptions and the structural dynamics of workplace interactions [6]. A quantitative understanding of these factors is essential for designing more effective, evidence-based interventions. This study, therefore, focuses on establishing a theoretical foundation for improving safety culture in construction and empirically demonstrating the importance of organizational culture in driving behavior.

Methodology

A. Participants and Data Collection

This study employed a cross-sectional questionnaire survey conducted from April to May 2025 at privately operated construction sites in the central region of South Korea. Using nonprobability purposive sampling, we recruited 225 construction workers, and all 225 responses were retained for analysis (no missing data). All responses were collected anonymously, and the study protocol was approved by the Institutional Review Board. The sample comprised 142 construction safety managers and 83 daily laborers. Both groups completed the same self-administered instrument using identical items on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), ensuring structural consistency across respondents. This integrated design enabled a quantitative assessment of how organizational culture factors influence safety behavior while accounting for job-specific perceptual differences, and it improved the statistical stability of the correlation and regression models used in the study.

B. Survey Instrument

The survey consisted of 18 items. Among them, nine items (A1–A9) assessed perceptions of industrial safety. These items were adapted and refined from validated measures in previous safety culture studies [4,14] to better reflect the context of South Korean construction sites. Items A1–A5 focused on individual responsibility and internalized safety values, whereas A6–A9 captured aspects related to organizational culture and interpersonal interactions [7].

The behavioral dimension (B1–B9) measured the extent to which workers adhered to safety procedures before, during, and after tasks. These items were developed based on practical indicators from the ISO 45001:2018 standard and previous research [13]. The survey was explicitly designed to align with the core components of ISO 45001:2018, such as leadership commitment, hazard awareness, behavioral control, and worker engagement [14], with a particular emphasis on operationalizing these elements from the workers' perspective.

Specifically, A6 (recognition of minor hazards), A8 (supervisor's emphasis on safety), and A9 (perception of peer cooperation) were designated as organizational culture factors. Items B1 through B9 covered concrete safety actions such as wearing PPE, conducting pre-task checks, and responding appropriately to hazardous situations. Reliability analysis indicated excellent internal consistency for both scales (Cronbach's α = 0.92 for safety perception; α = 0.96 for safety behavior).

C. Data Analysis Procedure

Data analysis was conducted using IBM SPSS Statistics 28.0 and Python-based statistical libraries (e.g., pandas, Statsmodels). The analysis process included the following steps:

1. **Reliability Testing**: Cronbach's alpha was calculated to assess the internal consistency of each scale.

2. **Correlation Analysis**: Pearson correlation coefficients were computed between safety perception items (A1–A9) and the average safety behavior score (B_avg) to examine linear associations and predictive potential.

3. **Multiple Regression Analysis**: An Ordinary Least Squares (OLS) regression was performed to determine the explanatory power of perception variables on safety behavior. The dependent variable was B_avg, and the independent variables included all A1–A9 items.

Multicollinearity was assessed using the Variance Inflation Factor (VIF), and the Durbin-Watson test was applied to examine residual autocorrelation. For significant predictors, 95% confidence intervals and standard errors were reported to enhance the interpretability of the estimated coefficients.

Model fit was evaluated using the coefficient of determination (R^2) and F-statistics, with statistical significance tested at the $\alpha = 0.05$ level. To further explore the relative influence of key organizational factors (A6, A8, A9), separate regression models were constructed. Interaction and mediation effects were also tested. Before analysis, all continuous variables underwent normality assessment using the Kolmogorov–Smirnov test. Potential outliers were assessed and none were removed; all 225 cases were retained for analysis.

Results

A. Reliability Analysis

To evaluate the measurement reliability of the survey items used in this study, a reliability analysis was conducted using Cronbach's alpha. The results are presented in Fig. 1. Cronbach's alpha is a coefficient that indicates the degree of internal consistency among items within a scale, reflecting how well they collectively measure a single underlying construct. Values above 0.70 are generally considered acceptable, while those exceeding 0.90 indicate excellent internal consistency. As shown in Fig. 1, the alpha value for the safety perception scale (A1–A9) was 0.92, and the alpha value for the actual safety behavior scale (B1–B9) was 0.96. These results demonstrate that both constructs exhibit a very high level of internal consistency. This suggests that the measurement instruments developed for this study effectively capture their intended concepts and that the respondents interpreted and answered the items consistently. The high reliability coefficients also provide theoretical justification for using average scores in subsequent statistical analyses. In correlation analyses**,** each perception item (A1–A9) was correlated with B_avg**.** In multiple regression, all A1–A9 items were entered simultaneously as independent variables, with B_avg as the dependent variable.Therefore, the items used in this study exhibit both reliability and response consistency as tools for measuring industrial safety perception and behavior. This implies that the instrument can also serve as a valid evaluation tool for future research and practical applications in similar contexts.

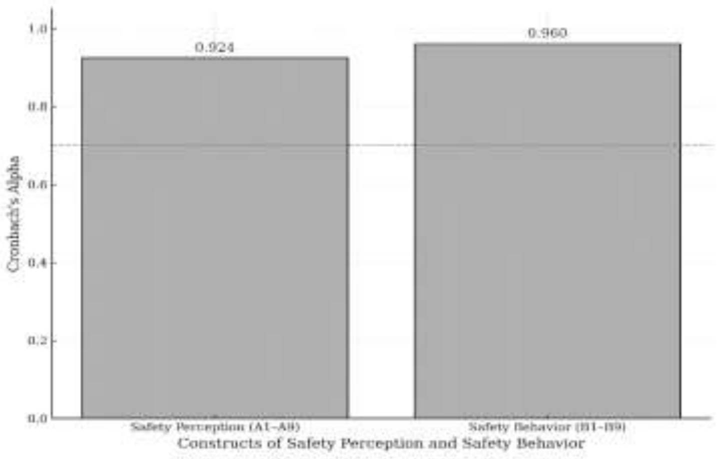

Fig. 1. Reliability coefficients for safety perception and behavior item groups (α > 0.90)

B. Relationship Between Safety Perception and Actual Safety Behavior

Fig. 2 presents the correlation between each safety perception item (A1–A9) and B_avg among construction site workers. To empirically examine the extent to which workers' perceptions of industrial safety influence their behavior, a multiple regression analysis was performed. The model yielded $R^2 = 0.79$ (adjusted $R^2 = 0.78$)**,** indicating that about 78–79% of the variance in B_avg was explained by the perception variables. This finding provides strong empirical evidence that workers' safety perceptions significantly influence their actual behavior. Among the predictors, the perception of a cooperative atmosphere among peers (A9) demonstrated the strongest positive effect ($\beta = 0.30$, $p < 0.001$), suggesting that a collaborative organizational culture substantially promotes safe behavior on construction sites. This was followed by the perception of supervisor emphasis on safety, A8 ($\beta = 0.15$, $p = 0.001$), and the recognition of minor hazards, A6 ($\beta = 0.15$, $p = 0.010$), both of which also had statistically significant positive effects. These results indicate that perceptions of safety culture involving both leadership and peer interactions have a measurable influence on individual behavior. Given the relatively high explanatory power of the regression model based on survey data, a five-fold cross-validation was conducted to verify its external validity. The average R^2 across folds was 0.75 (± 0.05), which is consistent with the original model, confirming its generalizability. Furthermore, the average root mean square error was 0.40 (± 0.03), indicating stable predictive performance. These findings suggest that the regression model does not suffer from overfitting and maintains predictive reliability in unseen data. To further explore the structural influence of perception on behavior, a mediation analysis was conducted. The total effect of A6 (recognition of minor hazards) on B_avg was 0.64, of which 0.24 (approximately 37.4%) was mediated through A9 (perception of peer cooperation). This implies that risk perception not only directly affects behavior but also exerts an indirect effect via the mediating role of collaborative organizational culture. The direct effect of A6, controlling for A9, remained significant at 0.40, further supporting the role of peer cooperation as a crucial facilitator in translating individual safety perception into actionable behavior. Standardized effects with 5,000 bootstrap samples: total = .64 (95% CI [.54, .73])**,** indirect (A6→A9→B_avg) = .24 (37.4%, 95% CI [.15, .34])**,** direct = .40 (95% CI [.31, .49])**, all** $p < .001$. Pearson correlation analysis also revealed that all perception items (A1–A9) were positively and significantly correlated with B_avg at the $p < 0.001$ level. In particular, A8 ($r = 0.77$) and A9 ($r = 0.77$) exhibited the highest correlations, followed by A6 ($r = 0.76$), A5 ($r = 0.74$), and A4 ($r = 0.73$). These findings indicate that workers' behaviors are closely tied to various perception factors, including attitudes of supervisors and coworkers, sensitivity to risks, and a sense of responsibility.

Fig. 2 visually summarizes these significant relationships, providing a foundational basis for subsequent regression and structural analyses. It also serves as a key resource for understanding how safety perceptions are translated into behavior on construction sites.

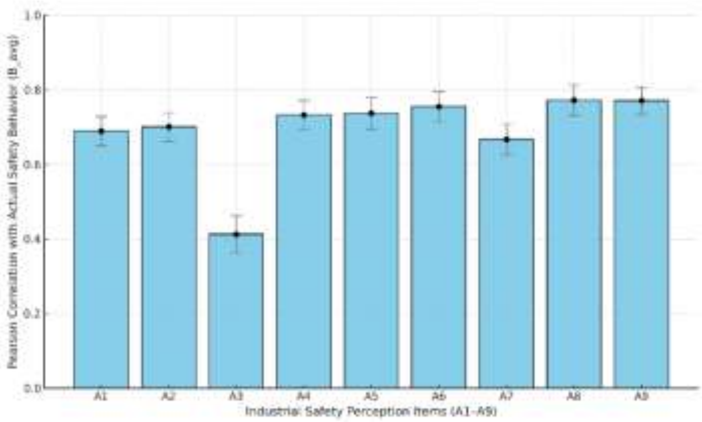

Fig. 2. Correlation between individual safety perception factors (A1–A9) and the average score of actual safety behavior (B_avg)

C. Comparative Analysis of the Impact of Safety Perception Factors on Behavior

Using data from 225 construction workers, this study conducted an OLS multiple regression analysis to examine how nine safety perception items (A1–A9) influenced the B_avg. The goal of this analysis was to statistically verify the impact of each perception factor on behavioral practice and to provide actionable insights for shaping an effective safety culture.

The results indicated that the perception of peer cooperation (A9) had the strongest effect on behavior ($\beta = 0.30$, $p < 0.001$), exhibiting a highly significant relationship. This finding suggests that fostering a cooperative atmosphere is a critical driver of safety behavior and that mutual interaction and a shared sense of responsibility among workers may serve as key channels for promoting a strong safety culture.

Additionally, the perception of supervisor safety emphasis A8 ($\beta = 0.15$, $p = 0.001$) and awareness of minor hazards A6 ($\beta = 0.15$, $p = 0.010$) also demonstrated statistically significant positive effects at the $p < 0.01$ level. These results imply that clear safety messaging from supervisors and heightened risk sensitivity among employees contribute positively to the execution of safe practices on-site.

In contrast, other perception items, including A1 ($\beta = 0.05$, $p = 0.36$), A2 ($\beta = 0.09$, $p = 0.12$), A3 ($\beta = 0.03$, $p = 0.27$), A4 ($\beta = 0.06$, $p = 0.30$), A5 ($\beta = 0.06$, $p = 0.28$), and A7 ($\beta = 0.03$, $p = 0.45$), did not reach statistical significance ($p > 0.05$). This suggests that these items may influence behavior indirectly or through secondary mechanisms rather than serving as primary behavioral drivers.

Overall, the findings underscore that promoting safety behavior in construction sites requires more than improving general awareness. Establishing a robust collaborative framework, implementing leadership-driven safety strategies, and enhancing workers' sensitivity to risk are critical components. Notably, the results highlight the importance of practical, trust-based organizational interactions over formalistic safety messaging. Sustainable improvements in safety perception and behavior likely depend on culturally grounded and interaction-focused interventions.

In summary, organizational culture-related factors, represented by A6, A8, and A9, exhibited statistically significant effects, empirically validating their role as key variables in designing effective, policy-level safety interventions.

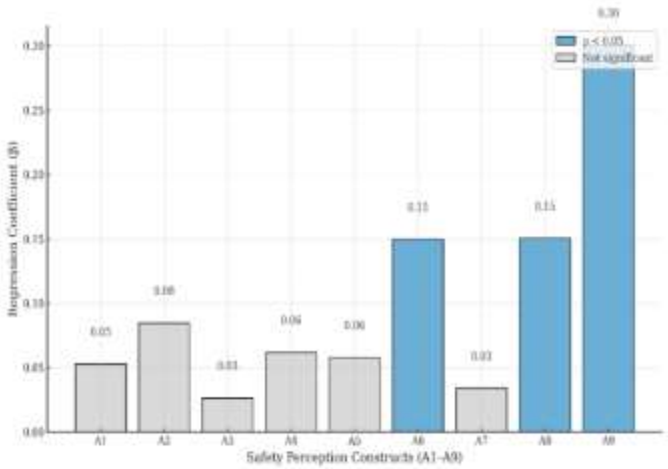

Fig. 3. Regression coefficients of safety perception items predicting actual safety behavior

Table I: Distribution Of Actual Safety Behavior Average Scores (B_Avg) By Score Interval

Score Interval (B_avg)	Frequency (n)	Percentage (%)
1.00–1.99	4	1.8
2.00–2.99	16	7.1
3.00–3.49	18	8.0
3.50–3.99	26	11.6
4.00–4.49	59	26.2
4.50–5.00	102	45.3
Total	225	100.0

D. Distribution of Actual Safety Behavior Scores

Table I presents the distribution of B_avg for all 225 participants, offering a quantitative overview of behavioral performance among construction workers. A substantial proportion of respondents fell within the 4.00–5.00 range, indicating that many workers actively practice safety behaviors on-site. This trend is consistent with the linear trend graph shown in Fig. 4, which further supports the finding that the overall level of safety behavior in the field is relatively high and consistently maintained.

Furthermore, Table I serves as a foundational descriptive statistic for comparing behavioral outcomes with levels of safety perception and for constructing regression models. The distribution pattern of the behavior variable provides key insights for interpreting model fit and contributes empirical justification for the inclusion of organizational culture factors as supplementary explanatory variables. This enhances the model's ability to explain variance in actual safety behavior based on perceptual and cultural determinants.

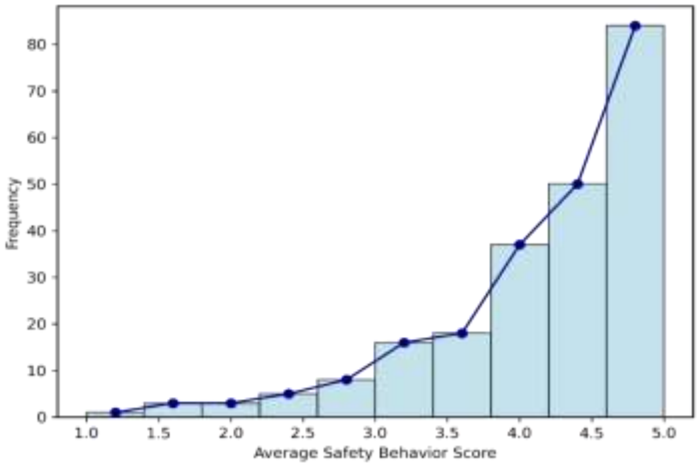

Fig. 4. Distribution and trend line of actual safety behavior average scores (B_avg)

E. Histogram Analysis of Safety Behavior Scores

Fig. 4 illustrates the distribution of B_avg for all 225 survey respondents. The histogram analysis revealed that most participants scored within the 3.8–4.5 range, with the highest frequency concentrated in the 4.0–4.2 interval. This indicates that a large proportion of workers perceived their behavior as reflecting a relatively high level of compliance with safety protocols.

The overall distribution exhibited a roughly symmetrical pattern, with only a few respondents selecting extremely low or high values. The overlaid trend line peaked near a B_avg score of 4.0 and gradually declined thereafter, suggesting that the behavioral performance level on-site remains stable above a certain threshold. This distribution pattern closely aligns with the interval-based frequency results presented in Table I, reinforcing the conclusion that overall safety behavior is maintained at a consistently high level.

Nonetheless, a small portion of the respondents recorded scores below 3.0, indicating that certain worker subgroups may exhibit relatively low levels of safety behavior. This finding implies the need for targeted interventions, such as culturally embedded organizational strategies or customized safety training programs, to support behavioral improvement in these specific populations.

The descriptive statistical analysis of the B_avg distribution provides a valuable foundation for interpreting the subsequent regression and correlation analyses. Specifically, it enables a deeper understanding of how safety perception variables predict actual behavior, while also identifying distributional characteristics that may influence model interpretation.

Table II: Mean Scores Of Safety Perception (A1–A9) And Actual Safety Behavior (B1–B9) Items

Items	A1	A2	A3	A4	A5	A6	A7	A8	A9
Safety Perception Mean (A1–A9)	4.44	4.48	3.83	4.54	4.52	4.48	4.20	4.22	4.19
Items	B1	B2	B3	B4	B5	B6	B7	B8	B9
Actual Safety Behavior Mean (B1–B9)	4.05	3.97	4.16	4.37	4.14	4.28	4.23	4.30	4.28

F. Mean Comparison and Regression Analysis of Organizational Culture Factors

Among the perception items, A4 (4.54) and A5 (4.52) recorded the highest means, followed by A2 (4.48) and A6 (4.48); A8 (4.22) and A9 (4.19) were moderately high. Table II summarizes the mean scores of all respondents for each safety perception item (A1–A9) and actual safety behavior item (B1–B9), allowing for a comparative understanding of the relative levels across items. A higher mean score indicates a higher level of perceived importance or behavioral frequency as reported by participants. In contrast, A3 (perception of organizational responsibility) showed one of the lowest means, whereas A8 (4.22) and A9 (4.19) were moderately high rather than the highest. These findings provide foundational insights for identifying priority areas for future safety culture interventions and educational program design. Fig. 5 visualizes the results of a multiple regression analysis examining the influence of three organizational culture-related perception items—A6 (recognition of minor hazards), A8, and A9—on B_avg. The regression model was statistically significant with $F = 161.58$ and $R^2 = 0.69$, and all predictor variables were significant at $p < 0.001$.

The standardized regression coefficients were as follows:

- **A9 (peer cooperation)** showed the strongest effect with $\beta = 0.36$, standard error = 0.04, and a 95% confidence interval [CI, 0.28, 0.45];
- **A6 (recognition of minor hazards)** followed closely with $\beta = 0.33$, standard error = 0.04, CI [0.25, 0.41];
- **A8 (supervisor's emphasis on safety)** had a moderate but significant effect with $\beta = 0.18$, standard error = 0.05, CI [0.09, 0.27].

VIF analysis revealed no multicollinearity issues, with values of VIF = 1.27 (A6), 1.51 (A8), and 1.39 (A9); all well below the common threshold of 5. Additionally, the Durbin-Watson statistic was 1.60, indicating no substantial autocorrelation in the residuals and confirming the adequacy of model assumptions. Note that the effect ordering in the reduced model **(**A9 > A6 > A8**)** is consistent with the full model in identifying A9 as the strongest predictor, while A6 and A8 exhibit comparable magnitudes in the full specification.

Fig. 6 presents a bar chart comparing the relative regression coefficients of the three predictors. The bars are sorted in descending order, with coefficient values labeled at the top of each bar, offering both numerical precision and visual clarity.

These results quantitatively demonstrate the influence of organizational culture perception on safety behavior. They provide a strong empirical basis for selecting key explanatory variables in future structural modeling efforts and policy-driven intervention design. Taken together, these visual and diagnostic results confirm a coherent effect hierarchy (A9 > A6 > A8) in the reduced OLS model and support the stability of the estimates (all VIF < 1.6; Durbin–Watson = 1.60). Building on this, we next test the perception-to-behavior pathway by estimating a mediation model in which A6 (recognition of minor hazards) influences B_avg indirectly through A9 (peer cooperation). This analysis clarifies the cultural mechanism by which organizational culture perceptions translate into observable safety behavior and informs the selection of core predictors for subsequent structural modeling and policy-oriented interventions.

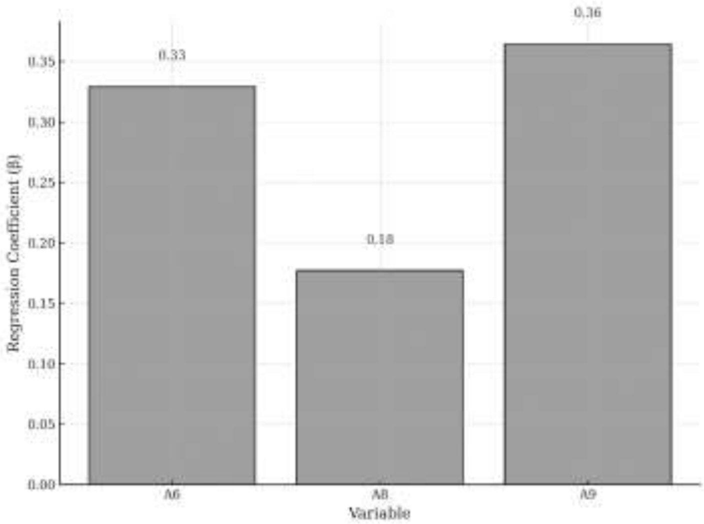

Fig. 5. Effects of organizational culture factors (A6, A8, and A9) on B_avg in a multiple regression model

Note**:** *Fig. 5 depicts a reduced OLS model (A6/A8/A9 only; $R^2 = 0.69$). In this reduced specification, the effect ordering is A9 > A6 > A8 (β = .36, .33, .18). By contrast, in the full OLS model (Sections III.B–C; $R^2 = 0.79$) A6 and A8 show comparable standardized effects (β = .15 each*), *while A9 remains the strongest predictor in both* models.

Discussion

This study empirically examined the structural relationship between construction workers' industrial safety perceptions and their actual safety behaviors, with a specific focus on quantifying the influence of organizational culture–related factors. Peer cooperation (A9) showed the largest effect (β = 0.30, $p < 0.001$). Supervisor emphasis on safety (A8; β = 0.15) and recognition of minor hazards (A6; β = 0.15) were also significant. Notably, the reduced OLS specification that includes only A6, A8, and A9 (Fig. 5) produces a different ranking—A9 > A6 > A8 (β = .36, .33, .18)—whereas in the full OLS model that jointly controls for all A1–A9 items, A6 and A8 converge to comparable magnitudes (β = .15 each). This discrepancy reflects shared variance with other perception items in the full specification; once those correlates are modeled simultaneously, the unique standardized effects of A6 and A8 attenuate and align, while the reduced model exposes a larger unique contribution of A6. In contrast, A2 and A7 were not significant. These results underscore the critical importance of a horizontally integrated safety culture that emphasizes interpersonal interaction over purely top-down control. The prominence of coworker cooperation aligns with Clarke's assertion that team-based culture and collaboration exert a decisive impact on safety behavior [15], while extending this framework to the context of Korean construction sites. Although safety prioritization as a value (A2) is frequently cited in prior work (e.g., Fang et al. [16]), our full OLS model indicates that—after accounting for correlated cultural and supervisory factors—A2 does not exhibit a unique association with behavior. By contrast, supervisory emphasis on safety (A8) remains a meaningful predictor, consistent with findings that clarifying expectations and modeling safety-first practices strengthen uptake (see Choi [9]). Notably, the "formal safety climate" indicator (A7) did not show a unique effect in the multivariable model. This suggests that formalistic or symbolic safety activities (e.g., short-term campaigns or documentation-oriented routines) are insufficient once cultural interaction mechanisms are simultaneously considered, converging with Jeong et al.'s critique of document-centric approaches [2]. Mediation analysis further indicated that awareness of minor hazards (A6) influences behavior indirectly through coworker cooperation (A9), highlighting the cultural pathway that translates perception into action. Rather than simple awareness reinforcement, it appears to be cultural mechanisms—trust, collaboration, shared responsibility—that render hazard sensitivity behaviorally consequential, echoing Clarke's team-based cultural approach [15]. These findings are also compatible with Griffin and Neal's safety-climate model—where climate enhances knowledge and motivation, leading to behavior [12]—while positioning organizational culture as a central mediator that organizes perception-to-behavior translation. The pattern reinforces the interaction model between situational and individual variables described by Christian et al. [7] and aligns with Park and Kim's mediation-based evidence linking climate and compliance [5]. Furthermore, Edmondson's psychological safety explains how culture enables peer feedback and decentralized monitoring [8]. Empirical reports on "deep culture" and safety performance (Wu and Li [6]) and the team-level effects of collaborative culture (Clarke [11]) converge with our results, suggesting that interactive, team-based strategies outperform hierarchical control. Recent studies likewise support these conclusions: interaction-based feedback systems in public projects (Lee et al. [17]), collaborative responses to unplanned hazards (Zhao et al. [18]), simulation-based risk-prediction training as a cultural lever (Kim et al. [19]), peer-feedback–driven education for behavioral change (Zhao and Xue [20]), and culturally embedded feedback-loop design improving outcomes (Ghosh and Young [21]). Particularly relevant is Al-Bayati's structural model mapping pathways among safety culture, climate, motivation, and behavior [22], which is theoretically congruent with the mediating role of organizational culture identified here.

Collectively, these findings bolster the policy implications of this study: cultural and interpersonal levers—especially peer cooperation—are pivotal for sustaining safety behavior in construction environments, arguing for a strategic shift from hardware-centered control to collaboration-oriented culture and value-based education on site.

Conclusion

Among construction workers, the study yields the following key conclusions**.** First, peer cooperation (A9) emerged as the strongest predictor of safety behavior, underscoring the need to shift from leader-centric safety management to an interaction-based model centered on team dynamics and mutual accountability [15]. Second**,** supervisor emphasis on safety (A8) and recognition of minor hazards (A6) were significant positive predictors of safety behavior in the multivariable model. By contrast, the safety-first value orientation (A2) did not show a unique association with behavior once correlated cultural and supervisory factors were controlled for (cf. [9,16]). Third, the formal safety-climate indicator (A7) did not independently predict behavior in the full OLS model, suggesting that campaign-driven or documentation-focused initiatives are insufficient without the accompanying cultural interaction mechanisms that embed safety practices beyond symbolic compliance [2]. Fourth, mediation analysis indicated that organizational culture facilitates the pathway from perception to behavior**,** with A6 exerting an indirect effect via peer cooperation (A9)**.** Structural changes that promote collaboration, autonomy, and feedback are therefore essential to bridge the gap between safety awareness and behavioral implementation [12,18,20,22]. Future work should build a more comprehensive, longitudinal model of safety culture by tracking perception dynamics over time, expanding samples across industries and organizational scales, and incorporating observational and qualitative interviews. Overall, this study offers empirically grounded insights for actionable, context-specific intervention**s** to improve safety behavior on construction sites and provides guidance for managers and policymakers seeking to enhance the real-world effectiveness of industrial safety policies [22].

References

1. M. Hallowell and J. Gambatese, "Construction safety risk mitigation: Systematic review of intervention effectiveness," Saf. Sci., vol. 126, p. 104657, 2020. doi: 10.1016/j.ssci.2019.104657.
2. G. Y. Jeong et al., "Superficial safety campaigns and real worker behavior: A gap analysis in Korean construction sites," Saf. Sci., vol. 146, p. 105527, 2022. doi: 10.1016/j.ssci.2021.105527.
3. Korea Occupational Safety and Health Agency (KOSHA), "2023 Occupational Accident Analysis Report," Ulsan. Korea, 2023.
4. D. Zohar, "Safety climate in industrial organizations: Theoretical and applied implications," J. Appl. Psychol., vol. 65, no. 1, pp. 96–102, 1980. doi: 10.1037/0021-9010.65.1.96.
5. J. Park and S. Kim, "Mediating role of organizational climate in safety compliance," Appl. Ergon., vol. 104, p. 103802, 2023. doi: 10.1016/j.apergo.2022.103802.
6. L. Wu and F. Li, "Deep culture and safety performance: Empirical evidence," J. Saf. Res., vol. 75, pp. 217–224, 2021. doi: 10.1016/j.jsr.2020.10.007.
7. M. S. Christian et al., "Workplace safety: A meta-analysis of the roles of person and situation factors," J. Appl. Psychol., vol. 94, no. 5, pp. 1103–1127, 2009. doi: 10.1037/a0016172.
8. Edmondson, "Psychological safety and learning behavior in work teams," Admin. Sci. Q., vol. 44, no. 2, pp. 350–383, 1999. doi: 10.2307/2666999.

9. Choi and T. Lee, “Supervisor influence and behavioral safety,” Int. J. Occup. Saf. Ergon., vol. 29, no. 1, pp. 55–63, 2023. doi: 10.1080/10803548.2022.2042894.
10. D. Brown et al., “Transformational safety training and emotional engagement,”, Saf. Health Work, vol. 14, no. 2, pp. 167–175, 2023. doi: 10.1016/j.shaw.2022.10.004.
11. R. A. Clarke, “Teamwork and safety: The role of collaborative culture in construction sites,” Saf. Sci., vol. 159, pp. 106–112, 2023. doi: 10.1016/j.ssci.2022.106112.
12. M. A. Griffin and A. Neal, “Perceptions of safety at work: A framework for linking safety climate to safety performance, knowledge, and motivation,” J. Occup. Health Psychol., vol. 5, no. 3, pp. 347–358, 2000. doi: 10.1037//1076-8998.5.3.347.
13. Neal and M. A. Griffin, “A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels,” J. Appl. Psychol., vol. 91, no. 4, pp. 946–953, 2006. doi: 10.1037/0021-9010.91.4.946.
14. International Organization for Standardization, ISO 45001:2018, Occupational Health and Safety Management Systems – Requirements with Guidance for Use. Geneva, Switzerland: ISO, 2018.
15. P. H. Waring and L. M. Reader, “Developing safety cooperation in construction: between facilitating independence and tightening the grip,” Constr. Manag. Econ., vol. 38, no. 12, pp. 1100–1115, 2020. doi: 10.1080/01446193.2020.1726978.
16. D. Fang and W. Wu, “Value-based safety programs and worker behavior,” J. Constr. Eng. Manag., vol. 149, no. 5, 2023. doi: 10.1061/(ASCE)CO.1943-7862.0002426.
17. S. Lee et al., “Interactive feedback loops in safety management of public construction,” Saf. Sci., vol. 163, p. 106244, 2023. doi: 10.1016/j.ssci.2023.106244.
18. H. Zhao et al., “Unstructured hazard response and collaborative culture in construction,” J. Saf. Res., vol. 79, pp. 110–118, 2022. doi: 10.1016/j.jsr.2021.09.005.
19. D. Kim et al., “Effect of simulation-based risk prediction training on safety culture,” Int. J. Environ. Res. Public Health, vol. 20, no. 6, p. 4875, 2023. doi: 10.3390/ijerph20064875.
20. X. Zhao and X. Xue, “Feedback-driven safety training strategies in construction sites,” Appl. Ergon., vol. 108, p. 103937, 2023. doi: 10.1016/j.apergo.2023.103937.
21. S. Ghosh and C. Young, “Embedding cultural feedback loops to improve construction site safety,” J. Constr. Eng. Manag., vol. 149, no. 12, 2023. doi: 10.1061/(ASCE)CO.1943-7862.0002418.
22. J. Al-Bayati, “Impact of construction safety culture and construction safety climate on safety behavior and safety motivation,” Safety, vol. 7, no. 2, p. 41, 2021. doi: 10.3390/safety7020041.