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Using Safety-Specific Transformational Leadership to Improve Safety Behavior Among Construction Workers: Exploring the Role of Knowledge Sharing and Psychological Safety

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Abstract

Leaders play a crucial role in shaping employees' safety behaviors (SBs). However, research on broader leadership styles has yielded inconsistent findings, emphasizing the need for a more tailored leadership approach, especially in high-risk industries, such as construction. Applying the social exchange theory and the positive organizational behavior framework, this study examined the impact of safety-specific transformational leadership (SSTL) on SB. This study uses a quantitative research design to collect data from employees of Turkish construction firms in Ankara and Istanbul. A cross-sectional research design was employed, with purposive sampling of data collected from 706 construction workers in Türkiye. The findings indicate that SSTL positively influences both SB and knowledge sharing, whereas knowledge sharing enhances SB. Knowledge sharing mediates the relationship between SSTL and SB. This study's findings suggest that implementing safety-specific transformational leadership (SSTL) can significantly improve safety behavior among construction workers by promoting knowledge sharing and psychological safety.

Keywords: transformational leadership; safety behavior; construction; knowledge sharing; psychological safety

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1. Introduction

Poor safety records in the construction sector have long been a source of criticism [1], particularly in developing nations such as Turkiye [2]. In 2023 alone, 1932 workers lost their lives in work incidents, with the construction industry accounting for the majority of these workplace fatalities [3]. Globally, the construction industry accounts for approximately 30 to 40% of work-related fatalities, despite employing only 7% of the global total workforce [4]. For example, in the United States and China, the construction industry significantly poses a higher danger and has more fatalities than other industries, such as mining, commercial, and industrial sectors [5].

Despite progress in technological innovations, safety regulations, and training initiatives, unsafe behavior remains a significant contributor to adversarial safety outcomes. While leadership plays a critical role in shaping employee behaviors and attitudes [2], traditional leadership approaches often fail to address the unique challenges of enhancing safety in high-risk industries, such as the construction sector. Specifically, existing studies have investigated several factors, such as benevolent leadership [2] and servant leadership [6], as critical approaches for improving safety behavior. Thus, it is critical to

research safety-specific leadership styles that may improve employee safety behavior in the construction sector.

Safety behavior is a critical challenge for most firms globally [7], particularly within the construction sector. Based on this, there are numerous research calls to investigate the link between leadership and employee safety behaviors (SB) [2,8]. Transformational leadership is among the most extensively researched leadership styles due to its potential to initiate, maintain, or promote SB across various occupations and disciplines [9–11]. Safety-specific transformational leadership (SSTL) integrates transformational leadership techniques and approaches while placing strong emphasis on occupational safety [12]. Compared with general transformational leadership, SSTL may serve as a more effective predictor of safety behavior, where leaders focus on their motivational and inspirational efforts to foster positive safety-related outcomes [13,14]. Despite this, there is a lack of empirical studies on the impact of SSTL on employee SB in the construction context.

In the general literature, an emerging study on context-specific safety leadership (i.e., SSTL) has been demonstrated to promote safety outcomes such as SB [14]. If SSTL indeed influences employee safety behavior, more research is needed to address questions concerning the mechanisms that govern this relationship. Knowledge sharing relates to the process by which subordinates mutually exchange information and their knowledge [15]. Prior studies highlight that leadership fosters knowledge-sharing behaviors and collaborative learning [16,17]. Safety-specific transformational leadership clearly outlines the interactive process by which leaders exert their influence on subordinates to accomplish organizational safety practices [14]. Moreover, leadership has also been argued to motivate followers to engage in knowledge-sharing behaviors [17], which, in turn, enhances safety behavior [2]. Thus, there are conceptual reasons for expecting knowledge sharing to mediate the relationship between SSTL and SB. Accordingly, the current research partly responds to the recent research call [14] to investigate knowledge sharing as a mechanism through which SSTL influences SB.

With SSTL, leaders motivate followers through a vision centered on safety and intellectual stimulation, such as encouraging employees to develop safer procedures, and are likely to promote knowledge sharing by presenting it as a significant contribution to the organization's safety objectives [12]. Moreover, leaders serve as facilitators of knowledge-sharing behavior [18], and safety-specific transformational leadership may be adept at ensuring this. The rationale behind this is that SSTL motivates and inspires followers with safety values [12]. Despite the distinctive characteristics of SSTL, Agarwal and Anantatmula [19], Siemsen et al. [20], and Yin et al. [21] argued that psychological safety is an enabler of knowledge sharing. However, the extant literature has yet to establish its interaction with knowledge sharing as a moderator concerning other employee behaviors, such as safety behaviors. In addition, in this study, psychological safety relates to the work context in which employees feel secure to interact with organizational structures in the workplace, grounded in conviction; they will not face punishment for doing so [22]. Accordingly, based on social exchange theory [23] and the positive organizational behavior perspective [24], this study develops a moderated mediation framework (Figure 1) to investigate the impact of SSTL on SB through the mediating role of knowledge sharing and the moderating role of psychological safety in the Turkish construction industry.

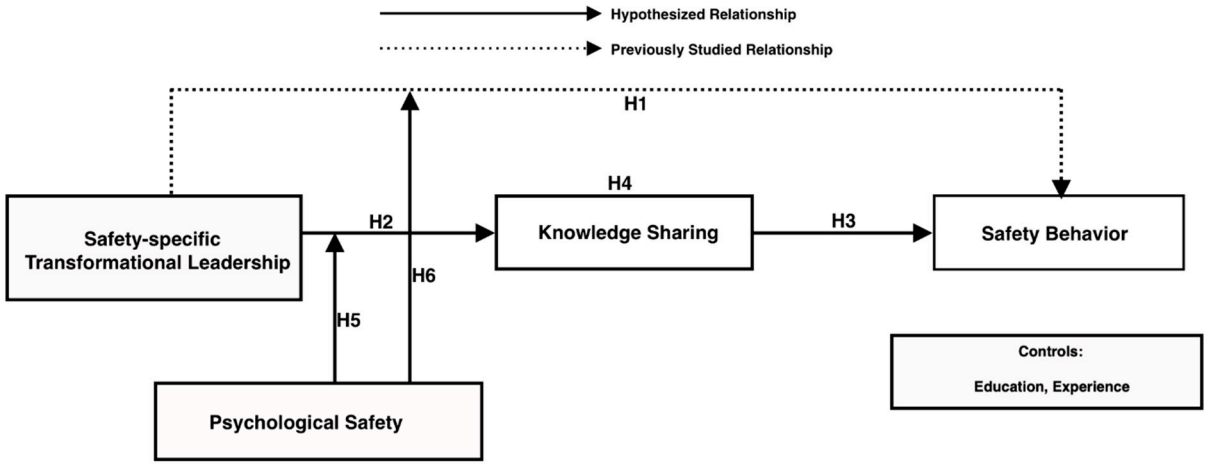

Figure 1. Research framework.

This study's research framework (Figure 1) explores how safety-specific transformational leadership influences safety behavior in construction workers, mediated by knowledge sharing and moderated by psychological safety. It suggests that leaders who inspire a shared safety vision and encourage safe practices support a climate of psychological safety, where workers feel comfortable sharing knowledge and concerns. This positively impacts their safety behavior. The variables used in this research are explained below:

1. Safety-specific transformational leadership (independent variable):

This leadership style, where leaders champion a safety vision and encourage employees to actively participate in achieving it, is the starting point.

2. Safety behavior (dependent variable):

This encompasses the actual actions and practices of workers related to safety, such as adhering to safety protocols, using personal protective equipment, and reporting hazards.

3. Knowledge sharing (mediating variable):

This refers to the exchange of safety-related information, best practices, and lessons learned among workers.

4. Psychological safety (moderating variable):

This is the belief that one can take risks, speak up with ideas or concerns, and admit mistakes without fear of negative consequences.

Relationships:

Hypothesis 1. *SSTL positively influences employee safety behavior.*

Hypothesis 2. *SSTL positively influences knowledge sharing.*

Hypothesis 3. *Knowledge sharing positively influences employee safety behavior.*

Hypothesis 4. *Knowledge sharing mediates the relationship between SSTL and employee safety behavior.*

Hypothesis 5. *For construction workers with high psychological safety, the positive impact of SSTL on knowledge sharing is stronger than that of those with low psychological safety.*

Hypothesis 6. *The indirect impact of SSTL on safety behavior through knowledge sharing is the strongest at a high level of psychological safety.*

Contributions:

- This study uses four variables: safety-specific transformational leadership, safety behavior, knowledge sharing, and psychological safety. Among these variables, safety-specific transformational leadership is an independent variable, safety behavior is a dependent variable, knowledge sharing is a mediating variable, and psychological safety is a moderating variable.
- Social exchange theory and the positive organizational behavior framework are used to examine the impact of safety-specific transformational leadership (SSTL) on safety behavior.
- The primary objective of this study is to investigate how safety-specific transformational leadership impacts safety behavior among construction workers, specifically exploring the roles of knowledge sharing and psychological safety.
- The research seeks to understand how leaders can encourage a safety-conscious environment in construction by promoting knowledge sharing and psychological safety, which leads to better safety outcomes for workers.

2. Theoretical Background and Hypotheses Development

2.1. Social Exchange Theory (SET)

SET has been widely applied to understand workplace behavior in various fields, such as business management, safety management, and social psychology [14,25]. Social exchange interactions are characterized by the continuous reciprocal transfer of resources between two parties, where these exchanges are interdependent and create future obligations [26]. The interactions in social exchange do not involve a predetermined agreement or explicit bargaining but rather entail discretionary cooperative behavior [27]. Studies indicate that leaders who inspire and motivate employees tend to be passionate about their organizational safety goals [14]. This is described as a reciprocal response from employees to their enterprises' initiative to promote positive emotions (e.g., harmonious passion) and social context (e.g., leadership) [14,25]. However, research has primarily focused on investigating other employee behaviors, such as safety behavior as a reciprocal response to employees' perceptions regarding exchange relationships in a social context (e.g., leadership) [14] and not the actual exchanges that occur among employees. Demonstrating that the organizational social context (i.e., SSTL) exchanges activities that result in employee exchanges (i.e., knowledge sharing) is essential to the idea that SSTL and knowledge sharing stem from social exchange. This understanding is critical for developing strategies that encourage employees' safety behavior in high-risk industries such as the construction sector.

2.2. Positive Organizational Behavior (POB) Perspective

Drawing from SET, this research assumes that when employees perceive leaders' inspiration and motivation in relation to safety goals, they are willing to share safety-related knowledge as reciprocal behavior with other employees, which in turn influences their safety behavior. In addition to SET, this study also integrates the perspective of positive organizational behavior (POB) to explain "when" such a relationship may occur. POB scholars recommend adopting a positive approach in organizational behavior research [25,28,29]. Given that POB places greater emphasis on the significance of individual positive psychological conditions [29], this study used POB to complement the SET assumption. In this study, the POB perspective helps underscore psychological safety beneficiaries (i.e., employees). The POB framework can offer a robust framework for understanding the psychological capacities and states that can moderate the relationship between SSTL and safety behavior. The theory is grounded on the tenet that positive psychological

states can enable individuals to perform at their optimum potential. Applying this framework to safety in the construction industry can shed light on why psychological safety is not merely a desirable attribute but a required catalyst that can unlock the full potential of SSTL on employees' safety behavior. Consistent with the POB perspective, we argue that employees who experience psychological safety are more capable of reciprocating the required safety standards in the workplace.

2.3. SSTL and Safety Behavior

Safety is a major concern for firms globally [2]. More specifically, safety behavior is of great importance in the construction sector because of the enormous proportion of fatalities relative to other industries [2,30]. In this study, safety behavior is defined as the behavior exhibited by individuals concerning safety [31]. Inappropriate safety behaviors are the principal cause of workplace accidents. In this context, enhancing individual safety behaviors may reduce the incidence of workplace accidents [32].

SSTL is a leadership approach that redefines the values of transformational leadership: idealized influence, intellectual stimulation, inspirational motivation, and individualized considerations to optimize and prioritize safety within a firm [12,28]. This safety-focused leadership style motivates employees to prioritize safety in their work activities [33]. Leaders who portray SSTL, such as conveying a clear safety vision, showing dedication to safety, and emphasizing individual safety concerns, play a critical role in shaping actions and behaviors regarding safety [33]. Moreover, previous studies have demonstrated a positive relationship between SSTL and various employee safety outcomes. For example, Irshad et al. [33] reported that safety-specific transformational leaders stimulate favorable interactions with followers by fostering autonomy and individual consideration, which enhances psychological well-being, a critical aspect of safe work behavior. Similarly, based on a sample obtained from airline pilots, Wu et al. [14] demonstrated that leaders with safety-specific transformational behaviors encourage and motivate their subordinates to adhere to safety standards rather than use assertive behavior to enforce safety behavior.

Furthermore, SSTL is associated with improved employee motivation. Research conducted on firefighters revealed that SSTL increased safety motivation, resulting in improved safety performance, which included the appropriate and efficient use of personal safety gear [34]. These findings highlight the importance of safety-specific transformational leadership in creating an environment that encourages employees to be inherently motivated to comply with safety protocols. However, it is important to note that these studies were conducted outside of the construction industry. Given the high-risk nature of the construction sector, it is crucial to investigate and establish a link between context-specific safety leadership approaches and employee outcomes to ensure workplace safety. However, to our knowledge, there is a lack of empirical research in the extant literature on the link between SSTL and safety behavior in the construction context. Furthermore, SET posits that the relationship between leaders and followers is founded on mutual obligation and reciprocity [23]. Thus, drawing from SET and advancing the current literature, we argue that SSTL can be viewed as a form of social exchange, where leaders prioritize workplace safety and motivate employees to adopt positive behaviors. In return, employees will likely reciprocate by complying with safety procedures and adopting safety behaviors. Hence, we propose the following hypothesis:

Hypothesis 1. *SSTL positively influences employee safety behavior.*

2.4. SSTL and Knowledge Sharing

Knowledge is regarded as one of the most critical assets of a firm [35]. Knowledge sharing involves the sharing of ideas between employees and other relevant individuals [36]. Various researchers have argued that employees often hesitate to share knowledge with others unless they are motivated to do so, because they view their knowledge as a source of authority and advantage [37,38]. From this standpoint, scholars in the knowledge management domain have explored numerous factors that may impact knowledge sharing within a firm, with leadership identified as a significant contributor to fostering knowledge sharing by inspiring employee motivation [39]. However, the literature is filled with studies that examine traditional leadership approaches to knowledge sharing [21,40]. In advancing the existing body of knowledge, this study anticipates that safety-specific transformational leadership can promote knowledge sharing because safety-specific transformational leadership can shape subordinates' attitudes and behaviors while fostering a passion for change [14]. With a new vision regarding safety protocols, subordinates are more inclined to respond positively to safety-specific transformational leaders' calls to share knowledge with other employees to shift the status quo.

Congruent with SET, it is well established that leaders play a critical role in motivating and influencing followers' behaviors and thoughts. From this perspective, numerous studies based on samples collected from nurses in the hospital context argue that proficient safety leadership can enhance safety knowledge when concerns about safety are supported by guidance, solutions, and relevant insights to foster a secure working environment [41,42]. Therefore, safety-specific transformational leaders can guide their subordinates to share acquired safety knowledge with their peers. Motivated by safety-specific transformational leaders' push for collaboration with other employees towards shared safety objectives, this study anticipates that employees will be more willing to share their knowledge with others. Thus, we posit the following hypothesis:

Hypothesis 2. *SSTL positively influences knowledge sharing*.

2.5. Knowledge Sharing and Safety Behavior

An earlier study confirmed that knowledge sharing is crucial because it can curb meaningless learning processes within organizations [43]. It has also been demonstrated that the most prevalent cause of errors and wrongdoings is a lack of experience and knowledge [44]. Based on this, Edmondson [45] argued that appropriate knowledge management encourages learning and work settings that boost employees' safety knowledge and circumvent the repetition of accidents and mistakes.

Based on the framework in [46], safety knowledge determines safety behavior. The study emphasized that safety knowledge influences safety participation and compliance. Within the SET framework, interactions among employees are founded on mutual obligation and reciprocity [23]. From this standpoint, when employees share knowledge, they build a shared reservoir of information that serves the entire organization, fostering a sense of mutual obligation and reciprocity. In return, individuals who gain knowledge are likely to respond by adopting positive behavior, which includes following safety standards and undertaking safety initiatives. Based on this, we argue that, in the construction context, knowledge sharing can be construed as a form of social exchange in which individuals offer their experience and knowledge regarding workplace safety to promote overall safety. This interaction strengthens relationships and may instill a sense of obligation among individuals to prioritize safety behavior. Thus, we posit the following hypothesis:

Hypothesis 3. *Knowledge sharing positively influences employee safety behavior*.

2.6. The Mediation Role of Knowledge Sharing

As discussed in the preceding sections, the relationship between SSTL and knowledge sharing (H2) and between knowledge sharing and employee safety behavior (H3) suggests that SSTL influences safety behavior through knowledge sharing. One of the primary causes of accidents in the construction sector is a lack of knowledge [47]. Shin et al. [48] demonstrated that safety knowledge has the most robust direct influence on safety behavior among various mechanism variables such as affective commitment and safety motivation. Similarly, Neal et al. [46] discovered that safety knowledge significantly predicts safety behavior. Considering these results, management of safety knowledge is essential. As a key aspect of knowledge management, knowledge sharing can be a useful instrument in disseminating knowledge, particularly in high-risk industries such as the construction sector, where a lack of knowledge is one of the primary reasons for safety accidents. Furthermore, unsafe behavior may be addressed or even averted with thorough and extensive safety knowledge sharing [49]. However, this process did not occur automatically. Moreover, leadership plays a critical role in managing knowledge sharing [50]. Despite this, the intervening role of knowledge sharing on the relationship between context-specific safety leadership (i.e., SSTL) and safety behavior remains unexplored.

It has been highlighted that human errors are commonly caused by poor motivation and knowledge related to operating processes [51]. This is relevant in the construction industry because construction workers are constantly exposed to various work hazards and possible fatalities. Hence, acquiring and disseminating knowledge on safe operating techniques and procedures is essential for workers in the construction sector to avert such incidents. To accomplish this, it has been highlighted that leaders who portray safety-specific transformational leadership behaviors often create an environment that facilitates collaboration and open communication [26], which can encourage knowledge sharing among employees. This collaborative environment may promote employees' awareness of safety measures, which can translate into better safety behaviors.

In safety-specific transformational leadership, genuine care for employee well-being and safety is clearly perceived and understood [13,14]. Congruent with SET, this fosters a sense of mutual obligations and collaboration between leaders and followers, encouraging employees to adopt leaders' safety standards and practices, which lowers self-restraint to comply with safety regulations. We contend that knowledge sharing can further promote safety adherence and collaboration because employees share safety information with each other to advance safety goals. Thus, we posit the following hypothesis:

Hypothesis 4. *Knowledge sharing mediates the relationship between SSTL and employee safety behavior.*

2.7. The Moderation Role of Psychological Safety

Despite decades of policy overhaul and wide-ranging safety research, the construction industry remains alarmingly dangerous in different regions of the world [3]. Statistics for developing nations are notably worse, albeit still unreliable, than those for advanced nations, where injuries and fatalities are nevertheless a cause for worry [52–54]. For example, Turkiye conservatively reported that 1932 workers lost their lives in 2023, with most occupational fatalities occurring in the construction sector [3]. Li et al. [55] stated that the primary cause of numerous accidents in the construction sector is human behavior. In this respect, various studies have examined behavior-based safety in the past decades [56]. These studies highlight the role of human behavior in preventing unsafe behaviors and accidents [55]. Although psychological safety acknowledges this human aspect, studies on psychological safety in the construction industry are limited [57,58]. Moreover, owing to its

risky tasks, the construction sector needs a psychologically safer workplace to minimize safety risks and occupational health hazards [57], which is a major challenge for leaders and firms in the construction sector. Despite this, the literature lacks research exploring psychological safety as a positive individual condition for the proposed predictor of safety behavior in the construction sector. Hence, psychological safety is proposed as a driving force that can weaken or strengthen research within our research framework (Figure 1).

Previous research has highlighted that psychological safety is crucial and valuable in high-risk and dangerous industries, where employee safety is essential [57]. Consistent with the positive organizational behavior perspective, individuals with more positive psychological resources (i.e., psychological safety) tend to deal with work-related challenges with more positivity, perseverance, and motivation [59,60]. Simply put, employees must possess a certain degree of motivation and positivity before sharing knowledge [25]. While safety-specific transformational leaders encourage, inspire, and motivate their followers to adopt workplace safety goals and foster safety citizenship behavior [14,61], employees need more positivity to share knowledge [25]. From this standpoint, Demirkesen et al. [57] highlighted that psychological safety promotes a positive environment, enabling individuals to feel more empowered to engage in knowledge sharing and undertake proactive behaviors. Hence, in this study, we anticipate that when employees have higher psychological safety, they are more likely to engage in greater knowledge sharing (i.e., sharing safety-related insights among their peers).

Furthermore, Edmondson [62] argues that psychological safety can determine the difference between a near miss and a catastrophic incident. Psychological safety fosters a collaborative work environment that enhances employee absorption [63]. It provides an environment in which employees feel safe expressing their opinions without fear of reprisal [22]. From this standpoint, Quansah et al. [64] highlighted that in a workplace with psychological safety, employees do not suffer negative outcomes such as ridicule or embarrassment, which could affect their sense of self and social standing when they express themselves. Thus, it can be inferred that such an enabling environment can further promote employees' self-confidence and morale. For example, in a highly psychologically safe work setting, highly motivated workers may be passionate about adhering to safety protocols and sharing safety-related insights acquired from safety leaders. Consistent with the positive organizational behavior perspective, they may also feel energized and inspired to report unsafe behaviors without experiencing distress or fear. Moreover, such individuals exhibit higher engagement in undertaking extra-role initiatives to accomplish firm objectives (e.g., safety performance) [3,64]. Hence, we posit the following hypotheses:

Hypothesis 5. *For construction workers with high psychological safety, the positive impact of SSTL on knowledge sharing is stronger than that of those with low psychological safety.*

Hypothesis 6. *The indirect impact of SSTL on safety behavior through knowledge sharing is the strongest at a high level of psychological safety.*

3. Methods

3.1. Participants and Data Collection

This study uses a quantitative research design to collect data from employees of Turkish construction firms in Ankara and Istanbul. Before data collection, permission was obtained from the senior management of the construction firms. The construction firms targeted were listed under the Turkish Contractors Association (https://www.tmb.org.tr (accessed on 2 August 2025)). Therefore, this study adopted a purposive sampling method (i.e., non-probabilistic sampling). Following approval from the senior management of the

targeted firms, the construction workers (i.e., the targeted respondents of this study) were offered an explanation regarding the objectives of the research [65]. Workers who consented to participate in the survey were assured of complete anonymity and were required not to disclose any identifiable or personal information in the survey [66]. Moreover, they were free to withdraw from participation without any consequences during the survey process. Following a recent similar study in the construction sector [1] and in recognition of their participation, participants were provided with a souvenir: a pair of protective gloves. An incentive approach was employed to promote collaborative interaction with the participants and encourage them to complete the survey based on their own experiences [67]. Data were collected between September 2024 and October 2024. The survey was administered electronically and through in-person visits based on the respondents' preferences. Owing to the possible influence of common method bias in survey-based research, the survey was administered in two waves with a one-month interval [68].

In the first wave, respondents completed questions related to SSTL, knowledge sharing, and psychological safety. In the second wave, respondents completed questions related to safety behavior. Before administering the first wave, each respondent was assigned a unique identifier (i.e., a code). This unique identifier was used to match the respondents in the second wave.

A total of 1060 questionnaires were administered, of which 753 were recovered. However, owing to incomplete responses, 47 responses were removed, resulting in a response rate of 66.60%. Table 1 presents the sample characteristics. The sample consisted of 677 (95.89%) males and 29 (4.11%) females. Based on experience, the majority of the respondents, 492 (69.68%), had at least five years of work experience. With regard to education, 213 had a high school education or less 213 (30.17%), 441 had a bachelor's degree/equivalent (62.47%), 14 had a master's degree or higher (1.98%), and 38 (5.38%) had other degrees. Based on age, 201 respondents were less than 25 (28.47%); 317 were 26–30 (44.90%); 144 were 31–35 (20.40%); 24 were 36–40 (3.40%); and 20 were above 41 (2.83%).

Table 1. Sample attributes.

Demographic Characteristics (n = 706)	Frequency	Proportion (%)
Gender		
Male	677	95.89
Female	29	4.11
Experience (years)		
Less than one	23	3.26
1–3	102	14.45
3–5	89	12.61
5–10	364	51.55
Above 10	128	18.13
Education		
High school or less	213	30.17
Bachelor's degree or equivalent	441	62.47
Master's degree or higher	14	1.98
Others	38	5.38

Table 1. *Cont.*

Demographic Characteristics (n = 706)	Frequency	Proportion (%)
Age (years)		
Less than 25	201	28.47
26–30	317	44.90
31–35	144	20.40
36–40	24	3.40
Above 41	20	2.83

3.2. Survey Instruments

Since the items used in the survey were originally in English, we followed Brislin's [69] translation and back-translation approach. The SSTL was measured using 10 items adapted from Kelloway et al. [70]. A sample item is "My supervisor provides a clear vision of what needs to be done to work safely". Knowledge sharing was measured using eight items adapted from Ni et al. [71]. A sample item is "I often discuss and exchange safety training contents with my co-workers". Psychological safety was measured using seven items adapted from Edmondson [22]. A sample item is "I am not afraid of the consequences of questioning the company's safety practices". Safety behavior was measured using 11 items adopted from Neal and Griffin [72] and Ye et al. [73]. A sample item is "I uphold the use of safety protection equipment at work". All participants completed the survey using a 7-point Likert scale from 1 (not at all) to 7 (very much). The questionnaire used for data collection is presented at the end of the manuscript.

3.3. Data Analysis Procedures

The questionnaire survey was thoroughly reviewed for inconsistencies and errors before data analysis. Data analyses were conducted using SPSS 29.0 and AMOS 26.0. Furthermore, the data collected were thoroughly screened to detect any cases of outliers, missing values, and multicollinearity issues, ensuring that the factors were suitable for statistical procedures [74]. Pearson's correlation was used to establish correlations among the measures. Subsequently, a confirmatory factor analysis (CFA) was performed to examine and test the measures' reliability and validity and establish the overall fitness of the proposed research model [75]. After validating the measurement model, the proposed research framework was tested using the Hayes PROCESS macro v5.0 [76]. Specifically, Model 4 was employed to test the direct and mediation (with 5000 bootstrap resamples). Model 8 was used to test the moderating hypotheses. Model 4 represents a mediating variable model, where an independent variable influences a dependent variable through a third mediating variable. Model 8 could refer to a moderating variable model, where the relationship between an independent and dependent variable is affected by a third moderating variable [76]. Furthermore, a significant effect was determined when the 95% confidence interval (CI) did not contain zero.

3.4. Non-Response Bias

A pre-test was performed to assess the quality of the data collected. Wave analysis was employed to assess the non-response bias [77]. Based on this approach, the survey responses were classified into two categories: early and late. Subsequently, an independent t-test was performed on the items for SSTL and safety behavior. The t-values for the measurement items revealed no significant differences between the two categories, indicating the absence of non-response bias in the data collected.

3.5. Common Method Bias (CMB)

Procedural and statistical approaches have been employed to control and test CMB [78,79]. The survey was presented to two experts and two professors in the construction and safety management fields for recommendations. The feedback received aided in the refinement of measurement items. Harman's one-factor test and the marker variable approach were employed for the statistical analysis. Harman's one-factor test results indicated that the first factor represented only 25.58% of the total variation [80]. Given this result, CMB is not a serious concern in the collected data [79]. This study also adopts the marker variable technique. This approach involves adding a theoretically unrelated construct to the main variables of the research framework. The results indicated that the highest correlation between the study's main and theoretically unrelated constructs was 0.04. This offers further evidence that CMB was not a serious concern in this study [81].

4. Analysis and Results

4.1. Reliability and Validity of the Measurement Model

The reliability and validity of measurement items are critical for establishing the quality of empirical research [82]. Accordingly, appropriate tests were conducted to examine the reliability and validity of the measures, specifically internal reliability, convergent validity, and discriminant validity. Hence, Cronbach's alpha (α), factor loading, composite reliability (CR), and average variance extracted (AVE) were used.

The confirmatory factor analysis results (demonstrated in Table 2) indicated that the factor loadings exceeded the minimum value of 0.6 [83] (see Figure 2). The loadings for all items are also shown in Table 2, ranging between 0.618 and 0.887. This range depicts robust connections between the observed indicators and their corresponding latent variables. Furthermore, Cronbach's alpha was used to test scale reliability. For all variables, the Cronbach's alpha values were between 0.895 and 0.964. The squared multiple correlation (SMC) values supported the measurement reliability of the items. Similarly, for all the variables, the CR values were between 0.905 and 0.965. Both the Cronbach's alpha and CR values exceeded the minimum threshold of 0.7. Moreover, the AVE values were above 0.5 (between 0.513 and 0.717). Taken together, the measurement model demonstrated sufficient convergent validity [84,85]. Accordingly, the items within the model capture the underlying variables that were measured.

Table 2. Confirmatory factor analysis results.

Construct/Item	Factor Loadings	SMC	α	CR	AVE
Safety-specific transformational leadership (SSTL)			**0.909**	**0.913**	**0.513**
SSTL1	0.653	0.504			
SSTL2	0.733	0.537			
SSTL3	0.717	0.514			
SSTL4	0.667	0.510			
SSTL5	0.758	0.575			
SSTL6	0.693	0.508			
SSTL7	0.815	0.665			
SSTL8	0.802	0.643			
SSTL9	0.618	0.502			
SSTL10	0.678	0.508			

Table 2. *Cont.*

Construct/Item	Factor Loadings	SMC	α	CR	AVE
Knowledge sharing (KS)			**0.926**	**0.925**	**0.608**
KS1	0.799	0.638			
KS2	0.831	0.691			
KS3	0.783	0.612			
KS4	0.794	0.631			
KS5	0.854	0.729			
KS6	0.748	0.559			
KS7	0.729	0.532			
KS8	0.685	0.510			
Psychological safety (PS)			**0.895**	**0.905**	**0.578**
PS1	0.795	0.632			
PS2	0.863	0.744			
PS3	0.748	0.560			
PS4	0.841	0.707			
PS5	0.727	0.528			
PS6	0.654	0.504			
PS7	0.667	0.507			
Safety behavior (SB)			**0.964**	**0.965**	**0.717**
SB1	0.800	0.639			
SB2	0.820	0.672			
SB3	0.858	0.736			
SB4	0.886	0.785			
SB5	0.819	0.672			
SB6	0.854	0.729			
SB7	0.854	0.729			
SB8	0.821	0.674			
SB9	0.887	0.786			
SB10	0.882	0.779			
SB11	0.826	0.682			

Note: α = Cronbach's alpha; CR = composite reliability; extracted; SMC = squared multiple correlation; AVE = average variance extracted.

Furthermore, consistent with Fornell and Larcker [84], the correlation matrix among the variables is lower than the nearby values of the square root of the AVE for each construct (Table 3), demonstrating discriminant validity. Finally, the overall fit of the measurement model was evaluated by applying various indices [86], presented in Table 4. These indices consisted of the normed chi-square, Tucker–Lewis Index (TLI), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Normed Fit Index (NFI), and Root Mean Square Error of Approximation (RMSEA). Table 4 shows that all indices were above the recommended thresholds, indicating that the model fit the data collected.

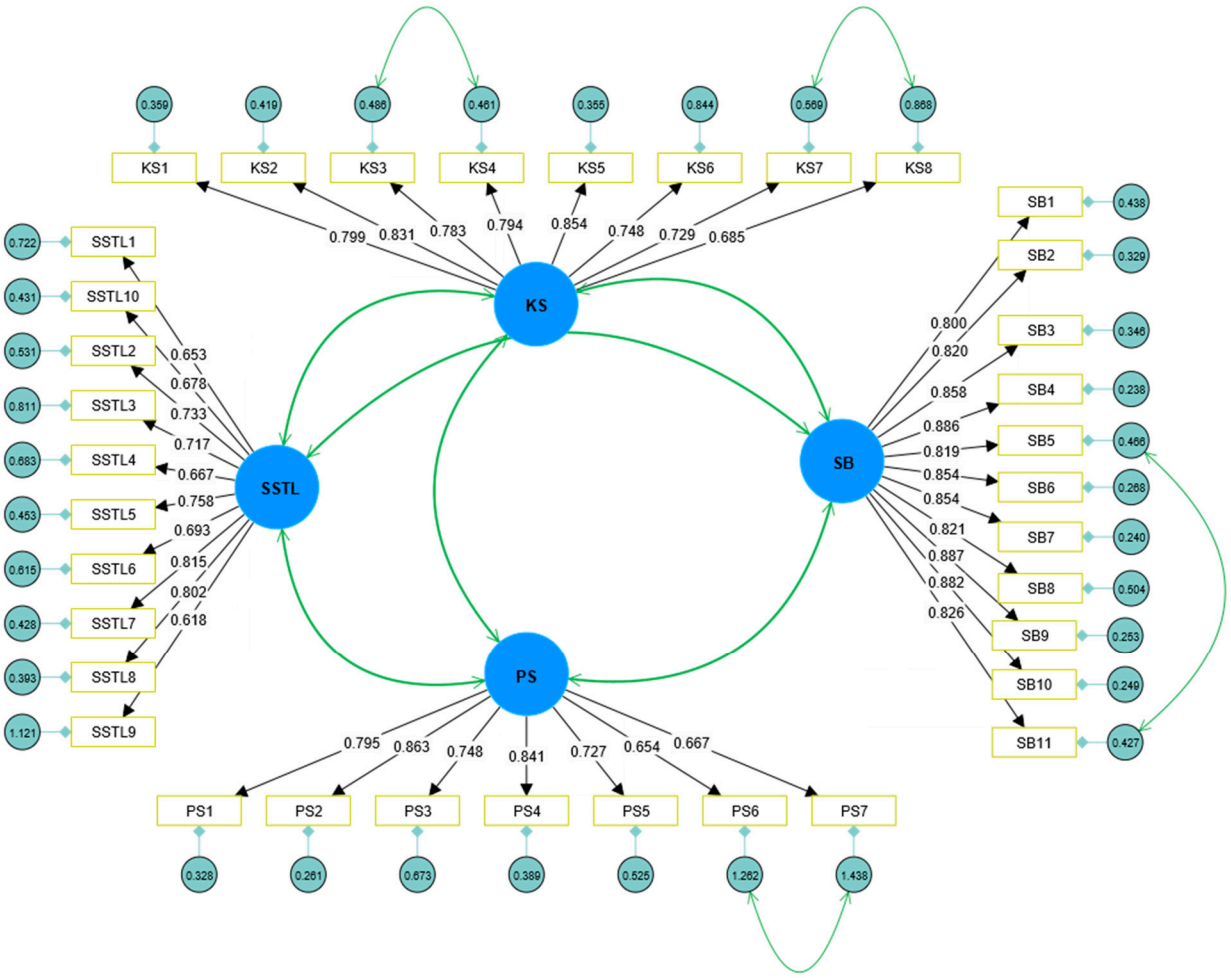

Figure 2. Factor loadings of the measurement items.

Table 3. Discriminant validity and descriptive statistics.

Construct	M	SD	SSTL	KS	PS	SB	Edu	Exp
SSTL	5.740	0.830	**(0.716)**					
KS	5.601	0.948	0.702 **	**(0.780)**				
PS	4.408	0.613	0.665 **	0.729 **	**(0.760)**			
SB	5.570	0.938	0.681 **	0.670 **	0.748 **	**(0.846)**		
Edu	-	-	0.004	0.012	0.009	0.016	-	
Exp	-	-	0.009	0.018	0.041	0.003	0.017	-

Note: Values in diagonal parentheses are square roots of AVEs; Exp = experience; Edu = education; SD = standard deviation; M = mean; ** = Significant correlations ($p < 0.01$).

Table 4. Research model goodness of indices.

Goodness of Fit Indices	Recommended Threshold	Reference	Results	Goodness of Fit
CMIN/df	<3	[74,86,87]	2.601, $p < 0.001$	Fit
GFI	>0.9		0.905	Fit
TLI	>0.9		0.936	Fit
IFI	>0.9		0.940	Fit
CFI	>0.9		0.941	Fit
NFI	>0.9		0.937	Fit
RMSEA	<0.08		0.061	Fit

4.2. Direct and Indirect Effect Results

Model 4 embedded in the Hayes PROCESS macro was used to test the direct and indirect effects [76]. The direct effects are possible and significant (i.e., H1–H3), as shown in Table 5. The results confirm that SSTL positively influences safety behavior (β = 0.470, t = 18.366, $p < 0.001$). SSTL positively influences knowledge sharing (β = 0.802, t = 41.582, $p < 0.001$). Safety knowledge positively influenced safety behavior (β = 0.374, t = 16.699, $p < 0.001$). Accordingly, support was found for H1–H3.

Table 5. Test of direct effects and mediation in the hypothesized model.

Outcome Variable	Independent Variable	Estimates (β)	Standard Error	t-Values	*p*-Values	95% CI
M1: KS	Intercept	0.999	0.112	8.939	0.000	[0.780, 1.219]
$R^2 = 0.493$	SSTL	0.802	0.019	41.582	0.000	[0.764, 0.840]
M2: SB	Intercept	0.774	0.108	7.156	0.00	[0.562, 0.986]
	SSTL	0.470	0.026	18.366	0.000	[0.420, 0.520]
$R^2 = 0.537$	KS	0.374	0.022	16.699	0.000	[0.330, 0.418]
The indirect impact of SSTL on safety behavior via knowledge sharing						
Direct effect of X on Y		0.470	0.026	18.366	0.000	[0.420, 0.520]
Total effect		0.770	0.020	39.296	0.000	[0.732, 0.809]
SSTL → KS → SB		0.300	0.024			[0.255, 0.348]

Note: CI = confidence interval.

Using the bootstrapping technique (a reliable method) for testing indirect effects [76,88], we examined whether SSTL leads to safety behavior through knowledge sharing. The results of the bias-corrected percentile confirm that knowledge sharing mediates the SSTL–safety behavior relationship (β = 0.300, BootSE = 0.024, BootLLCI = 0.255, BootULCI = 0.348). Moreover, Table 5 demonstrates that the main effect remained significant in the presence of the mediator. Thus, partial mediation was observed, supporting H4.

Moderation test results

The moderation and mediation hypotheses were tested using Model 8 embedded in the Hayes PROCESS macro [76]. The results for moderation and moderated mediation are presented in Table 6. Following recent research [89,90] and to prevent multicollinearity issues, all constructs were mean-centered before conducting the analysis. Experience and education were also included as covariates.

Table 6. Test of the moderating effect of psychological safety in the hypothesized model.

Relationships	Sample Estimate	Standard Error	t-Values	*p*-Values	95% CI	
					Lower	Upper
M1: knowledge sharing						
Intercept	5.578	0.016	340.281	0.000	5.546	5.610
SSTL	0.440	0.023	19.369		0.396	0.485
PS	0.466	0.020	23.852	0.000	0.428	0.505
SSTL × PS	0.044	0.017	2.690	0.000	0.012	0.077
Experience	0.049	0.028	1.781	0.075	−0.005	0.104
Education	−0.015	0.014	−1.045	0.295	−0.042	0.0127

Table 6. *Cont.*

Relationships	Sample Estimate	Standard Error	t-Values	*p*-Values	95% CI	
					Lower	Upper
The conditional direct effect of SSTL on KS at different levels of PS						
−1SD (Low)	0.397	0.025	15.655	0.000	0.347	0.447
+1SD (High)	0.483	0.030	16.107	0.000	0.424	0.542
R^2 = 0.625 ***						
M2: Safety behavior						
Intercept	4.905	0.129	38.381	0.000	4.697	5.203
SSTL	0.303	0.024	12.509	0.000	0.255	0.350
KS	0.110	0.023	4.770	0.000	0.065	0.155
PS	0.487	0.022	22.418	0.000	0.444	0.530
SSTL × PS	0.012	0.016	0.727	0.469	−0.020	0.043
Experience	−0.008	0.027	−0.312	0.755	−0.061	0.044
Education	0.020	0.013	1.513	0.130	−0.006	0.047
R^2 = 0.642 ***						
The conditional indirect effect of SSTL on SB through KS at different levels of PS						
−1SD (Low)	0.044	0.012			0.020	0.068
+1SD (High)	0.053	0.015			0.023	0.082
Index of moderation mediation						
	0.005	0.028			0.001	0.011

Note: CI = confidence interval; M = model; *** = Correlation is significant at $p < 0.001$. Consistent with the study's proposed hypothesis (Model 1), SSTL positively influenced knowledge sharing (β = 0.440, t = 19.369, $p < 0.001$), and the link was moderated by psychological safety (β = 0.440, t = 19.369, $p < 0.001$, [0.396, 485]). Further insights into this moderation analysis using simple slope analysis revealed that the conditional relationship varies at different levels of psychological safety (i.e., one standard deviation below the mean and one standard deviation above the mean). Specifically, the relationship was significant for different values of psychological safety. However, the relationship is weaker for construction employees with a low level of psychological safety (β = 0.397, t = 15.655, $p < 0.001$, [0.347, 447]), and the relationship becomes stronger for construction employees with a high level of psychological safety (β = 0.483, t = 16.107, $p < 0.001$, [0.424, 0.542]). Figure 3 depicts a visualization of the aforementioned conditional direct effect, supporting H5.

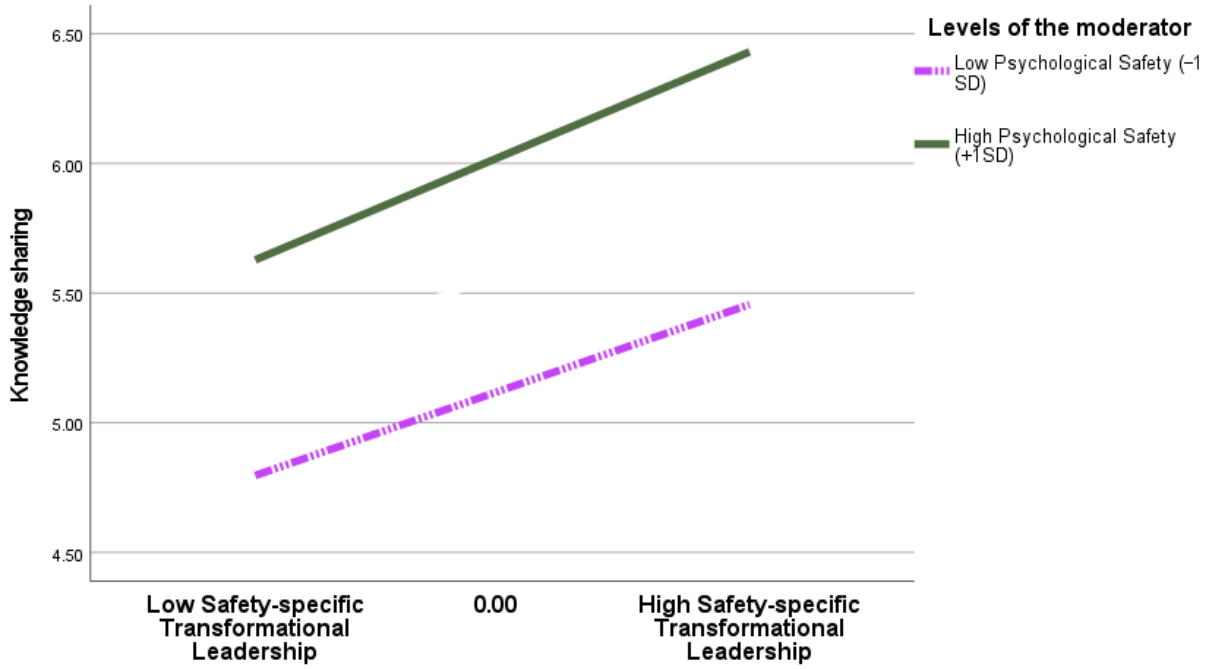

Figure 3. The interaction effect of SSTL and psychological safety on knowledge sharing.

Table 6 demonstrates the moderated mediation results. The conditional indirect effect indicates that psychological safety moderates the mediated relationship between SSTL and safety behavior through knowledge sharing. To gain further insight into the moderating pattern, the conditional indirect effect was plotted for different values of psychological safety (Figure 4). Specifically, the conditional indirect effect of SSTL on safety behavior through knowledge sharing was stronger at a high level of psychological safety (β = 0.044, SE = 0.012, [0.020, 0.068]), and the mediated relationship became weaker at a low level of psychological safety (β = 0.053, SE = 0.015, [0.023, 0.082]). Accordingly, we found that H6 was supported.

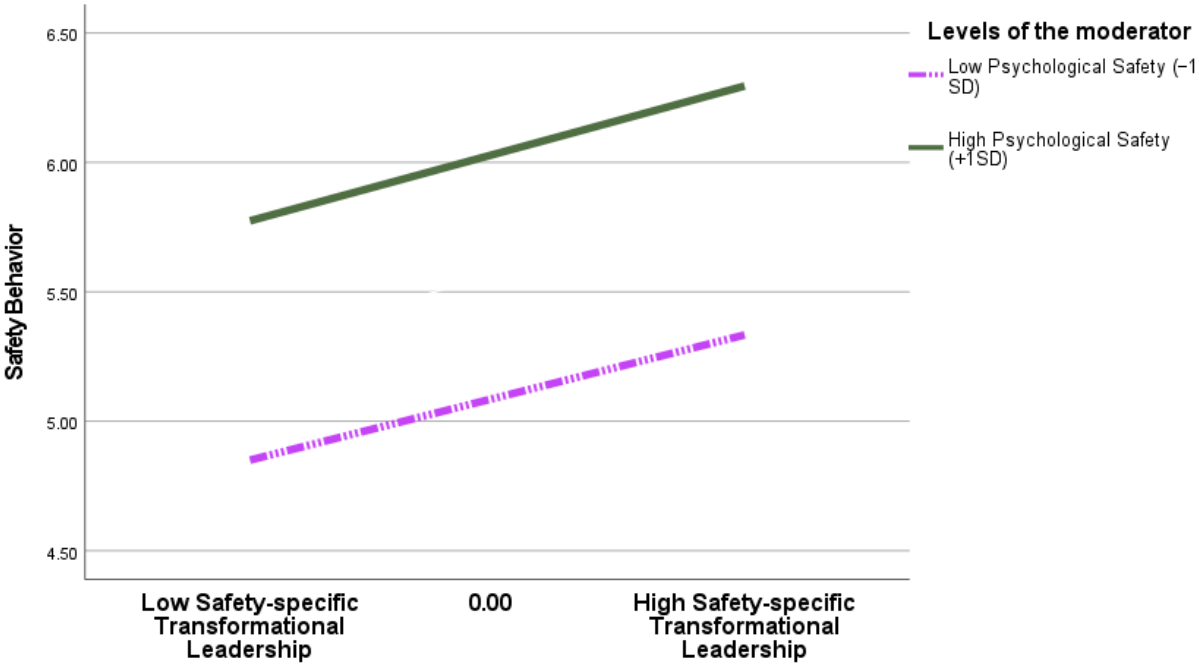

Figure 4. The indirect effect of SSTL on safety behavior through knowledge sharing at different levels of psychological safety.

5. Discussion

Grounded in the SET and positive organizational behavior perspectives, this study investigated the influence of SSTL on employee safety behavior in the construction sector in Turkiye. Moreover, this study aimed to demonstrate how SSTL influences safety behavior through knowledge sharing. Accordingly, we examined how SSTL influences safety behavior through the mediating role of knowledge sharing. The moderating role of psychological safety was also investigated.

The findings show that SSTL is positively associated with employee safety behavior. This result is consistent with prior research findings in the aviation sector [14]. One possible explanation for the consistency in these results is that safety-specific transformational leaders prioritize safety concerns. They motivate and inspire workers to establish areas for safety improvement. Such leaders can swiftly gain workers' trust by providing support and genuine care [26,64]. Thus, employees under this leadership approach reciprocate such support by adhering to safety measures to improve safety behavior. Cultural factors influence safety perceptions in Türkiye, particularly impacting how individuals assess and respond to risks in various settings. These factors include a strong sense of community and social responsibility, a hierarchical structure in social and professional settings, and a cultural emphasis on fate and trust in divine intervention, which can sometimes affect risk assessment and mitigation behaviors. Turkish culture often emphasizes close-knit

communities and strong social bonds [91]. This can lead to a heightened awareness of the safety of others within the community, fostering a sense of collective responsibility for ensuring safety. Turkish society has hierarchical structures that can influence safety perceptions. A cultural emphasis on fate and the belief that events are predetermined can sometimes influence how individuals perceive and respond to risk. Some may be more likely to accept risks as inevitable, potentially leading to a lower prioritization of preventative safety measures or a delayed response to potential hazards.

The findings show that SSTL is positively associated with employee safety behavior, consistent with prior research in the aviation sector [14]. Safety-specific transformational leaders prioritize safety concerns and inspire workers to improve safety practices. By providing genuine care and support, they gain employees' trust [26,64], which in turn motivates workers to adhere to safety measures and strengthen safety behavior. SSTL was positively associated with safety knowledge. This finding complements extant research on leadership and knowledge sharing. Though previous studies have established a positive link between broader transformational leadership and knowledge sharing [21,40,92], none of these studies considered the SSTL. Moreover, this finding supports the SET. This result implies that safety-specific transformational leadership facilitates reciprocity in safety-related knowledge-sharing practices. As individuals observe leaders' constant efforts and dedication to modeling safe behaviors, they feel inspired and motivated to reciprocate by offering their knowledge and insights. This reciprocal exchange is critical because it develops an environment in which workers understand the general organizational value of safety-related knowledge sharing.

Knowledge sharing is positively associated with safety behaviors. This finding offers empirical support for Edmondson [45] and Scarbrough [43] in that collective learning in the workplace promotes individuals' safety knowledge and prevents the repetition of mistakes and accidents. An earlier study confirmed that knowledge sharing is crucial because it can curb meaningless learning processes within organizations [43]. It has also been demonstrated that the most prevalent cause of errors and wrongdoings is a lack of experience and knowledge [44]. Based on this, Edmondson [45] argued that appropriate knowledge management encourages learning and work settings that boost employees' safety knowledge and circumvent the repetition of accidents and mistakes. When individuals proactively engage in knowledge sharing, specifically in relation to safety practices, lessons are learned to improve their safety behavior.

It was discovered that knowledge sharing mediates the relationship between SSTL and employee safety behavior. This finding is consistent with prior studies' findings that learning and safety knowledge serve as mechanisms between leadership and employee safety outcomes [2,18]. The explanation for this result is that safety-focused leadership, such as safety-specific transformational leadership, encourages greater effort among construction workers to share safety-related knowledge and motivate them to improve their safety practices. Such improvements in motivation and collective learning/knowledge sharing are transformed into practices manifested in safety behavior. Safety-specific transformational leaders cultivate and promote knowledge-sharing among employees. This not only develops a better-informed workplace but also one that is equipped to recognize the risk of safety breaches to improve safety behavior. Furthermore, we found that for construction workers with high psychological safety, the relationship between SSTL and knowledge sharing is stronger than that for workers with low psychological safety. Moreover, the indirect positive influence of SSTL on safety behavior through knowledge sharing is more pronounced at a high level of psychological safety than at a low level.

Construction leaders can foster a strong safety culture by embracing safety-specific transformational leadership (SSTL) and psychological safety. Some examples are as follows:

leaders should be actively present on-site, visibly demonstrating safety behaviors and participating in safety discussions. Leaders should articulate a clear and compelling safety vision, highlighting the importance of safety for both individual well-being and project success. Leaders should encourage workers to take ownership of safety by actively soliciting their input, encouraging them to identify hazards, and empowering them to stop unsafe work. Leaders should acknowledge and reward positive safety behaviors and accomplishments, reinforcing the importance of safety culture. Leaders should create a culture of open communication where workers feel comfortable raising safety concerns without fear of punishment.

6. Conclusions

This study enhances safety behavior among construction workers through the mediating role of knowledge sharing and the moderating role of psychological safety. Specifically, leaders who actively inspire and motivate their teams towards safety, coupled with encouraging a culture of open communication and trust (psychological safety), promote increased knowledge sharing about safety practices. This leads to workers adopting safer behaviors on the job.

Leaders who exhibit this style emphasize safety as a core value, set clear safety expectations, and actively participate in safety initiatives. When psychological safety is high, workers are more likely to share their knowledge and experiences related to safety, creating a collective learning environment. A sense of psychological safety, where individuals feel comfortable speaking up about safety concerns without fear of punishment, is crucial for promoting open communication and knowledge sharing. The study suggests that by facilitating a safe and open environment, leaders can significantly improve workers' safety behavior, potentially reducing accidents and injuries.

6.1. Theoretical Contribution

Theoretically, this study enriches the literature on leadership and safety management in several ways. First, the safety-focused leadership approach and safety behavior are crucial topics in the construction sector because the former concerns how to lead construction workers and the latter focuses on their job outcomes. However, there is a lack of empirical studies investigating the relationship between SSTL and safety behavior in the construction industry. Using a sample collected from the Turkish construction industry, we fill this void in the literature by offering empirical evidence that SSTL is a significant predictor of employee safety behavior. Based on this, this study responds to several research calls [14,26] for more specificity in leadership studies, urging researchers to move beyond broad categorization and develop more contextually driven frameworks. By doing this, this study establishes the foundation for future empirical investigation and extends SSTL into the construction context. In addition, the discovery of a positive relationship between SSTL and safety behavior demonstrates that this specific relationship is not limited to the aviation context.

Second, this study extends research streams that draw on SET as a theoretical framework in the literature on leadership and safety behavior [14,93]. Our findings extend the literature on the social interaction process through which safety-specific transformational leadership improves employee safety behavior. In the extant literature, while emerging research by Wu et al. [14] demonstrated that SSTL influences employee safety behavior, the exact link between safety-specific transformational leadership and knowledge remains unclear. However, the extant literature has not provided insights into how safety-specific transformational leadership influences knowledge sharing. Thus, by linking SSTL with knowledge sharing and investigating knowledge sharing as a mediating mechanism, this

study broadens the understanding of the link between SSTL, knowledge sharing, and safety behavior in the construction industry. Accordingly, we significantly extend the literature on leadership and positive social interaction. Hence, we fill the research void that Wu et al. [14] identified by demonstrating that knowledge sharing is a new mechanism in addition to the previously researched mechanisms of the leadership–safety behavior relationship [2,14].

Third, this study demonstrates that an individual's psychological state (i.e., psychological safety) is a contextual condition underlying the impact of SSTL on knowledge sharing. As an initial study to draw on and extend the positive organizational behavior perspective [24,94] in the context of SSTL in the construction sector, this research offers a unique insight to explain the conditions under which SSTL (positive leadership) can make employees more capable of engaging in knowledge. We found that psychological safety augmented the positive impact of SSTL on knowledge sharing. This finding suggests that psychological safety is a dynamic individual state that can either hinder or promote the diffusion of safety-related knowledge sharing among employees. By uncovering psychological safety as an individual psychological condition, this study bridges the safety-focused leadership and knowledge management literature, demonstrating how internal barriers, such as self-doubt or fear of reprisal, can impede the effectiveness of positive leadership (i.e., safety-focused transformational leadership). However, a secure psychological state can optimize the full potential of safety-related knowledge sharing. Thus, this study redefines psychological safety as not only a contextual facilitator but also an individual filter under which the safety leadership impact is processed, providing a new perspective for understanding safety-related knowledge sharing in the construction context.

Finally, the moderated mediation model contributes to our understanding of how the mechanism transmitting the influence of context-specific safety leadership (i.e., SSTL) to individual safety outcomes (i.e., safety behavior) is conditional on employees' psychological state (i.e., psychological safety). The findings of this study indicate that the interaction effect of safety-specific transformational leadership and psychological safety on knowledge sharing can be further extended to employee safety behavior, and the degree to which knowledge sharing mediates the influence of SSTL is highly contingent on employees' positive psychological states (i.e., the ability to speak up and report unsafe behaviors). Hence, in a secure psychological environment, it is critical for construction firms to seek to improve their workers' safety behavior by stimulating safety-related knowledge sharing [95].

6.2. Practical Implication

The findings of this study offer critical practical implications for management and employees in the construction sector. This research demonstrates that safety-specific transformational leadership directly impacts the safety behavior of construction workers. For construction leaders, safety-specific transformational leadership represents the most suitable form of leadership, yielding efficient and successful safety management. The management of construction firms should promote awareness of integrating the principles of SSTL into everyday management practices and fully leverage the benefits of SSTL to improve construction workers' safety behavior. Construction firms' leaders should prioritize professional and psychological well-being, actively listen to workers' concerns, and show genuine care for them, rather than solely enforcing punishment for less-than-ideal performance. Further, the management of construction firms should consider hiring professional human resource advisory firms to conduct training sessions and empower leaders in the application of SSTL. At the conclusion of each training session, an assessment can also be given to evaluate the leaders' understanding of SSTL.

For leaders in the construction industry, this research demonstrates that it is essential to establish an environment in which knowledge sharing is constantly encouraged and

woven into everyday construction activities. This can be accomplished by safety-specific transformational leaders by establishing well-structured avenues for employees to share safety-related information, such as peer-to-peer learning meetings, pre-shift safety briefings, or electronic channels for voicing near misses and solutions. For instance, leaders could inspire and motivate employees by sharing a personal account of learned safety lessons and then encourage employees to share their own experiences, thus creating a shared repository of safety knowledge. Such a process will not only reinforce leaders' safety messages but can also empower workers to turn such motivation into practical safety behavior.

A key consideration for leaders in the construction industry is the importance of fostering psychological safety as a fundamental aspect of safety-specific transformational leadership strategies. Leaders can achieve this by practicing behaviors that alleviate fear of reprisals and building trust, such as regularly listening to employees' safety concerns, recognizing contributions without condemnation, and addressing reported issues in a constructive manner. For instance, leaders should promote the sharing of near-miss experiences during safety meetings, express gratitude for their contributions, and use the information gained to strengthen safety practices. This creates an environment of psychological safety that allows employees to freely express their ideas or concerns. By prioritizing this approach (i.e., mechanism), leaders can facilitate the seamless dissemination of crucial safety knowledge, such as improved risk control measures, and ensure that lessons learned from prior events flow freely in the workplace, consequently improving safety behavior.

6.3. Limitations and Future Studies

While this research offers new insights and contributions to the leadership and construction safety management literature, it has certain limitations that open research opportunities for future studies. This study employed a cross-sectional design, which restricts causal inferences. Future studies could adopt a longitudinal approach to assess whether safety-specific transformational leadership can predict employee safety behavior over an extended timeframe. Furthermore, the sample used in this study is limited to the construction industry; future studies can replicate the research framework in other industries or conduct a cross-national study to deepen its applicability. Furthermore, there could be other mechanisms (i.e., mediators) that can bridge the SSTL–safety behavior relationship. For example, safety accountability [96], safety identification [14], and role definition [97] can be investigated as potential mediating mechanisms. Finally, although safety-specific transformational leaders motivate and inspire through their safety vision and intellectual stimulation with safety goals [12], the current study demonstrates that such efforts may fall short if individuals lack the psychological safety necessary to act on such motivation. Thus, other contextual individual psychological factors could also be examined in future studies [98].

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Informed Consent Statement: Informed consent was obtained from all participants prior to their participation in the study.

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