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SAFETY CLIMATE AGREEMENT FOR A SAFER WORK ENVIRONMENT: A MULTILEVEL MEDIATION ANALYSIS OF THE RELATIONSHIP BETWEEN LMX AND SAFETY BEHAVIORS

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Research demonstrated that leadership affects safety outcomes and is a proximal antecedent of safety climate. This work aims to show through an example the importance to use a multilevel mediational analysis to test a model in which the nature of some constructs is multilevel. In particular it is evaluated the effect that leader-member exchange (LMX) has on the supervisor's and coworkers' safety climate agreement, which in turn predict safety behaviors, would be different if we chose to ignore the nested structure of data. Furthermore, an example of how to use latent congruence model to operationalize agreement with a mediating role is given. Using a sample of 508 blue-collars and their supervisors, we estimated the conceptual model using a multilevel perspective. Our results confirmed that the relationship between LMX and safety behaviors is mediated by the supervisor's and colleagues' safety climate agreement. Implications for theory and practice are discussed.

Keywords: Safety climate agreement; Multilevel mediation modeling; Safety behaviors; Latent congruence model; LMX.

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Organizations can be seen as multilevel systems in which several entities are nested within each other (e.g., employees are nested in work-units, work-units are nested in departments, and departments are nested in organizations; Kozlowski & Klein, 2000). It follows that each entity is positioned at a different level and a single-level perspective may not be able to accurately explain complex organizational phenomena that take place at different levels. For instance, antecedents, mediators, moderators, and outcomes may be located at different levels (Kozlowski & Klein, 2000).

The basic idea of multilevel modeling is that the characteristics of an entity are related to the characteristics of one or more entities that are located at a different level (Gonzàlez-Romà & Hernandez, 2017). As an example, the culture of an organization that promotes certain safety practices, when implemented by a given team leader,[1] would induce a certain team safety climate, which in turn would inform individual safety behaviors. Statisticians have developed tools and software to accurately estimate these cross-level effects (Gonzàlez-Romà & Hernandez, 2017).

This paper is organized as follows: first, we lay out the reasons why scholars should analyze nested data using multilevel modeling, in particular considering a mediation analysis with nested data. Furthermore, we highlight the opportunity to use latent congruence model to operationalize agreement in a mediational multilevel model. Second, using data from an organizational research on safety climate, we estimate two multilevel mediation models using latent congruence analysis. Last, the consequences of such methodological and statistical choices are discussed.

Multilevel Modeling and Mediation Analysis

Ignoring the nested structure of a dataset, and thus analyzing data only at one level, may have several undesirable and unforeseen consequences (Gonzàlez-Romà & Hernandez, 2017; Heck et al., 2013). Perhaps the most important thing to note is the violation of the assumption of residuals' independence when dealing with nested data using ordinary least squares (OLS; Preacher et al., 2010): research has shown that employees that work in the same workgroup or unit tend to have similar perceptions, affects, attitudes, and behaviors (Gonzàlez-Romà & Hernandez, 2014). It follows that their responses on a measurement scale will also be similar, to a certain extent. Therefore, nested data generally violate the independence of residuals assumption. We are able to calculate this degree of non-independence by computing the intraclass correlation coefficient (ICC). Scholarly guidelines suggest that ICC equal to or higher than .05 may indicate a small to medium effect (LeBreton & Senter, 2008) and the nested structure should not be ignored (Julian, 2001). Conversely, if ICC coefficients are lower than .05, the seems to be a consensus that ignoring the nested structure of data leads to negligible consequences (Finch & French, 2011). Additionally, scholars have pointed out that using OLS models that analyze nested data only at the lower level led to increased Type 1 and Type 2 errors (Bliese & Hanges, 2004). Using a single-level structural equation modeling (SEM) approach to analyze nested data leads to similar issues (Finch & French, 2011).

Organizational researchers have long been interested in estimating mediation hypotheses with nested data (Krull & MacKinnon, 2001; Preacher et al., 2010). Preacher and colleagues (2010), using a multilevel structural equation modeling (MSEM) paradigm, suggested seven possible multilevel mediation designs, depending on the level of analysis of the predictor, the mediator, and the outcome. The authors also showed several applied examples to illustrate the flexibility of this framework.

Congruence among Subjects within an Organization and Statistical Issues

The study of congruence is very common in organizational research (Cheung, 2009). For instance, person-organization fit theories (see e.g., Lambert et al., 2003; Ostroff & Judge, 2007) are about congruence between individuals and their organization. These theories are related to the more general framework of person-environment fit theory, which posited that congruence between people and their environments influences behavior and psychological functions. This congruence can be measured directly, by asking individuals how well they fit with an environment, or in an indirect way, by getting the same measure from both parties (person and environment). Organizational research also discussed "system fit," that is the fit between workgroups and organizations, and group-environment fit, that is the congruence between the group and other intra- and extra-organizational subjects (Sweet, 2020). Fit has been conceptualized as complementary fit, that is the extent to which both person and environment provide what is required; and supplementary fit, that is the extent to which both person and environment are similar on a specific dimension. The lack of fit can affect organizational outcomes, as, for instance, commitment (Cable & DeRue, 2002; Greguras & Diefendorff, 2009), citizenship behaviors (Cable & DeRue, 2002), and safety outcomes (Sherry, 1991).

The study of misalignment between subjects involves the statistical modeling of congruence. Scholars have long tried to find the best way to operationalize congruence (also described as fit, agreement, or similarity) and it seems that there are three main options for congruence scholars: difference scores, polynomial regression, and latent congruence. Difference scores (i.e., algebraic difference, absolute difference, and squared difference) have long been criticized on the grounds of their low reliability, compared to their components' reliability (see e.g., Edwards, 2009). More than 25 years ago, Edwards (1993) proposed to overcome the reliability issue by estimating polynomial regressions with two predictors, their quadratic terms, and the interaction in the equation, creating a response surface. Both SEM and multilevel applications of this basic equation have been developed in the literature (Nesler et al., 2019; Zyphur et al., 2015). It should be noted that response surface analysis makes the assumption that congruence is symmetrical (Edwards & Parry, 2018) and is conceptually similar to a moderation analysis, although with some desirable features and advantages (Shanock et al., 2010).

Conversely, latent congruence offers more flexibility because the latent congruence factor can be integrated into conceptual models as predictor, moderator, mediator, or outcome without limitations (Cheung, 2009). For this reason, since our hypothesis is fundamentally a mediation hypothesis (see next section), we chose to use latent congruence. We will offer a brief overview of the computational steps associated with this technique in the data analysis plan and will implement such technique in the Section "Results."

An Application of Multilevel Mediation to Safety Climate Research

Comporting with job performance theory, safety behaviors are affected by safety-relevant individual differences (e.g., personal traits, ability, attitudes) as well as contextual factors (Burke & Signal, 2010; Neal & Griffin, 2004). Following Griffin and Neal (2000), safety behaviors can be distinguished between safety compliance and safety participation. Safety compliance can be viewed as the behaviors concerning adherence to and respect of safety procedures and working in a safe manner. On the other hand, safety participation means helping coworkers, promoting voluntary safety programs, and putting individual effort into improving safety at work. The value of this distinction has been supported by many studies (e.g., Casey et al., 2017; Griffin & Neal, 2000; Neal & Griffin, 2004, 2006; Neal et al., 2000). Among contextual factors that affect safety behaviors, safety climate is one of the most studied construct, and syntheses of these studies have been reported in reviews and meta-analyses (e.g., Beus et al., 2016; Burke & Signal, 2010; Christian et al., 2009; Clarke, 2006, 2010; Glendon, 2008; Griffin & Curcuruto, 2016; Guldenmund, 2007; Hofmann et al., 2017; Jiang et al., 2019; Nahrgang et al., 2011; Seo et al., 2004).

Zohar and Hofmann (2012) identified two processes that promoted climate: symbolic interactionism (Blumer, 1969; Schneider & Reichers, 1983) and collective sense-making (Weick, 1995, 2005), which broadly refer to members of organizational units interacting to create a mutual understanding of extracted environmental and social cues. Since group members interact more often with each other than with workers of other groups, it is likely that shared perceptions about their unit or about their organization emerge among them.

Safety climate can be studied at three levels: organizational-, group-, and individual-level. Organizational and group safety climates have been largely investigated separately (Zohar, 2000). Nevertheless, scholars made the point that these organizational processes take place simultaneously at several levels, and these processes at different levels are linked (e.g., Kozlowski & Klein, 2000). This implies that climates may have different meanings at different organizational levels, as well as cross-level relationships.

At the individual level, climate perceptions are often defined as *psychological climate* (James et al., 1978) that is "the individual's cognitive representations of relatively proximal situational conditions, expressed in terms that reflects psychologically meaningful interpretations of the situation" (James, et al., 1978, p. 786). At the group level, safety climate could refer to either supervisor's (e.g., Griffin & Curcuruto, 2016; Meliá & Sesé, 2007; Zohar, 2000; Zohar & Luria, 2005) or coworkers' practices (e.g., Brondino et al., 2012, 2013; Jiang et al., 2009; Meliá et al., 2008; Singer et al., 2007). At the group level, perceptions are aggregated (and averaged) within subunits, and usually the supervisor is the primary referent object. Zohar (2000, 2010) argued that the main determinant of variation in group-level safety climate is supervisory practices. Research provided evidence that organizational-level safety climate positively influences supervisor's safety climate, the latter being negatively related to safety outcomes such as injuries and micro-accidents (Zohar, 2000, 2010).

The role of coworkers at the group level has not been explored as much as other contextual group-level factors (e.g., the supervisor's role). Few studies considered coworkers as a possible source of safety climate, different from supervisor's ad management's source of climate (e.g., Brondino et al., 2012; Bronkhorst, 2015; Meliá et al., 2008; Silva et al., 2013; Zhang et al., 2018). Meliá et al. (2008) identified the group of coworkers as an important safety agent in addition to the contribution made by the organization and the supervisor. They also showed that organizational safety climate and supervisor's safety climate positively and significantly predict coworkers' safety climate. Brondino et al. (2012) showed that coworkers' safety climate had a stronger influence on safety-related behaviors than supervisors' safety climate. In sum, the importance of safety climate, in predicting safety performance has been highlighted in many researches (Christian et al., 2009). Nevertheless, the majority of studies have tested these relationships using individuals' perceptions of a group-level phenomenon, and only few studies have tested for cross-level effects using group-level climate (e.g., Neal & Griffin, 2006; Zohar & Luria, 2005). Furthermore, safety climate has been considered at organizational level, and few studies have explored the role of climate at the unit level.

Safety Implications of the Leader-Member Exchange Theory

Leadership has been recognized as an important antecedent of safety climate (Mullen & Kelloway, 2009; Zohar & Luria, 2005). LMX theory has become one of the most useful approaches for studying hypothesized links between leadership and organizational outcomes (Clarke, 2013; Schriesheim et al., 1999). Supervisor-subordinate relationships are deemed important by safety researchers for several reasons. As noted earlier, from a competitiveness standpoint, supervisors can influence their subordinates' behaviors, attitudes, and overall job-related performance (Hofmann et al., 2003). From a safety perspective, a supervisor's leadership style may focus on improving workplace safety (Michael et al., 2006).

LMX is defined as the quality of the interactions existing between supervisors and their subordinates (Graen & Uhl-Bien, 1995), thus the basic tenet of this theory is that leaders develop different types of exchange relationships with their subordinates, and the quality of these relationships affects both leader's and subordinates' behaviors and attitudes (Gerstner & Day, 1997; Liden et al., 1997). Unlike other leadership theories seeking to explain leadership based upon the leader's individual characteristics or on contingent situations, LMX focuses on the exchange between the leader and his/her subordinates as the main level of analysis (Graen & Uhl-Bien, 1995). LMX draws from social exchange theory (Blau, 1964) in order to explain the development of dyadic relationships and leadership's antecedents and outcomes. In sum, social exchange theory posits that there is a perceived obligation on the part of the subordinates to reciprocate high-quality relationships (Blau, 1964; Gouldner, 1960) and that the dyadic relationship is developed over time through a series of exchanges (Dienesch & Liden, 1986).

LMX has become a major focus of safety scientists because of its ability to product desired outcomes at multiple levels (i.e., individual, group, and organizational level; Gerstner & Day, 1997). A study has shown that LMX is correlated with safety behaviors (Hofmann, et al., 2003) and another (Zohar, 2002) highlighted that the quality of relationships between supervisor and subordinates is positively related to safety climate, a leading indicator of safety performance. Hofmann and Morgeson (1999) analyzed leadership as a predictor of safety outcomes: Their results showed that the quality of relationships between group leaders and their subordinates (i.e., LMX) predicted injuries in work groups, through the mediating effects of some safety climate dimensions (i.e., safety communication and management commitment). Along the same lines, Zohar (2002) suggested a mediation model in which leadership style influences safety climate perceptions in the group and hence the group's safety performance. All these results seem to confirm the importance of good quality of relationship between the supervisor and the subordinates for a safe work environment, and leads to the following hypothesis:

Hypothesis 1: at the individual level, LMX is positively related to safety behaviors (safety participation and safety compliance).

SAFETY CLIMATE AGREEMENT AS A MEDIATOR

Safety climate at the group level affects safety performance at individual level (Beus et al., 2016), and we can consider supervisor's climate perceptions as conceptually distinct from their subordinates' perceptions. The agreement in climate perceptions between employees nested within a unit and their supervisor can be evaluated as a type of system fit, specifically a group-environment fit, affecting individual performance, such as safety performance. This congruence between these two parties (i.e., the subordinates as a group and the supervisor) should be considered at the group-level, given the nature of the safety climate construct.

Safety climate research has suggested that there is a significant variation among work groups regarding the degree to which safety performance is expected, rewarded, and valued (Hofmann & Stetzer, 1996, 1998; Zohar, 2000). Yet, to date, the entirety of contributions that considered safety climate agreement did so by computing the agreement score as the agreement between coworkers and excluding their leader, dubbed as climate strength (see e.g., Gonzalez-Roma et al., 2002; Klein et al., 2001; Schneider & Salvaggio, 2002).

Recalling LMX theory (Graen & Uhl-Bien, 1995), one would expect that the degree of agreement between the supervisor and their subordinates' ratings of safety climate would be progressively higher as the number of interactions increase, due to high quality relationship. That is, over repeated social interactions, there will be more common exchange experiences for both the supervisor and the subordinates to rely on as the basis of their safety climate judgement. When this happens, both parties are more likely to evaluate the safety climate similarly, leading to a greater safety climate agreement. Conversely, when they do not have a clear common ground on which they can rely when assessing the safety climate, agreement on their perceptions may be low.

Recent research on LMX variability suggested that group characteristics determine the level of differentiation between the supervisor-subordinate relationships within a group. Workgroups with high levels of task and/or skill diversity represent a wide variety of resources that the leader could leverage, but they also represent employees with unique exchange needs. Hence, investigating LMX at the dyadic level makes sense groups are non-cohesive, heterogeneous, and somewhat independent (Sweet, 2020). Conversely, work units in blue-collar manufactural organizations are more likely to resemble cohesive, homogeneous, and interdependent groups in which all employees have the same level of skills. Hence, individual exchanges in such groups are similar (Henderson et al., 2009) and likely to affect the perceptions of all group members, rather than the individual employee (Sweet, 2020). In sum, the quality of the relationship between supervisor and their subordinates, that is LMX, affects safety climate agreement at group level.

As stated before, at the group level, safety climate perceptions are aggregated within subunits, and usually supervisor is the primary referent object, but coworkers as well are a possible source of safety climate. Brondino et al. (2013), in their development of an integrated instrument to evaluate safety climate, distinguished between the two safety climates: supervisor's safety climate (SSC) and coworkers' safety climate (CSC). Thus, in considering the agreement about safety climate perceptions, we can consequently speak about agreement between supervisor and his/her subordinates concerning supervisor's safety climate (SSC agreement) and agreement between supervisor and his/her subordinates about coworkers' safety climate (CSC agreement).

Given these premises, we propose to test the following hypotheses:

Hypothesis 2: LMX at the individual level is positively associated with SSC congruence at the group level.

Hypothesis 3: LMX at the individual level is positively associated with CSC congruence at the group level.

Considering the relationship between safety climate agreement at group level and safety behaviors, system fit theory suggests that group-supervisor fit can lead to positive outcomes, also in terms of safety performance (Sherry, 1991).Congruence about safety climate should be considered a supplementary fit, because it concerns the extent to which the group and the supervisor are similar on this specific dimension. Specifically, because agreement is the result of an increased relationship between the supervisor and their group (i.e., the supervisor has proved themselves as a trustworthy and reliable exchange partner; Goodwin et al., 2009), this could represent a kind of stored social capital which can be used to motivate both in-role (e.g., increased performance) and extra-role behaviors (e.g., safety participation). Specifically, both SSC and CSC agreement may have a positive effect on safety compliance. In fact, congruence may enhance communication and coordination with coworkers (Day & Bedeian, 1995; Neuman & Wright, 1999), which may put individuals in a better position when it comes to meeting task demands and perform in-role behaviors. Safety climate congruence could affect safety participation (and extra-role behaviors generally) through needs-supplies fit. Congruence can increase needs-supplies fit when it provides supplies for needs for affiliation, belonging, closure, or clarity. To the extent needs are fulfilled, satisfaction increases, and contextual performance may be enhanced (Morrison, 1994; Podsakoff et al., 2000). On the basis of these statements, the following hypotheses are predicted:

Hypothesis 4: SSC congruence at the group level is positively associated with safety compliance at the individual level.

Hypothesis 5: SSC congruence at the group level is positively associated with safety participation at the individual level.

Hypothesis 6: CSC congruence at the group level is positively associated with safety compliance at the individual level.

Hypothesis 7: CSC congruence at the group level is positively associated with safety participation at the individual level.

Figure 1 shows a graphical representation of our hypotheses. As safety climate is a group level variable, also agreement about safety climate should be considered at a group level. On the contrary, safety behaviors and the quality or the relationship of subordinates with their supervisor (LMX) can be considered as individual perceptions. Hence, the following hypotheses must be read as cross-level hypotheses

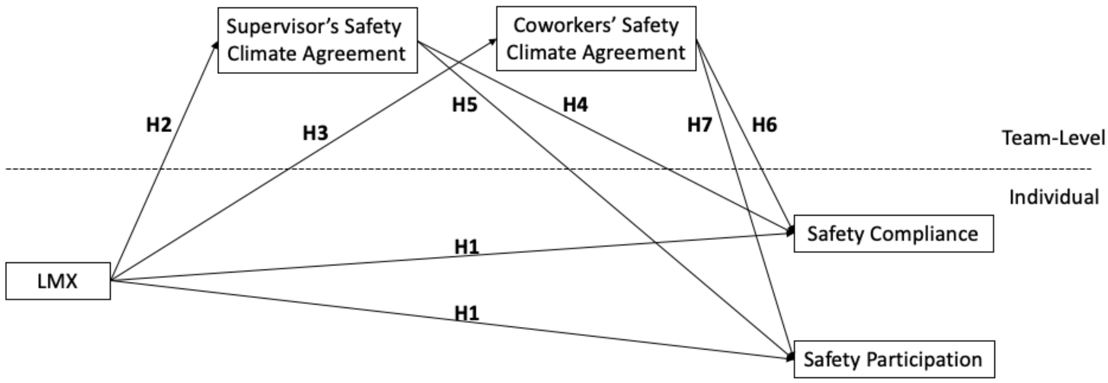

FIGURE 1
Proposed model.

METHOD

Participants

Considering the whole sample (N = 549), the participants were 508 blue-collar workers and their direct supervisors (N = 41), recruited in three heavy industry organizations in Italy. In these organizations, the work was organized so that immediate supervisors were every day in contact with the workers of their team. Ninety eight percent of the participants were male; 82% of the participants had a seniority of more than 10 years with their own organization. Interestingly, all the participants had a permanent contract and 12% of participants was unionized.

The average group size was 12.24 for work unit (range 3-58 employees). In order to carry out the latent congruence analysis, we excluded groups that on average estimated safety climate (both the coworkers' and supervisor's) higher than their respective supervisor. Therefore, we considered a subsample to 34 groups (N = 451, average group size = 13.27) to run the model on the supervisor safety climate agreement; and a subsample of 30 groups (N = 428, average group size = 14.27) to run the model on the coworkers' safety climate agreement. Further details on the need to ensure the directionality of agreement (i.e., the leader's score of safety climate needed to be higher than the average group score) will be discussed at length in the Subsection "Data Analysis."

Procedure

Participants answered the questionnaire during working hours, at the end or at the beginning of their work shift. A few days before administering the questionnaire, the top management organized an ad hoc meeting with the researchers, unions, the safety committee, and the designated safety officer to present the research. The data collection method was paper and pencil. Participating employees were told by the researchers that they had the possibility to take part into a large research project, if they wanted to, and were asked to sign the informed consent. During data collection, supervisors were not present to avoid any undue influence on their subordinates. Supervisors were invited to fill out their own questionnaire in a separate meeting. No incentives for participation or survey completion were given.

Measures

Leader-member exchange (LMX). Because the authors were interested in the overall relationship, they asked the subordinates to rate their LMX relationship with their immediate supervisor by using the LMX7 (Graen & Uhl-Bien, 1995; Uhl-Bien et al., 2000). LMX7 is a unidimensional 7-item scale focused on the perceptions of workers about the quality of the working relation with their immediate supervisor. The centroid item of the scale is "How effective is your working relationship with your supervisor." A 7-point Likert scale ranging from 1 (*not at all*) to 7 (*very much so*) was used such that higher scores reflected higher quality relationship. Internal consistency reliability (ω) was .93. Only employees were asked to rate this construct.

Coworkers' safety climate (CSC). The authors were interested in measuring the safety climate related to the workgroup by using the CSC scale of the Integrated Organizational Safety Climate Questionnaire (Brondino et al., 2013), which has 12 items split in four subdimensions (3 items for each subdimension): safety communication, safety mentoring, safety systems, and safety values. Subordinates and supervisors alike used a 7-point Likert scale ranging from 1 (*never*) to 7 (*always*), however supervisors were asked to assess CSC referring to their subordinates as a group, while subordinates were asked to assess CSC referring to their own colleagues as a group. In the present study only the comprehensive measure of CSC was considered, to reduce model complexity. An example of item, from values dimension, is "My team members are careful about working safely also when we are tired or stressed." Internal consistency reliability (ω) for CSC scale was .97 (safety communication .86, safety mentoring .86, safety systems .90, and safety values .88). As noted above, both the supervisors and the employees were asked to rate this construct.

Supervisor's safety climate (SSC). The authors were interested in measuring the safety climate related to the supervisor by using the SSC scale of the Integrated Organizational Safety Climate Questionnaire (Brondino et al., 2013), which has 10 items split in two subdimensions: supervisor reaction to the subordinates' safety behaviors (4 item) and supervisor's behaviors and effort to improve safety (6 items). An example of item, from the second subdimension, is "My direct supervisor uses explanations (not just compliance) to get us to act safely." Subordinates and supervisors alike used a 7-point Likert scale ranging from 1 (*never*) to 7 (*always*), however supervisors were asked to assess SSC referring to themselves, while subordinates were asked to assess SSC referring to their supervisor. Again, also for SSC only the comprehensive measure of SSC was considered, to reduce complexity. Internal consistency reliability (ω) for SSC scale was .95 (supervisor reaction .93, and supervisor behaviors and efforts .94). As noted above, both the supervisors and the employees were asked to rate this construct.

CSC Agreement. The degree of agreement was modelled as a between-level latent variable with two indicators, the group's aggregated average CSC score and the supervisor average CSC score.

SSC Agreement. The degree of agreement was modelled as a between-level latent variable with two indicators, the group's aggregated average SSC score and the supervisor average SSC score.

Safety behaviors were self-reported by employees and measured by a scale developed by Neal et al. (2000) which distinguished safety compliance and safety participation. Safety compliance is measured by a 4-item scale and assessed compliance with safety procedures (e.g., "I use all the necessary safety equipment to do my job") on a 7-point Likert scale ranging from 1 (*never*) to 7 (*always*). Safety participation is measured by a 4-item scale and assessed the extent to which individuals participated in safety-related activities (e.g., "I put in extra effort to improve the safety of the workplace") on a 7-point Likert scale ranging from 1 (*never*) to 7 (*always*). The internal consistency reliability (ω) of safety compliance scale was .86, and of safety participation scale was .75. Only employees were asked to rate this construct.

Data Analysis

As an assumption check, we will verify that the skewness and kurtosis values for each item do not exceed the known cutoff values of 3 and 10 respectively (Kline, 2011). To test construct validity, confirmatory factor analysis (CFA) and multilevel confirmatory factor analysis (MCFA) will be performed. Prior to running a MCFA, we ran a few preliminary analyses (Muthén & Muthén, 2017): (1) a traditional CFA using the sample total covariance matrix is useful to explore different model structures identified in the literature and determine the most appropriate factor structure. It is important to highlight that the parameter estimates and fit indexes resulting from this step models may be biased when data is multilevel due to correlated observations, especially when group sizes are large or when within factor structure is different from between factor structure; (2) we will estimate between-group level variation (i.e., the r_{wgj} index) to check whether a multilevel analysis is appropriate; (3) we will run a CFA using the sample pooled-within covariance matrix that will allow us to evaluate the factor structure at the within-group level. If the model estimated using the pooled-within matrix shows better fit than the Step 1 CFA, it means that the factor structure differs at the between and at the within level, or that the construct-relevant variance is primarily at the within-group level; last, (4) we will run a CFA using the sample between-group covariance matrix to test the adequacy of the between-group factor structure. At the end of this preliminary analyses, a MCFA will be performed.

While a traditional CFA, at the individual level of analysis, uses the total variance–covariance matrix, the MCFA separates the total sample covariance matrix into pooled within-group and between-group covariance matrices. The appropriate matrix is used in the corresponding level to assess the factor structure. The MCFA permits to test a variety of models: models with the same number of factors and loadings at each level, models with the same number of factors but different loadings at each level, and models with a different number of factors at the two levels. The CFA and MCFA models' goodness of fit was evaluated using chi square values, the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). We will run a MCFA on the SSC and CSC scales while we will run a traditional single-level CFA on the safety behaviors and LMX scales. For the latter, the nested nature of the data was taken into account by utilizing the <type=complex> option in Mplus.

Latent congruence model (LCM) analysis is a SEM-based approach to model agreement between two interdependent observations (e.g., the supervisor's self-evaluation of the SSC and the subordinates aggregated perception of SSC). Since we will model two between-level variables, we chose this basic LCM;

however, researchers are invited to use a more sophisticated item-level LCM if they are not modeling between-level variables. This will allow them to partial out measurement error (Cheung, 2009). Figure 2 shows a basic LCM diagram that involves two latent factors, the level (i.e., the mean), and the congruence of two interdependent manifest variables (i.e., the components). Running this approach involves basic SEM knowledge and skills.

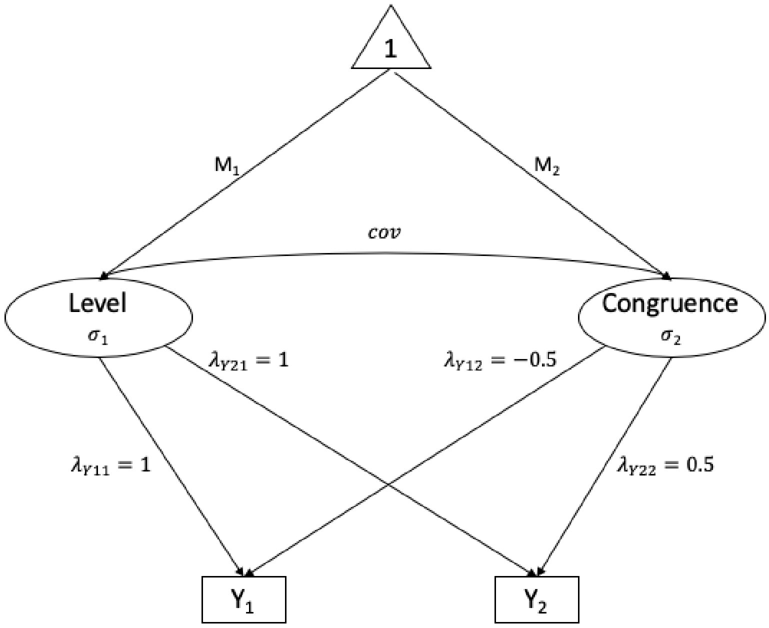

FIGURE 2
Basic latent congruence model.

As it is shown in figure 2, Y_1 and Y_2 are two interdependent manifest variables. The factor level is operationalized as the mean level of Y_1 and Y_2 and is specified as a latent factor that has two constrained factor loadings: $\lambda_{Y11} = 1$ and $\lambda_{Y21} = 1$. The factor congruence is operationalized as the difference in rating between Y_1 and Y_2 and is modeled as a latent factor with two constrained factor loadings: $\lambda_{Y12} = -0.5$ and $\lambda_{Y22} = 0.5$. The factor loadings are fixed at these values and not at the unit value because interpretation is easier in this way (Bolger et al., 2000; Cheung, 2009). The factor level's latent mean represents the grand mean (M_1) and factor variance represents the variability (σ_1) of the mean ratings of Y_1 and Y_2. The factor congruence's latent mean (M_2) represents the average difference between Y_1 and Y_2 and the factor variance represents the variability of the difference (σ_2). These two factors are allowed to covary. Given that there are two observed means, two observed variances, one observed covariance, two estimated means, two estimated variances, and one estimated covariance, this is a just-identified model. Structural regression parameters representing relationships between predictors and outcomes can be added to this model according to the researchers' theoretical model.

Despite the benefits that this approach can provide to congruence scholars, it also has some drawbacks. The most relevant one is that this technique is only able to examine directional difference, as opposed to nondirectional difference. Therefore, researchers need to specify a priori which of the two interdependent observations will be modeled as having a higher score ($\lambda_{Y22} = 0.5$) and which one will have its lambda fixed at –0.5. Cheung (2009) and Edwards (1993) suggested to split the sample in under-estimators and over-estimators to overcome this drawback and run two models that are equal but the fixed values of λ_{Y22} and λ_{Y12} are reversed. We faced a further limitation: in fact, at least 30 clusters are needed to run any multilevel analysis. There were 35 groups in which the aggregate SSC score was lower than the supervisor's self-evaluation and there were 30 groups in which the aggregate CSC score was lower than the supervisor's perception of CSC within their work-unit. Hence, only the results of these subsamples are presented in this contribution.

To test the hypothesized model multilevel path analysis model, we used the two-level random analysis in Mplus syntax (Preacher et al., 2010) as a starting point for developing the syntax for multilevel path analyses. We tested a 1-2-1 model where leader-member exchange was the predictor at the individual level (Level 1), the mediators, SSC and CSC agreements, were both specified at the group level (Level 2), and the outcomes, safety compliance and safety participation, were both specified at the individual level (Level 1). We used the multilevel package for the R environment (Bliese, 2016) to estimate within group homogeneity of perceptions (i.e., the r_{wgj} index) and Mplus version 8.4 (Muthén & Muthén, 2017) for all the other analyses.

RESULTS

Preliminary Analyses

At first, we analyzed missing values in the data, which revealed the maximum percent of missing values for items was 1%, and Little's missing completely at random (MCAR) test indicated that data were not missing at random, $\chi^2(507) = 792.76$, $p < .001$. Then we verified that skewness (range: –2.06, 0.42) and kurtosis (range: –1.21, 5.29) values for each item did not exceed 3 and 10 respectively (Kline, 2011), supporting normality assumptions. Means, standard deviations, and bivariate correlations among studied variables were reported in Table 1.

TABLE 1
Means, standard deviations, and bivariate correlations among studied variables

Variable	1	2	3	4	5
1. LMX	---	.19***	.41***	.77***	.49***
2. Safety compliance	.21***	---	.54***	.29***	.30***
3. Safety participation	.41***	.53***	---	.40***	.47***
4. SSC	.77***	.32***	.42***	---	.59***
5. CSC	.51***	.29***	.47***	.61***	---

Note. Values above the diagonal are referred to the CSC subsample ($N = 428$) and values below the diagonal are referred to the SSC subsample ($N = 451$). LMX = leader-member exchange; SSC = supervisor's safety climate; CSC = coworkers' safety climate.
*** $p < .001$.

Multilevel Confirmatory Factor Analysis

At first CFA for each scale (SSC and CSC) was conducted to test if the model structures identified in the validation studies were confirmed (Brondino et al., 2013; Neal et al., 2000). All the model showed good fit indexes: for SSC, $\chi^2(33) = 189.80$; CFI = .967; RMSEA = .099, 95% CI [.086, .113]; SRMR = .030; for CSC, $\chi^2(50) = 194.84$; CFI = .969; RMSEA = .077, 95% CI [.066, .089]; SRMR = .027.

Then between-group level variation was checked. For our study each group were composed of workers of the same department, working the same shift, and reporting to the same supervisor. Groups with less than 3 members were excluded. Then homogeneity of climate perceptions was assessed with $r_{wg(j)}$ (Bliese, 2000), excluding groups with $r_{wg(j)}$ lower than critical values identified by Dunlap, Burke, and Smith-Crowe (2003). The analysis of $r_{wg(j)}$ highlighted a high homogeneity inside groups for both the SSC scale (range .56-.97; *Mdn* = .83; *M* = 0.70) and the CSC scale (range .53-.97; *Mdn* = .86; *M* = 0.78). These results showed moderate to high homogeneity of climate perceptions within each group, which justifies averaging the individual scores within a group to compute the group-level aggregation of CSC and SSC scores (see Appendix A for a sample dataset with aggregated scores). This procedure created two observed variables (i.e., group SSC and group CSC) at the between level. Subsequently, we matched the supervisors' SSC and CSC scores to their own work units, creating two more between-level variables (i.e., supervisor SSC and supervisor CSC). Group SSC and supervisor SSC were used as manifest indicators to define the SSC latent congruence factor; while the group CSC and supervisor CSC were used as manifest indicators to define CSC latent congruence factor.[2]

The variability between groups on each item was examined by computing the intraclass correlation (ICC) for each item of the two scales (supervisor safety climate and coworkers safety climate). If values are less than .05, the multilevel model will be meaningless (Finch & French, 2011; LeBreton & Senter, 2008). The ICC for the items of each scale showed high variability between groups, ranging between .15 to .24 for SSC, and between .06 to .17 for CSC, confirming the need for a multilevel model.

We were not able to check separately at within and group level the factor structure of the scales because the estimation process did not converge. This could be due to the number of work groups that is near the recommended cut-off for this kind of analysis.

Finally, we ran a MCFA for SSC and CSC scales. The scales reported good fit indexes. For SSC we tested different solutions at within and between level and the best was that with a second order solution at within level and four factors which covariated at between level: $\chi^2(68) = 309.87$; CFI = .943; RMSEA = .086; $SRMR_w = .040$; $SRMR_b = .020$. For CSC the best model was that one with a second order structure at within and at between level: $\chi^2(103) = 278.22$; CFI = .961; RMSEA = .059; $SRMR_w = .031$; $SRMR_b = .049$. The CFA for LMX and safety behaviors showed good fit indexes as well: for LMX, $\chi^2(33) = 189.80$; CFI = .967; RMSEA = .099, 95% CI [.086, .113]; SRMR = .030; for the safety behaviors scale, $\chi^2(19) = 44.99$; CFI = .973; RMSEA = .053, 95% CI [.033, .073]; SRMR = .035.

Multileve Mediational Model

To estimate the hypothesized models (see Figure 1), we specified the Level 1 LMX, safety participation, and safety compliance slopes to be random. Additionally, we specified the direct relationship between LMX, safety participation, and safety compliance. At Level 2 (i.e., team level) we specified the cross-level indirect relationships of SSC agreement and CSC agreement on safety participation and safety compliance.

We estimated a multilevel path analytical model (see Figure 1). The unstandardized path coefficients are reported in Figures 3 and 4. We predicted that LMX will be positively associated with safety behaviors, that is both safety compliance and safety participation, at the individual level (Hypothesis 1). Our results show that LMX is indeed positively associated to safety participation ($b = .05$, $p < .001$) but it is not associated to safety compliance ($b = .02$, $p = .22$). It is worth noticing that, if we estimate these direct paths in a model without the second level variables, that is the two mediators, these parameters are higher: LMX was positively associated to both safety compliance (*b* = .20, *p* < .001) and safety participation (*b* = .42, *p* < .001). These results mean that adding the two mediators in the model decrease the direct effect, in one case causing it to disappear (the case of safety compliance).

We then predicted a cross-level mediation effect of supervisor's safety climate agreement on the LMX- safety compliance and LMX-safety participation relationship. Our findings show that LMX at the individual level was positively associated to supervisor's safety climate agreement at the group level (*b* = .23, *p* = .002; Hypothesis 2). In turn, supervisor's safety climate agreement at the group level predicted safety compliance (*b* = .17, *p* = .03; Hypothesis 4) and safety participation (*b* = .26, *p* = .05; Hypothesis 5), both considered at the individual level. Indirect effects were .04, 95% CI [.003, .08], for the cross-level mediation effect on safety compliance, and .06, 95% CI [.02, .10], for the cross-level mediation effect on safety participation. Thus, our results show empirical support for Hypotheses 2, 4, and 5. Our findings showed that LMX at the individual level was not associated to coworkers' safety climate agreement at the group level (*b* = .15, *p* = .07; Hypothesis 3), although it approached significance. In addition, coworkers' safety climate agreement at the group level was not associated to either safety compliance (*b* = .28, *p* = .21; Hypothesis 6) nor safety participation at the individual level (*b* = .37, *p* = .10; Hypothesis 7), although the latter approached statistical significance.

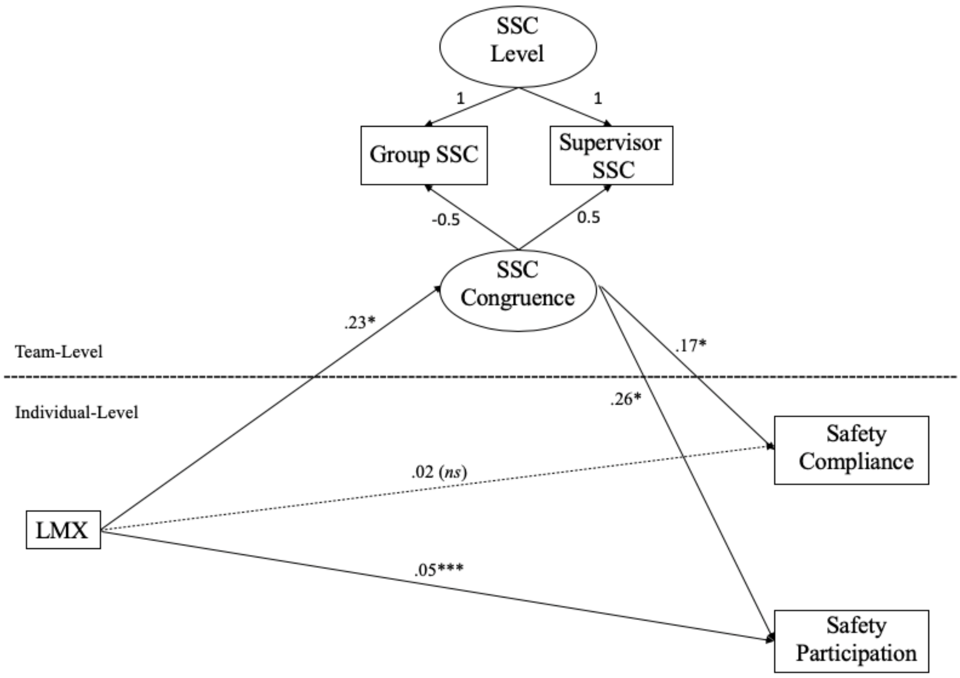

FIGURE 3
Estimated multilevel model (SSC).
Note. Model's fit indices: χ^2 (7) = 26.03; CFI = .93; RMSEA = .07; $SRMR_{within}$ = .003; $SRMR_{between}$ = .58.
* *p* < .05. *** *p* < .001.

DISCUSSION

The main aim of this paper was to estimate a multilevel mediation model, in an organizational research concerning safety in the work environment. Within the framework of safety climate research,

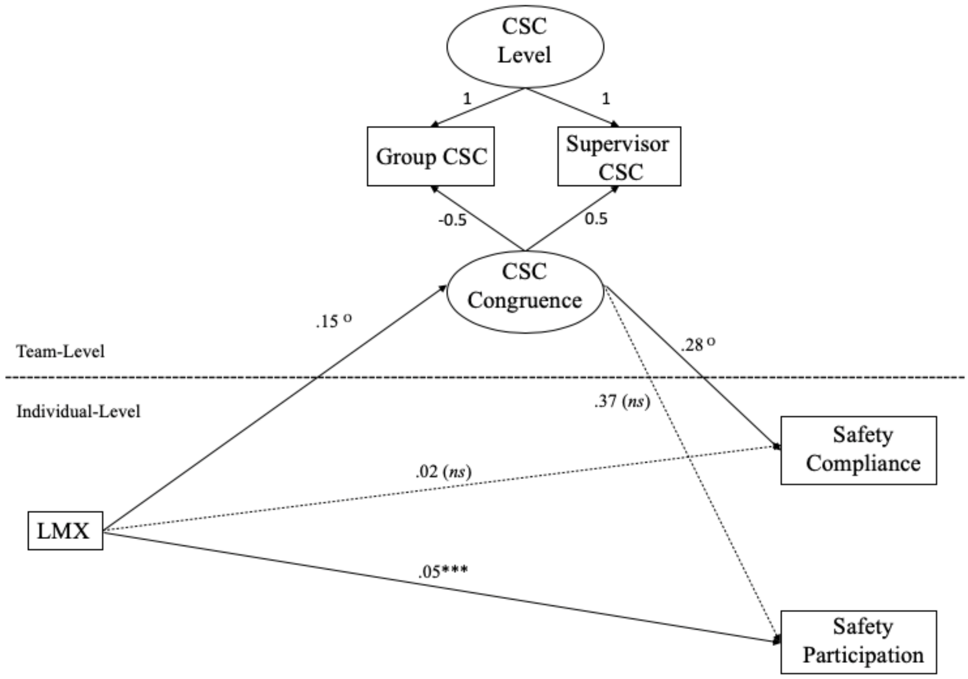

FIGURE 4
Estimated multilevel model (CSC).
Note. Model's fit indices: $\chi^2(7) = 17.45$; CFI = .96; RMSEA = .06; $SRMR_{within} = .004$; $SRMR_{between} = .46$.
*** $p < .001$. $^{\circ}p < .10$.

considering the importance of the quality of the relationships between supervisors and their subordinates (LMX), we tested the hypothesis that the agreement about safety climate mediated the relationship between LMX and safety behaviors. We considered the safety climate agreement between supervisors and their subordinates, because we postulated that good relationships between them would be associated with higher safety behaviors not only directly, as described in the literature, but also through the mediation of how safety climate is perceived by the supervisors and their subordinates. Considering the person-environment fit theoretical framework, and particularly the system fit (Sweet, 2020), the fit between the group and the supervisor can lead to positive outcomes. When the supervisor and the subordinate have a higher quality relationship, there is a better fit between safety climate perceptions, which in turn leads to higher safety performance. Supervisor-subordinate safety climate congruence fosters safety behaviors, while incongruence diminishes safety behaviors. In other words, safety behaviors are enhanced by high-quality leader-members relationships also because these high-quality relationships lead to a larger agreement about safety climate, that in turn lead to a higher level of safety behaviors.

Our results confirmed Hypothesis 1, showing that the direct relationships between LMX and safety behaviors is quite strong, which is in line with the previous literature (Hofmann et al., 2003; Zohar, 2002). Going beyond what the previous literature has found, we investigated the mediating roles of two types of agreement: supervisor's safety climate agreement and coworkers' safety climate agreement. The mediation effect of SSC was significant for both safety compliance and safety participation, confirming Hypotheses 2, 4, and 5. However, the mediation effect of coworkers' safety climate agreement in the LMX-safety compliance relationship approached significance only (Hypothesis 6), while it was not statistically significant for safety participation (Hypothesis 7). This different result in CSC agreement may be due to the smaller number of groups in the subsample for this analysis.

Our results can be interpreted in light of previous organizational theory. For safety compliance, fit can facilitate communication and coordination (Day & Bedeian, 1995; Neuman & Wright, 1999), which may increase knowledge acquisition, role clarity, and predictability of behavior (Motowidlo, 2003). As a result, individuals may be better able to meet task demands, which in turn should increase in-role behaviors. The effects of safety climate congruence on in-role behaviors (such as safety compliance) should depend on the degree to which the supervisor is interdependent with the group (Ancona & Caldwell, 1992). If they work independently, then the degree to which they are similar should have little effect on task performance. If the person is highly interdependent with others, then the effects of fit should be accentuated. In fact, agreement on the supervisor's safety climate seems to highlight a higher degree of interdependency between the supervisor and the work unit because the SSC is indeed generated by the supervisor and has a direct effect on employees. Thus, this kind of safety climate is relevant for both the supervisor and the group and may lead to higher in-role behaviors. Conversely, the CSC is generated by the colleagues and may have a little influence on the supervisor. Therefore, this kind of safety climate may be extremely relevant for employees but not so much for the supervisor, creating a degree of independence that is reflected in a null relationship with in-role behaviors.

Considering safety participation results, they are affected by safety climate congruence of both safety climates (SSC and CSC). Safety participation can be considered a contextual performance, which refers to behaviors that contribute to organizational effectiveness through their effects on the psychological, social, and organizational work context (Borman & Motowidlo, 1993). Supplementary fit can increase contextual performance because individuals are more likely to act in a proactive way with whom they have the same view, or feel similar (Graf & Riddell, 1972; Karylowski, 1976), and helping is considered an important dimension of contextual performance (Podsakoff et al., 2000).

To sum up, the supervisor's safety climate agreement is a stronger mediator, while the coworkers' safety climate agreement mediating role is lower, nonsignificant indeed for safety compliance. This may be explained by the safety agent congruence, which is true for the LMX and supervisor's safety climate agreement. Agreement between the supervisor and their subordinates, in fact, can be seen as the result of supervisors being able to self-rate themselves as safety climate agents, and those perceptions are similar to those held by employees in their units; thus, highlighting a shared rating of the leaders themselves.

The second issue that this study tried to address is the operationalization of congruence in a mediational model. More than 20 years ago Edwards (1993, 1994) proposed to use polynomial regression that fixed the problem of the decrease in reliability in difference scores and also permitted to study the relationships between the components and outcome variables. Unfortunately, after 10 years Cheung (2009) highlighted the limits of this approach (for instance, lack of control for measurement error, the issue of the measurement invariance, and the impossibility to explore complex theoretical models) and proposed the latent congruence model (LCM). This method addressed the issue related to the measurement error and allowed to study models that include multiple congruence constructs acting as independent variables, mediating variables, and dependent variables. For this reason, we embraced the latter approach. However, the debate seems still open. Edwards some years later stated that LCM is limited to linear relationships and therefore cannot address curvilinear relations (Edwards, 2009). The review by Glueck and Reschly (2014) tried to highlight lights and shadows of the different methods. They stated that LCM does not yet permit to model interaction and to study nonlinear relationships between congruence and/or its components and the outcome variable of interest. We chose the Cheung approach because it seems the best way to study mediational models, but the debate remains open. There are different methods, each of which can be used depending on the different type of relationships scholars want to test.

This study suffers from a number of limitations. First, the small number of work groups in the sample forced the authors to simplify the analyses. To this regard, some constructs were considered as unidimensional, path analyses were conducted instead of using a more complex model, and two separated models were run to study the mediating role of the SSC and CSC agreement, losing the possibility to test a comprehensive model with two mediators. Additionally, the need to analyze the congruence by splitting over-estimators and under-estimators forced us to exclude some groups from the analyses. Future studies could explore the mediating role of SSC and CSC agreement in both over-estimators and under-estimators. Another limitation is the cross-sectional design. Thus, we were not able to establish causal relationships and the directionality of the effects had to be inferred from previous literature. A further limitation is the absence of control variables related to leadership. Future research should focus on different types of leadership and their potential impact on LMX.

Notwithstanding these limitations, our study contributes to highlight the importance to use a multilevel mediational analysis to test a model in which the nature of some constructs is multilevel, showing also how to use LCM to operationalize agreement with a mediating role. Furthermore, it opens a new perspective in safety climate research, fostering to deeper explore the role of agreement between supervisor and his/her team member on safety climate perceptions as a possible mediator between antecedents and safety performance at team level.

NOTES

1. We use leader and supervisor interchangeably throughout this contribution.
2. As noted in the Subsection "Data Analysis" of this manuscript, one of the drawbacks of latent congruence modeling is that this technique assumes a directional congruence by fixing the factor loading of one observer's score to –.50 and the other to .50. These loadings impose a subtractive pattern of one observer's score minus the other observer's score.

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Appendix A

Sample Dataset with Aggregated Scores

ID	Group	LMX	SC	SP	SSCL	CSCL	SSCG	CSCG
1	150013	14	7.00	7.00	4.90	3.67	4.50	3.08
2	150013	38	6.50	5.25	4.90	3.67	4.50	3.08
3	150013	40	5.50	5.50	4.90	3.67	4.50	3.08
4	150013	26	3.00	3.25	4.90	3.67	4.50	3.08
5	150013	21	6.75	6.00	4.90	3.67	4.50	3.08
6	230012	32	6.25	6.00	4.60	4.50	4.90	4.18
7	230012	24	3.50	2.25	4.60	4.50	4.90	4.18
8	230012	38	6.50	6.75	4.60	4.50	4.90	4.18
9	230012	20	6.25	6.25	4.60	4.50	4.90	4.18
10	230012	31	6.50	6.00	4.60	4.50	4.90	4.18
11	230041	42	6.50	5.75	6.60	6.08	3.82	3.54
12	230041	30	5.75	5.25	6.60	6.08	3.82	3.54
…								

Note. ID = personal identifier; Group = clustering variable; LMX = leader member exchange score for each participant (Level 1 variable); SC = safety compliance score for each participant (Level 1 variable); SP = safety participation score for each participant (Level 1 variable); SSCL = leader's (self-evaluation) score on the supervisor's safety climate scale (Level 2 variable, each employee in each group was assigned the same value); CSCL = leader's evaluation on the coworkers' safety climate in the unit they supervised (Level 2 variable, each employee in each group was assigned the same value); SSCG = aggregated supervisor's safety climate score (Level 2 variable); CSCG = aggregated coworkers' safety climate score (Level 2 variable).