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Effects of Individual Risk Attitude, Safety Climate, and Affective Commitment on Safety Compliance

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Abstract

Although construction is one of the most dangerous sectors and even though small firms account for roughly 90% of all firms in the EU, there is little evidence about the role of safety climate as a determinant of safety performance both in the sector and in small firms. Moreover, risk attitude is surprisingly understudied as a determinant of safety performance. There have been few studies of individual risk attitude and safety performance, of which none has used validated or behavioral measures of risk attitude. This study tackles both these issues by collecting data on safety climate—using Zohar & Luria's (2005) safety climate questionnaire—and individual risk attitude—using Lejuez et al.'s (2002) Balloon Analog Risk Task (BART)—in a sample of small firms in the construction sector. The results obtained confirm the leading role of safety climate in explaining safety performance in small construction firms and reject the hypothesis that behaviorally measured risk attitude has an incremental explanatory power concerning safety performance.

Keywords: Safety climate; Risk-taking; Construction sector

1. Introduction

Despite improvements in workplace safety, construction workers continue to be at a very high risk of injury and death. In Italy, the construction sector shows the highest injury rate among Italian economic sectors, with a rate of 43.06 injuries per 1000 employees. Most injuries to construction workers also have very serious consequences. For example, the construction sector in Italy registers the highest number of workdays lost for employees (7.57 workdays lost) and the highest frequency of fatal accidents (0.18 deaths per 1000 employees).[1]

Given the magnitude of the phenomenon, the importance of having a better understanding of the factors that predict the accidents and injuries of construction workers is evident. The present research contributes to increase the knowledge about the determinants of safety compliance in two ways. On one hand, it analyzes the effect of an important factor commonly recognized as related to workers' safety performance and well being, namely perceived safety climate, in a sample of construction workers employed in small Italian firms in the Trentino region (North Italy). Safety climate has been widely studied in large firms of the manufacturing sector but little evidence has been collected about its roles in the construction sector or in small firms. On the other hand, our research investigates the effect of a less acknowledged factor, namely individual risk attitude, in determining workers' safety compliance.

1.1 Safety Climate

Perceived safety climate is recognized as one of the main antecedents of safety performance, i.e., safety compliance and safety participation, which, in turn, are the antecedents of workplace injuries. The construct of perceived safety climate was introduced by Zohar (1980), and it can be broadly defined as the perception of the importance of safety in a firm that is shared among employees. Starting from the seminal work by Zohar (1980), many other studies have analyzed the underlying factor structure of safety climate and, despite a high degree of heterogeneity, almost all these studies have identified managerial commitment to safety as the primary underlying factor of safety climate (Neal, Griffin & Hart, 2000).

After these early efforts to understand the factor structure of safety climate, subsequent contributions have refined the concept. On one hand, the distinction between psychological safety climate and group-level safety climate has been pointed out (Neal & Griffin, 2006; Christian, Bradley, Wallace & Burke, 2009). Concerning this, Neal & Griffin (2006)

[1] 1 Averages of the 2006–2008 three-year period obtained from the INAIL official database http://www.inail.it/Portale/appmanager/portale/desktop?_nfpb=true&_pageLabel=PAGE_OPENLINK&titolo=Banca%20dati%20statistica&link=http://bancadati.inail.it/prevenzionale/

emphasized that safety climate, like any other organizational climate, represents a set of shared perceptions rather than the perceptions of single organizational members; hence, safety climate should be measured as an aggregation of individual shared perceptions and must be related to group-level safety compliance. A meta-analysis by Christian et al. (2009) showed that psychological safety climate is less powerful than group-level safety climate in predicting safety compliance and safety participation.

On the other hand, the multilevel nature of safety climate was pointed out by Zohar & Luria (2005). These scholars noticed that climate may substantially vary inside the firm in relation to various firm levels, e.g., shopfloor or management, or to the various departments of the firm. This may be because different groups of employees have different supervisors that transmit different messages to them, as well as because shopfloor workers and managers are exposed to different information from the top level of the firm.

Overall, the meta-analyses by Clarke (2006) and Christian et al. (2009) confirmed the important role of safety climate in determining safety performance across industries and countries. These studies showed that safety climate helps reduce accidents by increasing safety participation (i.e., participation in safety programs, demonstrating initiatives, and putting effort into improving safety) and, even if to a lesser extent, safety compliance (i.e., adhering to safety procedures and carrying out work in a safe manner).

A crucial issue pointed out by Clarke (2006) and, in particular, by Beus, Payne, Bergman & Arthur (2010) concerns the possibility of reverse causation. Since the majority of the studies of safety climate have used cross-sectional information on safety performance, there may be high correlations between climate and performance not only because climate favors compliance and participation which in turn reduces injuries and accidents, but also because low accident rates enhance the perception and feeling of the importance of safety in the firm. In this regard, Clarke (2006) showed that the relationship between climate and injuries is stronger when measured in a prospective way, i.e., when accidents are recorded after the collection of climate perceptions. Beus et al. (2010), however, proposed a different interpretation of the link and showed that if the difference between psychological safety climate and organizational safety climate (i.e., group safety climate) is considered, the effect of injuries on climate perception is stronger than the effect of climate on injuries, at least for the organizational-level climate.

Although the construction sector is internationally recognized as a high-risk sector, perceived safety climate has been mainly investigated in firms operating in the industrial sector. Indeed, considering the construction sector, only few studies have investigated the underlying factors of safety climate and even fewer have studied the relationship between perceived safety climate and workers' compliance with safety procedures.

Dedobbeleer & Beland (1991) proposed the first safety climate measure for construction sites by adapting the questionnaire by Brown & Holmes (1986). The authors analyzed the psychological safety climate of a sample of American construction workers and identified two factors underlying the safety climate construct: management commitment to safety and workers' involvement in safety-related activities. This study confirmed the importance of the role of managers in determining safety climate. However, since their primary concern was the underlying factor structure of safety climate, they did not link climate to safety performance.

Glendon & Litherland (2001) studied the relationship between group safety climate and safety compliance in a sample of Australian road construction workers using the behavior sampling technique. This study failed to observe a significant relationship between safety climate and safe behaviour, most likely because of the small number of groups of workers considered, only five crews.

Gillen, Baltz, Gassel, Kirsch & Vaccaro (2002) explored the relationship between psychological safety climate, union status, and injury severity in a US sample of injured construction workers. The authors based their safety climate measure on Dedobbeleer & Beland's (1991) scale and found a positive relationship between climate and injury severity, and between safety climate and union status. The authors concluded that unionized workers have a higher perception of safety climate because they play a critical role in the enforcement of safety policies and have access to more formal training through their unions. In this case, however, collected data cannot shed light on the relationship between climate and safety performance.

Siu, Phillips & Leung (2003, 2004) studied the role of safety climate in a sample of Chinese construction workers using the same set of data. These studies used a measure of psychological safety climate based on the Donald & Canter's (1993) Safety Attitude Questionnaire and collected self-reported injuries in the previous six months. The authors found a positive but weak relationship between self-reported injuries and safety attitude, in particular concerning the management support, team leader practice, and team leader knowledge with the safety system subscales.

Jorgensen, Sokas, Nickels, Gao & Gittleman (2007) developed an English/Spanish safety climate scale specific for construction workers and tested it on a mixed sample of English-speaking and Spanish-speaking construction workers, finding a high degree of internal consistency in both subsamples. The authors, however, did not collect information on safety performance and, hence, did not provide evidence of the predictive power of their scale.

Given the scarcity of studies exploring the role of safety climate in the construction sector, the first aim of our study is to increase existing evidence of the relationship between the perceived safety climate of construction workers and compliance with safety procedures. A second and distinctive aspect of our research lies in the fact that compared with previous studies that have collected information on workers in medium and large-sized firms it collects information from workers in small firms. Indeed, despite previous studies focusing mainly on large firms, the European economy is dominated by small and medium-sized enterprises (SMEs), with more than 90% of European enterprises having fewer than 10 employees and with SMEs employing about 67% of private-sector workers. Restricting the focus to the construction sector, European firms have a mean of 4.9 employees and SMEs employ 88% of the total workers in the sector.[2]

[2] European Commission. Annual Report on EU Small and Medium-Sized Enterprises (2009), Table 4, Table 5, and Table 13. Available at http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/files/supporting-documents/2009/annual-report_en.pdf, assessed at 28 May 2012.

Additionally, looking at accident figures by firm size, although European firms sized 1-9 employees present slightly lower injury rates compared with larger firms, they register the highest rate of fatal injuries.[3]

Thus, the second aim of the research is to increase the scarce body of empirical evidence related to the role of safety climate in determining workers' injuries in SMEs.

Hypothesis 1. Safety climate is positively correlated with safety compliance.

An additional objective of our paper is to understand the relative importance of safety climate when taking into account a specific individual attitude that has been understudied within this context, namely individual risk attitude. The next paragraph is devoted to explaining this point.

1.2 Risk-taking and Safety Performance

An individual's attitude to undertake risky actions can be reasonably considered to be one of the most important determinants of safety performance. Indeed, it seems natural to assume that people more prone to take risks are less inclined to use protective equipment and safe procedures and, hence, are more subject to injuries. According to this assumption, individual risk attitude was considered to be among the first explanations for workplace accidents and injuries, but it was also rapidly discarded. Indeed, studies that took into account individual risk attitude reported mixed evidence. Some studies have shown that individual risk-taking does explain accidents and injuries (Mearns, Flin, Gordon & Fleming, 1998; Brown, Willis & Prussia, 2000; Prussia, Brown & Willis, 2003; Maiti, Chatterjee & Bangdiwala, 2004; Westaby & Lowe, 2005; Paul & Maiti, 2007, 2008; Paul, 2009), whereas others have reported the absence of any influence of risk-taking on safety performance (Landeweerd, Urlings, De Jong, Nijhuis & Bouter, 1990; Geller, Roberts & Gilmore, 1996; Salminen, Klen & Ojanen, 1999; Westaby & Lee, 2003; Westaby & Lowe, 2005).

A possible explanation for this inconclusive evidence can be found in the fact that previous studies have never used either a validated self-report or a behavioral measure of risk attitude. In this respect, some authors have mentioned the supremacy of behavioral scales over self-reported scales and suggested coupling self-reported measures with behavioral ones (Lejuez et al., 2002). As an argument limiting the validity of self-reported scales, Lejuez et al. (2002) pointed out the possibility of having poor self-reported measures about sensitive data because of the fear of incurring in negative consequences when reporting risky behavior. Moreover, the authors argued that the veracity of self-reported data may be compromised because of the lack of memory and the cognitive biases of responders. As a solution, they propose using a behavioral task, which has the advantage of avoiding recalling information from memory and being not too close to the theme under investigation, which avoids the problem of strategic answering.

As an additional consideration, in some of the papers where risk attitude is assessed, the items

[3] European Commission. Causes and circumstances of accidents at work in the EU (2009), Figure 1.5. Available at http://bookshop.europa.eu/en/causes-and-circumstances-of-accidents-at-work-in-the-eu-pbKE7809668/downloads/KE-78-09-668-EN-C/KE7809668ENC_002.pdf?FileName=KE7809668ENC_002.pdf&SKU=KE7809668ENC_PDF&CatalogueNumber=KE-78-09-668-EN-C, assessed at 28 May 2012.

used were similar to those used to measure safety compliance. For example, a recurrent item is whether the worker "ignores the rules to save time" (Brown et al., 2000; Prussia et al., 2003) or whether he/she has "the tendency to work quickly" (Maiti et al., 2004; Paul & Maiti, 2007, 2008; Paul, 2009). Thus, given this potential overlap between safety compliance and risk attitude, the observed effect may be spurious.

According to these considerations, we decided to give a second chance to risk attitude as an explanation of safety performance by employing two behavioral measures of risk attitude widely used in the decision making literature, namely the Balloon Analog Risk Task (BART) and the Holt & Laury (2002) lottery choice task (H&L task hereafter). The BART is a computer-based measure of risk-taking proposed by Lejuez et al. (2002) that consists in inflating a series of virtual balloons that are presented sequentially on a computer screen. The more the participant is able to inflate the balloon the higher the payoff he or she gains, but the higher is also the risk of explosion, i.e., the higher the risk of losing everything. The details of the task are presented in the methods' section.

The BART score has been proved to be a reliable measure of real-world risk-taking behavior. Indeed, high BART scores have been related to a large set of risky behaviors such as alcohol, cigarette and substance use, gambling, unprotected sex, aggression, and seatbelt use in both adults and adolescents (Lejuez et al., 2002, 2003b,a, Lejuez, Simmons, Aklin, Daughters & Dvir, 2004; Aklin, Lejuez, Zvolensky, Kahler & Gwadz, 2005, Hopko et al., 2006). Moreover, it has also been shown that BART scores possess adequate test-retest stability over a two week period (White, Lejuez & De Wit, 2008). Concerning the relationship between BART scores and other self-reported measures of aspects related to risk- taking, such as sensation seeking and impulsivity (Zuckerman, Eysenck & Eysenck, 1978; Barratt, 1985), the results are mixed. Indeed, while the original study reported significant relationships between BART scores and these scales (Lejuez et al., 2002), many subsequent studies have not found a strong relationship (Lejuez et al., 2003a,b; Aklin et al., 2005; Hopko et al., 2006). Overall, the BART has survived severe tests to obtain a good validation of everyday risk-taking. Thus, we decided to employ this task as a primary behavioral measure of risk attitude.

In the H&L task, participants face a sequence of choices between two options, namely a safe option and a risky option, which become riskier along with the sequence. The objective of the task is to record the maximum level of risk the participant is willing to accept, i.e., at which point in the sequence the subject switches from the risky to the safe option. In our task, the choice between the two alternatives was framed as a work situation in which the decision maker had to operate a hydraulic press to produce a finished product. The decision maker can decide to produce either in a safe manner, i.e., adopting all safety procedures, or in a risky way, i.e., not using all safety procedures. In this second case, he or she has the opportunity to gain more because of the time saved avoiding safety procedures, but this increases the risk of incurring an accident. Further details about the task are presented in the methods' section.

Lottery choice tasks *à la* Holt & Laury (2002) have been widely used to elicit risk preferences in experimental economics, and individual choices in these tasks have been linked to risky behaviors in real-world contexts. Lusk & Coble (2005), for instance, found a significant correlation between the risk attitude measured by the H&L task and the willingness to buy and eat genetically modified food. Anderson & Mellor (2008) instead showed that H&L risk attitude predicts health risky behavior such as cigarette smoking, heavy episodic drinking, obesity, and seatbelt non-use. Dohmen, Falk, Huffman, Sunde, Schupp & Wagner (2011) showed that the H&L score is related to survey measures of general risk-taking used in the German Socio-Economic Panel (SOEP) that correlates with the likelihood of holdings stocks, being self-employed, and smoking. Recently, Reynaud & Couture (2012) reported a weak correlation between behavior in the H&L task and the financial subscale of the DOSPERT questionnaire (Blais & Weber, 2006) in a sample of French farmers. H&L scores also showed a certain degree of stability over a four-month time period (Harrison, Johnson, McInnes & Rutstrom, 2005).

Taking into account the reviewed evidence and the previous considerations, we formulate the following hypothesis concerning the role of individual risk taking.

Hypothesis 2. Behaviorally measured risk attitude, both with the BART and with the H&L task, is negatively correlated with safety compliance and, in particular, it contributes to explaining safety performance after controlling for the effect of safety climate.

1.3 Affective Commitment

A second aspect that may interact with safety compliance, in particular when considering small firms, is affective commitment to the firm. Indeed, employees in small firms may become affectively attached to the organization and to the employer. Personal relations between the worker and either the supervisor or the employer may bias the perception of the level of safety inside the firm or it can also produce situations of gift exchange (Akerlof, 1982). In other words, situations in which the employee is willing to reciprocate the generosity of the employer.

Organizational commitment is a widely discussed construct that has been related to a series of organizational variables and has been defined in various ways, leading to high disagreement about its content, its dimensionality, and how it affects behavior (Meyer & Herscovitch, 2001). Among the various definitions present in the literature, Meyer & Allen (1991) provided a successful three-component characterization of organizational commitment that has been extensively tested and refined (Meyer, Allen & Smith, 1993; Hackett, Bycio & Hausdorf, 1994). According to this approach, commitment can be defined as a general force that binds an individual to the organization but that has a complex and multifaceted structure consisting of three components (Meyer & Herscovitch, 2001). The first component, affective commitment, aims to capture "emotional attachment to, identification with, and involvement in the organization" (Meyer, Stanley, Herscovitch & Topolnytsky, 2002, p. 21). The second component, normative commitment, aims to capture a sense of obligation to reciprocate or to remain in the organization that may originate from loyalty to the employer or from receiving benefits such as skill training or tuition payments. The third component, continuance commitment, aims to capture the perceived cost of leaving the organization originating from "side bets" and accumulated investment that the worker has put into the organization.

Many studies have investigated the relationship between organizational commitment and other variables that are potential antecedents, correlates, or consequences of commitment. As a general result, these studies have documented a high predictive power of commitment regarding turnover decisions, absenteeism, job satisfaction, and job performance (Mathieu & Zajac, 1990; Meyer & Allen, 1991; Meyer et al., 1993; Hackett et al., 1994; Meyer et al., 2002), and many of them have provided empirical support to the three-component specification of organizational commitment (Meyer et al., 1993; Hackett et al., 1994; Meyer et al., 2002). A robust result concerning the predictive power of the three components that has been pointed out by Meyer & Herscovitch (2001) and confirmed by the meta-analysis of Meyer et al. (2002) is that "compared to continuance and normative commitment, affective commitment (a) correlates significantly with a wider range of "outcome" measures and (b) correlates most strongly with any given outcome measure" (Meyer & Herscovitch, 2001, p. 311). Hence, it seems that affective commitment is the most important component of the three present in the model.

Despite a consistent number of studies having explored the implications of commitment on organizational outcomes, a striking observation is that few studies have linked commitment with safety performance and/or safety climate. Whenever a correlation is found, in many cases this was not the focus of the paper. The first study reporting the presence of a positive effect of affective commitment on accidents was by Hackett et al. (1994). These authors confirmed the three-component model of organizational commitment proposed by Meyer & Allen (1991) using two samples, nurse and bus drivers. As a side result, they showed that affective commitment is negatively related to the annual rate of traffic accidents of bus drivers when controlling for age, organizational tenure, and job satisfaction.

A second paper that has reported the correlation between safety outcomes and commitment is by Cohen & Ledford (1994). This paper aimed to study the effectiveness of self-managing work teams according to various outcomes, among which were organizational commitment and accident involvement. As a minor result of their paper, the authors found a negative correlation between workdays lost due to accident involvement and organizational commitment.

Another paper by Kivimaki, Kalimo & Salminen (1995) studied the relationship between perceived nuclear risk and organizational commitment in a nuclear power plant. In this case, the authors found that the higher the perceived risk of nuclear accident by the personnel, the lower the organizational commitment. Thus, when people are not attached to the firm, the perceived risk may be higher. This result suggests an effect of commitment on risk perception, but the authors do not link directly commitment with risky behavior or accidents/injuries.

Parker, Axtell & Turner (2001) was the first study whose focus was on the role of organizational commitment in shaping safety compliance. In this paper, the authors tested the mediating role of organizational commitment between work characteristics and safety compliance. Overall, the authors found that organizational commitment affects safe working when past levels of safe working and job and demographic characteristics are controlled for. Interestingly, they also found that previous levels of organizational commitment (measured 18 months earlier) do not explain safe working. Although these authors studied the relationship between organizational commitment and safe working, they did not take into consideration safety climate among the determinants of safe working.

The aim of Zacharatos, Barling & Iverson (2005) instead was to relate high-performance work systems and occupational safety. They showed that this type of work system affects occupational safety through safety climate and trust in management. Although the authors did not consider directly the effect of affective commitment, they employed this measure to validate the high-performance work system construct. Overall, the paper reported a significant zero-order correlation both between affective commitment and compliance and between affective commitment and safety climate.

Larsson, Pousette & Torner (2008) studied the effect of psychological climate, i.e., the individual perceptions of the work environment, on safety performance in the construction sector. These authors tested the mediating role of workplace commitment, i.e., organizational commitment, without finding any evidence. They found, however, a strong relationship between psychological climate and workplace commitment.

A recent meta-analysis by Clarke (2010) tested the presence of various mediation effects between psychological climate and safety outcomes, including safety behavior (i.e., compliance and participation). In the meta-analysis the author took into consideration both safety climate, which is supposed to be influenced by psychological climate, and organizational commitment, which is supposed to mediate the relationship between safety and psychological climates and safety performance. The results of the meta-analysis confirmed the hypothesized mediating role of organizational commitment between safety climate and safety behavior as well as the mediating role of the latter between safety climate and occupational accidents. This meta-analysis provided interesting insights into the relationships among these variables, i.e., safety climate, safety compliance, and organizational commitment. Note, however, that the hypothesized model could have been tested only because of the meta-analytic nature of the analysis. Indeed, no single study was included in the meta-analysis took into account all variables at the same time.

Finally, two recent papers, Mearns, Hope, Ford & Tetrick (2010) and Ford & Tetrick (2011), which studied respectively the effects of investment in workforce health and the relations among occupational hazards, attitudes, and safety performance, reported a positive relationship between safety climate and both organizational commitment and safety behavior (either safety compliance or safety participation).

Overall, there is a positive relationship between organizational commitment, of which the most important component is affective commitment, and safety outcomes. Some studies have found a mediating effect of commitment in the relationship between safety climate and safety compliance, while others have found only a relationship between climate and commitment and not between commitment and outcomes.

We believe that, in a sample composed of workers of small firms, affective commitment plays an important role in shaping safety behavior. Thus, we decided to include in our measures a measure of affective commitment to the firm. Building on the reviewed evidence our

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hypothesis regarding affective commitment reads as follows:

Hypothesis 3. Affective commitment is positively correlated with both safety compliance and safety climate.

1.4 Perceived Safety Costs and Safety Compliance

A further and new aspect that is worth considering when studying the effect of risk attitude and safety climate on safety compliance is the physical and psychological costs of implementing safety procedures. Indeed, looking at studies of safety compliance, the costs and benefits of adopting safety procedures and how these costs and benefits are evaluated by the employees have been largely ignored. Concerning the physical costs, for instance, wearing safety equipment may produce physical discomfort that may affect the decision to wear it. Indeed, safety helmets, heavy safety shoes, and harnesses can be uncomfortable, and the cost of wearing them may overcome the expected future benefits of avoiding injury.

On this aspect, Zohar & Erev (2007) pointed out how cognitive biases observed in decision making may interfere with the correct evaluation of the costs and benefits involved in the implementation of safety procedures. On one hand, the authors suggested that since the cost of implementation is certain and immediate, i.e., not wearing the helmet produces the immediate and certain elimination of the discomfort, and the benefit of the implementation is future and uncertain the consequences of not using the equipment can be underestimated because of the well-known melioration bias. This bias reflects the human tendency to excessively under-weight delayed outcomes compared with the immediate ones, which has been documented in various experimental settings (see, e.g., Frederick, Loewenstein & O'Donoghue, 2002). On the other hand, Zohar & Erev (2007) suggested that the very low probability of injury coupled with a learning process that over-weights recent outcomes under-weights small probability outcomes and thus the probability of getting injured.

Given these considerations, the importance of measuring the costs of the implementation of safety procedures becomes apparent. Indeed, taking into consideration the costs perceived by workers, one could explain the simultaneous presence of a high safety climate, a low risk attitude, and low compliance. Concerning perceived safety costs, we thus formulate the following hypothesis:

Hypothesis 4. Perceived safety costs are negatively correlated with safety compliance and are uncorrelated with safety climate and risk attitude.

2. Methods

2.1 Participants and Procedures

This study was conducted during the training courses held by CENTROFOR, the center for safety training and safety promotion of the province of Trento, between May and November 2011. Participants on the courses were 98 young workers employed in the construction sector (mainly employed as hod carriers in small firms in the province). Participation on safety training programs is compulsory for construction workers employed in the province of Trento. Participants completed questionnaires and behavioral tasks that measured risk attitude in the computer room of the center during the lunch break of the courses. Questionnaires were paper and pencil, while the risk-taking tasks were computerized. The risk-taking tasks were incentive compatible, namely workers were paid according to the results of their decisions. Workers were not paid nor given any other form of compensation for answering the questionnaires. Overall, it took about 30 minutes to complete both the questionnaire and the behavioral tasks. Concerning the response rate, 72 out of the 98 subjects provided all the information required. Responders ranged from 18 to 31 years (M = 22.27, SD = 3.07) and only four were women.

Both the questionnaires and the computerized tasks were administered anonymously, using an ID associated to each worker. Moreover, data on the firm's record of injuries were obtained anonymously from the statistical office of INAIL. In order to guarantee the anonymity of the firm, workers were asked to write the name of the firm on a sheet and put the sheet into an envelope marked with the ID associated to the participant. They then closed the envelopes and these were sent to the INAIL office. INAIL provided data on the firm by substituting the sheet with the name of the firm with a sheet containing firm data.

2.2 Survey and Experimental Measures

We collected individual information on risk propensity, demographic variables, the psychological aspects related to safety climate, and affective commitment to the firm. Moreover, we collected data on the injuries observed in each firm during the period 2000-2009.

Risk attitude was experimentally measured by two computerized tasks: the BART and the H&L. The BART task consists of a sequence of 30 virtual balloons the participant has to inflate. The balloons are presented to the participant one at a time on a computer screen (see Figure 1). To inflate each balloon, the participant has to press the "PUMP" button. Each time the button is pressed, the participant gains 1 euro cent but at the same time he or she runs the risk of bursting the balloon. If the balloon explodes, the participant loses all the money gained on that balloon. However, he or she can stop inflating the balloon by pressing the "COLLECT" button and have the money gained on that balloon transferred into a safe account. Both after an explosion and when the "COLLECT" button is pressed the software automatically advances to the next balloon.

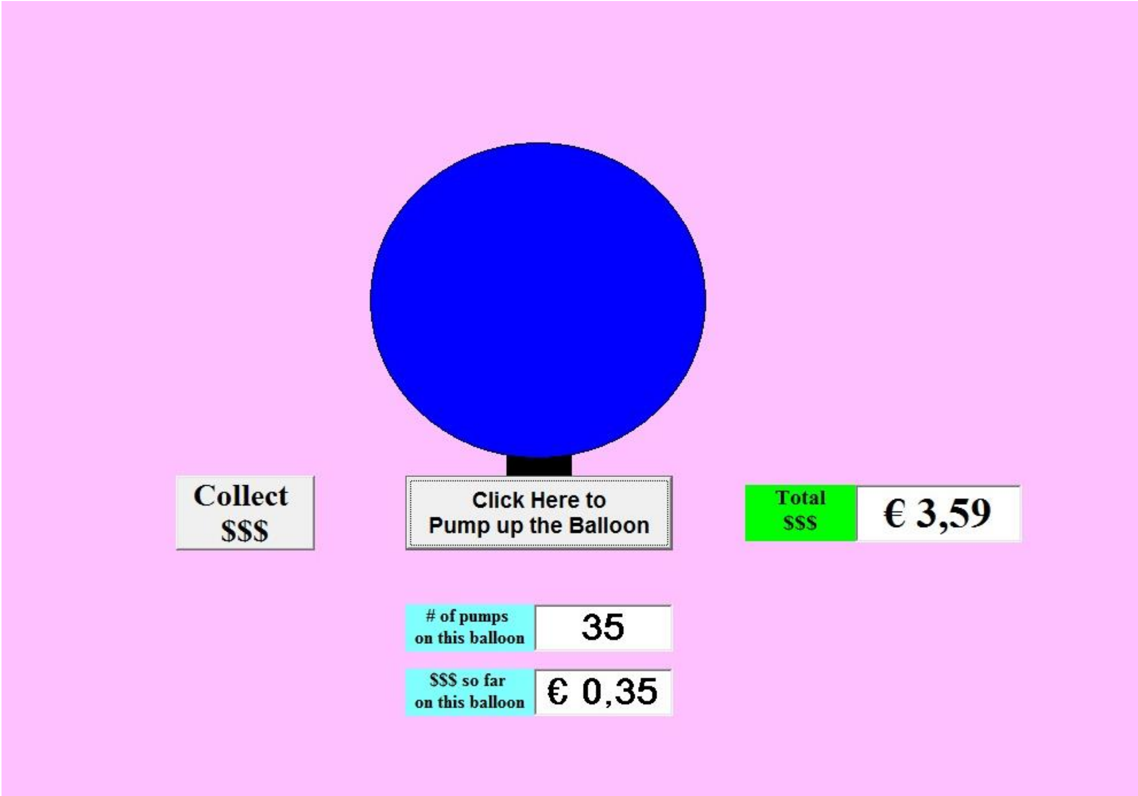

Figure 1. Sample screenshot of the Balloon Analog Risk Task.

Balloons may explode at different points and the explosion point is determined as a draw without replacement from an urn containing 127 white balls and 1 red ball. Each time the "PUMP" button is pressed one ball is drawn without replacement from the urn. If the drawn ball is red, the balloon explodes. Participants do not know the underlying stochastic process, they are simply told that when the balloon reaches the top of the screen it will certainly explode, but that there is the possibility that the balloon explodes after every pump. This task provides two measures of risk attitude, the average number of pumps over the 30 trials and the adjusted average number of pumps, which takes into account only the trials where the balloon did not explode.

The H&L task represents a production situation where the participant plays the role of a worker operating a computerized hydraulic press (see Figure 2). The task lasts for 21 trials and in each trial the worker must press a block of raw materials. He/she can decide whether to complete the task using safety procedures—green button on the left—or without using safety procedures—red button on the right. If he or she adopts safety procedures, he or she gains 5 euros; if not he or she has the chance to gain 10 euros—by working faster—but running the risk of getting injured and thus gain 0 euros. Monetary incentives remained constant during the 21 trials, while the probability of being injured increased with the trial number. The probability started at 0 in the first trial and incremented by three percentage points in each subsequent trial, reaching 60% in the last trial. Participants were told that only one of the 21 trials would be paid at the end of the experiment.

This task provides two measures of risk attitude. The classical one is the so-called switching point, which is measured as the trial number in which the participant switches from the risky option—production without safety procedures—to the safe option—production with safety procedures. The switching point is computed as the mean of two numbers: the first trial where the safe option is chosen and the last trial where the safe lottery is chosen incremented by one.[4] A second measure is the overall number of risky choices made in the 21 trials.

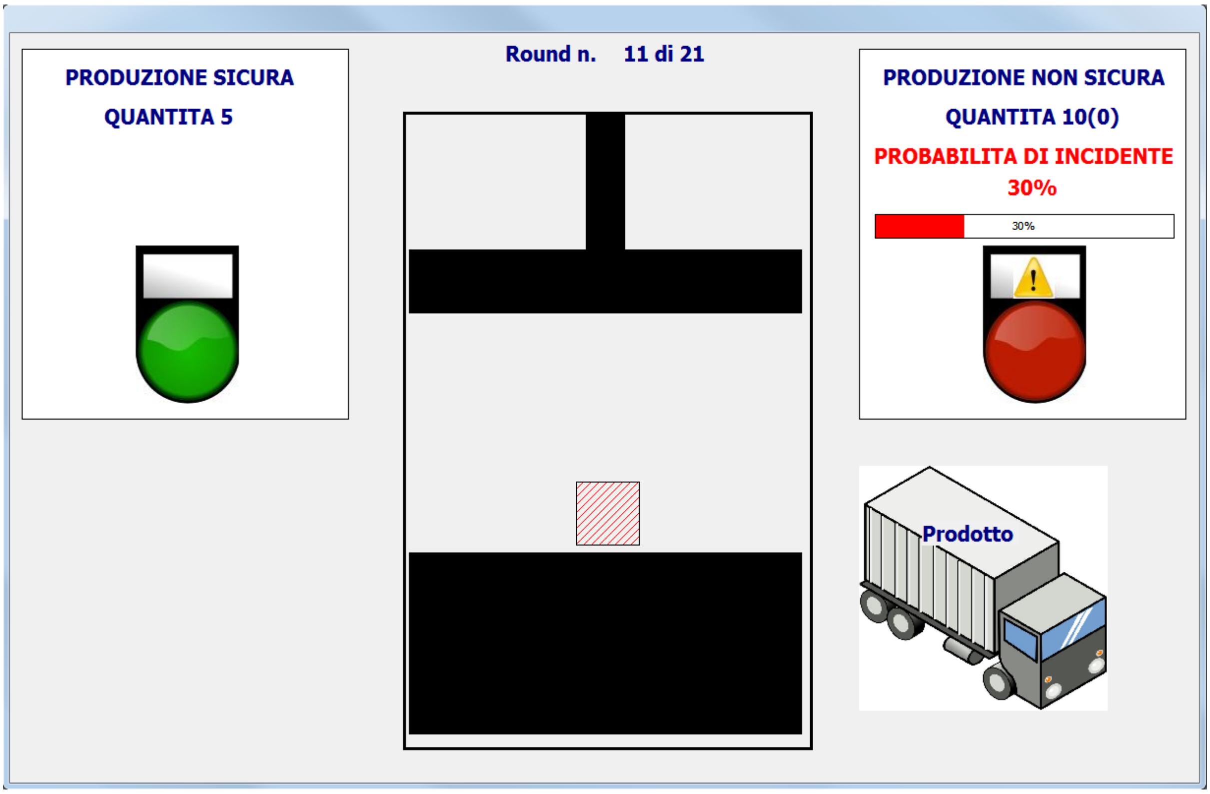

Figure 2. Sample screenshot of the framed Holt & Laurie risk task.

Both these behavioral measures of risk attitude have been collected in an incentive compatible way. In other words, the amount of money gained by the participant during the 30 trials of the BART and the outcome of a randomly chosen trial of the H&L were paid at the end of the experiment.

Concerning the measures adopted in the analysis, for the lottery-choice experiment we decided to use the number of risky choices instead of the switching point. This decision was motivated by two considerations: (i) the switching point can be computed for a smaller number of subjects, i.e., 52 instead of 72, and, (ii) the switching point and the number of risky choices variable showed a very high correlation (r = 0.91). For the BART we used the adjusted average number of pumps as in Lejuez et al. (2002) that is more appropriate because it solves the problem of truncation present in the average number of pumps.

Individual information was collected by means of a questionnaire. We collected the following

[4] Notice that the first number measure the first time the subject prefers the safe option to the risky one, i.e., the first time he is unsure of the preference for the risky option. While the second number captures the end of the indecision of the subject, i.e., the point where he starts always choosing the safe over the risky option.

information concerning demographic variables: the age, the gender (dummy: 1 if woman, 0 otherwise), and the nationality of the worker (dummy: 1 if Italian, 0 otherwise). Moreover, we collected individual information on years of experience in the construction sector (overall experience), tenure in current firm (firm experience), a dummy variable capturing whether the worker has experienced an injury since he or she started working in the construction sector (past injuries), and the number of injuries suffered (num past injuries).

Firm-related measures were obtained from the statistical office of INAIL, the Italian government agency for insurance against work-related injuries. INAIL provided historical information on the firm for the period 2000-2009 concerning the following aspects: number of employees of the firm, number of injuries occurred in the firm, number of workdays lost due to these injuries, and the ATECO classification of the firm.[5] Unfortunately, INAIL could not provide us with more recent data about firms' number of injuries, workdays lost, and employees. To obtain synthetic measures we computed the averages over the period 2000-2009. Therefore, the variables we take into consideration are the following: "firm size": average number of employees; "injury rate": average number of injuries per 1000 employees; and "wdl rate": average number of workdays lost per injury. The last two measures capture two aspects of the history of the firm. "Injury rate" provides a measure of the probability of getting injured in that firm, while "wdl rate" captures the average severity of those injuries.

Because of the nature of our study it was impossible to assess group-level safety climate, hence we used the same strategy of Nielsen et al. (2011) and assessed safety climate at the individual level, i.e., we measured psychological safety climate. We employed the 16-item organization-level safety climate questionnaire used in Zohar & Luria (2005). The safety climate score was obtained by averaging the scores of the 16 items answered on a five-point Likert scale.

Safety compliance was measured in two ways. We employed the safety compliance construct used by Neal & Griffin (2006) consisting of three items measured on a five-point Likert scale, and the safe working construct used by Parker et al. (2001) consisting of three items also measured on a five-point Likert scale.

Perceived safety costs were assessed by averaging the scores on a six-item questionnaire (five-point Likert scale). This questionnaire asked about the degree of accordance with the following statements: (1) The safety equipment hampers me in doing my job; (2) I work better when I don't use the safety equipment; (3) When I use the safety equipment I work more slowly; (4) Working using safety equipment requires more effort; (5) I have to force myself to remember to use the safety equipment; and (6) The safety equipment annoys me.

Affective commitment was measured by averaging the scores of the six-item questionnaire (five-point Likert scale) of the affective organizational commitment subscale used in Meyer et al. (1993).

Table 1 shows that almost all the psychological scales used possess a high degree of

[5] ATECO is the Italian translation of the Statistical Classification of Economic Activities in the European Community (NACE).

reliability. Indeed, excluding the safe working measure, all the psychological constructs show a Cronbach's α greater than 0.8, which signals a good level of internal consistency. Concerning the low internal consistency of the safe working construct, note that in the original work the authors also obtained a low α for the safe working scale (Parker et al., 2001) (α = 0.57 and α = 0.56 at two different points in time).

Table 1. Cronbach's α

Scale	N of items	α
Affective Commitment	6	0.887
Safety Compliance	3	0.841
Safe Working	3	0.400
Safety Costs	6	0.873
Safety Climate	16	0.923

The α is computed using all the available information. That is for each scale we used all the subject that answered all the items in the scale

A principal component factor analysis (see Table 2) confirmed that the items of each scale generally load onto the factor they were intended to represent. In fact, almost all safety climate items load onto Factor 1, all the safety costs items onto Factor 2, affective commitment items onto Factor 3, and safety compliance onto Factor 4. Further none of the items of safe working scale show high loadings in a single factor, confirming the low level of internal consistency.

Table 2. Principal component analysis - factor loadings

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
S. Clim. 1	0.760	-	-	0.104	-
S. Clim. 2	0.739	-	-	0.328	-
S. Clim. 3	0.770	-	-	0.194	-
S. Clim. 4	0.580	-	0.302	-	-
S. Clim. 5	0.610	-	0.159	0.241	-
S. Clim. 6	0.753	-	-	-	-
S. Clim. 7	0.559	-	-	-	0.376
S. Clim. 8	0.529	-	0.213	-	0.229
S. Clim. 9	0.744	-0.250	0.163	0.209	-
S. Clim. 10	0.491	-0.255	-	0.151	0.387
S. Clim. 11	0.443	-	0.159	0.308	0.408
S. Clim. 12	0.527	-	0.129	0.168	0.227
S. Clim. 13	0.399	-	0.166	-	0.547
S. Clim. 14	0.579	-0.117	0.111	0.172	0.377
S. Clim. 15	0.492	-	-	0.306	0.237
S. Clim. 16	0.598	-0.132	0.125	-	0.197
S. Comp. 1	0.418	-0.208	-	0.766	-
S. Comp. 2	0.454	-0.179	-	0.529	-
S. Comp. 3	0.477	-0.153	0.111	0.594	-
S. Work 1	0.331	-0.139	-	0.578	0.153
S. Work 2	-	-0.396	-	0.407	-
S. Work 3	0.241	-0.444	0.169	-0.168	-
S Costs 1	-0.113	0.814	-0.108	-	-0.125
S Costs 2	-0.148	0.770	-0.111	-0.118	-0.185
S Costs 3	-	0.846	-	-0.141	-
S Costs 4	-	0.842	-	-	-0.118
S Costs 5	-0.170	0.576	-0.170	-0.134	0.290
S Costs 6	-	0.641	-0.139	-0.412	-
Aff. Comm. 1	0.180	0.190	0.642	0.225	0.231
Aff. Comm. 2	0.140	0.104	0.565	-	0.179
Aff. Comm. 3	0.117	-0.414	0.870	-	-0.117
Aff. Comm. 4	0.129	-0.393	0.853	-	-
Aff. Comm. 5	-	-0.228	0.727	-	-
Aff. Comm. 6	0.166	-	0.615	0.250	0.276

The table shows the loadings of a 5 factors Factorial Analysis with varimax rotation. Sample size reduced to n = 82 due to missing data.

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3. Results

3.1 Descriptive Statistics and Correlation Analysis

Table 3 presents the descriptive statistics and zero-order correlations between our measures. The pairwise correlations show insights into the hypothesized links among our variables.[6]

As a first result, one can observe that, as expected, safety climate is strongly related to safety compliance (r = 0.51). This implies that the higher the perceived importance of safety in the firm, the higher the use of protective equipment. This gives support to Hypothesis 1 and confirms the findings obtained in the literature.

By looking at safety climate, an interesting observation is that the history of the firm seems to have some impact on safety climate. The average injury rate of the 2000-2009 decade is negatively correlated with the safety climate score (r = −0.26). This suggests that a higher rate of injuries in the past has a deleterious effect on safety climate perception. The other firm-related variables, i.e. firm size and severity of injuries, do not present a significant correlation with safety climate.

The effect of the history of the firm has no impact on the other variables. Neither affective commitment nor safety compliance seems to be influenced by the size of the firm, injury rate, or by the measure of the severity of the injuries. This aspect is interesting because it suggests that the history of injuries does not have a persistent effect on affective commitment. An important aspect that may help interpret these results is that interviewed workers did not contribute towards the observed history of the firm. Indeed, firm information refers to the decade 2000-2009, while the tenure of the workers in the current firm is rarely above two years. This crucial point suggests that the impact of the firm's injury record on compliance and on affective commitment may be present only in cases of the direct experience of those events. This hypothesis, however, cannot be directly tested with our data.

Moving to risk-taking measures, the correlations suggest that risk attitude does not play a role in explaining safety compliance. Indeed, both our behavioral measures of risk-taking, i.e., the adjusted number of pumps in the BART and the number of risky choices in the H&L, are poorly correlated with safety compliance and safe working. This suggests rejecting Hypothesis 2.

[6] The table considers the 71 male subjects for which all the information is available.

Table 3. Pairwise correlation Matrix

	#	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
H&L	1	8.54	4.46	—	0.13	0.14	**0.44**	0.17	0.09	-0.03	0.13	-0.15	0.06	**0.31**	0.08	0.13	0.00	0.17
BART	2	45.92	10.09	0.13	—	-0.00	-0.06	-0.12	0.02	-0.05	0.05	-0.11	-0.06	0.07	0.17	0.01	0.03	-0.03
Age	3	22.44	3.00	0.14	-0.00	—	-0.08	**0.25**	0.36	0.06	0.02	-0.10	-0.01	0.00	0.02	-0.00	-0.07	-0.05
Nationality	4	0.86	0.35	**0.44**	-0.06	-0.08	—	-0.16	-0.01	-0.07	0.17	-0.10	0.11	-0.01	-0.13	-0.13	0.12	0.06
Firm experience	5	2.38	0.93	0.17	-0.12	**0.25**	-0.16	—	**0.42**	**0.29**	0.04	-0.08	-0.10	-0.10	-0.11	0.06	-0.04	-0.08
Overall experience	6	3.12	1.30	0.09	0.02	**0.36**	-0.01	**0.42**	—	0.12	-0.08	0.10	-0.07	-0.07	0.08	0.09	-0.06	-0.05
Past injuries	7	0.14	0.35	-0.03	-0.05	0.06	-0.07	**0.29**	0.12	—	-0.14	0.11	0.03	0.01	-0.10	-0.18	0.00	-0.05
Firm size	8	11.07	15.70	0.13	0.05	0.02	0.17	0.04	-0.08	-0.14	—	0.05	**0.75**	0.02	-0.08	-0.08	-0.01	0.12
Injury rate	9	82.96	119.95	-0.15	-0.11	-0.10	-0.10	-0.08	0.10	0.11	0.05	—	**0.28**	**-0.26**	-0.16	-0.14	0.22	-0.15
Wdl rate	10	9.88	12.16	0.06	-0.06	-0.01	0.11	-0.10	-0.07	0.03	**0.75**	**0.28**	—	-0.05	-0.20	-0.16	0.10	0.09
Safety Climate	11	3.73	0.43	**0.31**	0.07	0.00	-0.01	-0.10	-0.07	0.01	0.02	-0.26	-0.05	—	**0.51**	**0.40**	**-0.34**	**0.40**
Safety Compliance	12	3.63	0.66	0.08	0.17	0.02	-0.13	-0.11	0.08	-0.10	-0.08	-0.16	-0.20	**0.51**	—	**0.54**	**-0.43**	0.21
Safe Working	13	3.34	0.61	0.13	0.01	-0.00	-0.13	0.06	0.09	-0.18	-0.08	-0.14	-0.16	**0.40**	**0.54**	—	**-0.52**	**0.32**
Safety Costs	14	2.61	0.79	0.00	0.03	-0.07	0.12	-0.04	-0.06	0.00	-0.01	0.22	0.10	**-0.34**	**-0.43**	**-0.52**	—	**-0.24**
Affective Commitment	15	3.77	0.84	0.17	-0.03	-0.05	0.06	-0.08	-0.05	-0.05	0.12	-0.15	0.09	**0.40**	0.21	**0.32**	**-0.24**	—

The table shows pairwise correlations. Significant correlations ($\alpha = 0.05$) are bold. Sample size reduced to n = 71 due to missing data.

More generally, risk-taking seems to be uncorrelated with almost all other variables. There is only a significant positive correlation between the H&L score, the measure of contextualized risk-taking, and the safety climate measure, and between the H&L and the nationality of the worker. These linkages suggest that, on one hand, climate and attitude towards risk may interact in shaping compliance to the safety rules, and, on the other hand, risk attitude may depend upon the country of origin of the worker, with Italian workers more prone to taking risk compared with foreigners.

Two aspects are interesting. The first is the observed direction of the relationship between risk attitude and safety climate. Higher levels of risk attitude correspond to higher levels of safety climate. This may signal the fact that given the same level of objective danger, those more prone to taking risks evaluate the situation as safer and thus perceive a higher safety climate. The second aspect refers to the different patterns of correlation that the BART score and the H&L score have with the other variables included in the analysis. This seems to suggest that the two tasks capture different aspects of risk-taking, as confirmed by the fact that their scores correlate only weakly.

Concerning the hypothesis about employees' affective attachment to the firm, one can observe a strong relationship between affective commitment and both safety climate and safe working. This partially supports Hypothesis 3, which argues for the presence of a positive relationship between affective commitment and both safety climate and safety compliance. Indeed, the feeling that the firm cares about the safety of its workers may enhance affective commitment to the firm, which, in turn, may trigger the willingness to reciprocate by increasing the adoption of safety procedures.

The last consideration is about the safety costs measure. As expected, this variable is negatively related to safety compliance, giving partial support to Hypothesis 4. The higher the perceived psychological and physical costs of the adoption of safety procedures the lower the compliance to these norms. In addition, however, safety costs also seem to be negatively related to safety climate and to affective commitment. These relationships suggest that high levels of perceived safety climate and affective commitment may reduce the perceived costs of the adoption of safety practices.

3.2 Determinants of Safety Performance

To test the hypotheses about the antecedents of safety performance we used regression analysis to control for the effects due to worker-related and firm-related variables. Because of the very few subjects that have been involved in accidents (10 out of 71), we decided to use the safety compliance and safe working scales instead of the workers' self-reported injuries as the measure of safety performance. Overall, we estimated four different models: two with safety compliance as the dependent variable (Table 4) and two with safe working as the dependent variable (Table 5).

Table 4. Safety Compliance Regressions

	Restricted model		Full model	
	Estimate	S.E.	Estimate	S.E.
(Intercept)	2.2732	(0.9748) *	1.9802	(1.1532) °
Saf. Clim.	0.6376	(0.1809) ***	0.6198	(0.1969) **
Saf. Cost	-0.2200	(0.0924) *	-0.2307	(0.0940) *
Saf. Comm.	-0.0092	(0.0873)	-0.0044	(0.0884)
H&L			0.0019	(0.0199)
BART			0.0068	(0.0071)
Firm size	0.0052	(0.0070)	0.0039	(0.0073)
Inj. rate	0.0002	(0.0006)	0.0002	(0.0007)
Wdl. rate	-0.0132	(0.0092)	-0.0118	(0.0095)
Past injuries	-0.1097	(0.2091)	-0.1196	(0.2135)
Overall exp.	0.0879	(0.0608)	0.0799	(0.0621)
Firm exp.	-0.1244	(0.0889)	-0.1080	(0.0986)
Age	-0.0058	(0.0241)	-0.0056	(0.0247)
Italian	-0.2185	(0.2000)	-0.2012	(0.2428)
	R^2 = 0.4099		R^2 = 0.4204	
	F(11; 59) = 3.726***		F(13; 57) = 3.180**	
			ΔR^2 = n.s.	

Signif. codes: *** = 0.001; ** = 0.01; * = 0.05; °= 0.1

In the two models reported in Table 4, safety compliance is regressed on two sets of independent variables. The first model (restricted model) considers the effect of safety climate, safety costs, and affective commitment controlling for both firm-related variables—firm size, injury rate, and wdl rate —and worker-related variables—past injuries, firm experience, overall experience, age, and nationality of the worker. The second model (full model) explores the incremental effect of risk attitude, i.e., H&L and BART scores, in explaining safety compliance. Overall, these models explain a consistent part of the variance in safety compliance. The full model explains more than 42% of the variance, while the restricted model explains about 41% of the variance.

Looking at these estimates, both models confirm the strong and significant impact of both safety climate and safety costs in predicting compliance. More precisely, the models show a positive relationship between safety climate and safety compliance and a negative relationship between safety costs and safety compliance. Thus, overall, these regressions provide strong support for both Hypothesis 1 and Hypothesis 3.

Table 5. Safe Working Regressions

	Restricted model		Full model	
	Estimate	S.E.	Estimate	S.E.
(Intercept)	2.5592	(0.8940) **	2.7647	(1.0636) *
Saf. Clim.	0.3554	(0.1659) *	0.3140	(0.1816) °
Saf. Cost	-0.3073	(0.0847) ***	-0.3131	(0.0867) ***
Saf. Comm.	0.1083	(0.0801)	0.1062	(0.0815)
H&L			0.0107	(0.0184)
BART			0.0004	(0.0066)
Firm size	-0.0044	(0.0065)	-0.0043	(0.0067)
Inj. rate	0.0003	(0.0006)	0.0003	(0.0006)
Wdl. rate	-0.0011	(0.0085)	-0.0013	(0.0087)
Past injuries	-0.4320	(0.1918) *	-0.4178	(0.1969) *
Overall exp.	0.0331	(0.0558)	0.0342	(0.0573)
Firm exp.	0.0943	(0.0816)	0.0787	(0.0909)
Age	-0.0132	(0.0221)	-0.0153	(0.0227)
Italian	-0.1073	(0.1835)	-0.1726	(0.2239)
	R^2 = 0.4232		R^2 = 0.4270	
	F(11; 59) = 3.935***		F(13; 57) = 3.268***	
			ΔR^2 = n.s.	

Signif. codes: *** = 0.001; ** = 0.01; * = 0.05; °= 0.1

Concerning Hypothesis 2, this does not find support. Indeed, when looking at the incremental effect of the introduction of both the H&L and the BART scores in the regression, this is not statistically significant ($F(2, 57) = 0.5159$). This result suggests that risk attitude does not help explain safety compliance beyond what safety climate and safety costs do.

The absence of the effect of both firm-related and individual-related variables is noteworthy. Indeed, looking at worker-related explanatory variables, one rejects the hypothesis that age, previous injuries, experience, and nationality have an impact when controlling for the effect of safety climate and safety costs. The absence of the effects of worker-related variables, in particular age and experience, may be because of the low variance of those variables in our sample. Indeed, because the sample of interviewed workers comprises young hod carriers participating in the training courses, the subjects have similar ages and levels of experience.

We repeated the analysis considering the safe working construct instead of safety compliance as the dependent variable. The estimated models, reported in Table 5, confirm the results obtained using safety compliance: safety climate and safety costs also proved to be robust predictors of compliance when measured with a different construct. Further, risk attitude still has no impact on safe working, and almost none of the firm-related and worker-related variables contribute to explaining safety performance.

Comparing the models in Table 4 and Table 5, however, a difference emerges: when safe working is used instead of safety compliance, a significant impact of past injuries on safety performance is observed. This result signals the presence of a negative relationship between having experienced an injury in the past and reporting low levels of compliance.

Overall, the results obtained give support to the previous research on safety climate, showing that this construct is one of the most important variables that explain compliance with safety procedures (Hypothesis 1). Additionally, we have also shown that the physical and psychological costs of wearing safety equipment and complying with safety procedures have strong impact on the compliance (Hypothesis 4). The other variables that we expected to explain compliance, i.e., affective commitment and individual risk attitude, do not seem to have strong impacts on safety compliance when safety climate and safety costs are partialled out.

3.3 Affective Commitment and Safety Climate

To test the second part of Hypothesis 3, namely that safety climate affects affective commitment, we analyzed the variables explaining affective commitment using a regression analysis. In order to do so we run the regression reported in Table 6 where we regress affective commitment on safety climate controlling for individual-related and firm-related variables.

The estimates show that safety climate is the only variable that significantly relates to affective commitment even when controlling for individual and firm-related aspects. This confirms what previously suggested by the zero-order correlation and gives support to Hypothesis 3: workers' perceptions that the firm cares about safety has a positive impact on affective attachment towards the firm. This result, however, is not robust. Indeed, overall the variance explained by the model is small ($R^2 = 0.1877$) and, overall, the model fails to be significant ($F(9, 61) = 1.566$).

Interestingly, neither the injury record of the firm nor having experienced accidents in the past plays a role in shaping affective commitment. This result is important when read in terms of the creation of a good working environment. Past injuries and accidents do not have a permanent deleterious effect on the working environment, even in small firms.

Table 6. Affective Commitment Regression

	Estimate	S.E.
(Intercept)	1.2104	(1.2880)
Saf. Clim.	0.7611	(0.2415) **
Firm size	0.0016	(0.0104)
Inj. Rate	-0.0006	(0.0009)
Wdl. Rate	0.0078	(0.0135)
Past injuries	-0.0777	(0.3090)
Overall exp.	0.0204	(0.0896)
Firm exp.	-0.0215	(0.1315)
Age	-0.0167	(0.0356)
Italian	0.0547	(0.2925)
	R^2 = 0.1877	
	F(9; 61) = 1.566 n.s.	

Signif. codes: *** = 0.001; ** = 0.01; * = 0.05; °= 0.1

4. Discussion

This study confirmed the presence of a robust and significant effect of safety climate on safety performance, giving support to what has already been documented in the literature. Our results, however, increase the amount of accumulated evidence about safety climate with regard to an important aspect: they demonstrate that safety climate is also an important determinant of compliance in the construction sector that, differently to previous studies of safety climate, is characterized by small firms.

As we have discussed, very few studies have analyzed the role of safety climate in the construction sector and even fewer reported a relationship between safety climate and safety performance (Glendon & Litherland, 2001; Gillen et al., 2002; Siu et al., 2003, 2004). Moreover, all studies of safety climate have focused on large firms; thus, the effects of climate on compliance in small firms could not be taken for granted. Indeed, in very small firms such those investigated in this study (about 10 employees), the perceived importance that management gives to safety, which is the most important factor underlying safety compliance, may be strongly influenced by the personal relationship that employees have with the firm’s owner, who often works side by side and shares the same risks as them.

In discussing the results on risk attitude, an important premise should be made. This study has been the first to use behavioral tasks, which are widely used in the study of the psychology of decision making, to investigate phenomena usually studied in labor psychology. Indeed, having observed the presence of inconclusive evidence regarding the predictive power of risk attitude in terms of safety compliance, we employed two behavioral measures of risk attitude with the purpose to overcome the problems present in previous studies. Neither of these two behavioral tasks, however, provided evidence of the effect of behaviorally measured risk attitude on safety performance.

The BART task, which is a validated measure of risk attitude that has been shown to be strongly correlated with everyday risky behaviors, does not contribute to explaining safety compliance. This result may be given two different interpretations. On one hand, this suggests that risk attitude plays no role in shaping compliance with safety procedures. On the other hand, however, this may also suggest that the BART captures a dimension of risk attitude that is not involved in the decision to comply with safety rules. This second interpretation is supported by a recent approach (Weber, Blais & Betz, 2002) in the psychology of decision making that suggest that human beings are not endowed with a stable context-independent risk attitude, but that they show very different degrees of risk-taking according to the domain in which they are involved. This approach, coupled with the evidence about risky behaviors the BART correlates with, suggests interpreting BART scores as a measure of a generic trait of risk attitude that works well in predicting everyday risk taking, but cannot capture the domain-specific workplace risk attitude.

We also used a second behavioral measure of risk-taking, the H&L task, which was also supposed to measure general risk attitude. In this case, again we did not find that risk attitude contributes to explaining safety performance, which gives support to the considerations already drawn for the BART task. The H&L score, contrary to the BART score, seems to be related to safety climate, although the two scores do not correlate. Thus, it seems that the two tasks capture different facets of risk attitude, but further research should be conducted to better understand this relationship.

The lack of correlation between the two behavioral measures of risk attitude employed in this paper is noteworthy. A possible explanation for this lack of correlation may be found in the different natures of the two tasks. Indeed, in the BART task participants were not informed about the underlying probabilistic structure of the task. In other words, they knew that the risk increases along with the number of pumps but they did not know the probability of explosion. By contrast, in the H&L task they were fully informed about the probability of winning and losing. This difference, on one hand, imply that, in the BART, participants must learn the probabilities of explosion during the task but, on the other hand, this makes the BART more natural in terms of the amount of information to be processed. Related to the learning process implied by the BART, some studies have reported different behavioral patterns according to how information is collected (Hau, Pleskac, Kiefer & Hertwig, 2008; Hertwig & Erev, 2009). In particular, these studies have reported a description-experience gap when people choose risky outcomes.

Related to the hypothesized higher computational difficulty of the choices in H&L tasks, Dave, Eckel, Johnson & Rojas (2010) collected evidence of higher noise in the risk attitude scores produced by the H&L task compared with another behavioral task—the Eckel & Grossman (2002) lottery choice task—when considering subjects with low mathematical skills. This evidence coupled with the more ecological nature of the BART task may help explain the absence of correlation. Additionally, in line with Weber et al.’s (2002) approach, one has to consider the possibility that the different natures of the tasks triggers two domain-specific risk attitudes with, for instance, the H&L more closely related to financial risk and the BART more closely related to everyday risky situations.

Further, a considerable amount of evidence suggests that affective commitment plays a role in determining various firm-related variables. However, few studies have related commitment to the organization with safety performance. Overall, four studies have reported direct evidence of a relationship between either commitment and compliance or commitment and climate (Parker et al., 2001; Zacharatos et al., 2005; Mearns et al., 2010; Ford & Tetrick, 2011), but none of these studies has investigated the construction sector. In this respect, we confirm the presence of a zero-order correlation between affective commitment and both safety climate and safety compliance. However, we provide evidence that when the effects of safety climate and safety costs on performances are partialled out the effect of affective commitment disappears. Thus, if affective commitment plays a role in determining performance, this passes through modifications of climate perception or through a different perception of safety costs.

The most plausible explanation for these correlations is that when the employees perceive that the firm cares about their safety, this increases the affective attachment they have and, in turn, they may reciprocate with an even higher compliance. The last link, however, is not present in our results and may be controversial, especially in small firms. Indeed, it may well be that reciprocation is in the opposite direction, namely that the employee may try to increase work-pace instead of increasing safety compliance.

Finally, our findings on safety costs are noteworthy. Looking at studies of safety compliance, the costs and benefits of adopting safety procedures and how these costs and benefits are evaluated by the employees have been largely ignored. This aspect—measured by means of a six-items questionnaire—proved to be a strong predictor of safety compliance together with safety climate. Obviously, the effect of this new variable must be confirmed by collecting additional evidence; however, the present study gives strong support to the necessity to include this variable when studying safety compliance. Indeed, looking at the effects of safety climate and of risk attitude on safety compliance, taking into account the psychological costs of the adoption of these procedures, allows us to eliminate some confounding factors. If, for instance, one finds no effect of risk attitude on compliance while controlling for safety costs, one can rule out the possibility of observing no effects on compliance because of individual differences in the perceived costs of the adoption of these procedures.

5. Conclusions

This study analyzed the role of safety climate, risk attitude, affective commitment, and safety costs on safety compliance in a sample of small construction firms. Overall, we found that safety climate and safety costs are the two most robust determinants of safety compliance and, contrary to our hypotheses, that neither affective commitment to the firm nor the behaviorally measured risk attitude contribute explaining compliance with safety norms.

Turning to the weaknesses of the study, a possible limitation that has also been pointed out by Beus et al. (2010) concerning previous studies of safety climate regards the causal direction of the relationship between climate and compliance. Indeed, the cross-sectional nature of our data does not allow us to rule out the possibility that climate is influenced by past levels of compliance. However, we partially control for this limitation using the firm’s records of injuries as a control.

A second issue is related to common method bias. Indeed, all the psychological variables were collected by means of a questionnaire, while the risk attitude scales were collected by means of behavioral tasks. The high degree of correlation we observe among the psychological scales and the simultaneous absence of correlation with risk attitude could also signal the presence of common method bias, and, if this is the case, a warning about the seriousness of this effect in studies using only questionnaires should be given.

To conclude, we underline the innovative aspects of this study: on one hand, it provides evidence that safety compliance is one of the strongest determinants of safety compliance in small-sized firms, a robustness check that has never been carried-out before. On the other hand, this is the first attempt to merge different fields of research using behavioral tasks in a labor psychology study.

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