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# Mitigating overconfidence bias: A cross-sectional pilot study of male maintenance workers in the engineering sector

Luca DI GIAMPAOLO<sup>1\*</sup>, Federica MARINO<sup>2</sup>, Claudia GIURGOLA<sup>3</sup>, Piergiorgio ASTOLFI<sup>4</sup>, Luca COPPETA<sup>5</sup>, Simone DE SIO<sup>6</sup>, Paola BORRELLI<sup>7</sup>, Teresa GALANTI<sup>8</sup>, Laura FORCELLA<sup>9</sup>, Maria Elisa MAIOLO<sup>10</sup>, Kavita BATRA<sup>11</sup>, Murat YILDIRIM<sup>12</sup>, Hicham KHABBACHE<sup>13</sup>, Amelia RIZZO<sup>14</sup>, Mahmood BAHRAMIZADEH<sup>15</sup>, Hiroo WADA<sup>16</sup>, Qiao NIU<sup>17</sup>, Hector NIETO<sup>18</sup>, Francesco CHIRICO<sup>19</sup>

## **Affiliations:**

<sup>1</sup> Department of Innovative Technologies in Medicine and Dentistry, "G. d'Annunzio" University, Chieti-Pescara, Italy. E-mail: luca.digiampaolo@unich.it ORCID: 0000-0003-3315-7197

<sup>2</sup> Department of Innovative Technologies in Medicine and Dentistry, "G. d'Annunzio" University, Chieti-Pescara, Italy. E-mail: federicamarinomdl@gmail.com

<sup>3</sup> Department of Innovative Technologies in Medicine and Dentistry, "G. d'Annunzio" University, Chieti-Pescara, Italy. E-mail: cgiurgola@yahoo.it

<sup>4</sup> Department of Innovative Technologies in Medicine and Dentistry, "G. d'Annunzio" University, Chieti-Pescara, Italy. E-mail: piergiorgio.astolfi@studenti.unich.it ORCID: 0009-0006-3118-7359

<sup>5</sup> Department of Biomedicine and Prevention, "Tor Vergata" University of Rome, Rome, Italy. E-mail: lcoppeta@gmail.com ORCID: 0000-0003-2470-6107

<sup>6</sup> Department of Anatomical, Histological, Forensic Medicine and Orthopedic Science, "La Sapienza" University of Rome, Roma, Italy. E-mail: simone.desio@uniroma1.it ORCID: 0000-0003-4538-3941

<sup>7</sup> Department of Medical, Oral and Biotechnological Sciences, Laboratory of Biostatistics, "G. d'Annunzio" University, Chieti-Pescara, Italy. E-mail: paola.borrelli@unich.it ORCID: 0000-0001-9389-627X

<sup>8</sup> Department of Psychological, Health and Territorial Sciences, "G. d'Annunzio" University, Chieti-Pescara, Italy. E-mail: teresa.galanti@unich.it ORCID: 0000-0003-1926-4877

<sup>9</sup> Università degli Studi eCampus, Novedrate (CO), Italy. E-mail: laura.forcella@uniecampus.it ORCID: 009-0008-3630-2779

<sup>10</sup> Department of Neurosciences, Imaging and Clinical Sciences, "G. d'Annunzio" University, Chieti-Pescara, Italy. E-mail: maiolo.elisa@hotmail.it ORCID: 0000-0003-2542-5745

<sup>11</sup> Department of Medical Education and Office of Research, Kirk Kerkorian School of Medicine at UNLV, University of Nevada, Las Vegas, United States of America. Email: kavita.batra@unlv.edu ORCID: 0000-0002-0722-0191.

<sup>12</sup> Department of Psychology, Faculty of Science and Letters, Agri Ibrahim Cecen University, Ağrı, Turkey. Psychology Research Centre, Khazar University, Baku, Azerbaijan. Email: muratyildirim@agri.edu.tr; ORCID: 0000-0003-1089-1380.

<sup>13</sup> Department of Psychology, Faculty of Arts and Human Sciences Fès-Saïss, Sidi Mohamed Ben Abdellah University, Fez, Morocco. Director of the UNESCO Chair "Lifelong Learning Observatory" (UNESCO/UMSBA), Fez, Morocco. E-mail: hichamcogn@gmail.com ORCID: 0000-0001-9587-2829.

<sup>14</sup> Department of Clinical and Experimental Medicine, University of Messina, Messina, Italy. E-mail: amrizzo@unime.it ORCID: 0000-0002-6229-6463.

<sup>15</sup> Department of Orthotics and Prosthetics, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran. E-mail: mbzoandp@gmail.com ORCID: 0000-0003-4719-938x.

<sup>16</sup> Department of Public Health & Division of Medical Education, Juntendo University Graduate School of Medicine, Tokyo, Japan. E-mail: h-wada@juntendo.ac.jp ORCID: 0000-0002-0752-3790

<sup>17</sup> School of Public Health, Shanxi Medical University, China. E-mail: niuqiao55@sxmu.edu.cn ORCID: 0000-0003-0015-3341

<sup>18</sup> Occupational Medicine School, University of Business and Social Sciences, Buenos Aires C1061 ABA, Argentina.

E-mail: [hnieto@live.com.ar](mailto:hnieto@live.com.ar) ORCID: 0009-0007-9325-8404

<sup>19</sup>Post-graduate School of Occupational Health, Università Cattolica del Sacro Cuore, Roma, Italy.

E-mail: [medlavchirico@gmail.com](mailto:medlavchirico@gmail.com) ORCID: 0000-0002-8737-4368.

**\*Corresponding Author:**

Luca Di Giampaolo, Department of Innovative Technologies in Medicine and Dentistry (DTIMO), "G. d'Annunzio" University, Chieti-Pescara, Italy. E-mail: [luca.digiampaolo@unich.it](mailto:luca.digiampaolo@unich.it)

## Abstract

**Introduction:** Overconfidence is understood as the susceptibility to cognitive error caused by overconfidence in one's own means and a lack of awareness of one's own limits. The purpose of the work is to investigate the level of overconfidence in 186 maintenance workers and identify those most at risk of injury based on certain characteristics such as gender, age, educational qualification, and task performed.

**Methods:** The study was conducted among the employees of a large metalworking company in central Italy over a three-months period. The validated questionnaire of Cavazza & Serpe was administered, on a voluntary basis, used for data collection, and subsequently descriptive analysis was carried out for data interpretation.

**Results:** The study surveyed 184 male maintenance workers (response rate: 81.1%). Workers over 51 years old showed higher negative emotions toward safety procedures (SP) and greater intention to transgress, though actual transgressions were low. Living arrangements and education influenced attitudes, with workers living with others reporting higher control ( $p=0.032$ ) and those with high school diplomas showing more positive attitudes ( $p=0.018$ ). Transgressive behavior correlated with reduced moral norms, positive emotions, and control (all  $p<0.001$ ). Negative attitudes toward SP were linked to higher transgression rates, emphasizing the need for targeted interventions to improve safety adherence.

**Discussion:** The results obtained are useful for planning training activities, targeted on the critical aspects that emerged, first of all on overconfidence bias, aimed at reducing injuries in the workplace.

**Take-home message:** Our findings highlighted the opportunity to propose training activities aimed at reducing accidents in the workplace by intervening in a positive way on attitudinal categories found to be more at risk of overconfidence. Based on the results obtained, specific training activities on attitudes and emotions toward safety procedures and PPE, as well as self-assessment and overconfidence risk, should be implemented for maintenance workers.

**Keywords:** Occupational health; overconfidence; risk perception; workplace safety.

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## INTRODUCTION

Overconfidence is a well-established cognitive bias wherein a person's subjective confidence in their judgments consistently exceeds the objective accuracy of those judgements [1,2]. Overconfident individuals are more susceptible to cognitive errors due to limited awareness of their own limitations. This phenomenon is often compounded by the "illusion of knowledge", where individuals

mistakenly believe they have greater control over events than they actually do [3]. Overconfidence is a critical issue to address because of its direct and indirect repercussions on workplace safety. Estimating the impact of overconfidence in organizations and implementing policies to mitigate it could significantly reduce work-related injuries and their associated costs.

A crucial distinction exists between the “illusion of control” and “perceived behavioral control”. The former involves an overestimation of one’s ability to influence uncontrollable events, whereas the latter pertains to an individual’s perception of their ability to execute a behavior effectively [4]. This distinction is fundamental to understanding and mitigating overconfidence bias in the workplace settings.

Risk perception is one of the pivotal aspects of workplace safety [5]. It encompasses how individuals assess the risks in their environment, influenced by personal experience, prior knowledge, cultural factors, and the availability of information [6]. Accurate risk perception is critical for adopting safe behaviors and making informed decisions in potentially hazardous situations. Despite its importance, the exploration of risk perception in workplace safety remains relatively underutilized [7]. Research highlights its potential to significantly reduce workplace injuries [6]. Recognizing how employee’s perception of risk influences their decisions and behaviors underscores the need for interventions that enhance risk awareness and safety consciousness [8-10].

To foster safer behaviors in the workplace, it is essential to identify the psychosocial factors underlying unsafe behaviors and to gain a comprehensive understanding of the mechanisms involved [11]. Attitude, long regarded as a predictor of behavior, plays a pivotal role in workplace safety. The Theory of Reasoned Action [12] and the Theory of Planned Behavior [5] offer valuable frameworks for linking attitudes with behavior, highlighting Perceived Behavioral Control as an additional predictor [13]. Addressing cognitive dissonance is a crucial step toward fostering attitude and behavior change that counteract overconfidence bias organizations can mitigate overconfidence and promote safety by cultivating a safety-oriented culture [14] that reduces workplace accidents.

Empirical studies indicate a strong relationship between organizational climate and management’s prioritization of worker safety. A positive safety climate correlates with increased use of protective and preventive measures [15]. Emotional factors, such as work engagement, also play a significant role. Work engagement, characterized by vigor, dedication, and involvement, reflects the quality of organizational management, fosters a sense of belonging and reduces turnover and absenteeism while increasing job satisfaction and performance [16]. Research supports the connection between a robust safety climate, affective attachment, and adherence to safety behaviors [17-19], with commitment emerging as a critical outcome of strategic management [20]. Stress is another significant factor linked to overconfidence. Acute stress impairs decision-making processes and self-control, often inducing overconfidence in otherwise non-anxious individuals. This underscores the importance of objective decision-making processes guided by established procedures rather than personal confidence [21,22].

To counter overconfidence and strengthen risk prevention strategies, organizations can leverage both internal expertise, such as Health, Safety, and Environment departments, and external professionals like Occupational Psychologist and Medical Officers.

The aim of this study was to analyze workers at higher risk of injury and propose targeted, effective interventions to mitigate the harmful effects of overconfidence. The findings provide valuable insights for planning training activities focused on critical issues, such as overconfidence bias, to reduce workplace injuries. Additionally, implementing systems for continuous monitoring of safety practices and fostering a proactive safety culture are essential for sustained improvements.

## **METHODS**

### ***Study design and procedure***

This cross-sectional study was conducted over three months by a multidisciplinary comprising occupational physicians, occupational psychologists, and representatives from the company’s Health, Safety, and Environment (HSE) and Human Resources (HR) sectors. Comprehensive planning sessions were conducted beforehand with sector representatives to coordinate timing,

logistics, and implementation strategies. Following this preparatory phase, direct meeting sessions were conducted with maintenance teams, each consisting of approximately 10 workers, operating on a three-shift rotation schedule, operating 7 days a week. These sessions introduced the study to the workforce, providing clear explanations of its objectives and procedures. Questionnaires were administered within maintenance boxes located in individual production units. This approach was selected not only for logistical convenience but also to reinforce the organization's commitment to addressing workplace-specific issues directly.

#### **Data collection and instruments**

Data collection utilized the validated questionnaire developed by Cavazza & Serpe [7], following anonymous completion of a socio-demographic profiling form.

The socio-demographic profiling form was composed of 9 questions addressing: gender, age, qualification, marital status, children (number and age), years of employment with the company, years the worker has held that job within the company, other jobs the worker may have held within the company, overall years of employment.

The Risk Perception Measurement Questionnaire used in this study was designed to evaluate various aspects related to workplace safety and behavior. It assessed attitudes toward the use of Personal Protective Equipment (PPE) and adherence to safety procedures, perceptions of control, and emotional responses associated with PPE use and the application of safety protocols. Additionally, the questionnaire examined social norms, intentions to transgress, moral norms, and habitual transgression behavior, providing a comprehensive understanding of factors influencing risk perception and safety practices.

Respondents rated statements on a Likert scale ranging from 1 to 7, with verbal descriptors associated at each extreme (1 = not at all agree, 7 = totally agree).

This assessment evaluates workers' attitudes toward the use of Personal Protective Equipment (PPE) through statements addressing both positive and negative beliefs. Positive belief includes statements such as "If I use PPE, I can avoid having an injury," While negative beliefs include, "Using PPE causes a slowdown in production."

To calculate positive attitude index, the mean value of the positive beliefs was multiplied by the score assigned to the positive statement "Workplace safety is very important to me." Similarly, the negative attitude index was derived by multiplying the mean value of the negative belief statements by the score assigned to the statement: "It is very important to me to finish my task as soon as possible." The overall attitude index was determined by averaging the scores from the positive and negative indices.

The perception of control index measures workers' sense of ease and ability in using PPE. It was calculated as the average of responses to two statements: "It is easy for me to use PPE"; and "I can easily overcome the difficulties involved in using PPE." A higher score corresponds to a higher perception of control over workers' use of PPE.

Emotions toward the use of PPE: The index of emotions toward the use of PPE consists of the average of the summation of participants' responses to 4 statements, 2 relating to negative emotions (e.g., "Wearing PPE while doing my job disturbs me") and 2 relating to positive emotions (e.g., "Wearing PPE while doing my job reassures me"). Higher scores correspond to more positive emotions.

Social norms: Workers' perceptions of coworkers' expectations about implementing safety behaviors were also assessed ("My coworkers think I should use PPE"). A statement was also introduced to measure the importance the worker assigns to the coworkers' opinions about issues concerning safety ("What my coworkers think about safety is very important to me"). In order to create an index of social norms, the average of the responses to the statement of expectations and this value multiplied by the score assigned to the second (expectations x importance).

The intention to transgress safety regulations was assessed using four statements, including, "I intend to use PPE in the next few days." One statement is formulated with the aim of minimizing social desirability effects as the behavior is sanctioned by current regulations ("I think I will happen

to not use PPE in the next few weeks”). A PPE use transgression intention index was then calculated from the mean of the responses. A higher score corresponds to a higher intention to transgress safety regulations.

**Moral norms:** The moral norms index was calculated from the average of responses to 3 statements (example: “I think it is very wrong not to use PPE in areas where it is required”).

The frequency of transgressive behavior was also measured by asking workers how often they failed to comply with PPE requirements. Workers were asked to respond to questions like, “Do you happen to disregard safety procedures in tasks where they are required?” For the measurement of behavior, a 4-point graded scale was used, from 1= never to 4= always, and each score intermediate was associated with a verbal category. A higher score corresponds to a higher frequency of transgression behaviors.

**Data analysis**

Descriptive analysis was carried out using median and interquartile range (IQR) for the continuous variables and percentage values for the categorical ones. Normality distribution was assessed by the Shapiro-Wilk. Univariate comparisons were investigated using the Kruskal Wallis test followed by the Sign test with Bonferroni’s correction for multiple comparisons. Additionally, Spearman’s correlation coefficient was calculated to examine the relationship between quantitative variables. A statistical significance was set at the level of  $\leq 0.05$  unless adjustment for multiple comparisons was needed. The 95% confidence intervals of proportions were calculated by the normal approximation to the binomial distribution. All analyses were performed using Stata software v18 (StataCorp, College Station, USA).

**Ethical aspects**

Informed consent was obtained from all subjects involved in the study. The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Department of Innovative Technologies in Medicine and Dentistry of the University “G. d’Annunzio” of Chieti-Pescara with the number CS.2018.19.47.

**RESULTS**

A total of 227 male employees with maintenance duties were recruited, of which 184 workers completed the questionnaire (response rate: 81.1%). Table 1 below provides socio-demographic characteristics of the sample.

**Table 1.** Socio-demographic characteristics of the sample (N=184).

	<b>Total (N = 184)</b>	<b>95% Confidence Interval of Proportion (UCL, UCL)</b>
	<i>n (%)</i>	
<b>Age (in years)</b>		
18 – 30 years	33 (17.9)	(12.7, 24.2)
31 – 40 years	44 (23.9)	(17.9, 30.7)
41 – 50 years	42 (22.8)	(17, 30)
51+ years	63 (34.2)	(27.4, 41.6)
<b>Qualification</b>		
University Degree	5 (2.7)	(0.9, 6.2)
Secondary School Degree	20 (10.9)	(6.8, 16.3)
High School Diploma	148 (80.4)	(74, 85.9)
<b>Marital status</b>		
Married or cohabitant	136 (73.9)	(66.9, 80.1)
Separated	11 (5.9)	(3, 10.4)
Single	34 (18.5)	(13.1, 24.8)
Widower	2 (1.1)	(0.1, 3.9)
<b>Children</b>		

No	67 (36.4)	(29.5, 43.8)
Yes (< 3 years old)	16 (8.7)	(5.1, 13.7)
Yes (6 – 11 years old)	25 (13.6)	(9, 19.4)
Yes (12 – 17 years old)	19 (10.3)	(6.3, 15.7)
Yes (> 18 years old)	54 (29.4)	(22.8, 36.5)
<b>Other jobs</b>		
No	61 (33.2)	(26.4, 40.5)
Yes	123 (66.9)	(59.5, 73.6)

Note: LCL: Lower Confidence Limit; UCL: Upper Confidence Limit

Notably, approximately 35% of the sample was over 51 years old, 74% were married or cohabiting, 63% had children, and 80% held a high school diploma. Comparison analysis revealed varying levels of negative emotions toward Safety Procedures (SP) across different age groups, (Table 2) with workers over 51 years of age exhibiting the highest score. Similarly, the intention to transgress displayed a similar trend. However, this intention did not align with actual behavior, as evidenced by item 1 (Q1: How often you don't comply with safety procedures in the jobs where they are required?), the answers were Never 13,7%, Rarely 57,4%, Every time 3,8% and Often 25,1%. Despite these findings, no statistically significant association was identified between transgressive behavior and any demographic variables.

**Table 2.** Distribution of behavior stratified by age groups.

	Age groups				p-value
	18 - 30	31 – 40	41 - 50	51 - older	
<i>Transgressive behavior</i>	14.0 (14.0-14.0)	14.0 (14.0-14.0)	14.0 (14.0-14.0)	14.0 (14.0-14.0)	0.243
<i>Positive attitude</i>	7.0 (6.5-7.0)	6.5 (6.0-7.0)	6.5 (5.5-7.0)	6.5 (6.0-7.0)	0.159
<i>Negative attitude</i>	4.0 (3.0-5.0)	4.3 (3.0-6.0)	4.5 (2.0-6.5)	4.5 (3.5-5.5)	0.523
<i>Negative attitude index</i>	12.0 (6.0-16.0)	10.5 (6.0-21.8)	13.5 (4.0-26.0)	13.5 (5.0-26.0)	0.783
<i>Positive attitude index</i>	49.0 (39.0-49.0)	45.5 (36.0-49.0)	45.5 (38.5-49.0)	45.5 (38.5-49.0)	0.500
<i>Attitude general index</i>	27.8 (25.3-31.5)	27.4 (24.1-31.4)	27.8 (25.0-32.5)	28.0 (25.8-34.5)	0.470
<i>Control perception</i>	5.5 (4.5-6.5)	5.0 (4.0-6.3)	5.0 (4.0-6.5)	6.0 (4.5-6.5)	0.069
<i>Positive emotions</i>	14.0 (11.0-14.0)	13.5 (11.5-14.5)	14.0 (12.0-14.0)	13.0 (12.0-14.0)	0.795
<i>Negative emotions</i>	2.0 (2.0-4.0)	3.0 (2.0-6.5)	2.0 (2.0-5.0)	4.0 (2.0-8.0)	0.055
<i>Emotions general index</i>	8.0 (8.0-8.0)	8.0 (8.0-9.0)	8.0 (8.0-8.0)	8.0 (7.5-10.5)	0.273
<i>Social standards</i>	30.0 (20.0-42.0)	28.0 (20.0-35.0)	30.0 (16.0-42.0)	36.0 (20.0-49.0)	0.089
<i>Intent to transgress</i>	5.3 (4.1-5.5)	5.3 (4.1-5.5)	5.3 (4.5-5.5)	5.5 (5.3-5.8) *	0.001
<i>Moral standards</i>	5.7 (5.0-6.7)	6.3 (5.3-7.0)	5.7 (5.0-6.7)	6.3 (5.0-7.0)	0.250

Note: Data are expressed in median and interquartile range (IQR). \* p < 0.05 for Bonferroni multiple testing correction other groups vs 50-over.

Regarding the perception of control, a difference was observed between workers who lived alone and those who did not, with higher control perception scores among the latter group, with a p= 0.032. (Table 3). However, no significant findings emerged when analyzing the relationship between perception of control and prior job experience.

**Table 3.** Distribution of Control Perception stratified by marital status.

	Marital status		
	Married / cohabitant	Separated / Widower	p-value
<i>Transgressive behavior</i>	14.0 (14.0-23.0)	14.0 (14.0-15.0)	0.470
<i>Positive attitude</i>	6.5 (6.0-7.0)	6.5 (6.0-7.0)	0.979
<i>Negative attitude</i>	4.0 (3.0-5.8)	4.0 (3.0-6.0)	0.534
<i>Negative attitude index</i>	12.0 (5.8-23.3)	12.0 (6.0-26.0)	0.905
<i>Positive attitude index</i>	45.5 (39.0-49.0)	42.0 (38.5-49.0)	0.309
<i>Attitude general index</i>	27.8 (25.0-32.9)	27.3 (24.0-33.3)	0.387
<i>Control perception</i>	5.5 (4.0-6.5) *	5.0 (4.0-6.0)	0.032
<i>Positive emotions</i>	14.0 (12.0-14.0)	13.0 (11.0-14.0)	0.239
<i>Negative emotions</i>	3.0 (2.0-7.0)	3.0 (2.0-6.0)	0.799
<i>Emotions general index</i>	8.0 (8.0-9.0)	8.0 (7.5-9.0)	0.228
<i>Social standards</i>	30.0 (17.0-42.0)	30.0 (16.0-42.0)	0.310
<i>Intent to transgress</i>	5.5 (5.0-5.8)	5.3 (5.0-5.5)	0.171
<i>Moral standards</i>	6.3 (5.0-6.8)	6.3 (5.0-7.0)	0.623

Note: Data are expressed in median and interquartile range (IQR). \* p < 0.05 for Bonferroni multiple testing correction other groups vs 50-over.

In terms of educational qualification, only the overall index of Attitude toward Safety Procedures (SP) registered a statistically significant difference (p= 0.018), with workers holding a high school diploma recording a median score of 28 (Table 4).

**Table 4.** Distribution of attitude towards safety procedures stratified by qualification.

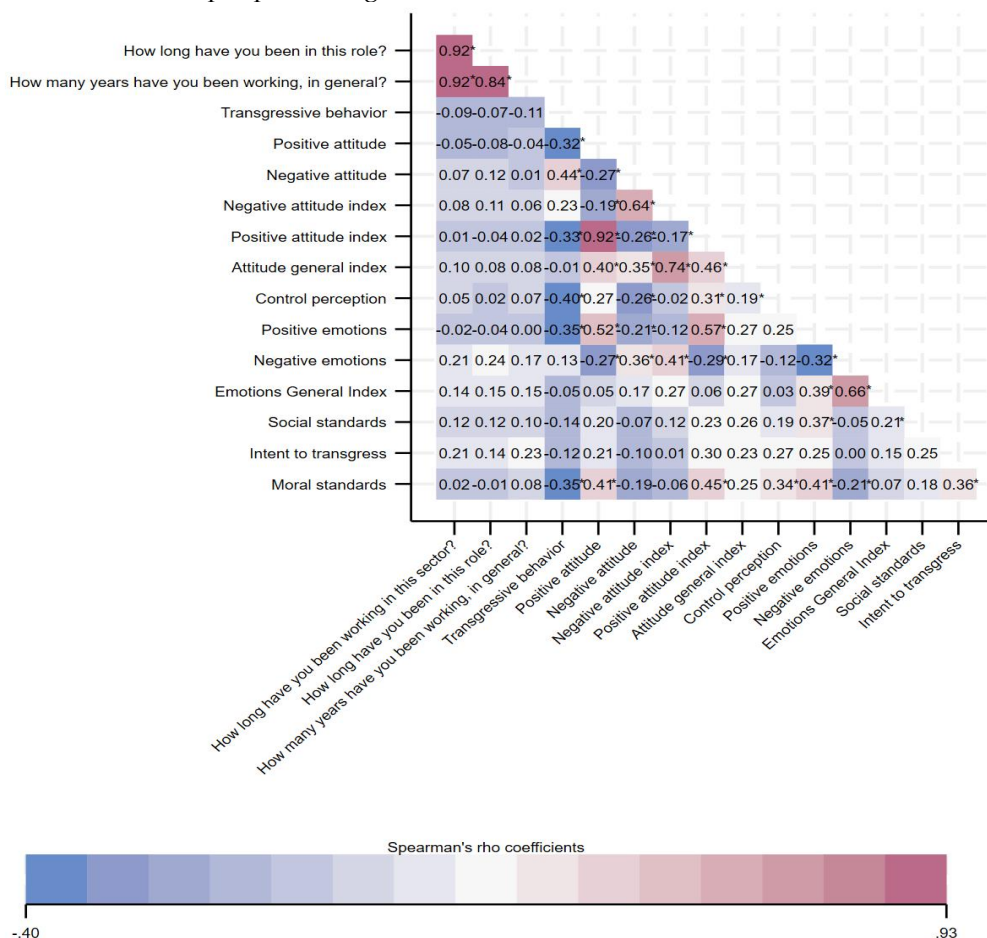
	Qualification			p-value
	University Degree	Secondary School Degree	High School Diploma	
<i>Transgressive behavior</i>	14.0 (9.0-14.0)	14.0 (14.0-15.0)	14.0 (14.0-19.0)	0.526
<i>Positive attitude</i>	6.5 (6.0-6.5)	6.5 (5.5-7.0)	6.5 (6.0-7.0)	0.372
<i>Negative attitude</i>	4.5 (2.5-6.0)	4.0 (3.0-5.0)	4.0 (3.0-6.0)	0.851
<i>Negative attitude index</i>	6.5 (6.0-10.0)	6.5 (4.0-16.8)	14.0 (6.0-24.0)	0.065
<i>Positive attitude index</i>	42.0 (39.0-45.5)	39.0 (34.0-49.0)	45.5 (39.0-49.0)	0.389
<i>Attitude general index</i>	26.3 (24.0-27.5)	25.4 (21.4-28.0) *	28.0 (25.0-33.9) *	0.018
<i>Control perception</i>	6.0 (5.5-7.0)	5.8 (4.0-6.8)	5.5 (4.0-6.5)	0.361
<i>Positive emotions</i>	14.0 (14.0-14.0)	12.0 (11.5-14.0)	14.0 (12.0-14.0)	0.133
<i>Negative emotions</i>	2.0 (2.0-4.0)	5.5 (2.0-8.0)	3.0 (2.0-6.0)	0.228
<i>Emotions general index</i>	8.0 (8.0-8.5)	8.0 (6.8-10.0)	8.0 (8.0-9.0)	0.911
<i>Social standards</i>	28.0 (12.0-30.0)	25.0 (7.0-38.5)	30.0 (20.0-42.0)	0.193
<i>Intent to transgress</i>	5.3 (5.0-5.3)	5.5 (5.0-5.5)	5.5 (5.0-5.8)	0.520
<i>Moral standards</i>	6.3 (5.3-7.0)	5.8 (5.0-6.5)	6.3 (5.0-7.0)	0.739

Note: Data are expressed in median and interquartile range (IQR). \* p < 0.05 for Bonferroni multiple testing correction other groups vs 50-over.

In addition, correlation analysis revealed several noteworthy correlations. Specifically, transgressive behavior increased as moral norms (rho= 0.35, p<0.001), positive emotions (rho= - 0.35, p<0.001 and perceived control (rho= -0.40, p<0.001) decrease. Conversely, a negative attitude towards Safety Procedures (SP) was positively correlated with transgression (rho= 0.44, p< 0.001), while

positive attitudes towards SP were associated with reduced transgressive behavior ( $\rho = -0.33$ ,  $p < 0.001$ ) (Figure 1).

**Figure 1.** Matrix heatmap representing correlations between variables.



Note: \*  $p < 0.05$ . The gradients in the heatmap vary based on the strength of the correlation.

## DISCUSSION

### General results discussion

Data analysis did not reveal any socio-demographic characteristics that would lead back to workers with risky behaviours as much rather some aspects regarding the attitudes and emotions of use of maintenance workers toward safety procedures were highlighted, this could predispose to the adoption of unsafe behaviours. Findings highlighted the significance of a rather “attitudinal ambivalence” towards safety procedures: workers over 51 years old, in fact, exhibited on one hand a higher intention to transgress safety protocols (median value of 5.5, higher than the other age groups,  $p = 0.001$ ), but a low rate of transgressions in the workplace on the other.

This study underscores the complex interplay of demographic, attitudinal, and perceptual factors in shaping workers’ adherence to safety protocols. Consistent with findings from Cavazza and Serpe [23], our study highlights the significance of attitudinal ambivalence toward the use of personal protective equipment (PPE) as a crucial predictor of workers’ tendency to transgress safety regulations. Despite assertions by some researchers [24] that individual characteristics do not adequately explain work injuries, our results suggest otherwise. Our findings indicated that age, educational background and living arrangements can influence workers’ perceptions and behaviours related to safety.

Specifically, older workers exhibited higher levels of negative emotions towards safety procedures and greater intention to transgress, despite ultimately adhering to safety protocols. One



possible explanation for these results could be found in the major experience and familiarity with safety procedures. This experience might lead to overconfidence, and a sense of invulnerability, especially if workers have not experienced serious incidents in the past [25] resulting in higher levels of negative emotions towards safety procedures and a greater intention to transgress. Research suggests that people's confidence in the accuracy of their beliefs increases with age [26] and that this could evolve into a minor perception of being at risk of injury due to the overconfidence in their skills and experience.

Furthermore, our study highlights the role of attitudinal consistency in promoting adherence to safety protocols. Workers with a positive attitude towards safety procedures demonstrated a lower tendency to transgress, while those with ambivalent or negative attitudes were more likely to engage in risky behaviours. This finding prompts reflections on the critical importance of motivation and commitment in the context of safety management and injury prevention. Workers with positive attitudes towards safety procedures are likely to be motivated and committed to workplace safety. They may perceive safety as a priority and feel personally responsible for adhering to safety protocols to protect themselves and their colleagues [20]. Furthermore, workers with positive attitudes towards safety procedures may have a higher sense of perceived control and self-efficacy in their ability to comply with safety guidelines. This sense of control could empower them to overcome obstacles or challenges that may arise in the workplace, reducing the likelihood of transgressing behaviour.

Lastly, our findings suggest that organizational factors, such as safety climate and perceived control, significantly influence workers adherence to safety protocols. Studies have found that organizational factors, such as commitment to safety [27], supervisor support [28] and intra-organizational trust [29] are strong predictors of safety compliance and adherence to safety protocols. Workers who perceive greater control over their work environment and who experience a positive safety climate are less likely to engage in transgressive behavior. Therefore, efforts to improve safety culture and empower workers to take ownership of safety processes [20] are essential for mitigating workplace risks and fostering a safer working environment. Building a robust safety culture involves promoting transparency, providing ongoing training, and ensuring that workers feel supported and valued within their organization. These measures not only encourage compliance but also enhance workers' overall engagement and accountability in maintaining workplace safety.

Moving forward, the implications of our study suggest several strategic approaches for enhancing workplace safety and injury prevention [30-33]. First and foremost, organizations should prioritize interventions aimed at addressing attitudinal ambivalence towards safety procedures, particularly regarding the use of PPE [34]. This may involve targeted training programs to cultivate positive safety attitudes and behaviours among employees. Secondly, focused efforts to mitigate the impact of demographic factors, such as age, educational background, and living arrangements, on workers' safety perceptions and behaviors should be emphasized. This could involve tailored interventions to address the unique needs and characteristics of different demographic groups within the workforce [35-38]. Finally, future research should continue to explore overconfidence biases through targeted interventions aimed at cultivating realistic self-assessments and promoting safety consciousness. A possible solution could be integrating strategies to mitigate overconfidence into safety initiatives, to reduce workplace injuries [39-41]. These strategies not only align with best practices in injury prevention but also contribute to a more adaptive and proactive safety culture across organizations.

### **Limitations**

This study included all maintenance workers employed by a single company, providing valuable insights into the perceptions and behaviours of this specific workforce. However, the study's findings are limited by the sample size and scope, which were confined to workers from one organization. To enhance the robustness and generalizability of the results, future research could expand the sample size by designing a multicentre study across multiple plants in the country. Additionally, including maintenance workers from the engineering sector in other manufacturing companies could provide a more diverse and representative dataset. Another limitation lies in the

socio-demographic form used in the study, which does not offer a detailed psychological characterization of the workers. This restricts the depth of understanding regarding individual differences that may influence safety behavior and risk perception. Future studies could address this gap by incorporating psychological moderators, such as personality traits or cognitive styles, to statistically explain individual differences and their impact on workplace safety.

Moreover, the cross-sectional nature of this study limits its ability to establish causality. Observations were made at a single point in time, making it challenging to determine whether the factors studied directly influence behaviours or are outcomes of existing workplace dynamics. Longitudinal studies would be valuable in examining changes over time and identifying causal relationships. Lastly, the study exclusively focused on male workers, which limits the generalizability of the findings to broader, mixed-gender workforces. Future research should strive for gender inclusivity to capture a more comprehensive understanding of maintenance workers' safety behaviours and perceptions across diverse demographic profiles.

## CONCLUSIONS

Our findings highlight the opportunity to propose training activities aimed at reducing accidents in the workplace by intervening in a positive way on attitudinal categories found to be more at risk of overconfidence. To address this, strategies were suggested to foster positive emotions toward compliance with safety procedures and to enhance workers' perception of control over safety practices. Based on the results obtained, specific training activities on attitudes and emotions toward safety procedures and PPE, as well as self-assessment and overconfidence risk, should be implemented for maintenance workers.

Drawing from a comparison with international literature, it becomes evident that action must be taken to improve corporate safety climate and worker engagement [42-47]. Establishing a multidisciplinary team involving external professionals (occupational physicians, occupational psychologists, technicians, and coaching experts) is deemed necessary to achieve the established objectives. Awareness of overconfidence bias is key to mitigating its consequences, as it encourages personal critical thinking and fosters a culture of continuous learning and improvement [48-57].

Training planning should utilize differentiated techniques and modalities tailored to the context to facilitate understanding and acceptance of the overconfidence concept by workers [58-66]. Moreover, regular evaluation of changes in workers' level of overconfidence following training intervention is crucial. Striking a balance between confidence in one's competencies and awareness of one's limitations is essential for implementing effective prevention measures for health and safety in the workplace.

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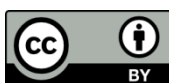
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