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Understanding Safety Attitudes: The Intersection Of Cognitive Dissonance And Risk Perception In The Maritime Industry

Capt. Vivek Trivedi[1*], Dr. Vijaykumar D. Patel[2], Dr. Kishore Barad[3]
[1*]PhD Scholar, Department of Maritime Studies, Ganpat University, Gujarat. vivektrivedi2873@gmail.com
[2]Assistant Professor, Mechatronics Engineering Department, Ganpat University, Gujarat.
vdp02@ganpatuniversity.ac.in https://orcid.org/0000-0002-1776-2701
[3]Senior director, Placement and executive education, Ganpat university, Gujarat.
director.placement@guni.ac.in, https://orcid.org/0009-0000-5747-7684

Abstract
The maritime industry operates within inherently hazardous environments, where safety compliance is critical but often compromised due to psychological and organizational factors. This study investigates the relationship between cognitive dissonance and risk perception in shaping safety attitudes among maritime professionals. Using a mixed-method research design, data were collected from 405 maritime personnel across various job roles and levels of experience. The study employed Structural Equation Modeling (SEM) to examine both the direct and indirect relationships between risk perception, cognitive dissonance, and safety attitudes. The results indicate that risk perception has a significant positive impact on safety attitudes, with cognitive dissonance partially mediating this relationship. Additionally, demographic factors—such as age, education, and experience—were found to influence both cognitive dissonance and safety attitudes, highlighting the importance of individual characteristics in safety behavior. The findings reveal that psychological conflicts can arise when operational demands contradict safety values, leading to rationalization and non-compliance. These insights emphasize the need for psychologically informed interventions, such as VR-based simulations, participatory safety training, and cognitive load monitoring, to reduce dissonance and enhance risk awareness. This study contributes to the literature on maritime safety by integrating psychological theory into safety behavior models and offering practical recommendations for fostering a resilient safety culture aligned with behavioral norms in maritime operations.
Keywords: *Attitudes, Cognitive Dissonance, Maritime, Maritime Safety, Psychological Factors, Risk Perception, Safety Behavior.*

1. INTRODUCTION

The maritime industry forms a vital sector of international trade, as the majority of worldwide trade takes place through water routes, amounting to more than 90% of global trade (Qiao et al., 2021). Technological advancement, strict regulatory structures, and extreme environmental conditions continue to make this one of the most dangerous sectors (Nævestad et al., 2019). High-risk work environments, long hours of work, isolation, and the nature of shipboard operations make it quite complex in safety terms, demanding a robust safety culture to address potential hazards (Meng et al., 2020).

Safety culture can be described as the overall values, attitudes, and practices in an organization to prevent risks and accidents, which contribute to an improvement in safety performance (Mišković et al., 2022). An organization with a positive safety culture stresses proactive hazard identification, strict compliance with safety procedures, and communication about risks (Bergheim et al., 2015). However, empirical research reveals that the marine industry safety compliance is not homogeneous, where at times, seafarers may overlook relevant safety rules and their applicability (Djukanović et al., 2020). This finding points out how psychological and behavioral mechanisms impact attitudes towards maritime safety, notably cognitive dissonance and risk perception.

- **Cognitive Dissonance and Safety Compliance**

The concept of cognitive dissonance, introduced by Festinger (1957), is the psychological discomfort felt by an individual when their beliefs are contradictory or their behavior goes against their attitudes. Mariners are often presented with the case of cognitive dissonance in maritime operations wherein they realize the significance of safety procedures but fail to implement them because of operational pressures, perceived inconvenience, or social norms (Leung et al., 2024). For example, a worker may feel that personal protective equipment is necessary; however, to avoid discomfort and save time, they may overlook safety precautions (McVeigh et al., 2019). The officer may also want the International Safety Management (ISM) Code enforced to the fullest, but where deadlines are approaching, minor mistakes are ignored just to ensure continued efficiency in service (Cheng et al., 2024).

Several factors bring about cognitive dissonance in maritime safety. Experience and overconfidence lead to a misplaced sense of control, whereby experienced sailors tend to underplay the risks after having experienced past incidents without consequences (Weston et al., 2022). Peer influence and groupthink can also support unsafe behaviors by having people conform to what is considered acceptable crew behavior to avoid social friction (Hinsberg et al., 2024). These psychological tendencies must be understood for designing interventions targeted to reduce cognitive dissonance and promote consistency in safety compliance.

- **Risk Perception and Its Influence on Behavior**

Risk perception, which determines safety behavior, is how a person perceives the gravity and probability of risk (Măirean et al., 2021). The perception of risk varies across individuals in the maritime industry, depending on experience, cultural background, educational background, and organizational safety climate (Liu et al., 2023). Studies show that seafarers with a higher risk perception are more likely to follow safety procedures, while those who have low risk perception might act riskily, considering that accidents are less probable or even inevitable (Larsen et al., 2021).

An important facet of risk perception is the normalization of deviance. Repeated exposure to situations of being in unsafe conditions without any untoward consequences lowers the risk perceived by individuals (Equils et al., 2023). For example, if seafarers observe or experience successful completion of tasks without incidents related to fatigue, they tend to justify that long working hours do not affect safety levels (Corrigan et al., 2019). This is a cognitive bias that can work against regulatory compliance, thus increasing the likelihood of accidents.

Table 1: Variations in Risk Perception Among Maritime Stakeholders
(Adapted from Hetherington et al., 2006; Lu & Tsai, 2008; Schröder-Hinrichs et al., 2012)

Risk Type	Seafarers' Perception	Ship Management's Perception	Regulatory Bodies' Perception
Fatigue & Overwork	"Part of the job, unavoidable."	"Needs management, but expected."	"Critical risk requires intervention."
Equipment Failure	"Fix it when it breaks."	"Preventive maintenance needed"	"Strict compliance required."
Fire Hazards	"Unlikely, but possible"	"Preparedness is important."	"High-risk, must be managed."
ISM Code Compliance	"Sometimes excessive"	"Necessary for legal compliance"	"Mandatory for safety culture"

Source: Self-prepared by author

This table illustrates disparities in risk perception, which often lead to gaps in compliance and variations in risk management strategies.

- **The Intersection of Cognitive Dissonance and Risk Perception**

Cognitive dissonance and risk perception are the two intertwined factors underlying safety attitudes in maritime operations. Whenever seafarers feel the tension of knowing and experiencing something opposed, a response is evoked through the perception of the individual toward the risk associated with that particular act. Some change their behavior accordingly with the assimilation of safety standards, while others continue with protocols, as they are not hazardous enough. Others may justify non-compliance by downplaying perceived risk to unsafe practices when they feel the latter is operationally efficient or convenient. Some seafarers also show groupthink characteristics, such as adopting the attitudes of prevailing crew norms instead of making their own independent risk assessment about safety. In this way, unsafe behaviors get normalized in a team, and the risk of accidents will be even greater. The understanding of the interaction between cognitive dissonance and risk perception is crucial in the development of effective safety interventions, as indicated in Figure 1, which demonstrates their influence on safety behavior.

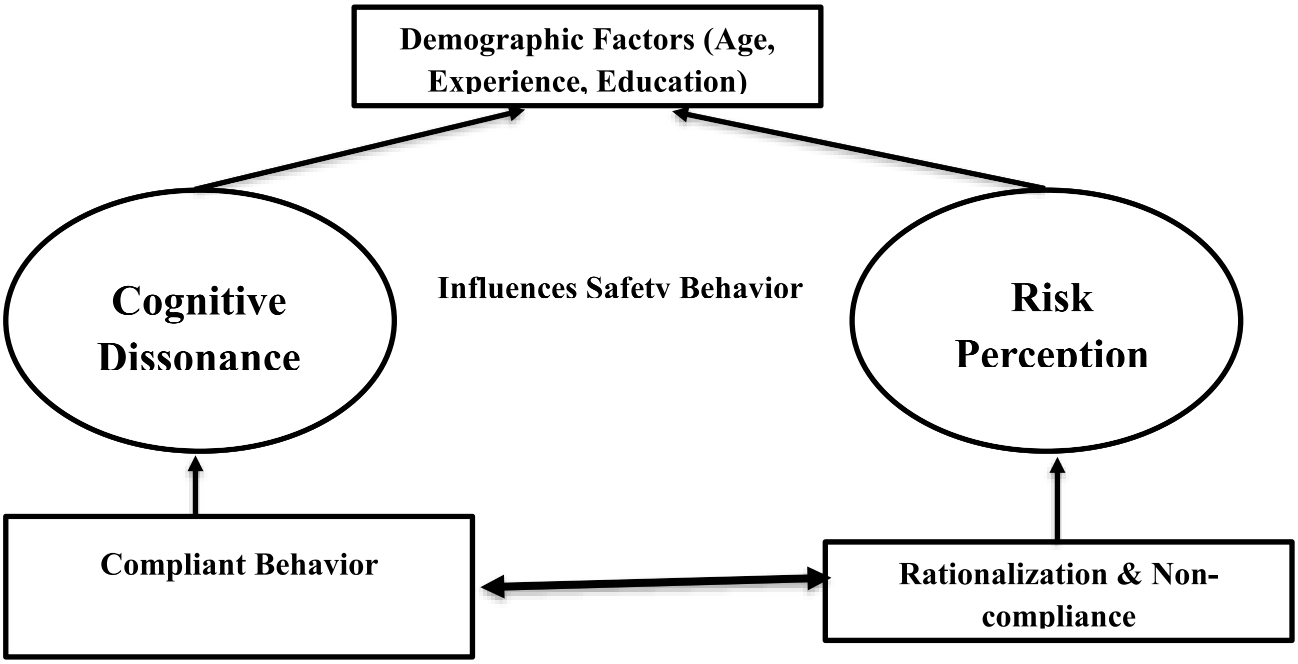

Figure 1: Conceptual Framework for Cognitive Dissonance and Risk Perception in Maritime Safety

Source: Self-prepared by author

This study in the area of maritime safety adds to the body of knowledge on the intersection of cognitive dissonance and risk perception in determining the impact on safety attitudes. By understanding these psychological mechanisms, maritime organizations can improve safety culture, minimize human error, and enforce safer regulations.

The study is structured as follows:

- **Section 2**: Literature review on maritime safety culture, cognitive dissonance, and risk perception.
- **Section 3**: Objective and Hypothesis of the study.
- **Section 4**: Research methodology, including data collection and analytical techniques.
- **Section 5**: Result Analysis
- **Section 6**: Discussion.
- **Section 7:** Conclusion.

This study consequently focuses on the improvement of maritime risk management strategies by targeting both organizational and psychological factors related to accident prevention.

2. REVIEW OF LITERATURE

2.1Review related to the influence of demographic factors on the interaction between cognitive dissonance and safety attitudes in the maritime industry.

Safety-II of maritime shipping, which focused on "how and why things go right," complemented safety-I, which centered on "what goes wrong," thus enhancing the effectiveness of countermeasures taken to ensure safety (Qiao, et. al., 2021). Female workers, less educated workers, and workers with shorter service tenures experienced more hazardous consciousness and citizenship behavior in construction (Meng, et. al., 2020). Virtual reality simulations increased the enjoyment of maritime industry safety training by increasing the perceived enjoyment, intrinsic motivation, perceived learning, and behavioral change, but decreasing the extraneous cognitive load (Makransky, et. al., 2022). Psychological capital related to safety climate positively and jobs positively, contributing up to a variance of 21% by job satisfaction regarding psychological capital toward maritime workers (Bergheim, et. al., 2015).

The cognitive load of seafarers that influenced their safety behavior and navigation safety included family care, fatigue, psychological condition, mount guard emotion, ship environment, and overtime work (Liu, et. al., 2023). Safety communication and training for safety very much predicted quality in the practice of safety supervisions in maritime (Mišković, et. al., 2022). The study of this article suggested a framework for determining navigational risk-influencing factors in remotely controlled MASS to be used for designing and operational planning of maritime transportation systems (Fan, et. al., 2020). Factors that may have influenced maritime safety culture included age, position, vessel type, and working conditions (Nævestad, et. al., 2019). There was growing consciousness of human factors and a positive safety culture shift in ports; however, much more focused research was required regarding specific complexities and constraints and common processes in a port environment (Corrigan, et. al., 2019).

H1: Demographic factors significantly influence the interaction between cognitive dissonance and safety attitudes in the maritime industry.

2.2Review related to the underlying factors that influence cognitive dissonance and risk perception among maritime industry professionals.

This maritime cyber risk perception was rather intricate, having different factors and cognitive biases involved and necessitating contextualized studies in the proper execution of mitigation techniques (Larsen, et. al., 2021). Perceived stress and job satisfaction among merchant seafarers were highly influenced by dispositional resilience and instrumental work support (McVeigh, et. al., 2019). Storytelling reduced cognitive dissonance and modified the risk perception of individuals from the Chinese diaspora concerning public health emergencies, which enhanced their mental health and wellbeing (Leung, et. al., 2024). Seafarers had to perform continuously at the limit of their cognitive capacity and needed better care in terms of their well-being to ensure safety at sea (Djukanović, et. al., 2020). Cognitive dissonance and its cognates (emotional dissonance and emotional labor) might have acted as musculoskeletal disorders' risk factors (Weston, et. al., 2022).

Poor indoor environmental quality could impair cognitive functions, though the extent of impacts of specific factors differed, and different studies contained inconsistencies (Wang, et. al., 2021). Maritime cyber risk perception was complex and involved influence from factors and cognitive biases; therefore, it should have been studied on a context-specific basis for effective mitigation strategies (Larsen, et. al., 2021). Generally, the factors affecting seafarers' cognitive load included family care, fatigue, psychological condition, mount guard emotion, ship environment, and overtime work, which affected their safety behavior and navigation safety (Liu, et. al., 2023). The risks associated with autonomous surface ship operations were interaction with manned vessels and object detection, while cyber-attacks, human error, and equipment failure came in second place (Chang, et. al., 2021). Human factors, including ship age, ship operation, voyage segment, information, and vessel condition, were critical factors of risk involved in all the maritime accidents that had variation with the kind of accident types (Fan, et. al., 2020).

H2: There are underlying factors that significantly influence cognitive dissonance and risk perception among maritime industry professionals.

2.3Review related to challenges and opportunities in integrating cognitive dissonance and risk perception into effective safety management strategies.

The concept of cognitive dissonance helped disaster communicators in their messaging to create more effective communication and introduced a preliminary CDI to plug into existing crisis communication models (Wood et. al., 2020). Storytelling helped the Chinese diaspora individuals in modifying their risk perception and mitigating cognitive dissonance in response to public health emergencies, improving their mental health and well-being (Leung, et. al., 2024). Cognitive dissonance may have played a role in vaccine refusal for those who did not trust the government and scientific organizations, implying that interventions based on dissonance may have reduced hesitancy (Equils, et. al., 2023). Aviation safety experts were keen to accept how emotions, cognition, or context influences risk perception in communication at such a working organization (Chionis, et. al., 2022). The risk governance framework model aligned participative worker perceptions of risk in the construction industry with organizational governance, thus resulting in increased safety fidelity, compliance, and trust (Hinsberg, et. al., 2024).

Optimism bias and illusion of control worked in a negative direction to predict risky driving behavior, and the risk perception mediated cognitive biases and self-reported risky driving (Măirean, et. al., 2021). This method proposed an accurate estimation of safety cognitive ability for high-risk-position employees and suggested improvement in the actual management of safety and the curbing of undesirable behavior (Cheng, et. al., 2024). Risk-based thinking in occupational safety and health management systems could have been a powerful and effective tool for planning and implementing safety measures in mining companies (Rudakov, et. al., 2021). Seafarers' cognitive burden and tension may have been detected by the EEG-based psychophysiological evaluation system in maritime virtual simulators, which also offered suggestions for better training (Liu, et. al., 2020).

Gap in Existing Research

Psychological processes that impact safety attitudes have not received significant attention despite having extensive research in marine safety. The study is conducted without major consideration of the effect of cognitive dissonance on the behavior of safety, but instead places greater emphasis on the organizational factors, technological breakdown, and legal requirements.

Operational pressure, social forces, and excessive confidence force the seafarers to frequently become aware of the threats to their safety, yet still engage in unsafe acts. Furthermore, risk perception studies are still dispersed and not incorporated into how personal perceptions may affect compliance and decision-making. While there are some pieces of research into safety culture, this does not investigate how the elements of risk perception and cognitive dissonance blend to drive behaviors.

A neglected aspect of reducing these psychological impacts on safety attitudes is how demographic characteristics, including age, experience, and education, influence individuals. Moreover, the effectiveness of interventions is restricted by the unknown challenges when these psychological constructs are integrated into effective safety management strategies. Safety at sea programs might remain relying on rule-based practices instead of psychologically aware strategies that are human-behavioral if the gaps are not addressed. For a better safety culture and for sustaining the effectiveness of safety measures, more knowledge of these concepts is required. By filling up those research gaps, the study will frame the objectives that will be recorded in the next section.

3. OBJECTIVES & HYPOTHESIS OF THE STUDY

➢ **Objectives**

Obj1 To assess the influence of demographic factors on the interaction between cognitive dissonance and safety attitudes in the maritime industry.

Obj2 To identify and extract the underlying factors that influence cognitive dissonance and risk perception among maritime industry professionals.

Obj3 To explore the challenges and opportunities in integrating cognitive dissonance and risk perception into effective safety management strategies.

➢ **Hypothesis**

H1: Demographic factors significantly influence the interaction between cognitive dissonance and safety attitudes in the maritime industry.

H2: There are underlying factors that significantly influence cognitive dissonance and risk perception among maritime industry professionals.

4. RESEARCH METHODOLOGY

4.1Research Design

Using a mixed-method approach, the study looks at how risk perception and cognitive dissonance have an effect on safety attitudes within the marine sector by combining qualitative & quantitative data. In-depth insights into the qualitative element ensure a clear understanding of safety practices among seafarers, and by quantitatively analyzing patterns and linkages.

4.2Data Collection Methods

The structured questionnaires enable the collection of primary data on standardized responses about cognitive dissonance, risk perception, and compliance with safety norms. Secondary data in the form of literature, safety reports, and regulatory guidelines contributes to contextual analysis and increases the reliability of the study.

4.3Target Population and Sampling

The target population is comprised of professionals involved directly in the compliance of onboard safety, which includes seafarers, safety officials, and vessel operators. Participants who have experience relevant to risk management and marine safety are selected by means of purposeful sampling. When the sample varies in terms of ranks, kinds of vessels, and geographic locations, the findings are more widely applicable. Using the Cochran formula, 385 maritime professionals were selected as the appropriate sample size for this study. The questionnaire was distributed to 430 participants of various levels and types of vessels to ensure reliability. After selecting 25 of the 430 responses, which were either incomplete or wrongly filled out, a final verified sample of

405 maritime professionals was obtained. Given this sample size's high statistical power and generalizability, the results of this study are going to be certainly representative of the larger marine workforce.

4.4Research Instrument

The main study instrument is a structured questionnaire, which includes:

- **Demographic Information** (age, experience, education, job role).
- **Cognitive Dissonance Scale** (assessing inconsistencies between beliefs and actions).
- **Risk Perception Scale** (evaluating risk assessment and decision-making tendencies).
- **Safety Compliance & Attitudes Scale** (measuring adherence to safety protocols).

Pilot testing is done on the instrument to guarantee its validity and dependability.

4.5Data Analysis Techniques

SPSS and Microsoft Excel are used to evaluate quantitative data, applying:

- **Descriptive statistics** to summarize findings.
- **Factor analysis** to identify key influences on safety behavior.
- **Multivariate Analysis of Variance (MANOVA)** investigates how demographic characteristics affect attitudes toward safety, risk perception, and cognitive dissonance.

In order to find recurrent patterns in safety decision-making and behavioral explanations, theme analysis is used to examine qualitative data.

4.6Ethical Considerations

Participants are provided with information consent so as to ensure participation voluntarily and the right to withdraw. Data anonymity and confidentiality are maintained through safe data handling and the removal of personally identifiable information. Solid commitment to the best ethical practice is what guarantees participant and data confidentiality.

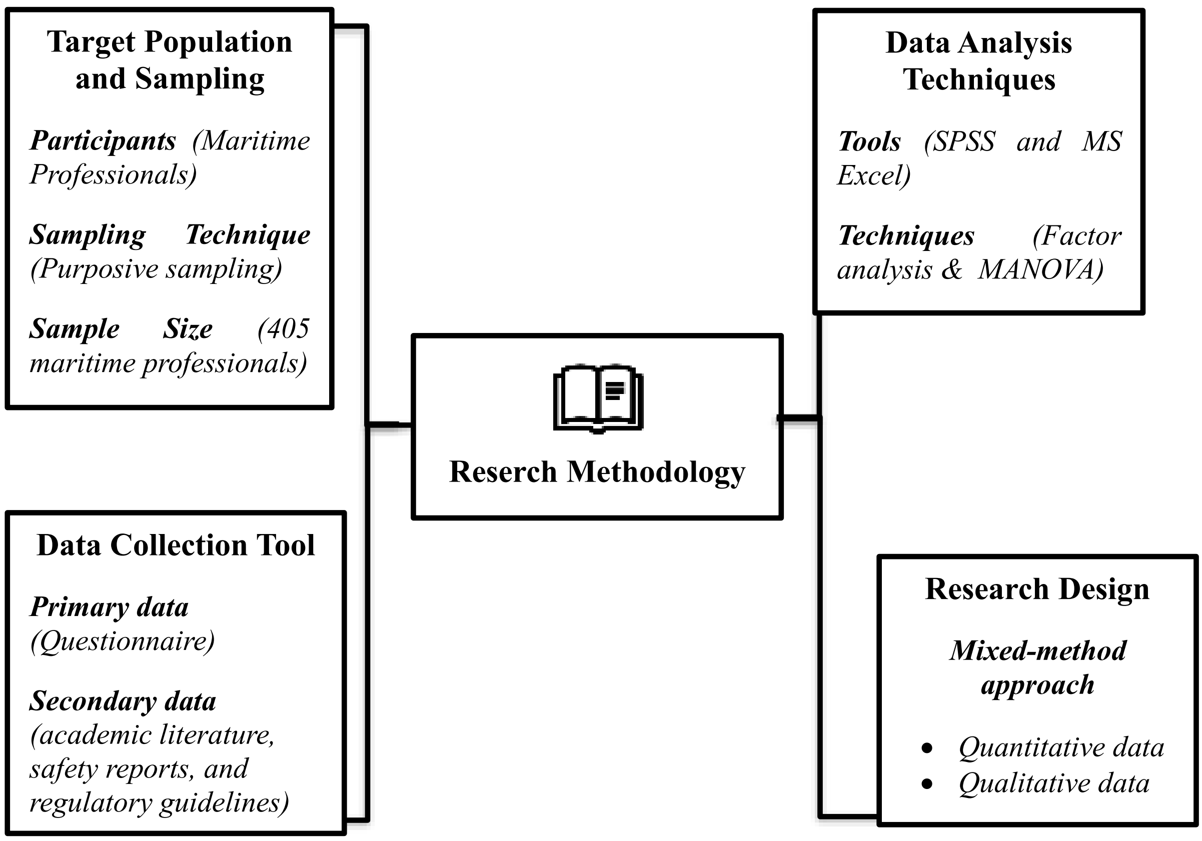

Figure 2: Research Methodology

Source: Self-prepared by author

This approach guarantees a detailed and insightful examination of the psychological factors that drive attitudes toward safety in the maritime industry.

5. RESULTS

This section comprises the findings and interpretation of the data. Reliability and validity, demographic characteristics, and objectives, as well as hypotheses, have been used to categorize the outcomes. A table displaying the results and an explanation of those results have been included in the aims and hypotheses.

Table 2: Reliability and Validity Statistics Table

Reliability Statistics				
Label	**Cronbach's Alpha**	**N of Items**	**KMO and Bartlett's value**	**Sig. value**
Risk Perception	0.936	8	0.833	0.000
Cognitive Dissonance	0.959	7	0.929	0.000
Safety Attitudes	0.957	6	0.912	0.000

Table 1 shows the reliability statistics present an incredibly high internal consistency among the three constructs, as indicated by the Cronbach's Alpha values greater than 0.9: Risk Perception (0.936), Cognitive Dissonance (0.959), and Safety Attitudes (0.957). It thereby addresses the claim that items within each scale reliably measure the respective constructs. Furthermore, the corresponding Kaiser-Meyer-Olkin values of involvement - Risk Perception (0.833), Cognitive Dissonance (0.929), and Safety Attitudes (0.912) are all clearly above the minimal threshold of 0.6, thus ensuring sampling adequacy for any future factor analysis endeavors. The Bartlett's Test of Sphericity is significant at $p=0.000$. Collectively, these results indicate that the measurement scales employed were both reliable and valid for further analysis.

Table 3: Demographic Characteristics of the Respondents

Sr. no.	**Demographics**	**Category**	**Frequency**	**Percentage**
1.	Gender	Male	309	76.3%
		Female	96	23.7%
2.	Age	Below 25 years old	106	26.2%
		25-39 years old	125	30.9%
		40-54 years old	103	25.4%
		55 years and above	71	17.5%
3.	Education Level	Highschool	82	20.2%
		Diploma in Nautical	127	31.4%
		Bachelor's Degree	101	24.9%
		Master's Degree	95	23.5%
4.	Job Role	Port Operations Staff	91	22.5%
		Non-officer Crew	63	15.6%
		Safety Officer	82	20.2%
		Engine Officer	91	22.5%
		Marine Superintendent	78	19.3%
5.	Years of Experience in the Maritime Industry	Less than 5 years	109	26.9%
		5-10 years	112	27.7%
		11-20 years	103	25.4%
		More than 20 years	81	20.0%

Table 2 shows the demographic profile of responders, revealing a diverse distribution across all categories. Of the total, 76.6% were male and 23.7% were female. According to the age distribution, 26.2% were under 25 years old, 30.9% were between 25 and 39 years old, 25.4% were between 40 and 54 years old, and 17.5% were 55 years old and above. The distribution of educational qualifications is as follows: 20.2% completed high school, 31.4% completed a diploma in nautical, 24.9% were graduates, and 23.5% were postgraduates. According to job role, 22.5% were port operations staff, 15.6% were non-officer crew, 20.2% were safety officers, 22.5% were engine officers, and 19.3% were marine superintendents. Years of experience indicated that 26.9% have less than 5 years of experience, 27.7% have 5-10 years of experience, 25.4% have 11-20 years of experience, and 20.0% have more than 20 years of experience. This comprehensive representation of all demographics provides a balanced foundation for the investigation.

5.1Results Based on Hypothesis

H1: Demographic factors significantly influence the interaction between cognitive dissonance and safety attitudes in the maritime industry.

Table 4: MANOVA Test Table

Source	Dependent Variable	df	Mean Square	F	Sig.	Wilk's Lambda (Sig.)
Corrected Model	Cognitive Dissonance	4	491.964	8.836	.000	
	Safety Attitudes	4	544.609	9.729	.000	
Intercept	Cognitive Dissonance	1	13298.459	238.841	.000	.000
	Safety Attitudes	1	7436.830	132.860	.000	.000
Age	Cognitive Dissonance	1	241.351	4.335	.038	.009
	Safety Attitudes	1	541.280	9.670	.002	.009
Education	Cognitive Dissonance	1	463.310	8.321	.004	.009
	Safety Attitudes	1	418.018	7.468	.007	.009
Job Role	Cognitive Dissonance	1	328.163	5.894	.016	.012
	Safety Attitudes	1	473.489	8.459	.004	.012
Experience	Cognitive Dissonance	1	583.717	10.484	.001	.005
	Safety Attitudes	1	320.845	5.732	.017	.005
Error	Cognitive Dissonance	400	55.679			
	Safety Attitudes	400	55.975			
Total	Cognitive Dissonance	405				
	Safety Attitudes	405				
Corrected Total	Cognitive Dissonance	404				
	Safety Attitudes	404				
a. R Squared = .081 (Adjusted R Squared = .072)						
b. R Squared = .089 (Adjusted R Squared = .080)						

Table 3 shows that the multivariate analysis demonstrates that demographic peculiarities, such as age, education, job role, and experience, strongly mediate the interaction between cognitive dissonance and safety attitudes in the maritime industry. The model is statistically significant for both cognitive dissonance (F = 8.836, p = .000) and safety attitudes (F = 9.729, p = .000), meaning that the totality of demographic variables contributes significantly to the variance in these psychological constructs. Age (p = .038 and .002), education (p = .004 and .007), job role (p = .016 and .004), and experience (p = .001 and .017) will all affect both dependent variables significantly. Hence, the significant Wilk's Lambda values have proven that demographic factors influence the multivariate relationship as well. Although, the R-squares are on the lower side (8.1% for cognitive dissonance and 8.9% for safety attitudes); they still signify that these demographic parameters are reasonably influential in seafarers' psychological responses and attitudes toward safety, which makes them significant in the maritime safety management strategy as far as workforce diversity is concerned.

H2: There is a significant relationship between risk perception and safety attitudes among maritime industry professionals.

H3: Cognitive dissonance mediates the relationship between risk perception and safety attitudes.

Table 5: Communalities Table

Communalities		
	Initial	Extraction
RP1	1.000	.766
RP2	1.000	.807
RP3	1.000	.777

RP4	1.000	.760
RP5	1.000	.772
RP6	1.000	.752
RP7	1.000	.785
RP8	1.000	.767
CD1	1.000	.783
CD2	1.000	.714
CD3	1.000	.767
CD4	1.000	.767
CD5	1.000	.690
CD6	1.000	.729
CD7	1.000	.772
SA1	1.000	.851
SA2	1.000	.819
SA3	1.000	.821
SA4	1.000	.810
SA5	1.000	.817
SA6	1.000	.855
Extraction Method: Principal Component Analysis.		

Table 4 shows that the communalities table using Principal Component Analysis is high extraction of all items from the constructs Risk Perceptions, Cognitive Dissonance, and Safety Attitudes, which indicates their strong contribution to the underlying latent factors. Its most significant items are RP2 (0.807), RP3 (0.777), and RP7 (0.785)-under Risk Perception-which assert that these are best understood by reference to elements that usually reflect Severity Awareness, Organizational Framing, and Optimism Bias, as derived from the extracted factor structure. Likewise, on the side of Cognitive Dissonance, indices like CD1 (0.783) and CD7 (0.772) suggest compliance-pressure conflict and cultural inconsistency may yield strong factor convergence as well. It is similarly interesting that high communalities were recorded on Safety Attitudes, with SA6 (0.855), SA1 (0.851), and SA3 (0.821)-which possibly embody Reactive Mindset, Safety Commitment, and Rule Adherence being the highest, thereby indicating that these items are good representatives of the construct. All in all, it is evident by the communalities that the identified factors could adequately characterize the dimensions underlying risk perception, dissonance, and safety attitudes in maritime contexts and, thus, support further analysis of the instrument's structural integrity.

Table 6: Rotated Component Matrix Table

Rotated Component Matrix[a]			
	Component		
	1	2	3
RP1	.838		
RP2	.868		
RP3	.844		
RP4	.844		
RP5	.855		
RP6	.837		
RP7	.862		
RP8	.835		
CD1		.835	
CD2		.804	
CD3		.797	
CD4		.797	

CD5		.741	
CD6		.785	
CD7		.818	
SA1			.818
SA2			.804
SA3			.800
SA4			.835
SA5			.809
SA6			.835
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 5 iterations.			

Table 5 shows the analysis via Principal Component Analysis using Varimax rotation reveals a distinct three-factor structure corresponding to the constructs of Risk Perception, Cognitive Dissonance, and Safety Attitude. All Risk Perception items (RP1-RP8) load strongly on Component 1, with loadings ranging from 0.835 to 0.868, which refers to a delineated dimension that incorporates factors of perceived vulnerability and clarity of communication. Component 2 captures all Cognitive-Dissonance items (CD1-CD7) and yields loadings of between 0.741 to 0.835, which refers to elements such as conflict from compliance pressure and cultural inconsistency. Finally, Component 3 comprises all Safety Attitude items (SA1-SA6), loading from 0.800 to 0.835 and representing attitudes such as safety commitment and proactive behavior. The absence of any cross-loading and the substantial loading values provide evidence for each construct's internal consistency and uniqueness, thus confirming the structural validity of the measurement model in the maritime industry.

Table 7: Convergent Validity of the Constructs

S. no.	Construct	Items	Standardized Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
1.	Risk Perception	RP1	0.862	0.958	0.957	0.739
		RP2	0.888			
		RP3	0.867			
		RP4	0.848			
		RP5	0.852			
		RP6	0.840			
		RP7	0.863			
		RP8	0.856			
2.	Cognitive Dissonance	CD1	0.861	0.942	0.943	0.701
		CD2	0.800			
		CD3	0.859			
		CD4	0.858			
		CD5	0.802			
		CD6	0.827			
		CD7	0.851			
3.	Safety Attitudes	SA1	0.913	0.958	0.959	0.794
		SA2	0.882			
		SA3	0.890			
		SA4	0.865			
		SA5	0.884			
		SA6	0.910			

Table 6 shows the three constructs deemed extraordinarily psychometric-adapted and significant for all three of Risk Perception, Cognitive Dissonance, and Safe Attitudes, strong measurement models floated under the respective factor models on which they were built. Risk Perception, including perceived vulnerability, severity awareness, organizational framing, environmental conditions, technological trust, familiarity bias, optimistic bias, communications clarity, comprised excellent reliability with highly standardized loadings (0.840-0.888), high Cronbach's Alpha (0.958), Composite Reliability (CR) 0.957 versus AVE of 0.739in percentile. This shows that those people who do maritime activities share and resonate well on many dimensions of risks in their operational environment. Cognitive Dissonance, determined by factors such as Compliance-Pressure Conflict, Reporting Inhibition, Outcome Justification, Policy-Practice Gap, Productivity-Safety Tradeoff, Hierarchical leniency, and Cultural inconsistencies, also indicates high internal consistency (Alpha = 0.942, CR = 0.943, AVE = 0.701), suggesting that contradictory safety expectations and operational demands are a significant psychological stressor for crews. Safety Attitudes, with factors like Safety Commitment, Risk Tolerance, Rule Adherence, Proactive Behavior, Incident Transparency, and Reactive Mindset, shows the overall highest validity (Alpha = 0.958, CR = 0.959, AVE = 0.794), showing the clear indication of strong culture and awareness of safety in the maritime environment. Indeed, the constructs were found not only to be statistically reliable and valid but also essential for understanding the behavioral safety dynamics in the maritime industry.

Table 8: Discriminant Validity

	CD	RP	SA
CD	0.837		
RP	0.432	0.860	
SA	0.716	0.494	0.891

Table 7 shows the results of discriminant validity, which were evaluated according to the Fornell-Larcker condition, vouching for the distinction of one construct from the others: Cognitive Dissonance (CD), Risk Perception (RP), and Safety Attitudes (SA). The square root of Average Variance Extracted (AVE) for each construct (diagonal values of CD = 0.837, RP = 0.860, SA =0.891) is greater than the inter-construct correlations (off-diagonal values), thus fulfilling the Fornell-Larcker condition. Though Cognitive Dissonance and Safety Attitudes share a relatively large correlation of 0.716, which is still below the AME square root, the separation of the related terms indicates that they truly measure different phenomena in concept. These constructions have thus been deemed to possess adequate discriminative validity, separating them as distinguishable constructs and, where appropriate, being included in subsequent structural modeling under maritime safety behavior research.

Table 9: Goodness of Model Fit Indices

The Goodness of Fitness Index	**GFI**	**AGFI**	**CFI**	**NFI**	**RMSEA**	**TLI**	**SRMR**
Calculated Value	0.900	0.876	0.968	0.947	0.060	0.964	0.028
Expected Value	**Above 0.9**	**Above 0.9**	**Above 0.9**	**Above 0.9**	**Below 0.10**	**Above 0.9**	**Less than 0.05**

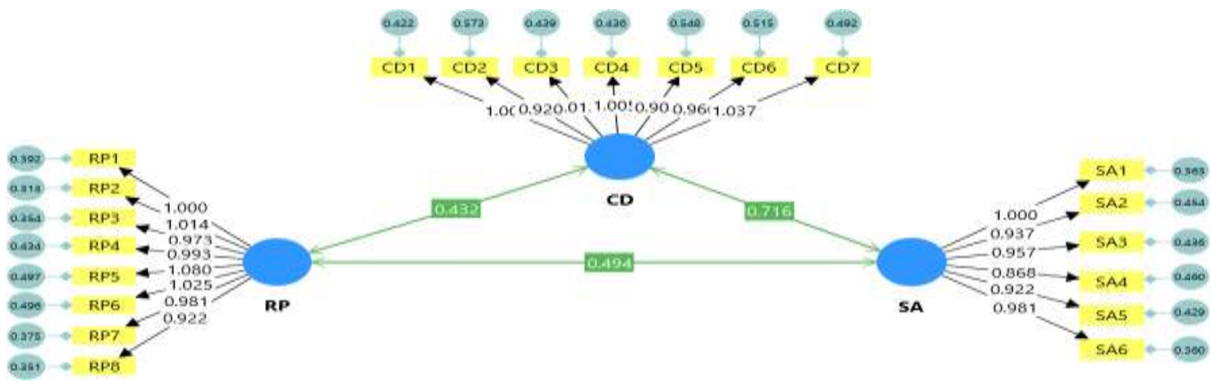

Figure 1 Measurement Model

Figure 1 shows the structural equation model with some interrelationships between Risk Perception (RP), Cognitive Dissonance (CD), and Safety Attitudes (SA). Each of these constructs is measured by several high-loading indicators, which show their strong reliability and validity. The relationship between Risk Perception and Cognitive Dissonance was found to be positive and moderate (0.432), while the direct effect of Risk Perception on Safety Attitudes was higher (0.494). On the other hand, Cognitive Dissonance acts as a strong force on Safety Attitudes (0.716). The factor loadings for all indicators are also consistently high (approx. between 0.90-1.00), confirming the strong construct measure. It is found that people with a keen awareness and perception of risk would more often come across cognitive dissonance, thus significantly enhancing their safety attitudes, which in turn fits the theoretical structure of the model.

Table 10: Hypothesis Testing

Hypothesis	Predicted Relationship	Direct Effect	Indirect effect	Total effect	Mediation
H2	RP -> SA	0.494	-	0.523	-
H3	RP -> CD -> SA	0.494	0.310	0.803	Partial Mediation

For H2: The outcomes validate the existence of a significant and positive direct relationship between Risk Perception (RP) and Safety Attitudes (SA), with a direct effect value of 0.494. This shows that when maritime professionals become more aware of risks such as environmental conditions, technological trust, and organizational framing, their attitudes toward safety, for example, in rules commitment, proactive behavior, and incident transparency, improve. The strength of this direct relationship underlines the critical role of perceived risk in shaping the behavior of safety-oriented individuals in the maritime environment.
For H3: The present hypothesis is confirmed by the identification of some mediation by Cognitive Dissonance (CD). The indirect effect of RP on SA through CD is 0.310, while the combined total effect, direct-indirect-measured at 0.803, is significantly higher than the direct effect. Risk perception will therefore directly affect safety attitudes while increasing cognitive dissonance in the form of internal conflict, reporting inhibition, or policy-practice gaps that will motivate people to develop safer attitudes. The fact that partial mediation exists shows that cognitive dissonance remains an important intermediary in enhancing safety behavior. In parallel, risk perception has an appreciable direct influence.

6. DISCUSSION

The findings from this study reveal a subtle interaction between cognitive dissonance and risk perception in shaping maritime professionals' safety attitudes. Specifically, and similar to the results shown in Bergheim et al. (2015), examining psychological capital and job satisfaction, a higher perception of risk was directly linked to stronger safety attitudes. This supports the finding that the more a seafarer became aware of risks, such as vulnerability and severity, the more positively they behaved toward safety. This aligns with the three-factor structure from our analysis (Component 1: Risk Perception; Component 3: Safety Attitudes) and the highly significant direct effect (β=0.494) in our structural model. However, cognitive dissonance partially mediated the relationship (indirect effect = 0.310), indicating that when individuals perceive high risks but, due to operational or social pressures, motives conflict with safety procedures, they still justify their behavior based on cognitive dissonance as explained in the literature (Festinger, 1957). Such dissonance-based justifications are similar to what Roeser termed "normalization of deviance" in other high-risk contexts (Equils et al., 2023) and agree with the classic review of dissonance theory, which views dissonance as a way to modify behavior (Hinojosa et al., 2017).

The study also found that demographic variables such as age, experience, and education significantly influence cognitive dissonance and safety attitudes, supporting previous MANOVA results showing these variables together explain a notable portion of the variance ($R^2 \approx 0.08$). These findings align with mixed-method observations that individual backgrounds affect the risk perception process (Liu & Yang, 2023) and that overconfidence from experience can decrease risk perception while increasing dissonance (Weston et al., 2022). The current results further validate Safety II perspectives by demonstrating that the cognitive gaps between Safety I and Safety II practices (Qiao et al., 2021) are largely responsible for most noncompliance: experienced crew fail to recognize hazards because they believe safe voyages are an illusion of control (Chang et al., 2021). Therefore, the interaction of these psychological mechanisms in the environment both supports and complicates existing literature on maritime safety culture and human factors (Hetherington et al., 2006; Schröder-Hinrichs et al., 2012).

Table 11: Comparison Table

Citation	Finding	Research Gap	How the Present Study Fills the Gap
Xi et al. (2022)	Safety climate positively impacts safety consciousness and behavior; consciousness mediates the effect.	Lacks a psychological explanation for why individuals resist safe behavior despite awareness.	Introduces cognitive dissonance as a mediating mechanism to explain the gap between safety knowledge and actual behavior.
Pekcan (2017)	Psychological contract breach leads to unsafe behavior; attentional failure reduces pro-safe actions.	Focused mainly on motivational/attentional resource theory, not dissonance arising from conflicting values and risks.	Explores how conflicting risk perception and safety norms create dissonance, leading to rationalization or unsafe choices.
Holland (2020)	Perception of safety in cruising is influenced by health risks; non-cruisers perceive more risk.	Focused on passengers, not crew; lacks integration of perception with behavior and cognitive processing.	Shifts focus to crew-side risk perception, linking it to cognitive mechanisms and observable safety behavior.
Arslan et al. (2016)	Introduced a framework to assess and improve safety culture through indicators and feedback.	Lacks psychological underpinnings behind attitudes; overemphasizes structural/organizational factors.	Combines structural influences with individual psychological constructs (risk perception, dissonance) for a fuller understanding.
Teperi et al. (2019)	ISM code supports Safety-I approach; human elements neglected; operative personnel under-involved.	Fails to explain why personnel disengage from safety culture; lacks focus on internal conflict or perception.	Explains disengagement through dissonance between policy and practice, emphasizing psychological strain on personnel.

The existing literature mostly considers organizational and structural influences on maritime safety behavior, but few examine the psychological factors that affect individual decision-makers in high-risk settings (Chen, et al., 2019; Xu, et al., 2021). For example, Xi et al. (2022) and Saleem et al. (2022) reported how safety climate impacts safety awareness and behavior among ship officers, with awareness acting as a mediator. Although their model highlights influences on behavior, it does not explain why officers might still engage in unsafe actions despite high safety awareness. Similarly, Pekcan (2017), Jones (2024), and Bankins (2015) used psychological contract theory to explain safety lapses. They suggest that motivational depletion results from cognitive failure but do not address the inner conflict that occurs when values oppose actions. In contrast, this study highlights the overlooked yet relevant psychological concept of cognitive dissonance, which further explains the disconnect between risk perception and actual safety behavior. This research offers new insights into maritime safety by demonstrating how perception develops and how individuals resolve conflicts between perceived risks and operational pressures. By integrating risk perception and cognitive dissonance into a structural model, it enhances explanatory power and practical relevance, providing a more grounded approach compared to earlier models that mainly relied on external or motivational factors.

7. CONCLUSION

The main objective of this study was to explore the psychological foundations of safety attitudes in the maritime industry, focusing on the relationship between cognitive dissonance and risk perception. Using empirical data collected from 405 maritime professionals and analyzed through advanced statistical modeling, the research revealed that cognitive dissonance plays a mediating role in how perceived risk influences safety attitudes. Furthermore, these psychological processes were found to be affected by demographic variables such as age, experience, and education. The findings suggest that safety behavior in the maritime context is not solely a result of regulations or law enforcement; rather, it stems from internal conflicts, perceived hazards, and individual reasoning under pressure. This investigation highlights the need to move beyond compliance-focused approaches to safety, advocating for a more psychologically informed understanding of maritime safety.

The study provides valuable insights for designing training programs, organizational strategies, and policy reforms in the maritime industry. It highlights that cognitive dissonance may affect maritime practitioners, particularly when the pressures of operational efficiency conflict with safety norms. Organizations can create targeted interventions to address these internal conflicts. Establishing open channels of communication can facilitate the incorporation of cognitive-behavioral techniques into safety training. Additionally, employing technology, such as virtual reality simulations, can help align safety awareness with behavior. Importantly, this underscores the necessity of viewing cognitive dissonance and risk perception as central elements of maritime safety culture, rather than peripheral concerns. As the industry evolves with technological advancements and increasing operational demands, these insights will be essential for ensuring long-term sea safety and resilience.

- **Implications for Maritime Safety Culture**

The training designed for officers should focus on strategies to address and resolve conflicts arising from cognitive dissonance, rather than merely emphasizing compliance with procedural guidelines. For example, using virtual reality-based simulations has proven effective in helping sailors navigate challenging environments and scenarios, thereby fostering intrinsic motivation and facilitating learning. The organization should implement risk-based thinking frameworks that have been successful in the mining and other industries to collaboratively identify hazards and reduce optimism bias. At the policy level, incorporating storytelling techniques into safety briefings could help align individual beliefs with the organization's safety norms, thereby reducing resistance stemming from cognitive dissonance. Additionally, conducting regular psychophysiological evaluations, such as EEG assessments within a simulator, can help identify early signs of cognitive overload. This approach will allow for timely interventions, such as workload adjustments or shifting work schedules, to prevent risk underestimation due to fatigue.

- **Limitations**

Since this study is cross-sectional, it cannot establish causal relationships. Longitudinal or experimental designs would be more effective in capturing changes in cognitive dissonance over time and across different operational contexts. Additionally, the use of a self-reported questionnaire format posed a risk of response biases, which is a common issue in observational studies. This highlights the necessity for further research that employs objective behavioral or physiological measures. While the current sample size of 405 is diverse, it may not accurately represent other maritime sectors, such as offshore oil installations or cruise liners, where perceptions of risk and organizational climate may differ. Lastly, although the models identified theoretically significant relationships, the relatively low R^2 values (8–9%) indicate that other unmeasured variables, such as cultural values or leadership styles, could also be influencing the outcomes.

- **Future Research Directions**

Future studies should employ longitudinal designs to assess the shifting perceptions of risk and behavioral compliance following dissonance-focused intervention, such as participatory risk workshops, literally throughout several voyages. Experimental manipulations could be set in place, for instance, by way of VR training with varying degrees of scenario realism, to explore the causal interplay between risk perception, dissonance, and safety behavior. Broadening the scope to emerging fields, with autonomous vessel operation as an example, would also verify if the well-established approaches to risk perception hold in human–machine teaming contexts. Wearable sensor technologies to track cognitive load and stress levels in real time, on the other hand, could help tie together these physiological findings with subjective self-reports of dissonance and identify latent fatigue effects. Finally, another future research track may compare national or cultural contexts to uncover broader social currents contributing to risk normalization and wider implications for dissonance-based intervention. Taking together, these trials will invigorate the comprehension of psychological drivers of safety and inform more resilient maritime safety cultures.

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