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Safety culture in maritime transport in Norway and Greece: Exploring national, sectorial and organizational influences on unsafe behaviours and work accidents

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ABSTRACT

The study compares crew members on Norwegian cargo vessels (N = 93) and passenger vessels (N = 76) with crew members on Greek cargo vessels (N = 99) and Greek passenger vessels (N = 99). The aims are to: 1) Examine the influence of national safety culture, sector safety focus and organizational safety culture on safety behaviours, compared with other explanatory variables (e.g. age, position, vessel type, working conditions) and to 2) Examine the influence of safety behaviours and other factors on occupational injuries. The paper focuses on the following unsafe behaviours: 1) Risk acceptance/violations, 2) Working under the influence of alcohol, or while being hungover and 3) Non-intervention/non-reporting. Organizational factors like demanding working conditions and organizational safety culture are the most important predictors of Risk acceptance/violations and Non-intervention/non-reporting. National safety culture is the most important predictor of respondents' tendency to work under the influence of alcohol/hungover. Respondents' occupational injuries are influenced by Risk acceptance/violations, nationality and age. The study indicates that safety culture at different analytical levels, influence different types of unsafe behaviours, which in turn influence the risk of work injuries. Thus, it is suggested that it is important to study safety culture at different analytical levels (i.e. the national, sectorial and organizational), to fully understand the influence of culture on safety in transport.

1. Introduction

The importance of maritime transport is indicated by the fact that about 90% of the world's merchandise is transported by sea. In spite of safety improvements in recent years, seafaring is still termed one of the most hazardous occupations (Oldenburg & Jensen 2012, cf. [8]). At EU level, in the period 2011–2016, there were on average 100 fatalities and 935 injuries annually reported in the European Marine Casualty Information Platform (EMCIP) [9]. On Norwegian ships, an average of 15 people was killed and 424 injured annually in the period 2004–2013 [36]. Thus, it seems that there still is a considerable potential for improving safety in the maritime sector.

The main safety prevention focus in the maritime sector is on technical barriers and safety management systems (SMS). SMS typically include management policy, appointment of key safety personnel, reporting systems, hazard identification and risk mitigation, safety performance monitoring etc. [52]. The SMS focus in the maritime sector is a result of the International Maritime Organization's (IMO) SMS requirement in the International Safety Management (ISM) code. IMO's primary goal with the ISM code was to gradually create a new safety culture in the maritime industry [53]. Organizational safety culture can be defined generally as "safety relevant aspects of culture in organisations" [15,4]. Antonsen [4] distinguishes between two aspects of organizational safety management. The first is the formal aspect of safety ("how things should be done"), as formulated in procedures, routines and organizational charts etc. The second is the informal aspect of safety ("how things are actually done"). Thus, it could perhaps be argued that the SMS requirements of the ISM-code refer to the formal aspect of organizational safety management, while the actual SMS implementation and enactment refer to the informal aspect, or the safety culture (cf. [31]).

Although studies have highlighted the importance of organizational

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safety culture for maritime safety, (cf. [21,27,28,50]), there seems to be few studies of maritime safety culture compared to other sectors. In 2005, Håvold reported literature searches indicating that only a couple of studies about safety culture and climate recently had been done in shipping [20]. A review conducted eight years later still found relatively few studies of safety culture at sea [38].

Previous research indicates however, that not only the organizational level is important for safety culture; it also indicates that the national level may be important for safety culture [17,20,25]. Research also shows important differences between sectors and subsectors when it comes to safety culture and safety performance [33,48,6]. Thus, if one is to fully understand the influence of safety culture on safety in maritime transport, one should study not only safety culture in organisations, but that particular to other social units, like sectors, regions and nations. Since safety culture is by definition shared, it must be related to social units. Nævestad [39] defines safety culture as safety relevant ways of thinking or acting that are (re)created through the joint negotiation of people in social settings. This definition can be applied to these different analytical levels, e.g. the organizational, sectorial and national.

The aims of the study are to: 1) Examine the influence of national safety culture, sector safety focus and organizational safety culture on safety behaviours, compared with other explanatory variables (e.g. age, position, vessel type, working conditions) and to 2) Examine the influence of safety behaviours and other factors on occupational injuries.

1.1. Previous research

1.1.1. Factors influencing maritime safety behaviours

1.1.1.1. Organizational safety culture. The most studied and well-documented characteristic of a good safety culture/climate is senior managers' commitment to safety [10]. Other key aspects of safety culture highlighted in several studies are an informed, reporting and learning culture, continually reflecting upon practice [41,42]. Håvold and Nesset [21] include safety behaviour as a safety outcome variable in a study where they develop the safety culture concept further into "safety orientation", which is defined as an implementation of the safety culture concept. The study is based on data 141 vessels and 2558 respondents. It is concluded that the study confirms the usefulness of safety culture/climate factors as predictors of unsafe behaviour. The influence of safety culture on seafarers' safety behaviour is also investigated by Lu and Tsai [27] by use of a safety culture survey combined with self-reported safety behaviour. This study also found a positive relationship between safety culture and safety behaviour.

1.1.1.2. Sector safety focus and safety culture. A previous study finds different organizational safety culture scores in different transport sectors (road, rail, aviation) [6]. The authors suggest that these differences are in accordance with the safety performance in each of the sectors, indicating that the safest lines of transport have the highest organizational safety culture scores. They argue that these differences are likely to be due to differences in framework conditions like rules/enforcement, competition and regulation.

Research also indicates that the risk of occupational injuries differs between different maritime subsectors. Hansen et al. [16] find that passenger vessels have lower risk of serious occupational injuries and fatal accidents than coastal cargo vessels, indicating a higher safety level in the former. This study also finds, however, that passenger vessel crews have a higher risk than coaster crews of all occupational accidents. The authors suggest that this paradox could indicate under-reporting and poorer organizational safety culture on board coaster vessels than on passenger vessels [16]. The paradox and the associated hypothesis motivate the study of Nævestad et al. [32,33], who compare and discuss safety culture and working conditions in Norwegian maritime passenger and cargo transport in light of the sectors' framework conditions: 1) Market and economy and 2) Rules and regulations. This study also examines the relationship between safety culture and safety behaviour, and it finds that the lower safety culture scores in the coastal cargo sector are related to higher levels of unsafe behaviours, which supposedly could be related to framework conditions. Finally, comparing occupational accident risks among the cargo vessel crews, Hansen et al. [16] found that vessels related to the petroleum industry (e.g. gas tankers) had the lowest risk, while coastal cargo vessels (coasters) had a higher risk.

1.1.1.3. National safety culture. Håvold [20] asserts that the research literature on national culture shows that it influences values, communication styles, methods of conflict resolution, decision making and organizational behaviour. Håvold found significant differences between nationalities (Filipino, Indian, Norwegian, Polish and Croat seafarers) on a factor labelled "Management and employee attitudes to safety and quality"; comprised of 11 items measuring aspects mostly related to organizational safety culture. One of the national safety culture aspects most relevant to safety seems to be related to employees' attitudes to their managers (e.g. [17]). Reluctance to question managers' decisions, report safety issues, report your own mistakes etc. to managers are indicators of poor safety culture, and can be expected to vary along the national cultural dimension of value of hierarchy, or deference to authority in a society [13,18,19].

1.1.1.4. Work pressure. Størkersen [48] underlines the importance of framework conditions and working conditions for unsafe behaviours in Norwegian coastal cargo transport. Størkersen et al. [47] study factors influencing safety onboard ten coastal cargo vessels sailing along the coast of Norway. This study indicates the importance of goal conflicts between safety and production on board. Although it should be noted that the study is based on small numbers, the authors found that one third of the respondents reported that they put themselves in danger to get the job done, while about 40% violate procedures to get the job done, especially because of efficiency demands [47]. This indicates that work pressure influences safety behaviour.

1.1.1.5. Manning level. Although it is difficult to find studies examining the relationship between manning level and safety behaviours, Nævestad [35] found that lower manning levels is related to personal injuries. This study does not measure behaviour, but it finds that lower manning levels is related to more work pressure, demanding working conditions, higher risk perception and lower safety culture scores.

1.1.1.6. Demanding working conditions. Previous research, especially from the coastal cargo sector has suggested relatively intense working patterns found in subsectors, e.g. coastal shipping [44–46]. Expert interviewees in a previous study [35] pointed to the potential high work load among deck workers on coastal cargo vessels with low manning levels and many port calls, because of many loading operations (requiring work before, during and after) and maintenance work. It was suggested that these work features seem to induce irregular working patterns and little rest. In a previous study, where seafarers rated work activities according to effort, coastal seafarers rated maintenance and loading tasks as highest, although navigation and watch keeping also required moderately high effort [44].

1.1.2. Factors influencing occupational accidents

1.1.2.1. Demographic factors. Hansen et al. [16] found the following factors to be related to occupational accident risk: 1) Age: younger seafarers had a higher risk, 2) Change of ship and the first period aboard a ship were identified as risk factors, 3) foreigners (Filipino) have a considerably lower accident risk than local (Danish) citizens, 4) the most serious accidents happened on deck. Jensen et al. [22], found the following factors to be related to personal accident involvement: 1) Seafarers' age (< 35 years), 2) Tour lengths (< 117 days), 3) Position (ratings had a higher risk of occupational accidents than other groups),

4) Work in engine room. Nævestad et al. [35] also found seafarers age (< 26 years) to predict occupational accidents.

Several studies find that nationality influences occupational accident risk. As noted, Hansen et al. [16] find that Filipino seafarers had a lower risk than Danish seafarers. In a study of occupational accidents in the Danish merchant fleet, Ádám et al. [55] found that Western European seafarers had an overall accident rate of 17.5 per 100,000 person-days, which proved to be significantly higher than that of Eastern European, South East Asian and Indian seafarers. The differences seem to be consistent between severity levels, which may indicate that results cannot (only) be attributed to different reporting rates. Bye and Lamvik [5] describe similar trends, based on Norwegian data. Discussing the lower occupational injury risk of Filipino seafarers compared to Western European seafarers, Lamvik and Ravn [25] assert that, although underreporting may explain some of these differences, e.g. due to fear of not getting contracts renewed, the differences should be treated as real national differences. They suggest that the differences could be due to differences in national culture, asserting that the Filipino seafarers primarily value themselves as providers for, and delegates from their family back home, which motivates a relatively safe work practice (cf. [24]).

1.1.2.2. Safety behaviours. To the authors' knowledge, there are few multivariate analyses from the maritime sector examining the influence of safety behaviour on work accidents, controlled for other important variables (age, position, nationality, type of transport). Nevertheless, it should be assumed that most of the above-mentioned relationships between demographic factors and accidents are mediated by behaviours. Jensen et al. [22] found lacking use of protective equipment to be related to personal accident involvement. Moreover, Ádám et al. [55] suggest that the observed differences in accident involvement between national groups of seafarers could be due to different safety behaviours without specifying what kind of behaviours. Although there seem to be few multivariate analyses of the relationship between maritime safety behaviours and occupational accidents, previous studies may be used to point to safety behaviours that may influence occupational accidents. First, studies from other sectors (e.g. rail and road) indicate an important relationship between procedure violations and work accidents [26]. This research also found that self-imposed or external pressure to do the job more efficiently or quickly was the most important factor influencing violations [26]. (See also Nævestad et al. [31], for a discussion of factors influencing procedure negligence in the maritime sector.) Second, previous research from the maritime sector may indicate that certain types of behaviour could be an important risk factor in the maritime sector, and/or that differences could be expected between national groups on these behaviours. In line with Lawton [26], research from Norwegian coastal cargo indicate that procedure violations and risk acceptance could be related to safety outcomes (worry about risk) [47]. Previous research also indicates that alcohol consumption may be an important risk factor in the maritime sector [2]. Moreover, research also suggests that some national groups may be reluctant to intervene towards, and speak their mind about safety to managers and colleagues [54]. This could indicate a lower safety orientation, which potentially could be related to accident involvement and perhaps also impede a reporting safety culture on board (cf. [42]).

1.1.3. Hypotheses based on previous research

To sum up, it is hypothesized, based on previous research, that the following variables influence maritime safety behaviours: 1) organizational safety culture, 2) sector safety focus, 3) national safety culture, and 4) demanding working conditions and work pressure.

Additionally, it is hypothesized, based on previous research, that the following variables influence occupational accidents: 1) demographic factors (age, nationality, position, line of work), 2) other factors (tour length, new on board, change of ship), 3) Safety behaviours (e.g. violations; especially related to work pressure, lacking use of protective equipment, alcohol use)

1.2. The "Safe Culture" project

The data in this project have been collected as part of the Safe Culture project, which is funded by the Norwegian Research Council, and undertaken by the Institute of Transport Economics - TØI (Norway), NTNU Social Research, SINTEF (Norway) and the National Technical University of Athens - NTUA (Greece). The project is exploring safety culture in land and sea based, professional and private transport in Norway and Greece. The present paper builds on and takes further the knowledge gained from previous studies, especially a conference paper from the Transport Research Arena conference (TRA), comparing factors influencing unsafe behaviours in Norwegian and Greek cargo transport [30], but also a conference paper from the 8th International Congress on Transportation Research (ICTR), comparing working condition safety culture and safety outcomes in Norwegian cargo and passenger transport [33]. The latter paper has also been developed into a paper submitted to a special issue devoted to the ICTR conference [32] (and is currently under review). The present paper takes insights from these studies further, comparing both passenger vessel and cargo vessel respondents in both Norway and Greece.

2. Method

2.1. Recruitment of respondents

The Norwegian respondents were recruited through the Norwegian researchers' contact with Norwegian shipping companies. Web links to the questionnaires were distributed by the shipping companies to all employees working on board vessels, along with an introductory text explaining the purpose of the survey and stressing that the surveys were confidential. The Greek respondents were recruited through a marketing research company in Greece, which was under the scientific supervision of researchers from the NTUA.

2.2. Description of the sample

In this study, only respondents who are either Norwegian (N = 169) or Greek (N = 198) are included. Norwegian respondents work on Norwegian vessels with mainly Norwegian crews, sailing in Norwegian waters. The same principles apply to the Greek respondents. This sampling strategy was chosen, as the project seeks to examine the influence of nationality and national safety culture. It should be noted, however, that the 84 respondents in Norwegian passenger transport were distributed on six different vessels travelling between Norway and three different countries. Due to small numbers of respondents on each vessel, these 84 respondents are divided on three different lines, each operated by two vessels. Among the passenger vessel respondents, 100% are working on nationally flagged vessels. Among the cargo crews, 98% of the Norwegian respondents work on nationally flagged vessels, while 78% of the Greek respondents work on nationally flagged vessels. The Norwegian cargo vessel respondents are mainly recruited from a pool of eight different shipping companies. In the Greek sample, 78 respondents denied naming the company/ship they work for. In the remaining Greek sample, 74 respondents belonged to five different shipping companies, while it was difficult to ascribe shipping company to the remaining 48 Greek respondents.

In Tables 1 – 3 the main characteristics of the survey sample are presented. It should also be noted that there are 11 women in the Norwegian sample and one in the Greek sample. Moreover, there are 96% full time employees in the Norwegian sample, and 99% in the Greek sample.

Table 1 indicates that 59% of respondents in the survey were aged between 36 and 55 years old. However, the share of young seafarers

Table 1
Distribution of respondents per nationality and age.

Nationality	< 26	26–35	36–45	46–55	56 +	Total
Norwegian cargo	17%	27%	20%	28%	8%	93
Greek cargo	3%	17%	27%	31%	21%	99
Norwegian passenger	7%	21%	22%	34%	16%	76
Greek passenger	2%	21%	37%	33%	6%	99
Total	7%	22%	27%	32%	13%	367
Norwegian	12%	24%	21%	31%	11%	169
Greek	3%	19%	32%	32%	14%	198

was larger in the Norwegian sample. This especially applies to the Norwegian Cargo sample. Table 2 shows the distribution of respondents per nationality and vessel type/sector.

Comparing subsectors within the two national samples (Table 2), results indicate that the main difference is that nearly a third of the Greek sample work on petroleum tankers (29%), while 20% of the Norwegian respondents work on live fish carriers. Norwegian passenger vessels are distributed on three lines, going to three different countries, while the Greek passenger vessels are distributed on two subsectors: passenger and ferry. Also, when comparing vessel characteristics between samples, results indicate that the average manning level on the Norwegian cargo vessels (avg. 6 people) is generally lower than on the Greek cargo vessels (avg. 19 people), probably reflecting different vessel sizes. The average self-reported manning level on the Norwegian passenger vessels is higher than on the Greek passenger vessels (140 people vs. 53 people). The manning level on the Norwegian passenger vessels range, however, from about 80 people to about 250 people.

As indicated by the manning levels, there are four times more cargo vessels in the largest vessel category (> 300 dwt) in the Greek cargo sample than in the Norwegian cargo sample (79% vs. 20%). The situation is the opposite in the passenger vessel sample with 89% of respondents in the largest category (> 300 dwt) in the Norwegian passenger vessels, compared to 65% of respondents among the Greek passenger vessels. Looking at the year of construction for the vessels, 54% of the Norwegian passenger vessels are constructed between 2004 and 2015, compared to 40% among the Greek cargo vessels, 78% among the Norwegian passenger vessels and 24% among the Greek passenger vessels. Table 3 indicates the distribution of respondents per nationality and position/line of work.

Table 3 indicates that 44% of the respondents in the Greek sample are employed in the machine department (3 positions), compared to 23% in the Norwegian sample. The share of captains is larger in the Norwegian sample, which also includes more respondents in catering. There are more deck officers in the Norwegian sample, and more deck crew in the Greek sample.

When it comes to the number of days on board in the two national groups, it is evident that the Greek seafarers (M = 236 days) in average stay onboard their vessels for far longer periods than their Norwegian counterparts (M = 26 days). Greek seafarers also have longer periods off board (M = 89 days) than the Norwegian (M = 26 days). The most prevalent watch schedule in Norwegian cargo was 6–6 (69%), and 12–12 in Norwegian passenger transport. For the Greek respondents a fixed watch schedule seems less common: 73% in Greek cargo transport answered: "it depends/not relevant", while 80% in Greek passenger transport did.

2.3. Survey measures

1) Background variables (15 questions): gender, nationality, age group, seafarer experience, position/area of work, employment status, vessel type, vessel size, manning on board, ship register, year vessel was built, days on/off board, work schedule, number/share of nationalities on board, number of employees in the shipping company.

2) Safety performance (5 questions): respondents' occupational injuries on board, ship acccidents, type of ship accidents, safety compromising fatigue and assessment of work-place safety level (1 − 10).

2a) Safety behaviours: (7 questions): Respondents were asked: "How often do you think the following events tend to occur for every 100 working days/nights on board? (cf. Table 4): (Answer alternatives: 1) Never, 2) 1–2 times, 3) 3–5 times, 4) 6–10 times, 5) 11–15 times, 6) 16–20 times 7) More than 20 times, 8) (Do not know/not relevant).

Previous factor analyses of the safety behaviour items including only the cargo vessel respondents from Norway and Greece, indicated a three-factor solution [30]. Thus, a principal component analysis (PCA) with oblimin rotation was used, selecting three components. The choice of the number of factors to retain was based on a combination of (a) inspecting the scree plot for a bending point, (b) inspecting the factor loadings in the component matrix, and c) by evaluating the expected conceptual and theoretical relationships between the items. Results showed two components with initial Eigenvalues higher than 1, and a third component with an Eigenvalue of 0.8, which together explained a total of 76% of the variance. By inspecting the scree plot, two bends were identified: one between factor 2 and 3 and one between factor 3 and 4. Thus, based on Eigenvalues, a two-factor solution would be appropriate, and based on the scree plot two or three factors would be appropriate. When interpreting the factor loadings in the pattern matrix, a similar solution as found in the previous study [30] was identified (Table 4). The first component measures "Risk acceptance/violations", the second measures "Working under influence/hungover", while the third measures "Non-intervention/non-reporting". This makes sense conceptually, as the second component not is correlated with the first component (0.087), and not strongly correlated with the third component. (−0.219). Moreover, it is difficult to conceptually relate the item on alcohol to the two other factors. Moreover, the first and the third component measure issues that could be separated analytically. These are: Risk acceptance/violations, which are related to working conditions and Non-intervention/non-reporting, which seem to measure aspects of reporting culture [30], and which also can be related to the national culture aspect of "deference to authority" [13]. Thus, a choice was made to keep the three-factor solution. Indexes summing the answers of the first factor (Cronbach's Alpha: .840) and the third factor (Cronbach's Alpha: .718) were made.

The four Risk acceptance/ violations items are primarily based on the research of Størkersen et al. [47], but also on Nævestad [35], and Lawton [26], underlining the relationship between violations (primarily related to work pressure) and accidents. The item about working under the influence/hungover was developed, as research indicates that alcohol consumption may be an important risk factor in the maritime sector [2], and that alcohol and drug abuse are greater for seafarers compared to workers ashore [40] (Kariris (2012) in reference [51]), partly because of their working situation (e.g. social isolation). The two items measuring Non-intervention and non-reporting were developed based on interviews and literature review in a previous study on

Table 2
Distribution of respondents per nationality and vessel type/sector.

Nationality	Bulk	General cargo	Tank	Live fish carrier	Other cargo	Greek Passenger	Greek Ferry	Norw. line 1	Norw. Line 2	Norw. Line 3	Total
Norwegian	20%	11%	0%	20%	4%	0	0	23%	9%	12%	169
Greek	8%	10%	29%	0%	4%	45%	5%	0	0	0	198
Total	13%	10%	16%	9%	4%	24%	3%	11%	4%	6%	367

Table 3
Distribution of respondents per nationality and position/line of work.

Nationality	Captain	Deck officer	Deck crew	Machine chief	Machine officer	Machine crew	Catering	Apprentice	Other	Total
Norwegian	14%	22%	11%	3%	13%	7%	16%	4%	11%	169
Greek	5%	10%	35%	6%	12%	26%	4%	2%	2%	198
Total	9%	15%	24%	4%	12%	17%	10%	2%	6%	367

Table 4
Questions, factors measuring maritime safety behaviour and factor loadings.

Questions	Risk acceptance/ violations	Working under influence/ hungover	Non-intervention/ non-reporting
I accept small risks because the "situation demands it" (e.g. because of time pressure, bad weather)	0.909		
I violate procedures to get the job done	0.893		
I work, even though I am so tired that safety may be compromised	0.783		
I refrain from using the required protection equipment in my work	0.643		
I work while being under the influence of alcohol (e.g. one beer or more), or while being hungover		0.993	
I refrain from telling risk taking colleagues to work in a safer way, as I find it impolite to intervene			0.940
I refrain from reporting safety problems and unsafe situations that I experience in my work to the ship management			0.793

internationalization and national culture in the maritime sector [54]. Nævestad [54] literature study indicates that seafarers on some vessels (especially some national groups) are reluctant to intervene towards managers and colleagues, because of deference to authority [13,18,19] and as they are afraid to unintentionally offend their colleagues [23]. Interviewees in Nævestad [54] study, asserted that Norwegian seafarers share a culture which is more outgoing than other national groups (e.g. Asian, Eastern European); which means that they are relatively unhesitant to speak their mind about safety issues to both their managers and their co-workers. This hypothesis, based on literature study and interviews, is the reason that the two Non-intervention/non-reporting items were developed.

3) Working conditions: (4 questions): How often do you think the following events tend to occur for every 100 working days/nights on board: "Your shift change is delayed because of work operations, for instance port calls?", "You work more than 16 h in the course of a 24-h period?, "You are interrupted when you are off duty". (Answer alternatives: 1) Never, 2) 1–2 times, 3) 3–5 times, 4) 6–10 times, 5) 11–15 times, 6) 16–20 times 7) More than 20 times, 8) Do not know/not relevant). The eight answer alternative was removed, and a "Demanding working conditions index" was made of these three questions (Cronbach's Alpha: 0.728). The survey also included a question on work pressure: "Sometimes I feel pressured to continue working, even if it is not perfectly safe" (Answer alternatives: 1 = totally disagree – 5 = totally agree, 6 = Do not know/not relevant).

4) Organizational safety culture (11 questions): an organizational safety culture index was made, consisting of questions from the GAIN-scale on organizational safety culture. This scale has been used in previous research from different transport sectors [37,6], including the maritime sector [35]. The GAIN-scale is presented in the"Operator's Safety Handbook" [12]. The GAIN-scale originally consists of 25 questions measuring five themes, but the scale was reduced to 11 questions, because of the total number of questions in the survey. Answer alternatives range from 1 (totally disagree) to 5 (totally agree). The 11 questions are:

- Ship management regards safety to be a very important part of all work activities
- The shipping company regards safety to be a very important part of all work activities
- Ship management detects crew members who work unsafely
- Ship management often praises crew members who work safely
- My colleagues on board usually report all safety problems and unsafe situations that they experience in their work
- My colleagues on board do all they can to prevent accidents and unwanted incidents
- There are routines (procedures) on board for reporting safety problems
- All defects or hazards that are reported are corrected promptly
- After an accident has occurred on board, appropriate actions are usually taken to reduce the chance of reoccurrence
- All crew members on board receive adequate training to work in a safe way
- Safety on board this vessel is better than on other vessels

An exploratory factor analysis (EFA) was conducted to examine the underlying factor structure of the 11 organizational safety culture items. Tests indicated that the items and the data were suitable for factor analysis. Bartlett's test of sphericity (approx. Chi-square) was 1625,833 ($p < 0.001$). The Kaiser–Meyer–Olkin's measure of sampling adequacy showed a value of 0.885. The cutoff value was sat at .4. Results showed two components with initial Eigenvalues higher than 1, which explained a total of 57% of the variance. All the 11 items loaded on the first component, while two items loaded on the second component, and the first. Only one of the (cross loading) items in the second component had a higher loading on the second component than the first. There was no substantial reason to keep the two items loading on the second component in a separate factor. Thus, a one-factor solution was chosen (Cronbach's Alpha = 0.870).

5) National safety culture: As the relationship between national safety culture and behaviour may be relatively abstract and difficult to explain theoretically, national safety culture is measured as descriptive norms [7] in the present study. Individuals' perceptions of peers' opinions about a given behaviour are often defined as injunctive norms, while individuals' perceptions of what peers actually do often are defined as descriptive norms [1,49]. Since injunctive norms are normative, they can be expected to directly influence peoples' behaviour. Descriptive norms may influence behaviour by providing information about what is normal [7]. Thus, the measure of national safety culture is "what respondents expect that other seafarers from their own country do". Answer alternatives range from 1 (none/very few) to 5 (nearly all/all). The items were introduced with the following sentence: "When working on vessels, I expect the following behaviours from other seafarers from my country: ":

Table 5
Scores for national safety culture index, sector focus on safety index and organizational safety culture index.

Sector	Nationality	National culture	N:	Std.d.:	Sector focus	N:	Std.d.:	Organizational safety culture	N:	Std.d.:
Bulk	Norwegian	10.3	33	5.0	7.8	33	2.2	44.2	33	8.1
	Greek	9.6	15	2.7	9.2	15	1.3	52.8	15	2.4
General cargo	Norwegian	10.3	19	4.0	6.4	19	2.7	47.1	19	4.2
	Greek	12.3	19	5.8	9.7	19	0.7	50.7	19	4.9
Tank	Greek	10.2	58	4.3	9.3	58	1.3	52.1	58	3.5
Live fish carrier	Norwegian	9.9	34	2.9	7.6	34	2.4	48.0	34	4.4
Passenger	Norwegian	8.9	76	3.3	8.0	76	2.2	48.2	76	5.2
	Greek	11.4	99	5.2	9.5	99	0.9	51.2	99	4.9
Total cargo	Norwegian	10.2	93	4.0	7.4	93	2.4	46.1	93	6.4
	Greek	10.4	99	4.4	9.4	99	1.2	52.1	99	3.6
Nationality	Norwegian	9.6	169	3.7	7.7	169	2.4	47.0	169	6.0
	Greek	10.9	198	4.8	9.5	198	1.0	51.7	198	4.3

- That they sometimes violate procedures to get the job done
- That they sometimes refrain from using the required protection equipment in their work
- That they sometimes work, even when they are so tired that safety may be compromised
- That they sometimes work being under the influence of alcohol (e.g. one beer or more), or while hungover
- That they sometimes take small risks if the "situation demands it" (e.g. because of time pressure, bad weather)
- That they sometimes avoid telling colleagues taking risks to work safely
- That they sometimes refrain from reporting safety problems and unsafe situations that they experience in their work to the ship management

These items were chosen based on the items measuring respondents' safety behaviours. An exploratory factor analysis (EFA) was conducted to examine the underlying factor structure of the 7 national safety culture (descriptive norms) items. Tests indicated that the items and the data were suitable for factor analysis. Bartlett's test of sphericity (approx. Chi-square) was 1681,208 ($p < .001$). The Kaiser–Meyer–Olkin's measure of sampling adequacy showed a value of 0.901. The cutoff value was sat at .4. Results showed one components with initial Eigenvalues higher than 1, which explained a total of 67% of the variance. The scree plot also indicated a one-factor solution, with a clear bend between component 1 and 2. Thus, a one-factor solution was chosen (Cronbach's Alpha = 0.913).

6) Sector safety focus: Sector safety focus is measured by means of two questions that were selected after a "scale if items deleted" analysis and a substantial consideration of five items in two previous studies [30,33]. The two selected items are: "Safety is more important than deadlines to our customers", "Safety is more important than price to our customers" (Cronbach's Alpha = 0.875). Unfortunately, the other three items that initially were considered were formulated in a relative way that could make them ambiguous, and thus less suitable for comparison across sectors. These items were therefore excluded. The excluded sector safety focus items are: "I don't expect safety improvements in my sector in the next 10 years", "Society accepts the current level of accidents that we have in my sector" and "Strong competition between companies impedes safety in my sector". The original intention was to measure sector safety culture by means of the five items.

2.4. Analysis of quantitative data

2.4.1. Comparison of means

When comparing the mean scores of different groups, one-way Anova tests, which compare whether the mean scores are equal (the null hypothesis) or (significantly) different are used.

2.4.2. Regression analyses

Four regression analyses have been conducted. In the three first analyses, the factors predicting respondents' answer on the dependent variables measuring the different types of unsafe maritime behaviours (i.e. risk acceptance/ violation, working under influence/ hungover, non-reporting/non-intervention) are analysed. Hierarchical, linear regression analyses are used, where independent variables are included in successive steps. The most basic independent variables are included first (e.g. age, position) then the other independent variables are included. In a fourth regression analysis, the factors predicting respondents' answers on the dependent variable measuring personal injuries are analysed. Logistic regression analysis is used in this analysis, as the dependent variable has two values (no = 1, yes = 2). B values are presented, and they indicate whether the risk of personal injuries is reduced (negative B values) or increased (positive B values), when the independent variables increase with one value. Of course, it is impossible to conclude about causality, as this is a cross-sectional and correlational study. The term predict is nevertheless used when the regression analyses are described.

3. Results

3.1. Safety cultural influences at three levels

Table 5 presents scores for the national safety culture index (7 items, min = 7, max = 35), sector focus on safety (2 items, min = 2, max = 10) and organizational safety culture (11 items, min = 11, max = 55). A high score on the national safety culture index indicates negative national safety behaviours, while high scores on the two other indexes indicate high safety focus.

Differences between the national groups on the national safety culture scales are not statistically significant, although there are considerable (2 points) national differences between respondents on General cargo vessels and passenger vessels. Greek respondents score in average significantly higher than Norwegian on the national safety culture index. The differences between subsectors within the national groups are considerable, indicating that respondents provide answers about the national level, based on experiences from their own sector.

The differences between mean scores for sector focus on safety are significant at the 1%-level. Greek respondents generally score higher on this index; differences are fairly similar in passenger and cargo transport. The differences between mean scores for organizational safety culture are also significant at the 1%-level. Greek respondents generally score in average about 2 points higher on this index; differences are largest in the cargo sector, especially in bulk transport.

Greek respondents score higher on all indexes in the tables, and they are more likely to use the maximum scores when answering the questions. As many as 42% of the Greek respondents answered "totally agree" on all the 11 organizational safety culture items, giving them the

Table 6
Mean scores for Demanding working conditions index and safety compromising work pressure.

Sector	Nationality	Demanding working conditions	N:	Std.d.:	Safety compr. work pressure	N:	Std.d.:
Bulk	Norwegian	7.3	32	4.5	2.0	33	1.3
	Greek	6.5	14	1.7	1.1	15	0.2
General cargo	Norwegian	6.5	19	3.5	1.6	19	0.8
	Greek	5.9	19	1.9	1.7	19	1
Tank	Greek	6.6	57	3.7	1.4	58	0.9
Live fish carrier	Norwegian	7.6	33	4.0	1.5	34	0.8
Passenger	Norwegian	5.7	71	2.3	1.4	76	0.9
	Greek	6.9	99	3.3	1.5	98	0.9
Total cargo	Norwegian	7.4	90	4.2	1.8	93	1.1
	Greek	6.4	97	3.1	1.4	99	0.8
Nationality	Norwegian	6.6	161	3.5	1.6	169	1.0
	Greek	6.6	196	3.2	1.4	197	0.8

"top score" of 55 points on this index. When it comes to sector focus on safety, 73% of the Greek respondents gave their own sector "top score". This could indicate a reporting effect among the Greek respondents. This issue is discussed further in Section 4.7.2.

3.2. Demanding working conditions and safety compromising work pressure

Table 6 presents scores for demanding working conditions index (3 items, min = 3, max = 21) and safety compromising work pressure (1 item, min = 1, max = 5).

Comparing mean scores on the demanding working conditions index, similar scores for Norwegian and Greek respondents are seen at a general level, but results indicate higher scores in Norwegian cargo transport compared to Greek cargo transport, and lower scores in Norwegian passenger transport than in Greek passenger transport. The table indicates higher levels of work pressure in the Norwegian sample, due to higher levels in Norwegian cargo transport, especially in bulk. Differences between mean scores on these two variables are not statistically significant.

3.3. Risk acceptance/violations index

3.3.1. Comparison of means

Table 7 shows mean scores on the Risk acceptance/violations index for nine variables. The Risk acceptance/violations Index is made by adding the scores of four items (cf. Table 4). The scores on the dependent variable vary between 4 (never) and 28 (more than 20 times every 100 working days/nights on board). The average score on the index is 7.4 points.

Table 7 indicate that Norwegian respondents score higher than Greek respondents on the Risk acceptance/violations index. Moreover, the youngest respondents have the highest score on the index, as well as apprentices and respondents working on live fish carriers. Work pressure and demanding working conditions give significantly higher scores on the index, while a positive organizational safety culture and sector focus on safety are related to low scores.

3.3.2. Regression analysis

In Table 8 results from a hierarchical, linear regression analysis are shown, where independent variables are included in successive steps to examine the variables predicting respondents' scores on the Risk acceptance/violations Index.

Table 8 provides five main results. First, demanding working conditions is the strongest predictor. The more demanding working conditions the respondents experience, the more likely they are to be involved in Risk acceptance/violations. The average score of the Norwegian and Greek seafarers is similar on the demanding working conditions index, but Table 6 indicates that the mean score for demanding working conditions in Norwegian cargo transport is higher than in Greek cargo transport, while the score in Norwegian passenger

Table 7
Means on the Risk acceptance/violations index for nine variables (N = 367).

Value	Age group	Nationality	Vessel type	Position	Work pressure	Demanding working conditions	Org. culture	Sector focus on safety	National culture
1 Score	< 26 years	Norwegian	Bulk	Captain	Totally disagree	3 points	11–30 points	1–4 points	4–7 points
	9	8.2	8.7	7.3	6.2	6	18.8	10.7	5.5
2 Score	26–35	Greek	General cargo	Deck officer	Disagree somewhat	4–6 points	31–40 points	5–7 points	8–14 points
	8.6	6.7	7.7	8.8	8.3	6.4	12.6	10.2	8.3
3 Score	36–45	–	Tank vessel	Deck crew	Neither/nor	7–9 points	41–45 points	8–10 points	15–21 points
	7.5	–	6.4	7.2	10.1	7.8	9.5	6.6	9.4
4 Score	46–55	–	Live fish carrier	Machine chief	Agree Somewhat	10–12 points	46–50 points	–	22–28 points
	6.7	–	8.9	6.8	13.6	9.3	7.7	–	11.9
5 Score	56 +	–	Other cargo	Machine officer	Totally agree	13–15 points	51–55 points	–	–
	5.4	–	7.1	8	16.6	11.2	5.8	–	–
6 Score	–	–	Greek passenger	Machine crew	–	16–18 points	–	–	–
	–	–	7.1	6.2	–	17.4	–	–	–
7 Score	–	–	Norwegian passenger	Apprentice	–	19–21 points	–	–	–
	–	–	6.8	10.2	–	12	–	–	–
P-value	0.000	0.000	0.008	0.004	0.000	.000	0.000	0.000	0.000

Table 8
Linear regression. Dependent variable: "Risk acceptance/violations Index". Standardized beta coefficients.

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9
Age group (< 26 = 2)	0.112*	0.079	0.038	0.039	0.065	0.058	0.021	0.009	0.003
Nationality (Greek = 2)		−0.167**	−0.168**	−0.146*	−0.102*	−0.111*	0.011	0.061	−0.030
Position (Apprentice = 2)			0.090	0.090	0.077	0.070	0.068	0.062	0.052
Vessel type (Tank = 2)				−0.055	−0.046	−0.051	−0.037	−0.042	−0.031
Sometimes I feel pressured to continue working, even if it is not perfectly safe					0.517**	0.410**	0.218**	0.202**	0.167**
Demanding working conditions index						0.228**	0.246**	0.241**	0.281**
Organizational safety culture index							−0.367**	−0.325**	−0.195**
Sector focus on safety								−0.145**	−0.144**
National safety culture: descriptive norms									0.206**
Adjusted R^2	0.010	0.034	0.037	0.037	0.303	0.343	0.419	0.431	0.453

* p < 0.05.
** p < 0.01.

transport is lower than in Greek passenger transport.

Second, the national safety culture index, measured as descriptive norms, contributes positively, indicating that the more unsafe behaviours the respondents say that they expect from seafarers from their own country, the more likely they are to be involved in unsafe behaviours themselves. Third, the higher organizational safety culture scores the respondents report, the less unsafe are their behaviours. Thus, a positive organizational safety culture may reduce the negative contribution of demanding working conditions and safety compromising work pressure. The same applies to the index "sector focus on safety". Thus, results indicate that customer focus on safety contributes to less violations and risk acceptance. Live fish carrier respondents (7.6 points) have the lowest score on this index, while Greek ferry respondents (9.9 points) have the highest score.

In conclusion, results indicate that variables at the national, sectorial and organizational level influence respondents' Risk acceptance/violations, while background variables like age, position and vessel type do not contribute significantly. In Step 8 the Adjusted R^2 is 0.453 which indicates that the independent variables explain about 45% of the variance in the dependent variable.

3.4. Working under the influence of alcohol, or while being hungover

3.4.1. Comparison of means

The average score on the variable "working under the influence of alcohol, or while being hungover" is 1. Results indicate no significant differences between age groups, or between the values on the variables measuring demanding working conditions or sector focus on safety. Differences between positions were significant at the 10%-level. The difference between Greek (1.1 points) and Norwegian (1 point) respondents are significant at the 1%-level. Moreover, the score of General Cargo vessel respondents (1.2 points) is significantly different from the other vessel types at the 1%-level. Significant differences at the 1%-level were found between the values on the index measuring organizational safety culture: the average "working under the influence of alcohol…" score for the lowest organizational safety culture score was 1.3 points. Significant differences at the 1%-level were also found between the values on the index measuring national safety culture-descriptive norms: the average "working under the influence of alcohol…" score for the highest national safety culture score was 1.3 points.

3.4.2. Regression analysis

Table 9 presents results from a hierarchical, linear regression analysis, where independent variables are included in successive steps to examine the variables predicting respondents' scores on the variable: "I work while being under the influence of alcohol (e.g. one beer or more), or while being hungover".

Table 9 provides two main results: national safety culture, measured as descriptive norms, is the strongest contributor to working while being under the influence of alcohol, or while being hungover, followed by vessel type, specified as general cargo. Interestingly, nationality ceases to contribute significantly in Step 7, when national culture is included, indicating that the contribution of nationality seen from Step 1–6 is a result of what the survey measure as national culture. Organizational safety culture also ceases to contribute significantly when national culture measured as descriptive norms is included, and this is hard to explain. This may indicate that the initial contribution of organizational safety culture was due to national variations in organizational safety culture scores (cf. Table 5). In Step 8 the Adjusted R^2 is 0.240 which indicates that the independent variables explain about 24% of the variance in the dependent variable.

3.5. Non-intervention/non-reporting

3.5.1. Comparison of means

The scores on the Non-intervention/non-reporting index vary between 2 (never) and 14 (more than 20 times every 100 working days/nights on board). The average score is 2.5.

Table 9
Linear regression. Dependent variable: "I work while being under the influence of alcohol (e.g. one beer or more), or while being hungover". Standardized beta coefficients.

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Age group (< 26 = 2)	0.048	0.030	0.038	0.060	0.079	0.080	0.057
Nationality (Greek = 2)		0.143**	0.148**	0.152**	0.267**	0.246**	0.091
Position (Apprentice = 2)			0.078	0.064	0.052	0.057	0.037
Vessel type (General cargo = 2)				0.279**	0.274**	0.280**	0.256**
Organizational safety culture index					− 0.286**	− 0.314**	− 0.057
Sector focus on safety						0.071	0.066
National culture: descriptive norms							0.369**
Adjusted R^2	0.000	0.017	0.021	0.096	0.161	0.162	0.240

*p < 0.05.
** p < 0.01.

Table 10
Linear regression. Dependent variable: Non-reporting/non-intervention index Standardized beta coefficients.

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9
Age group (< 26 = 2)	0.055	0.027	0.026	0.028	0.045	0.044	− 0.002	− 0.003	− 0.009
Nationality (Greek = 2)		− 0.140*	− 0.140*	− 0.091	− 0.066	− 0.066	0.080	0.085	− 0.012
Position (Apprentice = 2)			0.003	0.003	− 0.006	− 0.006	− 0.009	− 0.010	− 0.020
Vessel type (Tank = 2)				− 0.121*	− 0.114*	− 0.114*	− 0.096	− 0.096	− 0.087
Sometimes I feel pressured to continue working, even if it is not perfectly safe					0.371**	0.367**	0.132*	0.130*	0.093
Demanding working conditions index						0.010	0.030	0.030	0.073
Organizational safety culture index							− 0.443**	− 0.439**	− 0.303**
Sector focus on safety								− 0.014	− 0.011
National culture									0.217**
Adjusted R2	0.000	0.016	0.013	0.023	0.159	0.157	0.268	0.266	0.290

* p < 0.05.
** p < 0.01.

High scores on the Non-intervention/non-reporting index are likely to be negative for safety.

A comparison of mean scores on the index indicate that the following groups have significantly higher scores on this index: Norwegian respondents (2.7 points) (vs. 2.3 points for Greek respondents), respondents reporting of high work pressure, demanding working conditions, low organizational safety culture, low/medium sector focus on safety and high scores on the national safety culture measured as descriptive norms (i.e. high level of violations and risk taking among other seafarers from their own country). Differences between mean scores were not significant between age groups, vessel types or positions/lines of work.

3.5.2. Regression analysis

Table 10 shows results from a hierarchical, linear regression analysis, where independent variables are included in successive steps to examine the variables predicting respondents' scores on the Non-intervention/non-reporting index.

Table 10 provides two main results. First, organizational safety culture, which is the strongest contributor, contributes negatively, indicating that the higher organizational safety culture scores the respondents report, the less likely they are to refrain from intervening against colleagues who take risks and to refrain from reporting safety problems and unsafe situations to the ship management. This indicates, as expected, that non-reporting/non-intervention is closely related to organizational safety culture, in which reporting culture is a central aspect [42]. The relationship with national safety culture measured as descriptive norms indicates that respondents' scores on the non-intervention/non-reporting index is related to the safety behaviours that they attribute to seafarers from their own country, including non-reporting/non-intervening. In Step 8 the Adjusted R^2 is 0.290 which indicates that the independent variables explain about 29% of the variance in the dependent variable.

3.6. Personal injuries onboard

Respondents were asked whether they had been injured in their work on board in the last two years. A total of 80 respondents (22%) answered that they had been injured in their work on board in the last two years: 14% answered that they had a little injury which did not require medical attention, 4% had a little injury which required medical attention and 4% had an injury which required medical attention and a period of work absence. Comparing nationalities, results indicate that 29% of the Norwegian respondents had been injured, compared to 14% of the Greek. Only 3% of the Greek respondents had an injury requiring medical attention, while 14% of the Norwegian had. Differences were significant at the 1% level. Differences between age groups were only significant at the 10%-level and results indicate that the youngest group (< 26 years) had the highest share of injuries (46%). Differences between vessel types were only significant at the 10%-level and results indicate that live fish carrier respondents had the highest share of injuries (35%). Differences between positions were not significant. Results indicate that apprentices (44%) and deck crew (25%) had the highest share of injuries. The latter group is focused on in the regression analysis, because of a small number of respondents, and thus injuries, in the apprentice group.

A logistic regression analysis was conducted with personal injuries as dependent variable, to find the variables predicting personal injury among the respondents (Table 11). In this analysis, the injury variable, which originally had four answer alternatives, was dichotomized, 0 = no personal injury, 1 = personal injury.

Table 11 provides three main results. The first is that nationality influences respondents' work injuries in the last two years on board. This is the variable with the strongest contribution. As noted, the Norwegian seafarers reported to have been more involved in injuries than the Greek seafarers. The analyses in Table 11 indicates that this to some extent could be due to Risk acceptance/violations and age (< 26

Table 11
Logistic regression. Dependent variable: Personal injuries on board in the last two years (dichotomized: 0: no personal injury, 1 = personal injury). B values.

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9
Age group (< 26 years = 0, Other = 1)	0.285**	0.371*	0.385*	0.376*	0.418	0.403*	0.403*	0.388*	0.373*
Nationality (Greek = 0, Norwegian = 1)		2.203**	2.097*	2.399**	2.083*	1.952*	2.005*	1.985*	2.226*
Vessel type (Live fish carrier = 0, Other = 1)			0.786	0.849	0.865	0.875	0.882	0.848	0.888
Position/line of work (Deck crew = 0, Other = 1)				0.627	0.641	0.665	0.657	0.665	0.657
Risk acceptance/violations index					1.159**	1.163**	1.175**	1.153**	1.164**
Working under the influence of alcohol/hungover						0.218	0.241	0.263	0.304
Non-reporting/non-intervention index							0.929	0.917	0.940
Sometimes I feel pressured to continue working even if it is not perfectly safe								1.172	1.224
Organizational safety culture index									1.025
Nagelkerke R^2	0.037	0.073	0.074	0.084	0.173	0.181	0.182	0.186	0.188

** p < 0.01.
* p < 0.05.

years). However, as these variables are included in the regression analyses, the differences can only partly be attributed to them. The contribution of nationality is only reduced somewhat when Risk acceptance/violations is included in the analysis.

The variable with the second strongest contribution is the Risk acceptance/violations index; indicating that the more violations and risk accepting behaviour you are involved in, the more likely it is that you are injured on board. The variable with the third strongest contribution is age group, indicating that controlled for the other variables, the youngest seafarers have a higher risk of being injured on board. This could hypothetically have been related to position/line of work, but the analysis controls for deck worker. When comparing age groups for the two nationalities, there are four times more young respondents (< 26 years) in the Norwegian sample compared to the Greek (12% vs 3%) (cf. Table 1). In Step 9 in Table 11 the Nagelkerke R^2 is 0.188 which indicates that the independent variables explain 19 % of the variance in the dependent variable.

4. Discussion

The aims of the study were to: 1) Examine the influence of national safety culture, sector safety focus and organizational safety culture on safety behaviours, compared with other explanatory variables (e.g. age, position, vessel type, working conditions) and to 2) Examine the influence of safety behaviours and other factors on occupational injuries.

4.1. The influence of safety behaviours on occupational injuries

Nationality was the variable with the strongest influence on injury involvement, reflecting that Norwegian respondents were involved in more injuries. Previous research has also found differences in occupational injury risk between nationalities (cf. [16,22]; Adam et al., 2014). Although these studies were unable to explain their results, the study could indicate that different safety behaviours shed light on such observed differences in accident risk between different national groups on vessels. Moreover, results also indicate that safety behaviours to different extents are influenced by national safety culture.

The second most important variable influencing personal injuries was Risk acceptance/violations, and it is therefore concluded that this is the most important type of safety behaviour in the study. The Norwegian respondents in the cargo sector score considerably higher than the Greek cargo respondents on the Risk acceptance/violations index (9.2 points vs. 6.3 points), while the Norwegian respondents in the passenger sector score slightly lower than the Greek passenger respondents on this index (6.8 vs. 7.1 points). It is also important to note that the other types of safety behaviour were not found to influence occupational injuries.

The variable with the third strongest contribution was age group (i.e. < 26 years). This result is also in line with previous research. Jensen et al. [22] and Hansen et al. [16] both found young age to be related to work accidents on board. Contrary to these studies, the present results do not indicate other background variables; e.g. position, vessel type to influence seafarers' injury risk. This could be related to the fact that the present study includes relative broad measures of safety behaviours, that could explain the relationships between such background variables and occupational accidents. More research is needed to examine this hypothesis further.

It is also important to note that significant relationships between work pressure and occupational injuries were not found, nor between organizational safety culture and occupational injuries. Nævestad [35] found such relationships, but that analysis did not include safety behaviour. This could indicate that the relationship between working conditions and injuries found by Nævestad [35] is mediated by safety behaviour. This seems to be the reason that results do not indicate significant relationships between these work related variables and injuries when safety behaviour is included in the analyses. This should be examined in future research.

4.2. The influence of working conditions on safety behaviour

Our analysis indicates that working conditions only influenced one of the studied safety behaviours (i.e. Risk acceptance/violations), and not the two other studied behaviours. Demanding working conditions was the strongest predictor of Risk acceptance/violations. Safety compromising work pressure was the fourth most important predictor of Risk acceptance/violations. Norwegian cargo respondents score higher than the other groups on the demanding working condition index, and the safety compromising work pressure index, and they also score higher on the Risk acceptance/violations index. Previous research from the coastal cargo sector has also found a relationship between challenging work conditions and risk taking. Størkersen et al. [47] found that a third of the coastal cargo respondents reported that they put themselves in danger to get the job done, while about 40% violate procedures to get the job done, especially because of efficiency demands [47].

4.3. The influence of framework conditions on working conditions

Based on previous research, it can be hypothesized that the working conditions influencing unsafe behaviours in the Norwegian coastal cargo sector are influenced by the framework conditions of the sector. Størkersen [48] attributes the relative high shares of risk taking and procedure violations in the coastal cargo sector to challenging framework conditions, e.g. tight economical margins. Similarly, interviewees in the study of Nævestad [35] describe relatively low manning levels in this sector, a high number of port calls and a high work load between port calls. Several studies point to relatively intense working patterns in the sector [44,46]. Such negative framework conditions are probably why results show that the Norwegian cargo respondents score higher than the other groups on the demanding working condition index and the safety compromising work pressure index (cf. Table 6). Passenger transport scores lower on these indexes, especially Norwegian passenger transport. This is probably related to the framework conditions in the passenger transport sector: port calls, work activities and perhaps also work roles are more regular and well defined, manning levels are higher etc. These issues are examined more thoroughly in Nævestad et al. [33] and Nævestad et al. under review [32]. Moreover, nearly a third of the Greek sample (and, thus, over half of the Greek cargo sample) work on petroleum tankers (29%), which is known to have stricter regulations, a high safety focus from the transport buyers (oil companies) and a higher safety level [29]. Additionally, the cargo vessels of the Greek respondents are generally larger vessels with higher manning levels. This may further indicate that the national groups of cargo vessels are not totally comparable. Finally, other studies comparing different transport sectors find framework conditions like legislation/enforcement, transport buyer focus on safety, type of transport, regulation/inspections to be important for organizational safety culture and safety performance in different sectors [43,48,6].

4.4. The influence of sector safety focus on safety behaviour

As previous research indicates the importance of sector and framework conditions for safety, questions aiming specifically to measure the sector's safety culture were developed. The two questions used for this purpose focus on respondents' perceptions of transport buyers', or customers' focus on safety versus deadlines, and on safety versus price. The two questions were combined into a customer focus on safety index. The reason for this operationalization is that previous research has found that customer focus on safety is a central aspect of the framework conditions influencing sector safety level [37]. Thus, it is not surprising that results indicate that high sector focus on safety scores are related to less Risk acceptance/violations among the respondents. Sector focus on safety does, however, not influence the two other types of safety behaviours that the present paper focuses on. A possible

explanation may be that Risk acceptance/violations is closely related to production pressures and demanding working conditions, which previous research has found to be relatively sector-dependent [32,33]. Finally, it should also be noted that respondents' perceptions of who the customers are, and their expectations, probably are quite different in cargo and passenger transport.

4.5. The influence of organizational safety culture on safety behaviour

Results indicate that organizational safety culture is the third most important variable predicting Risk acceptance/violations. The relationship was negative, indicating that a positive organizational safety culture is related to less Risk acceptance/violations. Thus, it seems that a positive safety organizational safety culture may reduce the influence of negative working and framework conditions on safety behaviour. Nævestad [35] also finds a similar relationship between organizational safety culture and injury involvement. This could, as noted, suggest that a relationship between these two variables are not found in the present study, as the influence of organizational safety culture is mediated by safety behaviours. The result that organizational safety culture influences safety behaviours is in accordance with previous studies (e.g. [21,27]).

4.6. The influence of national safety culture on safety behaviour

In the present study, it is attempted to develop the concept of national maritime safety culture further, by specifiying it as descriptive norms: individuals' perceptions of what other people actually do [7]. Such normative pressures on behaviour have been found to influence safety behaviours (and thus accident risk) in several studies in other transport sectors, e.g. road (e.g. [11,14]), but this perspective has to the authors' knowledge not been applied to analyse national maritime safety culture before. It was found that national safety culture, measured as descriptive norms was important for the three types of safety behaviours that the paper focuses on, although its importance varied. When applying the descriptive norms perspective on national safety culture, the types of behaviour that the descriptive norms focus on are very important, as it is hypothesized that descriptive norms may influence behaviour by providing information about what is normal and expected [7].

In this study, the behaviours included in the descriptive norms-national culture index reflect the items measuring respondents' self-reported safety behaviours. The Risk acceptance/violations index items were based on variables found to be significantly different between Norwegian and foreign seafarers in a previous study [47]. The foreign groups on these vessels were not Greek, they were Eastern European, Asian (and Nordic). Second, these variables were related to differences in worry about risk on board [47]. Thus, it may perhaps be suggested that the "Risk acceptance/violations" index first and foremost measures behaviours influenced by work related factors and framework conditions, and only to a lesser extent differences in national culture. In accordance with this assumption, results indicate that demanding working conditions was the most important predictor of "Risk acceptance/violations", but it was nevertheless found that national safety culture was the second most important predictor. The observed relationship between risk acceptance/violations, working conditions and accidents, is in accordance with Lawton [26], who found a relationship between violations (primarily related to work pressure) and accidents.

The item measuring Working under the influence/hungover was based on research indicating that alcohol consumption may be an important risk factor in the maritime sector [2], Hetherington et al. [18]. We, therefore, wanted to examine whether results indicate national differences when it comes to the tendency to work while under the influence, or while hungover. A minor, but significant difference between the Greek and the Norwegian seafarers was found. National safety culture was the most important predictor of this type of safety behaviour.

Previous research indicates that seafarers on some vessels (especially some national groups) are reluctant to intervene towards managers and colleagues, because of deference to authority [13,18,19], and as they are afraid to unintentionally offend their collegaues [23]. Interviewees in Nævestad [54] study, asserted that Norwegian seafarers are part of a workplace culture which is more outgoing than other national groups (e.g. Asian, Eastern European); being relatively unhesitant to speak their mind about safety issues to both their managers and their co-workers. This is the reason that the two Non-intervention/non-reporting items were developed. Norwegian respondents (2.7 points) scored significantly higher than the Greek respondents (2.3 points). The small difference does not support the interviewee hypothesis that Norwegian seafarers are more outgoing (cf. [54]). It may, however, be noted that the result of the comparison could be influenced by the subsectors within the national groups (cf. section 4.8.3), or the comparison with Greek seafarers which not necessarily are different. Moreover, Non-intervention/Non-reporting is also an important aspect of organizational safety culture (cf. [42]), and in accordance with this, it was found that organizational safety culture was the most important predictor of non-intervention/non-reporting, followed by national safety culture. Thus, it is difficult to conclude about the hypothesis that Norwegian seafarers are more outspoken than other national groups, based on the comparison with Greek seafarers.

It is interesting to examine the importance of national culture for safety behaviours in the maritime sector, as previous research underlines that the maritime industry is the only example of a fully globalized industry [3]. International research asserts that approximately two-thirds of all ship crews are now multinational [18]. It should, thus, perhaps be assumed that nationality is of less importance in this sector. But as noted, previous studies indicate that nationality predicts personal accident risk on board merchant vessels [16,22]. In line with this, it was found that nationality (i.e. Norwegian) was the variable with the strongest influence on respondents' work injuries in the last two years on board. The previous research does not specify the mechanisms explaining the relationship between work injuries and nationality. In the present study, results indicate that safety behaviours, which was strongly related to national safety culture, is an important mechanism that perhaps may explain some of the national variations in occupational injury risk, but not all of it. Future research should examine further factors which could shed light on this relationship.

4.7. Methodological issues that may shed light on the results

The present study compares national groups, national behaviours and national culture, based on self-reports in limited samples. It is therefore highly relevant to discuss the extent to which the results can be generalised to Norwegian and Greek seafarers in general (external validity), and whether the results can be replicated in later studies using the same methods (reliability). Below, it is discussed how the national samples in the study, especially the distribution of subsectors, may limit the possibilities to generalise to Norwegian and Greek seafarers in general. On the other hand, however, it may be argued that the distribution of subsectors within the national samples is suitable for studying the combined influences of the national, sectorial and organizational influences on maritime safety behaviours. The potential influence of national reporting effects is also discussed as a bias which may limit the possibility to replicate the study using the same methods. It is concluded that it is impossible to rule out the potential existence of such reporting effects doing cross-cultural survey research, but that the general results seem to be in accordance with previous research, given the distribution of subsectors in the national samples. Finally, the false consensus effect is also discussed as a potential source of bias.

4.7.1. The distribution of national groups in the sample

When discussing national differences and the importance of national culture, it is important to note that the results are also contingent on the

limited distribution of national groups in the sample (i.e. Norwegian and Greek). Thus, if other national groups of seafarers also had been included, a stronger effect of national safety culture than organizational safety culture and work-related factors would perhaps have been observed. It is also important to remember that the respondents in the national samples also are different when it comes to age groups: there are four times more young respondents (< 26 years) in the Norwegian sample compared to the Greek (12% vs 3%). Results have also indicated important differences between the position types of the respondents and the composition of subsectors in the two national samples. The importance of position evokes an issue that should be examined in future research: professional mariner training is likely to influence both attitudes and behaviours. Thus, future cross-cultural research in the maritime sector could examine the potential influence of training on safety behaviours across sectors and nationalities.

4.7.2. National reporting effects?

Greek respondents report of higher national safety culture scores (i.e. higher prevalence of unsafe behaviours among seafarers from their country) and lower scores on the Risk acceptance/violations index (safer self-reported behaviour). This is difficult to explain. This could be related to differences in their actual experienced levels of unsafe national behaviours (i.e. different national safety culture), or national differences in baselines and expectations. Such effects have been found in other cross-cultural studies of transport safety behaviours (cf. [34]). The answer alternatives for the behaviour and national culture items were therefore made absolute instead of relative to avoid such methodological effects of national differences in baselines. In spite of this, differences between the national groups when it comes to answering the questionnaires can, however, not be ruled out. As noted, 42% of the Greek respondents answered “totally agree” on all the 11 organizational safety culture items, and 73% of the Greek respondents gave their own sector “top score” on the sector focus on safety items. It is hard to explain such tendencies; they could be due to different levels of experience with surveys, lacking trust of anonymity etc. [34], indicating the challenges of doing cross-cultural survey research.

One can, however, not attribute the greater parts of the main results to potential national reporting effects. As noted, previous studies find that the occupational accident risk of Northern or Western European seafarers is higher than other national groups ([16,5]; Adam et al., 2014). In accordance with this, results from the present study indicate a greater proportion of injuries (29% vs. 14%) and severe injuries (14% vs. 3%) among Norwegian seafarers, compared with Greek seafarers. Taking these differences as the point of departure, the results concerning safety behaviours, working conditions and organizational culture are not unexpected. Moreover, when discussing possible reporting effects, the generalisiability and validity of the results, one should remember that the different national samples are not totally comparable, when it comes to age groups, position groups and the distribution of subsectors (e.g. the national distribution of coastal cargo vs. petroleum tankers in the cargo samples). These differences are reflected in the different national results, and they limit the possibility to generalise about national differences, based on the study. This is discussed below.

4.7.3. The distribution of subsectors in the sample

When discussing the importance of national factors in the sample, it is important to note that the distribution of subsectors in the sample not are totally comparable. More than half of the Greek cargo sample work on petroleum tankers, while the Norwegian cargo sample respondents largely work in the coastal cargo sector. This limits the possibility to generalise results from the cargo sector to the national level. Results indicate that the second most important variable influencing personal injuries was Risk acceptance/violations, and that Norwegian respondents in the cargo sector score considerably higher than the Greek cargo respondents on the Risk acceptance/violations index (9.2 points vs. 6.3 points), while the Norwegian respondents in the passenger sector score slightly lower than the Greek respondents on this index (6.8 vs. 7.1 points). This seems to indicate that sector could be more important than nationality in the sample, perhaps as the national samples are not totally comparable. Additionally, the cargo vessels of the Greek respondents are generally larger vessels with higher manning levels. This may further indicate that the national groups of cargo vessels are not totally comparable. On the other hand, it could perhaps also be argued that the relative importance of subsectors with different framework conditions influencing different organizational and work-related factors is in line with the assertion that the maritime sector is a globalized industry, where one perhaps could assume that sectorial aspects are more important for safety than national aspects. The present study indicates the importance of safety culture at different levels. Future research may also gain additional insights by analyzing the influence of different analytical levels in a multilevel framework. Due to lacking information about the relationship between Greek respondents and their shipping companies, the present data did not allow for this do be done according to the study aims.

4.7.4. The false consensus mechanism

Descriptive norms may also influence behaviour through the false consensus bias, in which individuals overestimate the prevalence of risky behaviour among their peers to justify their own behaviour [7]. This is the main objection to the operationalization of national safety culture as descriptive norms. The differences between mean scores within subsectors on the national safety culture index could indicate the existence of such a false consensus mechanism. On the other hand, although respondents were asked about behavioural expectations to seafarers from their own country, it is reasonable to assume that respondents primarily answer this question based on experiences with national seafarers from their own sector, which they presumably are most familiar with. The differences between subsectors within the national groups are considerable, indicating that respondents provide answers denoting the national level, based on experiences from their own sector. Given the differences between subsectors indicated by previous research, and the differences between subsectors in the current study, the variation within the two national groups on the national safety culture index is perhaps as expected.

What results do indicate, however, when comparing the two national groups, is that the Greek respondents generally rate the national safety culture of seafarers from their own country as less safe (i.e. higher scores) than the Norwegian seafarers. These national patterns in the respondents’ expectations to the behaviours of seafarers from their own countries is an important argument against the contention that the national safety culture measure is a result of the false consensus mechanism. It is difficult to conclude about this, as one should expect a certain variation within national groups, due to their experiences from their own subsectors. More research is needed on the possible interaction between these two variables.

5. Conclusion

The result that organizational safety culture influences safety behaviours is in accordance with previous studies. Few previous studies have, however, also compared the influence of national safety culture and sector safety focus on safety behaviours. The results indicate that safety culture at different analytical levels influences different types of unsafe behaviours. Thus, the study indicates the importance of studying safety culture at different analytical levels, if one is to fully understand the influence of culture on safety in transport. One of the most important conclusions is that a positive safety culture at one analytical level (the organizational) may reduce the negative impact of safety culture at other analytical levels (e.g. the national). A positive organizational safety culture may also reduce the negative impact of challenging working conditions on safety behaviours and subsequently occupational accidents. Future studies should examine these issues further.

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