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(No. 20180309)

Ocean Conservation Experiment and Network (OCEAN): Exploring what motivates people to protect our oceans
Theme 3: Ocean Advocacy

By

Massachusetts Maritime Academy (Contractor)

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Tokyo 105-0001, JAPAN
TEL : 81-3-6257-1812 E-mail : info@iamu-edu.org URL : http://www.iamu-edu.org

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Massachusetts Maritime Academy (Contractor)

Contractor : Francis X McDonald, MassMA
Research Coordinator : Paul S. Szwed, MassMA
Research Partner : Matthew J. Rooks, KU-GSMS
Beatriz Y. Gonzalez, Panama Maritime University

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Massachusetts Maritime Academy (Contractor)

Research Team

Paul S. Szwed (Research Coordinator)

Professor, Massachusetts Maritime Academy, pszwed@maritime.edu

Matthew J. Rooks

Associate Professor, Kobe University, Graduate School of Maritime Studies

Beatriz Y. Gonzalez

Advisor, Directorate of Seafarers of the Panamanian Maritime Authority

Abstract:

Some estimates claim that by 2050, there will be as much plastic in the ocean as fish [1]. While plastics pollution in our oceans is largely a land-sourced problem [2], public scrutiny of the shipping community persists. This study examines how seafarer pro-environmental attitudes and behaviors can be influenced. Using between-subject experimental design, current (and future) seafarers were surveyed through the IAMU members' networks. The survey measured ocean literacy, culture, and seafarer attitudes and behaviors about plastics pollution. 202 complete and usable responses were received (representative of seafarers worldwide). 98 respondents participated in pre- and post-test surveys, where each respondent was randomly assigned to a control or treatment group. Descriptive statistical, mediational, and gain-score analyses were performed. As in previous shipping safety studies, analysis confirmed group- and future-oriented (and not self- or now-oriented) people are positively disposed to pro-compliance attitudes and behaviors. There was no evidence of the treatments mediating the relationship between awareness and behaviors. Analysis supported that treatments (commitment pledges and goal setting) had positively influenced pro-environmental behaviors. On average, there was an 8.5% gain in attitude and a 10.4% gain in behavior. As previously identtified, culture matters and, in order to be most effective, training should be adjusted to be responsive to differences in culture. Simple treatments (such as commitment pledges and goal setting) may be more influential than awareness alone and should be incorporated into compliance and other training. Despite the focus of this study, there are potential beneficial spill-over effects into other areas of pro-compliance interest [3].

Keywords: Oceans, sustainability, conservation, commitment, goal setting, MARPOL, plastics, pro-environmental, pro-conservation, attitudes, behavior, between-subject experimental design

1. Executive Summary

This research report contains the work package summaries for the OCEAN (Ocean Conservation Experiments and Network) Project that was conducted in 2018-2019. This executive summary provides the most important aspects of that research project and its conclusions.

Background: Increasingly, there is heightened interest in conserving our all-important oceans and public attention often turns toward and scrutinizes shipping and the maritime industries as significant contributors of ocean pollution. Through conventions like MARPOL and STCW, the IMO has put in place safeguards to prevent pollution of the marine environment.

Problem: Yet, maritime accidents and ocean pollution still occur, usually involving the human element as a key contributing factor. When the requirements for training seafarers are more closely examined, particularly the model courses devoted to personal safety and social responsibility, it becomes evident that more can be done to influence or change seafarer pro-environmental (or pro-compliance) behaviors – since it is well established that education and awareness alone are insufficient.

Objectives: The overarching objective of this OCEAN Project was to determine the efficacy of selected ocean advocacy interventions (or treatments) on promoting pro-environmental behaviors. Specifically, this study examined the influence of commitment and goal setting on current and future seafarers' attitudes and behaviors regarding plastics pollution and MARPOL V compliance.

Analysis: Through an extensive review of the literature, studies, and research (Section 4) of ocean conservation, ocean literacy, behavioral theory, and pro-environmental behavior treatments, an experimental design was created to explore the objective (Section 5).

Several hypotheses were posited, including whether or not commitment pledges and goal-setting may have a positive influence on the MARPOL attitudes and behaviors of seafarers. To test these hypotheses using the between-subject experimental design (involving a preliminary survey and a follow-up survey with control and treatment groups), a series of survey instruments were developed to test ocean literacy, seafarer MARPOL attitudes and behaviors, conservation commitment, and conservation goal setting.

During the period from October of 2018 through January of 2019, the methodological protocol was administered (Section 6). The initial survey was administered to current and future seafarers from around the world, with the majority of responses coming from students at maritime education and training institutions. Respondents were asked a series of questions to determine their ocean literacy, attitudes and behaviors toward MARPOL V and plastics pollution, and culture. 284 current and future seafarers responded to the survey, of which 202 of the responses were complete and usable. 98 of the respondents voluntarily participated in a follow-up survey four to six weeks later (66 of which were complete and usable).

Using a randomization technique, some respondents were provided a commitment pledge and goal-setting treatments regarding ocean conservation and reducing plastics pollution. The commitment pledge involved committing to some of six plastics pollution prevention behaviors. The goal setting involved creating one goal for reducing plastics usage and another for ocean conservation in general. From these 66 complete matched pairs of pre- and post-test survey, 28 had been randomly assigned the treatments (commitment and goal-setting) and 38 were in the control group (with no treatment). The post-survey involved re-testing the pro-compliance MARPOL attitudes and behaviors (for all respondents) and asking about performance on the commitments and goals (for the treatment group).

Three different types of analyses were performed (Section 7): descriptive statistical analysis, mediation analysis, and gain score analysis – each intended to analyze different aspects of the hypotheses explored by the between-subject experimental design of the OCEAN Project.

Results: As in previous maritime studies involving safety culture, the descriptive regression analysis confirmed individuals who identified as culturally group- and future-oriented (and not self- or now-oriented) are positively disposed to pro-environmental (or pro-conservation) attitudes and behaviors. There was no evidence of mediating effect from treatments on the relationship between awareness and attitudes and behavior. Finally, the gain score analysis provided support that the treatments (commitment and goal setting) had a positive influence on pro-environmental (or pro-conservation) behaviors. One average, there was an 8.5% gain in attitude and a 10.4% gain in behavior.

Recommendations: There are several potential implications of this research (Section 8).

First, treatments such as commitment and goal setting have a positive influence on positively changing pro-environmental attitudes and behaviors (those by seafarers about MARPOL V and plastics pollution in this case). This has a stronger potential than education and training alone to promote the desired attitudes and behaviors. Therefore, such treatments should be adopted in conjunction with traditional maritime training and education to more effectively and completely influence seafarer behaviors.

Additionally, it is evident that culture matters and training likely needs to be tailored to specific cultures and also to shape culture.

While this OCEAN Project resulted in hopeful results – that pro-compliance attitudes and behaviors can be effectively motivated, actions taken should be tempered until such time as additional and more extensive study can be completed because this study was limited by design and sample size.

2. Contents

3. Introduction

3.1. Background

We rely on our high seas and oceans for food and natural resources, trade and commerce, recreation and tourism, biodiversity and clean water, as well as carbon storage and climate regulation, among many other critical life-sustaining and enriching functions. While our high seas and oceans are unusually resilient and in relatively reasonable health according to some measures [4], it is also in a state of decline (e.g., [5], [6], [7]). Some of this is due to naturally-occurring changes and some is due to man's behaviors. As one of our last global commons, the high seas and oceans are subject to a well-known economic effect known as the "tragedy of the commons" [8]. In such a case, shared finite resources (such as fisheries in the high seas and oceans) become depleted and diminished when rational individuals who have rights to the commons exploit the resource out of self-interest rather than to benefit the common [9]. It is particularly difficult to manage or regulate such situations. However, just as behaviors are what create a "tragedy of the commons," it is quite possible that solutions may be found by examining how to change those behaviors.

Only several decades ago, global concern for the environment varied by geography and demography – concern was higher among people in developed nations than in developing nations. More recently, at the turn of the millennium, global concern for environmental issues and support for environmental protection was at a high level uniformly across geo/demography [10]. In 2013, again based on an international survey, global concern for the environment waned to a 20-year low [11]. On the surface, you might expect environmental conservation behaviors to vary as awareness and concern increases or decreases. However, conservation behaviors did not change dramatically during fluctuations in awareness of and concern for environmental issues [12], [13]. This provides some evidence that awareness alone does not alter behavior sufficiently to affect the environmental concern. In a global survey of experts' evaluation of progress toward achieving the seventeen UN sustainable development goals, the goal for protecting our high seas and oceans ranked second from the bottom [14].

This report will provide an overview of research conducted to explore methods of altering pro-environmental (or pro-compliance) behavior. In specific, the research looks are current and future mariners and examines how commitment and goal setting influence their attitudes about and behaviors concerning plastics pollution and MARPOL V compliance.

3.2. Motivation

Seafarers are required to possess personal safety and social responsibilities according to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978 (as amended). The validated model training course on Personal Safety and Social Responsibility (Model Course 1.21) [15] indicates that students should demonstrate competence in "taking precautions to prevent pollution of the marine environment" through approximately three hours of instruction. Given the fact that students must develop knowledge, understanding, and proficiency in ten topics (including a brief introduction to International Convention for the Prevention of Pollution from Ships (MARPOL)), it is likely that the only way this is presented through straight lecture. As a result, it is unlikely that such training might be effective at altering compliance behaviors. As became evident from the literature, education and awareness alone are note effective in promoting behavior change [16], [17], [18].

The literature [19] suggests four reasons why behavior change is difficult when it comes to conservation efforts.

- First, education (or awareness) alone does not alter behavior.
- Second, our thinking is biased and short-sighted. For example, one international study [20] indicated that people believe environmental problems are worse elsewhere (i.e., local better than global) and will get worse over time (i.e., better now than in future). As a result, environmental issues are viewed as lower priority [21].
- Third, we often perceive ourselves as separate (or unconnected) from nature and as a result, have less incentive to engage in conservation behaviors [22].
- Finally, our social norms guide our behavior. For example, when there is widespread concern for environmental issues, the underlying assumption is that conservation is not the norm, which serves to exacerbate the problem [23].

In an effort to understand how to influence pro-environmental (or pro-compliance) behaviors more effectively than education and awareness alone, this research explores other methods to motivate altered behavior.

3.3. Project Objectives

This research has the following overarching objective: Determine the efficacy of selected ocean advocacy interventions (or treatments) on promoting pro-environmental behaviors. Specifically, the research will examine the influence of commitment and goal setting on current and future seafarers' attitudes toward and behaviors regarding plastics pollution and MARPOL V compliance.

While potentially generalizable, the findings may provide International Association of Maritime University members additional tools and techniques to "contribute to the enhancement of … marine environmental protection" (Article I of the IAMU Basic Agreement). Additionally, it has the potential to allow MET institutions and the maritime industry to be better able to prepare and train seafaring professionals to "promote safe, secure, and efficient shipping on *clean oceans*" (Article III of the IAMU Basic Agreement).

3.4. Organization

This research report will follow a standard format. The first three sections will be devoted to background and information.

- Section 1 – Executive Summary
- Section 2 – Contents
- Section 3 – Introduction

The middle five sections will constitute the body of the report and will provide outputs or deliverables from the five main work packages of the project.

- Section 4 – Review of Literature (Work Package 1)
- Section 5 – Research Design (Work Package 2)
- Section 6 – Methodology & Data Collection (Work Package 3)
- Section 7 – Analysis & Results (Work Package 4)
- Section 8 – Conclusions & Recommendations (Work Package 5)

These work packages are illustrated in the figure below, which illustrates how the work packages were sequenced.

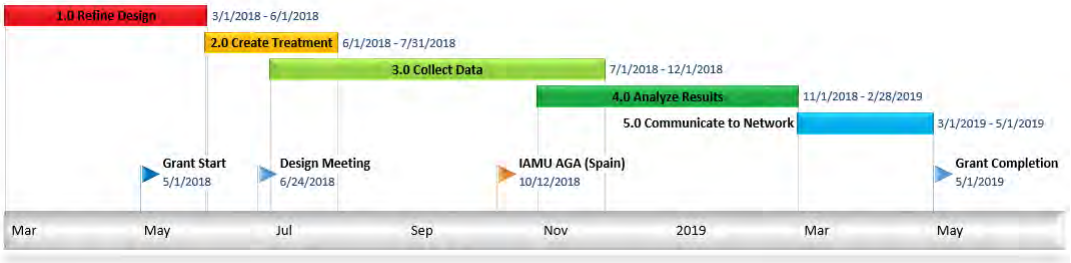


Figure 3.1: Gantt chart for OCEAN project

The rest of the report will be devoted to acknowledgements, references, and appendices. The appendices contain key process and work product documents.

- Section 9 – Acknowledgements
- Section 10 – References
- Section 11 – Appendices

4. Annotated Bibliography (Work Package 1)

This section corresponds to the first work package of the OCEAN research project – extension of review of literature. The preliminary design of the study was presented in a paper published in the proceedings of the IAMU annual general assembly in 2016 [24] – see Appendix 1. According to the agreed upon plan of research, the first phase (and work package) of the project was to extend the review of literature provided in this paper.

For the purposes of this report, an annotated bibliography of key references was included to provide an explanation of the relevance of the reference to this study, highlight key contributions of the references, and a description of ideas and issues that would be important to this study.

A ten-step review process [25] was used to conduct the literature review. Using the preliminary research design [24], searches were conducted using Google Scholar for each of the constructs to identify relevant articles to be examined. Combinations of these constructs and key words that related them (as well as context specific terms such as "seafarer," "maritime," and "shipping") became the search terms. The initial searches uncovered 987 potentially relevant articles. This collection was narrowed to 102 articles of interest using an analysis of titles and review of abstracts. While a great many of these articles of interest were used and cited throughout this study, the following 30 articles have been included in the annotated bibliography as being the most relevant and important articles for this research.

Five categories of references were identified:

1. Conservation Awareness / Ocean Literacy: This set of references explains why such research is necessary and also describes previous work in the area of ocean literacy, which is one of the instruments used in the OCEAN research project.
2. Theories of Behavior: In an effort to understand how behaviors might be influenced, it is important to first understand some of the theories that explain precursors to those behaviors. In the context of ocean conservation, understanding and applying these theories of behavior is particularly important [26]. These theories are broken down into three general categories: self-interest motivation, pro-social motivation, and one that integrates both self-interest and pro-social motivations.
3. Pro-Environmental Behavior (PEB) Treatments: Typically using meta-analyses, this set of references describes a variety of treatments used to motivate pro-environmental behavior (PEB). They also often describe the efficacy of various treatments. Using this set of meta-analytical studies, a combination of treatments (commitment and goal setting) were selected for the OCEAN research project.
4. Commitment and Goal Setting Studies: In order to determine how best to frame the commitment and goal setting treatments in the OCEAN research project, several studies using these treatments were examined.
5. Safety Culture: In addition to measuring ocean literacy, the OCEAN research project also set out to measure seafarer pro-compliance behaviors toward MARPOL and ocean plastics pollution. Since safety culture has been studied extensively in the maritime context, and instrument was adapted from the safety culture literature and developed for measuring pro-compliance behaviors.

The following sections will provide the summary of the literature review work package in the form of an annotated bibliography of the most relevant and important references in each category.

4.1. Conservation Awareness / Ocean Literacy

a. Reference: [27] Schultz, P. Wesley. "Conservation means behavior." *Conservation Biology,* Vol. 25, No. 6 (2011): pp 1080-1083.

a. Abstract: Most instances of deteriorating environmental conditions are caused by human behavior. Although there are certainly instances of such environmental conditions developing from natural processes, most are largely the result of human activity. Drivers of phenomena such as climate change, loss of species' habitats, and ocean acidification rarely are the result of malicious intent, but rather the consequence of the lifestyles of billions of humans. Accordingly, efforts to promote conservation must change behavior. [28], [29] This fundamental link between conservation and behavior has been noted in a number of recent publications. Mascia et al. [30] state that "Biodiversity conservation is a human endeavor: initiated by humans, designed by humans, and intended to modify human behavior…." Cowling [31] calls this realization "an epiphany for…natural scientists." And Balmford and Cowling [32] note that "conservation is primarily not about biology but about people and the choices they make." Here I would go one step further and propose that conservation is a goal that can only be achieved by changing behavior.

a. Highlights: Article states conservation (e.g. ocean conservation) can only be achieved by changing behaviors.

Article illustrates four research findings that illustrate the challenge for changing behavior:

1. Education does not typically result in behavior change.
2. Human thinking is biased and promotes short-sighted responses to environmental threats.
3. Individuals generally perceive themselves as separate from nature.
4. Social norms guide behavior.

b. References: [33] Centers for Ocean Sciences Education Excellence (COSEE). "Ocean literacy: The essential principles and fundamental concepts of ocean sciences for learners of all ages." Version 2: March 2013.
Retrieved: 4 August 2018: http://oceanliteracy.wp2.coexploration.org

[34] Santoro, Francesca, Santin Selvaggia, Gail Scowcroft, Géraldine Fauville, and Peter Tuddenham. *Ocean literacy for all: a toolkit*. Vol. 80. UNESCO Publishing, 2017.

[35] Cava, Francesca, Sarah Schoedinger, Craig Strang, and Peter Tuddenham. "Science content and standards for ocean literacy: A report on ocean literacy." Retrieved March 25 (2005): 2015.

[36] Schoedinger, Sarah, Lynn Uyen Tran, and Lynn Whitley. "From the principles to the scope and sequence: A brief history of the ocean literacy campaign." NMEA Special Report 3 (2010): 3-7.

b. Highlights: The Ocean Literacy Campaign (Project/Initiative) is intended to be used as a tool for educators to enhance awareness (and literacy) of our oceans.

Scientists and educators worked collaboratively together to develop a set of principles and a framework for fostering ocean literacy.

To be ocean literate, individuals must understand seven basic principles of ocean sciences:

1. The Earth has one big ocean with many features. (8)
2. The ocean and life in the ocean shape the features of the Earth. (5)
3. The ocean is a major influence on weather and climate. (7)
4. The ocean made Earth habitable. (3)
5. The ocean supports a great diversity of life and ecosystems. (9)
6. The ocean and humans are inextricably interconnected. (7)
7. The ocean is largely unexplored. (6)

The seven principles are supported by sub-principles (number for each noted in parentheses above). There are also topics and sub-topics which support each principle.

A framework is available for the principles that provides comprehensive conceptual flow diagrams for four different developmental stages within the K-12 grades.

Ocean literacy has been used as a construct for measuring individual's perception of and knowledge about the ocean (see next reference for example).

c. Reference: [37] St John, Freya AV, Gareth Edwards-Jones, and Julia PG Jones. "Conservation and human behaviour: lessons from social psychology." *Wildlife Research*, Vol. 37, No. 8 (2011): pp 658-667.

c. Abstract: Despite increased effort from non-governmental organisations, academics and governments over recent decades, several threats continue to cause species declines and even extinctions. Resource use by a growing human population is a significant driver of biodiversity loss, so conservation scientists need to be interested in the factors that motivate human behaviour. Economic models have been applied to human decision making for many years; however, humans are not financially rational beings and other characteristics of the decision maker (including attitude) and the pressure that people perceive to behave in a certain way (subjective norms) may influence decision making; these are characteristics considered by social psychologists interested in human decision making.We review social-psychology theories of behaviour and how they have been used in the context of conservation and natural-resource management.Many studies focus on general attitudes towards conservation rather than attitudes towards specific behaviours of relevance to conservation and thus have limited value in designing interventions to change specific behaviours (e.g. reduce hunting of a threatened species). By more specifically defining the behaviour of interest, and investigating attitude in the context of other social-psychological predictors of behaviour (e.g. subjective norms, the presence of facilitating factors and moral obligation), behaviours that have an impact on conservation goals will be better understood, allowing for the improved design of interventions to influence them.

c. Highlights: Article notes that theory of reasoned action, and its extension the theory of planned behavior, are models most commonly used by social psychologists interested in understanding human behavior.

Article describes these theories and explains the various constructs:

- Behavioral beliefs
- Outcome evaluation
- Attitude
- Normative beliefs
- Motivation to comply
- Subjective norm
- Control beliefs
- Power beliefs
- Perceived behavioral control
- Behavioral intention
- Behavior

Article emphasizes importance of behavioral intention on behaviors. Article summarizes several studies where social-psychological models have been used to examine conservation behaviors. Namely, the article summarizes 11 attitude studies. Article also explores potential for other studies looking at subjective norms and perceived behavioral control. In discussion, article suggests that in order to understand the predictors of behavior, studies must specifically define behavior of interest in terms of target, action, context and timescale, as well as norms and other constructs.

d. Reference: [38] Hynes, Stephen, Danny Norton, and Rebecca Corless. "Investigating societal attitudes towards the marine environment of Ireland." *Marine Policy*, Vol. 47 (2014): pp 57-65.

d. Abstract: This paper presents the results of a nationwide survey in Ireland that explored the values, concerns and preferences of individuals towards the Irish marine environment. The results of the Irish survey are also compared to the results from similar surveys carried out in other maritime countries in the EU. The results of the Irish survey demonstrate a reasonable level of knowledge of the main threats facing Ireland's marine environment and of the importance of non-market as well as market ecosystem services provided by the seas around the Irish coast. The results also suggest that the Irish public are skeptical of the ability of government and private industry to manage the Irish marine economy but instead place a large amount of trust in the competency of scientists. The perception of whether or not they consider where they live as being a coastal area would also suggest that the Irish public hold a much more narrow view of what constitutes a coastal area than that held by statistical agencies such as Eurostat.

d. Highlights: Ireland, an island nation, has many people who rely on the sea for its resources and their livelihoods, as well as for recreation and transportation.

The marine environmental policy agenda in Europe is moving forward as a result of directives such as the European Marine Strategy Framework Directive, and other directives.

Several similar previous studies have examined public awareness, attitudes, and perceptions about the marine environment (including in New Zealand, Australia, Japan, the United States, and Europe.

This study focused exclusively on Ireland and 812 individuals were surveyed using a controlled sampling procedure. Roughly one-third of those surveyed believed the condition of the waters and beaches of Ireland was poor. Respondents were asked to rate threats and many identified macro-issues (such as climate change or invasive species), but less than half identified farming or aquaculture as posing a threat.

Irish respondents were also less confident than their European counterparts about the governments' ability to manage marine protection.

e. Reference: [39] Kosenius, Anna-Kaisa, and Ollikainen Markku. "Ecosystem benefits from coastal habitats—A three-country choice experiment." *Marine Policy*, 58 (2015): 15-27.

e. Abstract: Coastal habitats provide a variety of benefits for citizens living in littoral countries. The economic value of changes in coastal habitats in the context of the implementation of the Baltic Sea Action Plan, targeting good ecological status by 2021, in two coastal sites was estimated using the choice experiment method. The selected aspects of marine ecosystem were described in conjunction with ecological changes modeled within the Finnish–Swedish archipelago and the Lithuanian coast. The benefits for Finns, Swedes, and Lithuanians for changes in the adjacent coastal site were estimated with the conditional logit and random parameters logit models accounting for preference heterogeneity. The willingness to pay estimates for healthy perennial vegetation, protection of currently pristine areas, and size of fish stocks differed significantly between populations. The transfer errors ranging from 40%, when transferring the estimates for the same coastal site between populations, to 400%, when transferring between both sites and populations, underline careful consideration in value transfers.

e. Highlights: The study examined the issue of valuation as it pertained to coastal environments and willingness to pay for conservation.

The study focused on a specific region of Sweden-Finland-Lithuania – the first such choice experiment survey on marine quality improvement in the region.

A twelve-page survey was used according to best practices. [40]

The study returned 2,271 responses (roughly evenly distributed among the three regions) and represented response rates of nearly 36.6 to 38.1%.

Lithuania (with relatively lesser coastal recreational areas and inland waters) had visited coastal regions more often, and was perceived as a more important food producer than by the respondents of the other regions.

Even though the willingness to pay for attribute levels differed, the model did not produce a statistically significant estimate of pooled welfare for Sweden and Lithuania.

Transfer errors remain relatively large even when controlling for income.

f. Reference: [41] Guest, Haley, Heike K. Lotze, and Douglas Wallace. "Youth and the sea: Ocean literacy in Nova Scotia, Canada." *Marine Policy*, Vol. 58 (2015): pp 98-107.

f. Abstract: Improving public awareness about the ocean can benefit the environment, economy, and society. However, low levels of 'ocean literacy' have been identified in many countries and can be a barrier for citizens to engage in environmentally responsible behavior or consider ocean-related careers. This study assessed the level of ocean valuation, knowledge, interaction and interest of public school students grade 7–12 (ages 12–18) in Nova Scotia, Canada, a region with strong connections with the sea. A survey was used in 11 public schools, with a total of 723 students participating in a quiz and survey. Many quiz questions were aligned with the 'Ocean Literacy Principles' established by the Ocean Literacy Campaign in the United States. Although the average quiz score was below 50%, students reported a high valuation of the marine environment and diverse interest in the oceans, including jobs and careers. There was a distinct difference in knowledge of biology-related questions and abiotic-related questions, with students having more knowledge of and interest in topics concerning ocean life. A significant positive correlation between knowledge and value indicated that ocean-literate students might value the marine environment more strongly. Students reporting greater interaction with the ocean also demonstrated higher knowledge levels, and students with higher knowledge levels were more likely to be interested in ocean-related jobs and careers. Participants′ high valuation of the marine environment and interest in ocean jobs and careers suggests important links between ocean literacy and environmental and economic benefit, respectively. Enhancing interactions with the ocean through experiential learning could be the most effective way of improving ocean literacy as well as marine citizen- and stewardship.

f. Highlights: Article provides definition of ocean literacy as "an understanding of the ocean's influence on you – and your influence on the ocean" taken from [33].

Study created a survey instrument to test students' ocean literacy. Instrument consisted of 11 multiple choice questions about the ocean, eight open-ended questions about the ocean, six scaled questions about values toward the ocean, and demographic questions. Several questions were fairly simplistic – "a whale is a fish, mammal, or both." Others were more requiring – "what causes sea level rise?"

A total of 723 students participated in the survey. Average score was 5.23 out of 11. Generally as grade level increased from 7 through 12, scores improved.

Study suggests students grade 7 – 12 in Nova Scotia value the ocean highly and are interested in learning more about the marine environment, yet possess generally low levels of ocean knowledge.

Students' level of interaction with ocean was positively correlated with ocean literacy.

This result is similar to other studies [42], [43], [44], [45], [46] around the world.

g. Reference: [47] Steel, Brent S., Court Smith, Laura Opsommer, Sara Curiel, and Ryan Warner-Steel. "Public ocean literacy in the United States." *Ocean & Coastal Management*, Vol. 48, No. 2 (2005): pp 97-114.

g. Abstract: The 2004 Pew Ocean Commission report suggests a need to improve public literacy about oceans. The authors of the report assume that enhancing public awareness and knowledge of oceans will lead to increased public support for ocean restoration efforts. Following this line of reasoning, our study investigates current levels of public knowledge and informedness concerning oceans, and also explores the correlates of knowledge holding. Using data gathered from a national random sample of 1233 citizens in Summer/Fall 2003, two hypotheses—transsituational and situation-specific—are examined as explanations of public knowledge levels concerning ocean policy issues. The trans-situational hypothesis evaluates socioeconomic status (SES) as an explanation for levels of knowledge. The situation-specific hypothesis evaluates personal experiences and contexts that might overcome SES characteristics. We also examine the effect of information source use on knowledge holding. Findings suggest that both trans-situational and situation-specific hypotheses are useful in explaining knowledge levels. We also find that information sources, such as newspapers and the internet, are likely to improve citizen knowledge on ocean issues, while television and radio have a negative effect.

g. Highlights: The study found the public is not well informed about oceans and ocean policy (i.e., ocean literate).

A random sample of US households yielded responses from 1233 individuals.

33.5% indicated they were not informed.

52.2% indicated they were somewhat informed.

h. References: [48] McKinley, Emma, and Stephen Fletcher. "Improving marine environmental health through marine citizenship: a call for debate." *Marine Policy*, Vol. 36, No. 3 (2012): pp 839-843.

[49] McKinley, Emma, and Stephen Fletcher. "Individual responsibility for the oceans? An evaluation of marine citizenship by UK marine practitioners." *Ocean & Coastal Management*, Vol. 53, No. 7 (2010): pp 379-384.

h. Abstract: In recent times, the governance of the marine environment has evolved from being primarily top down and state directed to being more participatory and community based. This paper proposes that an extension of this trend would be the inculcation of a societal sense of marine citizenship to deliver the sustainable management and protection of the marine environment through enhanced individual involvement in policy development and implementation. The potential role of marine citizenship in UK marine governance was examined by surveying UK marine practitioner's views on both the current and future role of marine citizenship. Observations from this study identified three key factors for discussion including conflicting opinions over the implementation of marine citizenship into policy; that marine education and a sense of personal attachment are integral to the development of marine citizenship; and that as yet, the potential implications of an enhanced sense of marine citizenship are uncertain. This research highlights the recognition amongst marine practitioners that higher levels of citizen involvement in the management of the marine environment would greatly benefit the marine environment, with additional benefits possible through an increased sense of marine citizenship.

h. Highlights: Study involved 42 interviews of marine practitioners as categorized:

- Local governance organizations
- Regional governance organizations (government and NGOs)
- National governance organizations (government and NGOs)
- International governance organizations (e.g. UNEP)
- Academics and other groups

The majority of interviewed individuals agreed that public *should* play a very active role in marine decision-making.

Article described the following factors that are important for development of marine citizenship:

- Marine education
- Personal attachment to the marine environment
- Personal (not governance) responsibility for the marine environment

The article concluded that there was a lack of consensus about the potential role of marine citizenship as a policy mechanism.

The article proposed a model of influential factors of marine citizenship (including awareness, concern, education, participation, decision-making, PEBs and perception, and personal/social responsibility.

The related article defines marine citizenship and calls for a debate.

4.2. Theories of Behavior

a. References: [50] Ajzen, Icek. "The theory of planned behavior." *Organizational Behavior and Human Decision Processes*, Vol. 50, No. 2 (1991): pp 179-211.

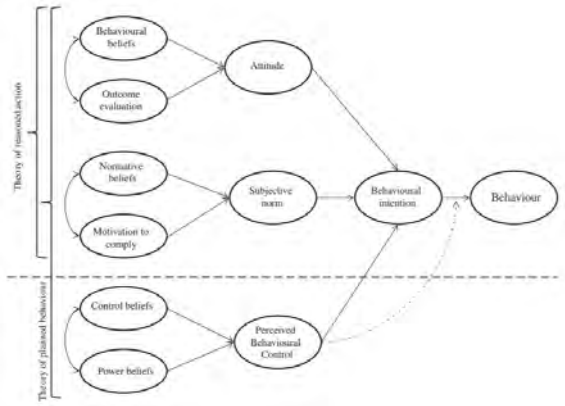
[51] Fishbein, Martin, and Icek Ajzen. *Belief, attitude, intention, and behavior: An introduction to theory and research*, (1977), Reading, MA: Addison-Wesley.

[52] Ajzen, Icek, and Martin Fishbein. *Understanding attitudes and predicting social behavior*, (1980), Englewood Cliffs, NJ: Prentice-Hall.

a. Abstract: Research dealing with various aspects of the theory of planned behavior is reviewed, and some unresolved issues are discussed. In broad terms, the theory is found to be well supported by empirical evidence. Intentions to perform behaviors of different kinds can be predicted with high accuracy from attitudes toward the behavior, subjective norms, and perceived behavioral control; and these intentions, together with perceptions of behavioral control, account for considerable variance in actual behavior. Attitudes, subjective norms, and perceived behavioral control are shown to be related to appropriate sets of salient behavioral, normative, and control beliefs about the behavior, but the exact nature of these relations is still uncertain. Expectancy value formulations are found to be only partly successful in dealing with these relations. Optimal rescaling of expectancy and value measures is offered as a means of dealing with measurement limitations. Finally, inclusion of past behavior in the prediction equation is shown to provide a means of testing the theory's sufficiency, another issue that remains unresolved. The limited available evidence

concerning this question shows that the theory is predicting behavior quite well in comparison to the ceiling imposed by behavioral reliability.

a. Highlights: This is one of the models most commonly used by social psychologists in understanding human behavior. Extended by theory of planned behavior. Lays the groundwork for similar studies in conservation. [26]



Vallerand et al., 1992 [25]

Figure 4.1: Theories of planned behavior (TPB) and reasoned action (TRA)

b. Reference: [53] Armitage, Christopher J., and Mark Conner. "Efficacy of the theory of planned behaviour: A meta□analytic review." *British journal of social psychology* Vol. 40, No. 4 (2001): pp 471-499.

b. Abstract: The Theory of Planned Behaviour (TPB) has received considerable attention in the literature. The present study is a quantitative integration and review of that research. From a database of 185 independent studies published up to the end of 1997, the TPB accounted for 27% and 39% of the variance in behaviour and intention, respectively. The perceived behavioural control (PBC) construct accounted for significant amounts of variance in intention and behaviour, independent of theory of reasoned action variables. When behaviour measures were self-reports, the TPB accounted for 11% more of the variance in behaviour than when behaviour measures were objective or observed (R 2s = .31 and .21, respectively). Attitude, subjective norm and PBC account for signi cantly more of the variance in individuals' desires than intentions or self-predictions, but intentions and self-predictions were better predictors of behaviour. The subjective norm construct is generally found to be a weak predictor of intentions. This is partly attributable to a combination of poor measurement and the need for expansion of the normative component. The discussion focuses on ways in which current TPB research can be taken forward in the light of the present review.

b. Highlights: Article examined 161 articles that contained 185 independent empirical tests, including 44 prospective self-reported behavior and 19 prospective measures of behavior that were taken from observed records.

Meta-analysis distinguished three types of perceived behavioral control measures:

- Self efficacy – or confidence in one's own ability to carry out a particular behavior
- Perceived control over behavior – or perceived controllability of behavior
- Perceived behavioral control

Theory of planned behavior accounted for 27% of variance in behavior.

Theory of planned behavior accounted for 39% of variance in behavioral intention.

Overall, TPB compares favorably to similar previous studies.

Perceived behavioral control was found to contribute uniquely to the prediction of behavior.

The analysis did find differences between measures of PBC, perceived control over behavior, and self-efficacy. PBC and self-efficacy were found to be more significant and strongly correlated to both intention and behavior. Perceived control over behavior was found to be weak and unreliable.

One criticism of TRA and TPB is that these behavioral decision-making models tend to rely on self-reports, despite the evidence of self-presentational biases.

Future work may study desire, intention, and self-prediction.

c. Reference: [54] Schwartz, Shalom H., and Judith A. Howard. "A normative decision-making model of altruism." In Rushton, J P & Sorrentino, R M (Eds.), *Altruism and helping behavior* (1981), pp 189-211, Hillsdale, NJ: Lawerence Erlbaum.

c. Abstract: N/A

c. Highlights: In contrast to the TPB, which is essentially a general behavior theory, the so-called norm-activation theory (NAT) has been developed specifically for a specific type of behavior, altruism or helping behavior.

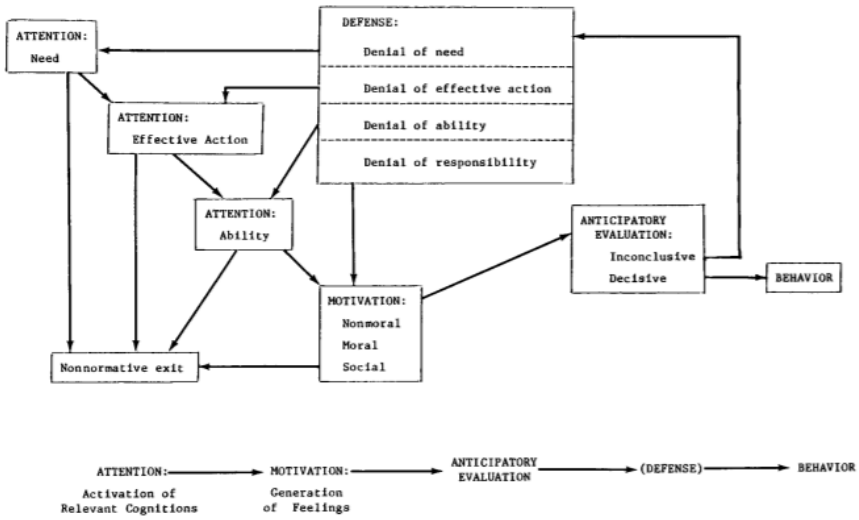


Figure 4.2: Norma-activation theory (NAT)

Basic assumption of the NAT is that people help other people if they feel morally obliged to in a given situation, which the authors refer to as an *activated* personal norm.

It is important to note that this norm must be activated (often from a personal value system) in order for it to become a determinant of behavior. To be activated, four conditions must be fulfilled:

- A person needs to be aware of the need for help
- A person need to be aware of the consequences a certain behavior would have for the person in need (also called the awareness of consequences)
- A person needs to accept responsibility for their actions (ascription of responsibility)
- A person has to perceive themselves of performing the helping actions (similar to perceived behavioral control)

From this theory, it is unclear how this applies to a non-person object, like the environment.

d. Reference: [55] Stern, Paul C., Thomas Dietz, Troy Abel, Gregory A. Guagnano, and Linda Kalof. "A value-belief-norm theory of support for social movements: The case of environmentalism." *Human Ecology Review*, Vol. 6, No. 2 (1999): 81-97.

d. Abstract: We present a theory of the basis of support for a social movement. Three types of support (citizenship actions, policy support and acceptance, and personal-sphere behaviors that accord with movement principles) are empirically distinct from each other and from committed activism. Drawing on theoretical work on values and norm-activation processes, we propose a value-belief-norm (VBN) theory of movement support. Individuals, who accept a movement's basic values, believe that valued objects are threatened, and believe that their actions can help restore those

values experience an obligation (personal norm) for pro-movement action that creates a predisposition to provide support; the particular type of support that results is dependent on the individual's capabilities and constraints. Data from a national survey of 420 respondents suggest that the VBN theory, when compared with other prevalent theories, offers the best available account of support for the environmental move

d. Highlights: This theory attempts to link NAT to findings about the relation between general values, environmental beliefs, and behavior.

Here too, personal norms must be activated by ascription of responsibility and awareness of consequence (primary assumption).

However, a causal chain is formed whereby awareness of consequences is a necessary prerequisite for ascription of responsibility.

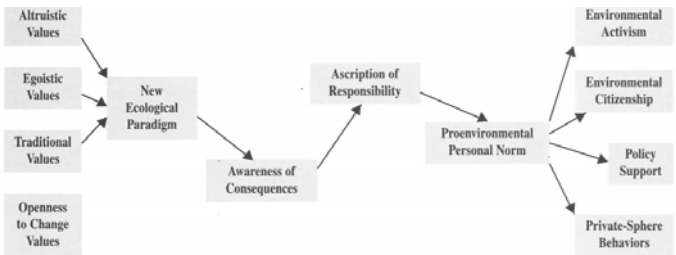


Figure 4.3: Value-based norm (VBN) theory

Above depicts VBN theory as applied to environmentalism with direct causal relationshios between pairs of adjacent variables.

e. Reference: [56] Klöckner, Christian A. "A comprehensive model of the psychology of environmental behaviour—A meta-analysis." *Global Environmental Change,* Vol. 23, No.5 (2013): pp 1028-1038.

e. Abstract: To address global environmental challenges it is crucial to understand how humans make decisions about environmentally relevant behaviour, since a shift to alternative behaviours can make a relevant difference. This paper proposes a comprehensive model of determinants of individual environmentally relevant behaviour based on a combination of the most common theories in environmental psychology. The model is tested using a meta-analytical structural equation modelling approach based on a pool of 56 different data sets with a variety of target behaviours. The model is supported by the data. Intentions to act, perceived behavioural control and habits were identified as direct predictors of behaviour. Intentions are predicted by attitudes, personal and social norms, and perceived behavioural control. Personal norms are predicted by social norms, perceived behavioural control, awareness of consequences, ascription of responsibility, an ecological world view and self-transcendence values. Selfenhancement values have a negative impact on personal norms. Based on the model, interventions to change behaviour need not only to include attitude campaigns but also a focus on de-habitualizing behaviour, strengthening the social support and increasing self-efficacy by concrete information about how to act. Value based interventions have only an indirect effect.

e. Highlights: Several studies [57] have shown that norm-activation can trigger pro-environmental behaviors.

The authors suggest the CADM is supported by the data as a general model of environmental behavior.

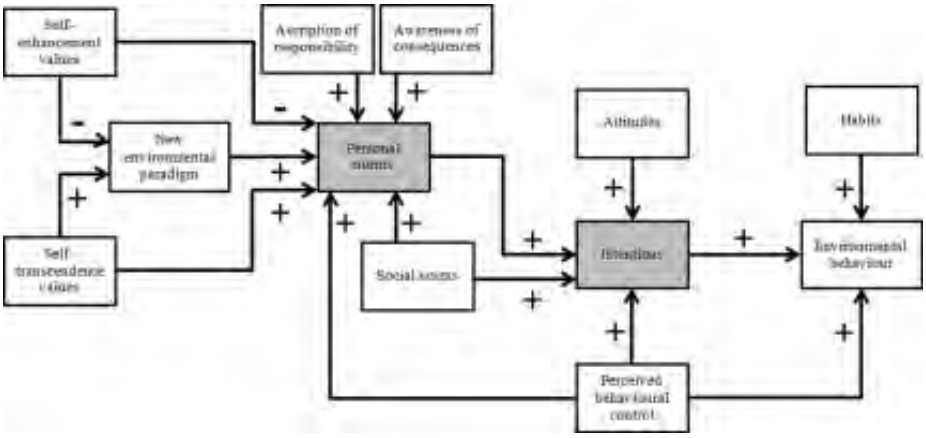


Figure 4.4: Comprehensive action determination model (CADM)

It can be used as a general framework in identifying important proximal and distal predictors of varying kinds of environmentally relevant behavior.

f. Reference: [58] Bamberg, Sebastian, and Guido Möser. "Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour." *Journal of Environmental Psychology*, Vol. 27, No. 1 (2007): pp 14-25.

f. Abstract: This meta-analysis of psycho-social determinants of PEBs [58] which examined 57 correlational studies from 1995 to 2006, as an extension of a landmark previous study [59], and which confirmed similar results. This study uses theoretical framework that integrates the Norm Activated Model [60] which suggests people are pro-socially motivated and the Theory of Planned Behavior [61] which suggests people are motivated by hedonic self-interest. The following diagram illustrates this integrated model and identifies how those 57 multi-construct studies correlated across key components or constructs of the integrated model.

f. Highlights: This meta-analyses noted the missing values problem experienced by such multi-attribute structural equation modelling approaches – with 57 samples spread to test 36 pooled means needed across the nine constructs.

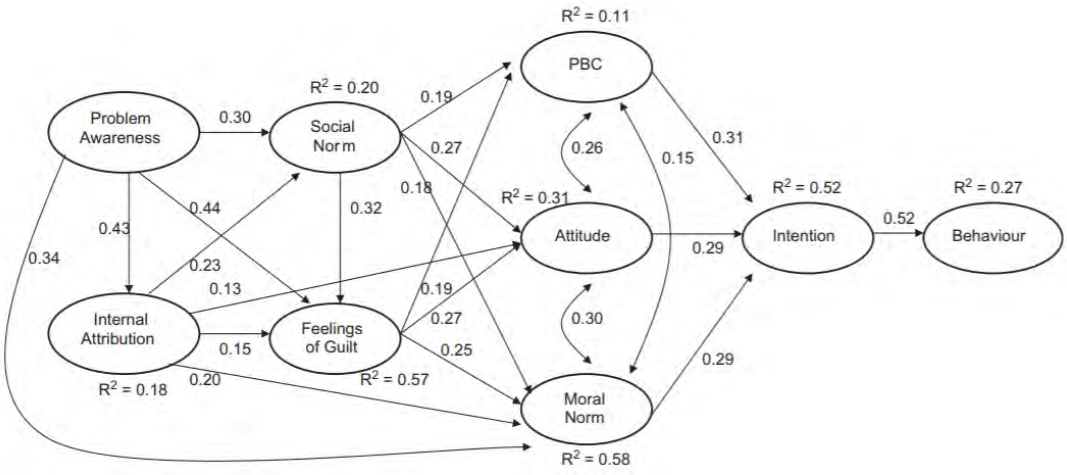


Figure 4.5: Results of multi-attribute structural equation model (MASEM)

The study also confirmed that PEBs are a mixture of self-interest and pro-social behaviors.

The total effect of problem awareness on behavior as well as intention is higher than the total effect of the more proximal determinants moral norm, attitude and PBC. The strong total effect of problem awareness on behavior and intention results mainly from its strong association with feelings of guilt and moral norm. Obviously, knowledge is a necessary, however not sufficient precondition for developing pro-environmental moral norms and attitudes.

g. Reference: [59] Hines, Jody M., Harold R. Hungerford, and Audrey N. Tomera. "Analysis and synthesis of research on responsible environmental behavior: A meta-analysis." *The Journal of Environmental Education*, Vol. 18, No. 2 (1987): pp 1-8.

g. Abstract: Despite the wealth of information which exists concerning environmental behavior, it is not known which variable or variables appear to be most influential in motivating individuals to take responsible environmental action. A meta-analysis of environmental behavior research was undertaken in an attempt to determine this. An exhaustive search of the empirically based environmental behavior research conducted over the past decade yielded a substantial number of studies representative of a broad academic base. The characteristics and findings of these studies served as the data for the meta-analysis. As a result of the meta-analysis, the following variables were found to be associated with responsible environmental behavior: knowledge of issues, knowledge of action strategies, locus of control, attitudes, verbal commitment, and an individual's sense of responsibility. A model of predictors of environmental behavior is proposed.

g. Highlights: This model provides a more expansive view of what influences PEBs – to include situational variables or factors.

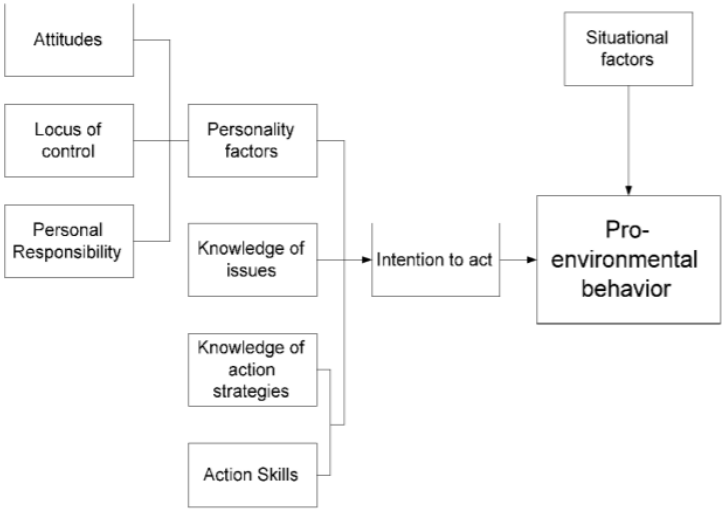


Figure 4.6: Model of responsible environmental behavior

h. Reference: [62] Kollmuss, Anja, and Julian Agyeman. "Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?." *Environmental Education Research*, Vol. 8, No. 3 (2002): pp 239-260.

h. Abstract: Numerous theoretical frameworks have been developed to explain the gap between the possession of environmental knowledge and environmental awareness, and displaying pro-environmental behavior. Although many hundreds of studies have been undertaken, no definitive explanation has yet been found. Our article describes a few of the most influential and commonly used analytical frameworks: early US linear progression models; altruism, empathy and prosocial behavior models; and finally, sociological models. All of the models we discuss (and many of the ones we do not such as economic models, psychological models that look at behavior in general, social marketing models and that have become known as deliberative and inclusionary processes or procedures (DIPS)) have some validity in certain circumstances. This indicates that the question of what shapes pro-environmental behavior is such a complex one that it cannot be visualized through one single framework or diagram. We then analyze the factors that have been found to have some influence, positive or negative, on pro-environmental behavior such as demographic factors, external factors (e.g. institutional, economic, social and cultural) and internal factors (e.g. motivation, pro-environmental knowledge, awareness, values, attitudes, emotion, locus of control, responsibilities and priorities). Although we point out that developing a model that tries to incorporate all factors might neither be feasible nor useful, we feel that it can help illuminate this complex field. Accordingly, we propose our own model based on the work of Fliegenschnee and Schelakovsky (1998) who were influenced by Fietkau and Kessel (1981).

h. Highlights: This model does not attribute a direct relationship between environmental knowledge and PEBs.

This model also suggests barriers to PEBs (e.g., old behavior patterns, lack of internal incentives, etc.)

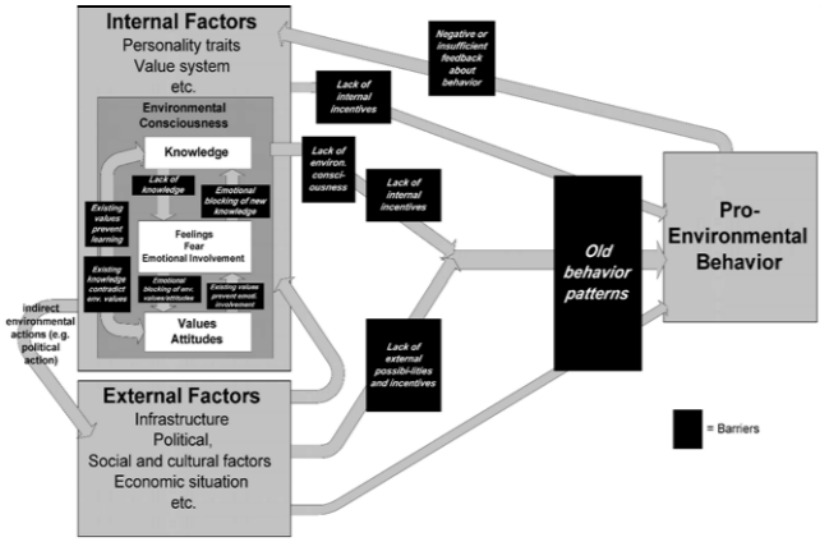


Figure 4.7: Model of pro-environmental behavior (PEB)

i. Reference: [63] Steg, Linda, and Charles Vlek. "Encouraging pro-environmental behaviour: An integrative review and research agenda." *Journal of Environmental Psychology*, Vol. 29, No. 3 (2009): pp 309-317.

i. Abstract: Environmental quality strongly depends on human behaviour patterns. We review the contribution and the potential of environmental psychology for understanding and promoting pro-environmental behaviour. A general framework is proposed, comprising: (1) identification of the behaviour to be changed, (2) examination of the main factors underlying this behaviour, (3) design and application of interventions to change behaviour to reduce environmental impact, and (4) evaluation of the effects of interventions. We discuss how environmental psychologists empirically studied these four topics, identify apparent shortcomings so far, and indicate major issues for future research

i. Highlights: It is important for researchers and policy-makers to systematically evaluate the effects of various treatments and interventions. All too often, intervention strategies focus too much on education rather than structural strategies, such as policies and incentives.

Four key issues should be addressed:

- Identification of the key behavior that must be changed.
- The examination of the main factors underlying that behavior.
- Application of interventions (or treatments) to change the relevant behaviors and their determinants.
- Evaluation of intervention effects on behavior itself, its main determinants, environmental quality, and quality of human life.

When applying an interdisciplinary approach, [64] it is practical to apply the following criteria:

- Measure actual behavior (whenever possible)
- Pay attention to the particular conditions under which a particular theory is ascribed
- Make sure to examine contextual factors
- Clearly describe which behaviors are being studied under which conditions using a specific treatment (or intervention)
- Use experimental design
- Understand how people adapt to policies and settings over time

4.3. Pro-Environmental Behavior (PEB) Treatments

a. Reference: [65] Kurisu, Kiyo. "Behavioral model development for understanding PEBs," in *Pro-Environmental Behaviors*, (2015), pp 47-62, Tokyo: Springer.

a. Abstract: Various models have been proposed to aid understanding of the key factors for PEBs and the relationships between them. This chapter explains some of the more well-known general behavior models that can be applied to PEBs, such as Schwartz's model and the theory of planned behavior (TPB) model first. Then, models specific to PEBs, such as value–belief–norm (VBN) model, motivation–opportunity–ability (MOA) model, and two-phase model, are explained. Besides, since many works have been conducted to investigate the determinants for PEBs, the motivation to compile and assess the preceding works naturally rises. The meta-analyses of preceding works are also shown in this chapter and finally the empirical models which refer to several theories empirically show the relationships involving not only sociopsychological variables but also sometimes sociodemographic variables. The aim of these trials is not to establish a new theory but to show the applicability of previous theories and to understand the influential factors on the target PEB. In the final section, several examples of these trials are shown.

a. Highlights: This summary does not introduce a new model.

Instead, it illustrates the utility of the existing theories.

b. Reference: [66] Osbaldiston, Richard, and John Paul Schott. "Environmental sustainability and behavioral science: Meta-analysis of proenvironmental behavior experiments." *Environment and Behavior,* Vol. 44, No. 2 (2012): pp 257-299.

b. Abstract: To provide practitioners with useful information about how to promote proenvironmental behavior (PEB), a meta-analysis was performed on 87 published reports containing 253 experimental treatments that measured an observed, not self-reported, behavioral outcome. Most studies combined multiple treatments, and this confounding precluded definitive conclusions about which individual treatments are most effective. Treatments that included cognitive dissonance, goal setting, social modeling, and prompts provided the overall largest effect sizes (Hedge's $g > 0.60$). Further analyses indicated that different treatments have been more effective for certain behaviors. Although average effect sizes are based on small numbers of

studies, effective combinations of treatments and behaviors are making it easy to recycle, setting goals for conserving gasoline, and modeling home energy conservation. The results also reveal several gaps in the literature that should guide further research, including both treatments and PEB that have not been tested.

b. Highlights: This comprehensive meta-analysis of PEB experiments [66] examined 87 published reports containing 253 experimental treatments that measured an observed, not self-reported, behavioral outcome.

Focused on intervention-based research in which factors thought to influence PEB were manipulated and behavioral outcomes were measured objectively.

Quantitative review identified ten types of treatments in four different categories:

- Convenience
  - Making it Easy – by changing situational conditions making a specific behavior easier to do.
  - Prompts – by providing non-informational reminders focusing on *when* to perform the next specific action.
- Information
  - Justifications – by providing reasons for performing a specific behavior.
  - Instructions – indicating *how* to perform a specific behavior.
- Monitoring
  - Feedback – which provides information about the extent to which a behavior has been performed previously.
  - Rewards – (or incentives) that include any kind of monetary gain received as a result of participating.
- Social-psychological processes
  - Social Modeling – includes any kind of information passing via demonstration or discussion where the initiator indicates they personally engage in the behavior.
  - Cognitive Dissonance – such that preexisting beliefs and attitudes are used to encourage participants to behave in ways that reduce cognitive dissonance.
  - Commitment – which asks participants to make some sort of verbal or written commitment to engage in a specific behavior.
  - Setting Goals – includes asking participants to aim for a predetermined goal.

Weighted average of effect sizes indicated the following four treatments to have moderate to large effect sizes (where the average effect size of all studies was 0.45):

1. Cognitive Dissonance (0.94)
2. Setting Goals (0.64)
3. Social Modelling (0.63)
4. Prompts (0.62)

However, most studies used multiple treatments which confounded results. This study cross-tabulated all of the treatments and found six to be particularly effective:

1. Rewards and Goals (0.78)
2. Instructions and Goals (1.31)
3. Commitment and Goals (0.71)

4. Prompts and Making it Easy (1.10)
5. Prompts and Justification (0.78)
6. Cognitive Dissonance and Justification (0.89)

There was no one treatment (a “silver bullet”) that was highly effective across all the possible PEBs. Therefore, it is important to match treatment to behaviors.

Of all the PEBs described in Table 4, MARPOL compliance may be most similar to public recycling (requiring compliant behavior in public and not private setting), Commitments (1.08) seem to be most effective behind Making it Easy (1.46) and Justifications (1.71) – both of which are commonly already performed. Using the cross-tabulated data from Table 2, Setting Goals pairs well with Commitments. Also, other studies have noted that Goal Setting is most effective treatment [67], [68], [69]. Also, since public recycling requires less effortful behavior and engagement, fewer treatments are needed.

c. Reference: [70] McKenzie-Mohr, Doug, and P. Wesley Schultz. "Choosing effective behavior change tools." *Social Marketing Quarterly*, Vol. 20, No. 1 (2014): pp 35-46.

c. Abstract: Achieving a sustainable future will require that people do things differently. Community-based social marketing (CBSM) provides a framework for fostering sustainable behavior, and the approach is being increasingly utilized across a range of domains including energy conservation, recycling, reducing water consumption, promoting sustainable seafood consumption, and many others. This article provides guidance to practitioners about the optimal use of specific behavior change tools. The article summarizes commitment strategies, social diffusion, goal setting, social norms, prompts, incentives, feedback, and convenience as effective tools for encouraging changes in behavior. For each, we summarize the basic approach and provide recommendations regarding when each tool is most appropriate, depending on the existing levels of barriers and benefits associated with the target behavior. The article concludes with three examples of CBSM to illustrate this selection process.

c. Highlights: Traditionally, programs encouraging sustainability rely on information-intensive or education campaigns [71] with limited results [72].

Community-based social marketing (CBSM) is an intervention that involves several steps:

1. Select behavior(s)
2. Identify barriers and benefits
3. Develop strategies (e.g., commitment, goal setting, prompts, norms, convenience, etc.)
4. Pilot CBSM strategies (and evaluate efficacy)
5. Implement broad-scale and evaluate

It lists several behavior change tools:

- Commitment
- Goal Setting
- Social Diffusion (to provide visibility among influence community)
- Social Norms

- Prompts
- Incentives
- Feedback (usually passive monitoring of behavior)
- Convenience (by reducing barriers)

The article provides several relevant examples that have had success changing behaviors supported by the literature for each of the different behavior change tools.

CBSM seems to be more of a process rather than a unique technique, although it may also reinforce the intervention when social media and marketing are involved (through social diffusion).

d. Reference: [73] Lo, Siu Hing, Gjalt□Jorn Y. Peters, and Gerjo Kok. "A review of determinants of and interventions for proenvironmental behaviors in organizations." *Journal of Applied Social Psychology*, Vol. 42, No. 12 (2012): pp 2933-2967.

d. Abstract: A review of empirical studies on proenvironmental behaviors (PEBs) in organizational contexts is presented. Twenty-one studies met the inclusion criteria. Quantitative effect sizes were compared where statistics were available and research designs were comparable. Characteristics of the dependent variable and the targeted organizational (sub)populations were systematically examined. With respect to individualspecific determinants, the results show relatively consistent effects for attitudinal determinants and past behavior. For organization-specific influences, management and physical facilitation were frequently significant. Findings related to other factors are less conclusive. Given the available evidence and feasibility considerations, it is recommended that interventions focus on physical facilitation, tailored persuasive communication, and active engagement of middle management. It is further recommended that future research integrates the analysis of individual and organizational determinants.

d. Highlights: For the review period, 21 studies met the evaluation criteria:

- About PEB
- About the determinants of PEB
- Original data (i.e., not review articles)
- Organizational context
- Target group is working (i.e., non-students) and environmental sustainability is principle concern
- Identified concrete behaviors

Even though there was some congruence, there is a lack of integrated analysis between individual and organizational determinants.

There is insufficient study of social norms on organizational PEBs.

There is also insufficient evidence of determinants of PEBs in organizational contexts.

It appears that treatments (i.e., determinants) will be context dependent.

e. Reference: [74] Paillé, Pascal, and Jorge Humberto Mejía-Morelos. "Antecedents of pro-environmental behaviours at work: The moderating influence of psychological contract breach." *Journal of Environmental Psychology*, Vol. 38, No. (2014): pp 124-131.

e. Abstract: This study uses the tenets of social exchange theory to examine employee willingness to perform proenvironmental behaviours (PEBs) in a workplace setting. The first aim of the study was to examine the indirect effect of perceived organisational support on pro-environmental behaviours via job attitudes. The second objective was to clarify whether a psychological contract breach affects the relationships between perceived organisational support and job attitudes. Using a convenience sample (N ¼ 449), we report that perceived organisational support has an indirect effect on PEBs through employee commitment to the organisation. Additionally, organisational support moderates the effect of a perceived breach on employee job satisfaction.

e. Highlights: This article proposed a PEB model for a specific work setting.

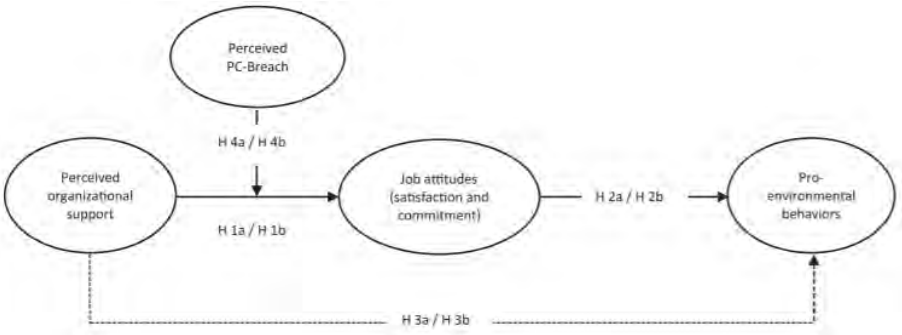


Figure 4.8: Model explaining pro-environmental behavior (PEB)

A cross-sectional field study of 1,500 alumni from a major Mexican university was performed.

While 69% of the variance of PEB could be explained by POS, there was no support for the mediator or moderator effects.

There is evidence that a strong relationship between employer and employee provides a barrier to employee disengagement with PEBs at work.

A breach of psychological contract turned out to be an impediment to obtaining environmental sustainability.

PEBs in organizational settings turned out to be different from that of individuals in a private setting.

4.4. Commitment and Goal Setting Studies

a. Reference: [75] Lokhorst, Anne Marike, Carol Werner, Henk Staats, Eric van Dijk, and Jeff L. Gale. "Commitment and behavior change: A meta-analysis and critical review of commitment-making strategies in environmental research." *Environment and Behavior*, Vol. 45, No. 1, (2013): pp 3-34.

a. Abstract: Commitment making is commonly regarded as an effective way to promote proenvironmental behaviors. The general idea is that when people commit to a certain behavior, they adhere to their commitment, and this produces long-term behavior change. Although this idea seems promising, the results are mixed. In the current article, the authors investigate whether and why commitment is effective. To do so, the authors first present a meta-analysis of environmental studies containing a commitment manipulation. Then, the authors investigate the psychological constructs that possibly underlie the commitment effect. They conclude that commitment making indeed leads to behavior change in the short- and long term, especially when compared with control conditions. However, a better understanding is needed of the possible underlying mechanisms that guide the commitment effect. The authors see commitment making as a potentially useful technique that could be improved by following up on findings from fundamental research. They provide suggestions for future research and recommendations for improving the effectiveness of commitment-making techniques.

a. Highlights: This meta-analysis sought to examine studies published from the period 1976 to 2010. They searched words such as “commitment,” “pledge,” and “behavioral contracting” related to a range of environmental topics and identified 19 relevant studies.

It focused on studies of direct (and not mediator) measures.

It found that commitment making is general effective within the intervention period (average effect size of 0.27).

It also showed that commitment plus another intervention (treatment) increase effect size by about 0.06 to 0.1) over commitment alone.

It was unable to compare or contrast commitment to other interventions (with the limited number and types of studies).

The act of committing leads to fundamental changes in the individual. An individual needs to change their self-concept in order to be in align with the new behavior. Also, or perhaps instead, the individual needs to change cognitions values, and attitudes to be more favorably aligned with the desired behavior. These internalized changes lead to sustain the behavior over a longer period of time.

As a result, through commitment, internalization can occur, yielding behaviors that are motivated by personal, durable feelings and beliefs.

b. Reference: [76] Baca-Motes, Katie, Amber Brown, Ayelet Gneezy, Elizabeth A. Keenan, and Leif D. Nelson. "Commitment and behavior change: Evidence from the field." *Journal of Consumer Research* Vol. 39, No. 5 (2012): pp 1070-1084.

b. Abstract: Influencing behavior change is an ongoing challenge in psychology, economics, and consumer behavior research. Building on previous work on commitment, self-signaling, and the principle of consistency, a large, intensive field experiment (N = 2,416) examined the effect of hotel guests' commitment to practice environmentally friendly behavior during their stay. Notably, commitment was symbolic—guests were unaware of the experiment and of the fact that their behavior would be monitored, which allowed them to exist in anonymity and behave as they wish. When guests made a brief but specific commitment at check-in, and received a lapel pin to symbolize their commitment, they were over 25% more likely to hang at least one

towel for reuse, and this increased the total number of towels hung by over 40%. This research highlights how a small, carefully planned intervention can have a significant impact on behavior. Theoretical and practical implications for motivating desired behavior are discussed.

b. Highlights: Small, carefully planned interventions can have a significant impact on behavior.

Specifically, guests in the treatment conditions (i.e., lapel pins to symbolize commitment) were 25% more likely to reuse towels and reused 40% more towels. Incidentally, they were also more likely to turn off lights when leaving rooms – which represents a potential spill-over effect.

On the other hand, a generalized commitment (agreeing to a pro-environmental message), while generating 98% involvement, was ineffective in motivating behavior.

This research supports the theories.

Two overall observations were made:

1. Guests were more likely to commit in general than in specific (98% versus 83%).
2. Behavior changes when the initial act requires a cost or effort (and thus the individual reinforces their prosocial behavior).

In summary, one small change in a process can have marked impacts.

4.5. Seafarer Safety Culture

a. Reference: [77] Lu, Chin-Shan, Chen-Ning Hsu, and Chen-Han Lee. "The impact of seafarers' perceptions of national culture and leadership on safety attitude and safety behavior in dry bulk shipping." *International Journal of e-Navigation and Maritime Economy*, Vol. 4 (2016): pp 75-87.

a. Abstract: This research aims to examine the effects of national culture and leadership style on safety performance in bulk shipping companies. Survey data collected from 322 respondents working in dry bulk carrierswas used, a multiple regression analysis was conducted to analyze the influence of national culture and leadership styles (i.e. transformational, passive management, and contingent reward) on safety attitude and safety behavior. The results indicate that national culture dimensions such as power distance, uncertainty avoidance, collectivism, and long-term orientation had a positive influence on safety behaviour. Long-term orientation had a positive influence on safety attitude, whereas masculinity had a negative influence on safety attitude of seafarers. Specifically, this research found that transformational leadership had a positive influence on safety attitude and safety behaviour of seafarers. Moreover, practical implication from the research findings to improve ship safety in dry bulk shipping were discussed.

a. Highlights: Of all the dimensions of culture, long-term orientation (degree to which a culture values the future) [78] seemed to be the strongest indicator of safety attitudes and behavior – this could have potential relevance to pro-environmental behaviors.

While the study itself was interesting in that it tried to relate Hoefstede's cultural dimensions and Bass's transformational (transactional) leadership scales to determine

safety culture and attitudes, what is most interesting is how they measured culture and attitude.

Safety attitude and behavior was measured using the following:

Safety Attitude	1. I think accidents are avoidable.
	2. I think it is not necessary to ignore safety regulations to get a job done.
	3. I think that not all accidents are preventable, some people are just unlucky.
	4. I will keep my work equipment in safe working condition.
	5. I encourage others to be safe.
	6. I report safety problems to my supervisor when I see safety problem.
Safety Behavior	7. I follow all safety procedures regardless of the situation I am in.
	8. I follow safety rules that I think are necessary.
	9. I keep my work area clean.
	10. I correct safety problems to ensure accidents will not occur.

Additionally, the cultural dimensions were also of interest as a potential moderator of PEB interventions:

Power Distance	1. My supervisors make most decisions without consulting me.
	2. I tend to avoid any potential arguments with my supervisor.
	3. I am always afraid to disagree with my supervisor.
Uncertainty Avoidance	4. I like to work in a well-defined job where the requirements are clear.
	5. It is important for me to work for a

	company that provides high employment stability.
	6. I think that the company should use clear and explicit guidelines when evaluating me.
	7. Group success is more important for me than my personal accomplishment.
	8. Working in a group is better than working alone.
Collectivism	
	9. Decisions made by the group are better than those made by individuals.
	10. Contributing to the group is the most important aspect of work.
	11. I do not like to help and care for others.
	12. I stress on making a career than quality of
Masculine	life.
	13. Making a career is more important than good relationships with co-workers.
	14. I prefer long-term outlook than immediate benefit.
	15. I respect for social and status obligations within limits.
	16. I think to have a sense of shame is
Long-Term Orientation	important.
	17. I think the perseverance is important in my life.
	18. I do not mind giving up today's fun for success in the future.
	19. I work hard for success in the future.

b. Reference: [79] Lu, Chin-Shan, Kee-hung Lai, YH Venus Lun, and T. C. E. Cheng. "Effects of national culture on human failures in container shipping: The moderating role of Confucian dynamism." *Accident Analysis & Prevention*, Vol. 49, (2012): pp 457-469.

b. Abstract: Recent reports on work safety in container shipping operations highlight high frequencies of human failures. In this study, we empirically examine the effects of seafarers' perceptions of national culture on the occurrence of human failures affecting work safety in shipping operations. We develop a model adopting Hofstede's national culture construct, which comprises five dimensions, namely power distance, collectivism/individualism, uncertainty avoidance, masculinity/femininity, and Confucian dynamism. We then formulate research hypotheses from theory and test the hypotheses using survey data collected from 608 seafarers who work on global container carriers. Using a point scale for evaluating seafarers' perception of the five national culture dimensions, we find that Filipino seafarers score highest on collectivism, whereas Chinese and Taiwanese seafarers score highest on Confucian dynamism, followed by collectivism, masculinity, power distance, and uncertainty avoidance. The results also indicate that Taiwanese seafarers have a propensity for uncertainty avoidance and masculinity, whereas Filipino seafarers lean more towards power distance, masculinity, and collectivism, which are consistent with the findings of Hofstede and Bond (1988). The results suggest that there will be fewer human failures in container shipping operations when power distance is low, and collectivism and uncertainty avoidance are high. Specifically, this study finds that Confucian dynamism plays an important moderating role as it affects the strength of associations between some national culture dimensions and human failures. Finally, we discuss our findings' contribution to the development of national culture theory and their managerial implications for reducing the occurrence of human failures in shipping operations.

b. Highlights: In a maritime context, study explores impacts of national culture on human casualties in container shipping.

The results find power distance is significantly influence on human failures in container shipping operations.

Collectivism is negatively related to human failures.

Confucian dynamism plays an important moderating role between national culture dimensions and human failures.

The study creates development of Hoefstede cultural measures and scales for maritime context.

c. Reference: [80] Håvold, Jon Ivar. "National cultures and safety orientation: A study of seafarers working for Norwegian shipping companies." *Work & Stress*, Vol. 21, No. 2 (2007): pp 173-195.

c. Abstract: Up to now, little work has been conducted on safety in relation to national culture. This paper examines the association between national culture and the safety orientation of seafarers on Norwegian-owned vessels. Safety orientation is the result of cultural, organizational, and contextual factors that create attitudes and behaviours that in turn influence safety. In this study a safety culture/orientation questionnaire was designed and used to determine risk and safety characteristics. Survey data was collected from 2,558 seafarers from 27 countries. The sample used consisted of seafarers from the 10 countries for which there were more than 10 respondents. Five national (cultural) characteristics were calculated using Hofstede's Value Survey

Model 94. Multivariate analysis of variance revealed that (a) the number of nationalities represented on a vessel was related to their attitude towards safety issues, such that two-nation vessels obtain relatively negative scores regarding these issues, and (b) national culture was related to safety culture, such that high power distance, high uncertainty avoidance, and high individualism were positive for safety. The implications of these findings for practice and future research are discussed.

c. Highlights: This was one of first studies of influences of national culture (as measured by Hoefstede's cultural dimensions) on safety culture and climate.

The study examined Norwegian-owned vessels – 2,558 seafarers from 27 countries were sampled.

Of those sampled, 10 countries had at least 10 seafarers responding and this was deemed sufficient to make conclusions from. Otherwise, the remaining 17 countries had too few respondents from which to draw conclusions.

High power distance, high uncertainty avoidance, and high individualism were positively related to safety.

5. Research Design (Work Package 2)

This section corresponds to the second work package of the OCEAN research project – design of experiment. The preliminary design of the study was presented in a paper published in the proceedings of the IAMU annual general assembly in 2016 [24]. According to the agreed upon plan of research, the second phase (and correspondingly the second work package) of the project was to refine the research design and create the measurements and treatments.

For the purposes of this report, it was deemed most appropriate to describe each of the instruments used for the experiment, provide some background on how those instruments were grounded in (or adapted from) the literature, and explain how the instruments were tested (when appropriate).

In August of 2018, a design meeting was convened by the research team in Detroit, Michigan, USA. The purpose of the meeting was to refine the experiment, develop the requisite instruments, and establish a protocol for data collection. A detailed summary of that meeting and project status report are provided in Appendices 3 & 4. The following items were completed during that design meeting:

- Review of research proposal, scope of work, timeline.
- Review of IAMU/MMA consignment contract.
- Scoped research focus.
- Affirmed experimental design.
- Developed experimental protocol.
- Designed and refined or adopted the measurement instruments.

The experimental design was reviewed, revised, and affirmed as follows:

1. Overarching Framework: The overreaching framework previously proposed [24] was simplified and adjusted to reflect the extended literature review.
2. Ocean Literacy Instrument: Ocean literacy is basic knowledge and competence in the area of ocean science and ocean-related topics. An ocean literacy instrument measures the degree to which a person is ocean literate (i.e., demonstrates their knowledge about the ocean).
3. Seafarer MARPOL Attitudes and Behaviors: Since the focus of this study was on ocean conservation broadly (and plastics pollution specifically) and since the object of the study was present and future seafarers, an instrument was adapted to a MARPOL and environmental protection context from studies of maritime safety culture.
4. Conservation Commitment Treatment: A commitment treatment focused on motivating ocean conservation pro-environmental behaviors was adopted. It used widely-used commitment developed by the United Nations called the Clean Seas Pledge and intended to help motivate work on the sustainable development goal aimed at protecting the oceans.
5. Goal Setting Treatment: Based upon the relevant literature, two goal setting statements were developed (using SMART goal framework) as the goal-setting treatment.
6. Cultural Dimensions Instrument: Following the lead of other studies of maritime safety culture, a standard instrument for measuring the five dimensions of national culture [81] was adopted.
7. Additional Demographics: Since survey research often examines cross-tabular results and analysis across various dimensions of demographics, a few additional demongraphic questions were added to the end of the overall instrument – namely, gender, nationality, amount of experience, and professional specialty.
8. Institutional Review Board Process: As is required, the research design was submitted to an institutional review board to ensure the protection of human subjects.

The following sections will provide the overarching framework of the research design, the various instruments used, and a summary of the requisite approval process.

5.1. Overarching Framework

After evaluating a range of behavioral theories (including [50], [51], [52], [53], [54], [55], [56], [58], [59], [62], and [63]), a simplified version of the theoretical framework proposed in [24] was developed.

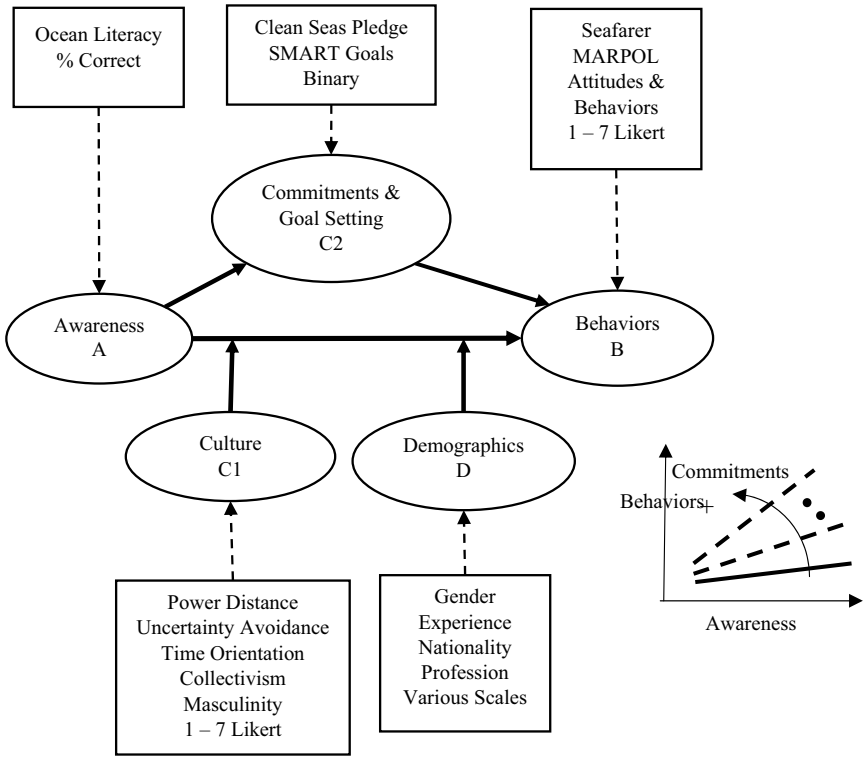


Figure 5.1: Research design for OCEAN research

In this research design, the ovals represent constructs (which typically cannot be directly measured) and the squares represent the instruments (which attempt to measure the constructs). The arrows originating in one construct and terminating in another indicate a direct relationship between two constructs. For example, in figure 5.1, awareness (A) and understanding of the ocean (measured using the ocean literacy instrument) is the independent variable and attitudes and behaviors (B) (measured using the seafarer MARPOL attitudes and behavior instrument) is the dependent variable. So, it could be hypothesized that increased awareness (ocean literacy) results in increased levels of pro-environmental behaviors. This relationship is represented as the solid line on the plot inset on the right side of figure 5.1 where *awareness* is the independent variable (x-axis) and *behavior* is the dependent variable (y-axis). This forms our basic hypothesis:

H1a: There is a positive relationship between ocean literacy (A) and seafarer attitudes regarding MARPOL compliance (B1).

H1b: There is a positive relationship between ocean literacy (A) and seafarer behaviors regarding MARPOL compliance (B2).

As noted previously, from the literature, it should expected that a weak positive or negligible relationship between these two variables [19], [41] exists. If the later were to be the case, then there would likely not be sufficient evidence to support the null hypothesis therefore the alternative hypothesis (i.e., that there is no relationship between awareness and behavior) should be adopted. This would be support of the concurrence in most of the theories of behavior in that awareness (alone) does not in and of itself determine behavior.

Next, it would be important to know if any relationship existed between culture (as measured using Hofstede's [81] cultural dimensions of power distance, time orientation, uncertainty avoidance, collectivism, and masculinity) and attitudes or behaviors. While not depicted in figure 5.1, this would be represented by a direct line between culture (C1) as the independent variable and behavior (B) as the dependent variable. According to the literature [82], [80], [83], [77], it would seem that like safety culture, that MARPOL compliance attitudes and behaviors are positively effected by increasing long-term orientation and collectivism. Similarly, there would be expected to be a negative relationship between masculinity and pro-environmental behaviors. This would seem to be in alignment with the findings that those who take pro-environmental attitudes and behaviors do so for concerns for the future [20], [21] and concerns for fellow citizens [23]. This forms our next set of hypotheses:

H2a: Long-term orientation (C1) is positively related to seafarer attitudes regarding MARPOL compliance (B1).

H2b: Long-term orientation (C1) is positively related to seafarer behaviors regarding MARPOL compliance (B2).

H3a: Collectivism (C1) is positively related to seafarer attitudes regarding MARPOL compliance (B1).

H3b: Collectivism (C1) is positively related to seafarer behaviors regarding MARPOL compliance (B2).

H4a: Masculinity (C1) is negatively related to seafarer attitudes regarding MARPOL compliance (B1).

H4b: Masculinity (C1) is negatively related to seafarer behaviors regarding MARPOL compliance (B2).

It is unclear how power distance and uncertainty avoidance would be related to seafarer attitudes and behavior toward MARPOL compliance.

Returning to the research design diagram of figure 5.1, *culture* (C1) and the other *demographics* (D) could also moderate the relationship between *awareness* (A) and *behaviors* (B). With different values of culture or demographics (such as gender differences), the relationship between the independent variable and the dependent variable may change. This is illustrated by the inset plot on the right of figure 5.1. For example, as long-term orientation increases, the slope of the line which illustrates the relationship between awareness and behavior also increases.

H5a: Culture (C1) strengthens the relationship between awareness (A) and seafarer attitudes regarding MARPOL compliance (B1).

H5b: Culture (C1) strengthens the relationship between awareness (A) seafarer behaviors regarding MARPOL compliance (B2).

H6a: Awareness (A) more strongly influences seafarer attitudes regarding MARPOL compliance (B1) for women (D).

H6b: Awareness (A) more strongly influences seafarer behaviors regarding MARPOL compliance (B1) for women (D).

In order to test the potential mediational relationship of the conservation treatment (or intervention, a between-subject between-subject experimental design (common in psychological research) [84], [85] was created as shown in figure 5.2.

N1:	A	(B)		B
N2:	A	(B)	C2	B

Figure 5.2: Between-subject experimental design

In the between-subject experimental design, there are two groups (N1 and N2). Subjects are randomly assigned to either the control group or the treatment group. N1 is the control group and N2 is the treatment group (that receives treatment between the pre- and post-testing). Both groups were subjected to the same pre-testing. In this case, since we were examining awareness and behavioral action, we were interested in assessing participants *awareness* (A), or ocean literacy as measured [86], [87]. Likewise, since these groups are being drawn from a global population, we will also want to assess contextual factors [88] such as *demographics* (D) or *culture* (C1) as measured using Hofstede's cultural dimensions [89], [90]. Treatments were *commitments* using the UN Clean Seas Pledge and *goal setting* using a pair of SMART goals – taken together as a unified treatment called *commitment* (C2). Once the treatment, noted as C2 was applied to the treatment group, then after prescribed period of time, both groups were subjected to post-testing to measure seafarer attitudes and *behaviors* (B) toward MARPOL compliance, a form of compliance behavior, which would equivalent to the pro-environmental behaviors of the literature.

Given this between-subject experimental design, we can test whether the treatment, as an independent variable, has a direct influence on behavior. The following hypotheses arise from that potential relationship:

H7a: There is a positive relationship between the presence of commitment statements (C2) and seafarer attitudes regarding MARPOL compliance (B1).

H7b: There is a positive relationship between the presence of commitment statements (C2) and seafarer behaviors regarding MARPOL compliance (B2).

H8a: There is a positive relationship between the presence of goals (C2) and seafarer attitudes regarding MARPOL compliance (B1).

H7b: There is a positive relationship between the presence of goals (C2) and seafarer behaviors regarding MARPOL compliance (B2).

This can be determined by examining the differences between the randomly assigned control group and the randomly assigned treatment group and how they respectively perform in the pre- and post-tests without and with the treatments of commitment and goal setting.

Another opportunity is to explore the potential mediator effect of the two treatment (C2) on the influence of *awareness* (A) on *behaviors* (B).

The following six sections describe the instruments developed to test these hypotheses using the above research design.

5.2. Ocean Literacy Instrument

Ocean literacy is "understanding the ocean's influence on you and your influence on the ocean" [33], [34]. The Ocean Literacy Network began in the USA in 2002 with the development of ocean content to support the teaching of geography. In 2004, the Ocean Literacy Initiative began in the USA. Since then, the initiative has grown global, including associations now in South America, Europe, and Asia, in addition to North America.

Ocean Literacy is defined by a set of seven principles [36], [35] and several subprinciples. These were intended to be used to inform educational curricula at the K-12 level, but have increasingly been used to create instruments to measure ocean literacy among the public [38], [39], [41], [49]. An ocean literate person: 1. understands the essential principles and fundamental concepts about the ocean, can communicate about the ocean in a meaningful way, and 3. is able to make informed and responsible decisions regarding the ocean and its resources [33]. Since it would be difficult to assess communications and decision making abilities directly using survey format, this study (as many others) has focused primarily on the knowledge component of ocean literacy.

In July of 2018, a 15-item instrument (with elements from each of the ocean literacy principles) was created and beta-tested among 24 undergraduate and graduate maritime students enrolled in a course at the University of Southeast Norway. There were 11 students from USA, 4 from Norway, and one each from Albania, Bangladesh, Greece, Iran, Turkey. Four students declined to declare their nationality. The instrument indicated 29.2% were literate (answering more than 70% of questions correctly), 62.5% were minimally literate, and the remaining 8.3% were not literate (answering less than 20% correctly).

The following is the aggregate performance of this student cohort, by principle (with percentage of students who answered correctly in parentheses):

1. Principle 5 (84%)
2. Principle 6 (64%)
3. Principle 1 (62%)
4. Principle 2 (52%)

5. Principle 3 (42%)
6. Principle 4 (36%)

As can be seen, a stong majority (84%) of students were most familiar with concepts about the diversity of life in the ocean (Principle 5). On the other hand, a minority of students (36%) were familiar with the facts surrounding how the ocean made earth habitable (Principle 4). These results were similar of those from found by California State University Maritime Academy when it evaluated the ocean literacy and values of its incoming class (170 students responded) and compared it to four other US colleges and high schools (an additional 443 students) who use the same instrument [91].

The top three knowledge areas answered most correctly were:

1. Approximately 71% of Earth is covered by water. (96%)
   Principle 1a
2. The largest and most important biomass in the ocean are microbes. (88%)
   Principle 5b
3. The ocean is made up of many different zonal ecosystems. This vast variety of living spaces allows for the ocean to have a greater diversity of animals than on land. (88%)
   Principle 5c

The most incorrectly answered questions (principles) were:

1. There is one ocean with many basins. (28%)
   Principle 1a
2. Most of all rain that falls on land originally evaporated from the ocean. (28%)
   Principle 3d
3. Most beach sand (tiny bits of animals, plants, rocks, and minerals) is formed by erosion of upland rocks carried to the ocean by rivers. (36%)
   Principle 2b

Using the literature and results of this beta-test and other studies, a simplified 10-item Ocean Literacy instrument was developed. The following are those ten items with the correct answers identified by the principle from which the correct answer may be found.

Ocean Literacy Instrument

T/F: Throughout the ocean, there is one interconnected circulation system powered by wind, tides, the force of the Earth's rotation, the Sun, and water density differences.

- True – Principle 1c [33]
- False

How much of the Earth's water is contained in the oceans?

- 50%
- 75%
- 85%
- 95% - Principle 1e [33]

- 100%

The largest and most important biomass in the ocean are:

- Microbes – Principle 5b [33]
- Shrimp and jellyfish
- Small and medium bait fish
- Sharks and whales

Which is the largest reservoir of rapidly cycling organic and inorganic carbon on the Earth?

- The forests
- The ocean – Principle 3e [33]
- The soil
- The air (atmosphere)

____ Percent of the world's population live within 100 km (62 miles) of the coast.

- 10%
- 25%
- 50% – Principle 6f [33],
- 75%
- 100%

The ocean's absorption of solar radiation _____ the Earth's weather and climate.

- Amplifies
- Moderates – Principle 3b [33]
- Has little effect on
- Randomizes

T/F: Roughly one-third of all rain that falls on land originally evaporated from the ocean.

- True
- False – Principle 3d [33]

Most of the oxygen in the atmosphere originally came from:

- The activities of photosynthesis organisms on the Earth.
- The activities of photosynthesis organisms in the ocean. – Principle 4a [33]
- Equally from the photosynthesis activities on the Earth and in the ocean.

T/F: The ocean is made up of many different zonal ecosystems based upon circulation, temperature, salinity, sunlight, nutrients, pressure, predation, and substrate. This vast variety of living spaces allows for the ocean to have a greater diversity of animals than on land.

- True – Principle 5f [33]
- False

T/F: Humans rely on the ocean for most of our fresh water and oxygen.

- True

- False

5.3. Seafarer MARPOL Attitudes and Behaviors Instrument

In many situations, the first step in trying to modify behaviors is to select the specific behavior that needs modification [70]. This instrument was developed to attempt to measure seafarer attitudes and behaviors related to MARPOL, marine environmental protection, and plastics pollution.

Since this study is unique for its context, an instrument was needed to evaluate seafarer attitudes and behaviors toward marine pollution and specifically MARPOL V. Since no such instrument was found to exist, one needed to be developed/adapted. The design team decided to adapt an instrument from another, similar domain rather than take the time-intensive effort of creating and validating a new instrument from first principles. In this case, since safety, safety culture, and safety compliance [92], [93], [94] have been studied extensively in the maritime context (e.g., [79], [77]), the scales for safety attitude and behavior were modified to reflect pro-environmental behaviors and attitudes. Fifteen items were developed to span attitude and behavior, span all levels of the cognitive, affective, and psychomotor domains, and to be fully consistent with the parent instrument.

Like the safety attitude and behavior instrument, the following five-point Likert scale [95] was used for all fifteen prompts described below:

- Strongly disagree
- Disagree
- Neither disagree nor agree
- Agree
- Strongly agree

Seafarer MARPOL Attitudes and Behavior Instrument

The following are the prompts for the fifteen items in the MARPOL attitudes and behaviors instrument (which were used in conjunction with the above Likert scale):

- I am fully aware of MARPOL V regulations.
- I believe MARPOL V is sufficient for environmental protection.
- I believe MARPOL V is insufficient to adequately protect the marine environment from garbage and I have adopted additional personal practices.
- I believe the requirements of MARPOL V are excessive and there are times when strict compliance isn't necessary.
- I have been adequately trained in basic environmental protection procedures.
- I follow all environmental procedures regardless of the situation.
- I follow the environmental procedures that I think are necessary.
- I correct environmental violations when I see them.
- I report environmental violations that I am aware of.

- I encourage others to adhere to environmental practices.
- I believe marine environmental pollution (garbage) has adverse effects on our oceans.
- I believe it is necessary for seafarers to reduce the amount of waste they produce.
- I believe that operational marine pollution is an unavoidable consequence of maritime shipping.
- I believe that accidental marine pollution is an unavoidable consequence of maritime shipping.
- I believe dealing with marine pollution is the responsibility of the ship's owner or the shipping company, and not the seafarer.

5.4. Conservation Commitment Treatment

There have been several meta-analyses about what influences pro-environmental behaviors (see e.g., [65], [66]). One comprehensive beta-analysis by Osbaldiston and Schott [66] described ten basic types of treaments which they sorted into four categories (i.e., convenience, information, monitoring, and social-psychological processes). They noted that goal setting had the second largest effect size among the studies and that when goal setting was combined with commitments, it was among the top strongest effect sizes among the studies, and considerably stronger than goal setting alone.

Therefore, in concurrence with the literature, a combination treatment of commitment and goal setting was applied for the purposes of this research. In looking at the categories of pro-environmental behaviors, it was determined that MARPOL compliance (which is a form of pro-conservation behavior in a specific professional maritime setting) shares similarities with recycling in that it requires compliant behavior in public and private settings (even if there are more significant penalties for non-compliance). As a pro-environmental behavior, goal commitment pairs well with goal setting [75], [74], [73].

It was determined that it would be difficult to address MARPOL compliance directly with actual seafarers due to the potential for self-preservation bias and also that future seafarers (i.e., maritime cadets and students) may not have direct experience with MARPOL compliance behaviors even if they possess MARPOL compliance attitudes. Therefore, a commitment treatment using an existing pledge about personal use of plastics was selected as being a close proxy to uncover commitments toward compliance behaviors.

The UN Clean Seas Pledge [96] is a commitment treatment (or intervention) that describes seven commitment statements, which individuals, companies, governments, or non-governmental organizations can participate. As framed in this study, these are individual in nature and not specific to an organizational or maritime setting [73].

<u>Conservation Commitment Treatment</u>

- I commit to say no to plastic straws.
- I commit to avoid products with plastic microbeads.
- I commit to choose products with no or less plastic packaging.
- I commit to remember my reusable bags.
- I commit to using a reusable water/drinking bottle.
- I commit to bring my own take-out container.

Clearly, these are designed to mitigate or lessen the impact of plastics pollution in the oceans. This relates directly to the UN sustainable development goals [97]. In particular, Goal 14 is devoted to "conserve and sustainably use the oceans, seas, and marine resources." As such, this treatment is deemed to be an adequate, non-triggered proxy for conservation commitment that would be relevant for MARPOL compliance behaviors. This sort of extension has been demonstrated to motivate pro-environmental behaviors in the workplace [74].

5.5. Conservation Goal Setting Treatment

Two specific goal statements were selected for the treatment to pair with the commitment pledge. In alignment with the individual proxy nature of the Clean Seas Pledge, the two goal statements were derived to support the reduction of plastics.

Goal Setting Treatment

I pledge to reduce my use of plastics by: _____.

Please type in a SMART goal for how you intend to reduce your use of plastics in the next 4 – 6 weeks.

I pledge to protect the oceans by: _____.

Please type in a SMART goal for how you intend to protect the oceans in the next 4 – 6 weeks.

Goals have had a long history of being demonstrated to support behavior change in the industrial and organizational psychology field [98], [99].

A widely accepted goal setting practice is to decide what you want to obtain or achieve and then write down a "SMART" goal. SMART goals are:

- **S**pecific in that they define the who, what, when and where of your goal.
- **M**easureable, so you can track your progress,
- **A**ttainable so they should be something that is within your personal ability to achieve,
- **R**ealistic in that it is possible for you to achieve, and
- **T**imebound in that you are required to complete them in a set timeframe.

However, despite widespread usage, there is some concern about the efficacy of SMART goals [100], even in the environmental context [101]. Despite these criticisms, since they are ubiquitous, SMART goals were selected the form of the second complementary treatment to commitment.

5.6. Cultural Dimensions Instrument

Based upon Hofstede's theory of dimensional national cultures [81], [102]; many studies have examined the importance of culture on decision-making and behavior. Three such studies examined how national culture influenced safety attitudes and behaviors aboard ships [77], [79], [80]. Using the exact scales from those studies, three questions were asked within each of the five dimensions of

Hofstede's national culture. By studying cultural dimensions literature [103], [104], [105], the scales developed in the maritime studies were deemed appropriate for this research.

Like the safety attitude and behavior instrument, the following five-point Likert scale [95] was used for all ten prompts described below:

- Strongly disagree
- Disagree
- Neither disagree nor agree
- Agree
- Strongly agree

It should be noted that, while there is evidence to suggest a four-point scale (without the "neither" option) may produce stronger results, the five-point Likert scale was maintained as a component of the cultural dimensions instrument. This instrument is based upon the seminal work of Geert Hofstede and has been used in hundreds of studies to become the overwhelmingly dominant metric of culture. The existing instrument has been tested for validity and reliability extensively. More recent studies (e.g., [106]) have examined new prompts (yet retain the five-point scale) in an effort to show the five cultural dimensions at work at an individual level. This new 26-item CV-SCALE instrument shows adequate reliability, validity, and across-sample and across-national generalizability. If future work is continued, an exploration of how four- versus five-point scales may be incorporated.

Cultural Dimension Instrument

The following are the prompts for the ten items in the cultural dimensions instrument (which were used in conjunction with the above Likert scale):

Power Distance

- My supervisors make most decisions without consulting me.
- I should not disagree with my supervisor.

Uncertainty Avoidance

- It is important to have instructions spelled out in detail so that I can always know what I'm expected to do.
- It is important for me to work for a company that provides high employment stability.

Collectivism

- Group success is more important for me than my personal accomplishment.
- Decisions made by the group are better than those made by individuals.

Masculinity

- I do not like to help and care for others
- Making a career is more important than good relationships with co-workers.

Long-Term Orientation

- I work hard for success in the future.
- I would rather save my money for the future rather than spend it on something fun today.

5.7. Demographics Information

The following additional demographic information was also asked of participants:

- What is your gender?
  - Male
  - Female
- What is your nationality? _____
- How many years of seafaring experience do you have?
  - One year or less
  - 2 – 5 years
  - 6 – 10 years
  - 11 – 20 years
  - More than 20 years
- What is your professional specialty?
  - Deck
  - Engine
  - Other: _____

5.8. Institutional Review Board

In the USA, any research involving human subjects (with few exceptions) must undergo review by an independent body, named the Institutional Review Board. The Institutional Review Board (IRB) is an administrative body established to protect the rights and welfare of human research subjects recruited to participate in research activities conducted under the auspices of the institution with which it is affiliated. Since the contractor and the lead researcher are affiliated with a state university within the USA, this research was subject to IRB review. The provisions of such a review are codified in Title 21 of the US Code of Federal Regulations.

Since Massachusetts Maritime Academy has a collaborative agreement with Bridgewater State University for its research to be reviewed by their IRB. This required training for the lead researcher, or primary investigator (PI) on Human Subject Research for Social and Behavioral Researchers offered through the Collaborative Institutional training Initiative. This training was completed on 8 March 2018. Following the design meeting, described earlier in this report, an application was completed (see Appendix 5). The application included all of the following information:

- Investigator(s) information
- Study timeline
- Funding status
- Recruitment/selection of subjects
- Abstract of project
- Compensation (to be provided to participants)

- Confidentiality statement (to be provided to participants)
- Informed consent statement (to be provided to participants)

The following is the informed consent / confidentiality statement provided:

"You are invited to participate in a survey about ocean literacy and seafarer attitudes and behaviors toward MARPOL V compliance. If you decide to participate in this study, your participation will involve answering a short survey that should take no longer than 10 minutes to complete. If you elect, you may volunteer for an even shorter follow-up survey in about six weeks. Although you may not personally benefit, this study is important to the marine industry because it may shed light on how to increase MARPOL V compliance and reduce pollution from shipping. There are no foreseeable risks, and you may refuse to answer particular questions or withdraw from this study at any time. Your confidentiality will be kept to the degree permitted by the technology being used. If you agree to participate, please click on the link below to continue to the survey. You will have the option to refuse to answer individual questions and may change your mind and leave the study at any time without penalty. Thank you for your participation."

In addition, all of the questions from all of the instruments (noted previously in this section) were also submitted for evaluation. A random selection criteria was applied to determine which participants would receive the treatment and which would not. Since a follow-up to both control group and treatment group participants was required by the research design, the following statement was provided at the end of the first survey:

"We intend to conduct a short follow-up to this initial survey in six weeks. Participation is voluntary; an iPod tablet will be randomly awarded to one participant. If you are interested, please provide an email address so that we can contact you and ask a few follow-up questions."

After a four to sex week period, the following follow-up survey was sent to the individuals who opted in to the follow-up survey.

The follow-up survey consisted of the following questions, seafarer attitude and behavior questions about MARPOL compliance.

"In the previous survey, you committed to reducing your use of plastics.

I commit to avoid products with plastic microbeads.
I commit to choose products with no or less plastic packaging.
I commit to remember my reusable bags.
I commit to using a reusable water/drinking bottle.
I commit to bring my own take-out containers.

<Indicate those selected.>

1. How often were you able to maintain those commitments?
    a. Always
    b. Frequently
    c. Sometimes
    d. Infrequently

e. Never

2. If you were not able to maintain those commitments, please describe why.

In the previous survey you made the following goal to reduce your use of plastics in the previous 4-6 weeks.

3. How successful were you in achieving this goal?
    a. Better than expected – I exceeded my goal.
    b. Goal achieved – I achieved the goal.
    c. Worse than expected – I set out to achieve my goal, but did not achieve it.
    d. Much worse than expected – I never worked on achieving my goal.

4. What were some of the ways in which you were able to reduce your use of plastics?

In the previous survey you made the following goal to protect the oceans in the previous 4-6 weeks.

5. How successful were you in achieving this goal?
    a. Better than expected – I exceeded my goal.
    b. Goal achieved – I achieved the goal.
    c. Worse than expected – I set out to achieve my goal, but did not achieve it.
    d. Much worse than expected – I never worked on achieving my goal.

6. What were some of the ways in which you were able to protect the ocean?"

On 24 September 2018, the application was submitted to the IRB for review. On 27 September 2018, the IRB sent a letter that approved this research (see Appendix 6).

6. Methodology (Work Package 3)

Data were obtained for the study by administering a questionnaire survey to current seafarers and future seafarers from around the world. The survey was first deployed through the professional networks of the research team and then through the networks of the International Association of Maritime Universities. Of the 284 responses, 202 were usable for the pre-test survey. The International Chamber of Shipping (ICS) estimates the worldwide population of seafarers serving on internationally trading merchant ships is 1,647,500 (of which 774,000 are officers and 873,500 are ratings) [107]. Using an online sample calculator, such a sample size is sufficient to support an 85% confidence interval with a 5% margin of error. Alternatively, if a 95% confidence interval (often considered an industry standard) is desired, the sample size would be sufficient to support a 6.9% margin of error.

Due to nature of the survey design and administration, block-randomization was not possible. A time-based randomization technique was used to determine whether or not to apply the *commitment* and *goal setting* treatments. This randomization technique satisfied the two key criteria: 1. Respondents were equally likely to be assigned to either control or treatment group, and 2. Assignments were independent of other respondents (due to different start times and completion times). Of the 202 who completed the pre-test survey, 98 respondents voluntarily agree to participate in the post-test survey; 66 of which were complete and usable for this research. Of the 66 complete and usable matched pairs of pre-test and post-test surveys, 28 had the *commitment* and *goal setting* treatments applied due to random "selection" and the remaining 38 had no treatment and were considered the control group. In psychological research, such a randomization technique is often used and will result in unequal sample sizes in different conditions, but recent texts [85] state "Unequal sample sizes are generally not a serious problem, and you should never throw away data you have already collected to achieve equal sample sizes."

From a *demographic* perspective, the respondents overwhelmingly male (84.6%), predominantly from two nationalities (34.5% Japanese and 47.7% American), with a median seafaring experience of less than one year of experience, and predominantly from the deck side professional specialties (42.1%). This is overrepresented of women, which represent only 2% of the world's maritime workforce according to the International Trade Workers Federation [108]. However, this gender breakdown varies by sector and is generally higher at maritime education and training institutions (when surveying mariners of the future). The two predominant nationalities are due to the fact that the researchers actively obtained survey participation at their home and neighboring institutions. Other nationalities were so low as not to be worthy of further analysis due to the small sample sizes. While the vast majority of the respondents (82.8%) had little or no experience (indicating that they were students, or future seafarers), 9.8% had two to five years of experience, 5.2% had six to ten years of experience, and the remaining 2.2% were roughly evenly split between eleven to twenty years of experience and more than twenty years of experience. Additionally, ocean literacy levels among the seafarers sampled was roughly equivalent to that of the general population as found in similar studies [41], [39], [38], [46], [42], [37].

An attempt was made to gather input from more actual seafarers, and agreements were made with shipping organizations, but the survey was not administered due to labor contractual issues.

The survey was initial pre-test survey administered between October 2018 and January 2019. The follow-up post-test survey was administered in batches four to six weeks after the pre-test survey was administered. The survey instrument is described in extensive detail in the previous section.

7. Analysis & Results (Work Package 4)

7.1. Descriptive Statistical Analysis Results

Figure 7.1 presents the correlations of the key variables measured in this research. Even though it would be mathematically possible to provide means, standard deviations, and ordinal ranks for the dimensions of culture (i.e., power distance, uncertainty avoidance, time orientation, collectivism, and masculinity), those statistics would be beyond the ordinal level of measurement [109]. Further, the mean would be an ineffective description of a collection of cultures and a median or modal value would be more informative, although in this research, it was not important to consider.

	PD	***UA***	***TO***	***C***	***M***	***MA***	***MB***
Power Distance (PD)	1.000	--	--	--	--	--	--
Uncertainty Avoidance (UA)	0.301**	1.000	--	--	--	--	--
Time Orientation (TO)	0.185**	0.547**	1.000	--	--	--	--
Collectivism (C)	0.249**	0.589**	0.544*	1.000	--	--	--
Masculinity (M)	0.011	0.125*	-0.223*	0.090**	1.000	--	--
MARPOL Attitudes (MA)	0.129**	0.177*	0.321*	0.297***	-0.119*	1.000	--
MARPOL Behaviors (MB)	0.319*	0.436**	0.555	0.573**	-0.202*	0.243**	1.000

Standard errors reported in parentheses. *, **, *** indicates significance at the 90%, 95%, and 99% respectively.

Table 7.1: Basic Regression Results for Seafarer *MARPOL Attitudes* and *Behaviors*

This basic regression analysis indicates there is evidence to support hypotheses (H2a and H3a) that *long-term orientation* and *collectivism* are positively correlated to *MARPOL attitudes* of seafarers. There was evidence to support the hypotheses (H3b) that *collectivism* orientation was positively correlated to *MARPOL behaviors* of seafarers, but there was

insufficient evidence to support the hypotheses (H2b) that *long-term orientation* was positively correlated to *MARPOL behaviors* of seafarers. As noted in previous studies (e.g., [77]), this would tend to make intuitive sense in that individuals with collective (as opposed to individualistic) and long-term (as opposed to short-term) orientations would be more inclined to exhibit outward-oriented, future-focused pro-environmental attitudes and behaviors. Further, there is also evidence to support the hypotheses that *masculinity* is negatively correlated with *MARPOL attitudes* and *behaviors*. This also makes intuitive sense in that individuals who exhibit masculine (as opposed to feminine or nurturing) orientations (characterized by assertiveness, aggression, competition, etc.) might disrupt team dynamics and weaken pro-environmental culture, again as noted in [77], but toward safety culture.

7.2. Mediation Analysis Results

Baron and Kenney [110] proposed a four-step approach in which several regression analyses are conducted and the significance of the coefficients is examined at each step. In this case, the following regression analyses were conducted:

1. Simple regression with *ocean literacy* predicting *MARPOL attitudes and behaviors*
2. Simple regression with *ocean literacy* predicting treatments (i.e., commitments and goal setting)
3. Simple regression with treatments (i.e., commitments and goal setting) predicting *MARPOL attitudes and behaviors*
4. Multiple regression with *ocean literacy* and treatments predicting *MARPOL attitudes* and *behaviors*

When there are statistically significant relationships in each of the first three steps, then step four is performed.

	Ocean Literacy	***MARPOL Attitudes***	***MARPOL Behaviors***
Ocean Literacy	1.000	-	-
MARPOL Attitudes	0.437** (0.039) $R^2_{adjusted} = 0.29$	1.000	-
MARPOL Behaviors	0.231* (0.062) $R^2_{adjusted} = 0.15$	0.503*** (0.037) $R^2_{adjusted} = 0.45$	1.000

Standard errors reported in parentheses. *, **, *** indicates significance at the 90%, 95%, and 99% respectively.

Table 7.2: Basic Regression Results for Seafarer MARPOL Attitudes and Behaviors

However, in this research, while there was a statistically significant relationship between *ocean literacy* and *MARPOL attitudes* and *behaviors*, there were nonsignificant relationships in each of the second and third steps, and thus, mediation is not likely or possible, even when considering exceptions or alternative explanations [111], [112]. Therefore, in other words, it is unlikely that the treatments can be considered mediators to the relationship between *ocean literacy* and *MARPOL attitudes* and *behaviors* of seafarers. As indicated in table 7.2, the only significant relationship is that

ocean literacy has weak to moderate predictive power on *MARPOL attitudes* and *behaviors* of seafarers.

Therefore, there is evidence to support the hypothesis (H1) that there is a positive relationship between *ocean literacy* and *MARPOL attitudes* and *behaviors* of seafarers. In this case, one could conclude awareness does enhance pro-environmental attitudes and behaviors. However, even though there is statistically significant positive correlations between *ocean literacy* and *MARPOL attitudes and behaviors*, this is a weak to moderate explanatory power for social sciences. Additionally, while it might seem reasonable that seafarers might possess a higher degree of ocean literacy than the general public, this turned out not to be the case. The ocean literacy levels found among seafarers in this study

7.3. Gain Score Analysis

In this study, 93 respondents voluntarily participated in both the pre-test survey and the post-test survey which occurred four to six weeks after the pre-test survey. Of those who participated, 66 provided complete and useful responses to both the pre-test survey and the follow-up post-test survey administered between four and six weeks after the initial survey. A randomization technique was used to apply treatments to such respondents: 28 respondents were given the *commitment* and *goal setting* treatments as part of the pre-test survey and 38 of the respondents were given no treatment, the control condition. There are many ways in which to examine pre-test to post-test differences. In this research, a gain score was calculated as the difference between post-test results and pre-test results. Positive gains indicated an increase in *MARPOL attitudes* and *behaviors* from the pre-test to the post-test. Negative gains, or decrements, indicated a decrease in *MARPOL attitudes* and *behaviors* from the pre-test to the post-test.

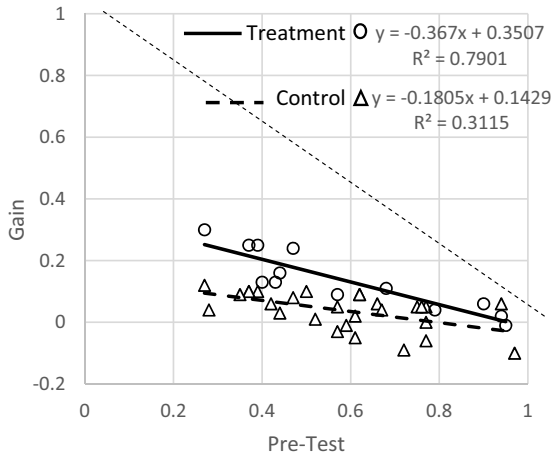


Figure 7.1: Gains in *MARPOL Attitudes* of Seafarers

The survey components corresponding to seafarer *MARPOL attitudes* were aggregated into a single score and non-dimensionalized on a scale from 0 to 1 for both the pre-test and post-test results, which when subtracted to obtain the gain were also normalized on a scale of 0 to 1. In

figure 7.1, the pre-test scores for *MARPOL attitud*es were plotted on the x-axis and the corresponding gains (post-test minus pre-test) were plotted on the y-axis. All 38 results for the control group are represented with triangular markers and a dashed regression line. All 28 results for the treatment group are represented with circular markers and a solid regression line. The dotted line (that runs horizontally downward from 0, 1 to 1,0 with a slope of -1) represents the boundary of possible scores above which it is not possible to have a pre-test, gain combination.

The mean value for gain in *MARPOL attitudes* (between pre- and post-test) for the 38 respondents in the control group is 3.8% (with a standard deviation of 6.0%). The mean value for the gain in *MARPOL attitudes* for the 28 respondents in the group who received commitment and goal setting treatments is 12.3% (with a standard deviation of 9.7%). This represents a difference of 8.5% in gain. In other words, on average, respondents subject to treatment increased their *MARPOL attitude* by almost third of an increment on the 5-point Likert scale for agreement with the *MARPOL attitude* statements (1.0 ÷ (5-points – 1) = 25%).

In figure 7.1, it should also be noted that, in addition to this difference in slope of the regression lines between the control and treatment groups (which corresponds to the difference in gains between the two groups), almost all of the data for the treatment group dominates (or is greater than) almost all of the data for the control group. This indicates a clear and significant difference resulting from the commitment and goal setting treatments when it comes to *MARPOL attitudes* for seafarers.

The mean value for gain in *MARPOL behaviors* (between pre- and post-test) for the 38 respondents in the control group is 4.3% (with a standard deviation of 6.6%). The mean value for the gain in *MARPOL attitudes* for the 28 respondents in the group who received commitment and goal setting treatments is 14.6% (with a standard deviation of 10.3%). This represents an average increase of 10.4% in gain for the treatment group as compared to the control group. In other words, on average, respondents subject to treatment increased their *MARPOL behavior* by almost half of an increment on the 5-point Likert scale for agreement with the *MARPOL behavior* statements.

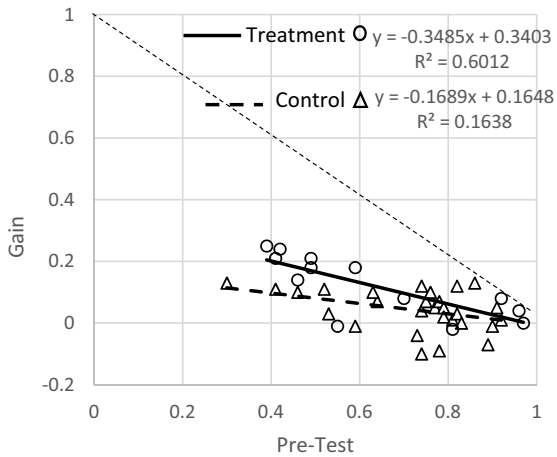


Figure 7.2: Gains in *MARPOL Behaviors* of Seafarers

While the average difference in gains for *MARPOL behavior* is greater between the treatment and control groups (10.4% increase in gain on average from pre-test to post-test) than for the same groups regarding MARPOL attitudes, the clustering of the data for the treatment and control groups overlaps considerably (as is evident in figure 7.2), making the relationship less significant. This is also demonstrated by the increased standard deviations in the *MARPOL behavior* responses over the *MARPOL attitude* responses.

As a result of this gain score analysis, there is evidence to support the hypotheses (H7 and H8) that *commitment* statements and *goal setting* treatments are positively related with *MARPOL attitudes* and *behaviors* of seafarers.

8. Conclusions & Recommendations (Work Package 5)

Ship owners are always seeking ways to improve their environmental records. The International Maritime Organization (IMO) has prescribed a means to ensure seafarers are aware of MARPOL and pollution prevention through the STCW and the corresponding model courses that recommend instruction in personal safety and social responsibility. However, as has been demonstrated repeatedly in the literature, awareness (or education) alone does not alter behavior. Therefore, other means of promoting desired pro-environmental attitudes and behaviors should be explored in the maritime setting.

Based upon the results of this research, which examined MARPOL attitudes and behaviors of both current and future seafarers, simple treatments (such as commitment statements or pledges and goal setting) have the potential to more significantly influence seafarer attitudes and behaviors. These results showing the potential impact of simple treatments are similar to those of the previous studies in different contexts.

Several implications can be drawn from the findings of this research. First, treatments such as commitment pledges and goal-setting have been demonstrated to work positively in improving both pro-environmental attitudes and behaviors, even in a maritime setting. Second, since shipping is a multi-national business, and culture (as defined through Hofstede's five dimensions) plays an important role on pro-compliance behaviors when it comes to MARPOL and environmental protection. Specifically, collectivism and long-term orientation are positively related to MARPOL attitudes of seafarers and collectivism is positively related to MARPOL behaviors of seafarers (while masculinity is negatively related to both). Therefore, different treatments and messages may be needed for different cultures to achieve the desired changes in pro-environmental behaviors. Third, while the treatments (commitments and goal-setting in this case) did not exhibit mediating influence on the relationship between ocean literacy (awareness) and MARPOL attitudes and behaviors, increased awareness was associated with increased levels of pro-environmental attitudes and behavior. Therefore, in addition to trying and using different pro-environmental behavior treatments (and there are many – only two of which were tested here) and customizing training and communications to culture, organizations may also like to strategically enhance awareness (i.e., ocean literacy).

However, this research was limited in sample (such that it captured more future seafarers than current seafarers), limited in sample size (as it was small and often too small to perform thorough analysis), and limited in the data collection since survey method was used and self-reported reaction data were provided (rather than actually observing behaviors). It is always possible, given the subject of the study – MARPOL compliance attitudes and behaviors, that respondents (particularly actual seafarers) might be reluctant to provide fully accurate reactions because of potential personal repercussions and any interests consideration against their employer. Future studies might address any or each of these limitations, including performing data collection in a natural shipboard or maritime setting. Finally, this study was conducted at a specific moment in time and longitudinal studies to examine both short- and long-term effects of pro-environmental behavior treatments would be beneficial to the enhancement of shipboard pollution prevention.

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11.Appendices

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NOTE: These appendices are not part of the print report and are available in electronic format only from the publishers.

International Association of Maritime Universities

Meiwa Building 8F, 1-15-10 Toranomon, Minato-ku, Tokyo 105-0001, Japan

Tel : 81-3-6257-1812 E-mail : info@iamu-edu.org URL : http://www.iamu-edu.org

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