



Me and My Behavior: An Experiment on Individual Characteristics and Compliance Behavior in Recreational Fishing

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Specialty section:

This article was submitted to
Marine Conservation
and Sustainability,
a section of the journal
Frontiers in Marine Science

Received: 02 July 2020

Accepted: 13 August 2020

Published: 24 September 2020

Citation:

Mackay M, van Putten EI,
Yamazaki S, Jennings S and Sibly H
(2020) Me and My Behavior: An
Experiment on Individual
Characteristics and Compliance
Behavior in Recreational Fishing.
Front. Mar. Sci. 7:579213.
doi: 10.3389/fmars.2020.579213

Non-compliance with regulations is a complex problem in recreational fisheries management, having the potential to evoke uncertainty for conservation and socio-ecological outcomes and to undermine management efforts. While we know that in fisheries people make trade-offs between following or breaking rules, it is of interest to determine how people respond to different management incentives to curtail non-compliance. The overall aim of this study is to examine what individual psycho-social characteristics are associated with responses to instrumental and normative management incentives in a recreational fisheries context through the use of an economic experiment. We examined five psycho-social characteristics, three of which (expectation of behavior of others, social norms, and risk preferences) have separately been explored within the fisheries compliance literature, while two factors (ecological values and personality types) have yet to be explored. While information about these two latter characteristics is limited within the fisheries compliance literature, our results suggest that they are relevant predictors for certain compliance groups across compliance incentives. The findings underline that there is significant heterogeneity in the associations between psycho-social make-up and compliance behaviors. Knowledge of this behavioral relationship can progress fisheries management toward increased innovation by encouraging the management of the individual fisher rather than the average fisher.

Keywords: economic experiment, social norms, fisheries management, psycho-social characteristics, marine social science

INTRODUCTION

Marine recreational fisheries are ecologically, culturally, and economically important. Recreational fisheries are generally managed as a regulated open access resource, but the common pool nature of recreational fisheries makes them vulnerable to overexploitation. The success of fisheries management depends on factors such as strong leadership, social capital, and incentives (Gutiérrez et al., 2011) as well as having congruent objectives (Hilborn, 2007), and good governance (Potts et al., 2020). Recreational fisheries are traditionally managed via a mixture of regulations and rules

(Morison, 2004). However, achieving an acceptable rate of compliance in recreational fisheries is inherently difficult because there is often no formal mechanism to monitor and record the actions of recreational fishers (Green and McKinlay, 2009). Additionally, due to the high numbers and wide distribution of fishers enforcement of rules and regulations for recreational fishing is costly and typically low (Raakjær Nielsen and Mathiesen, 2003; King and Sutinen, 2010). Non-compliance is a tenacious problem in recreational fisheries management, posing a risk to marine conservation and socio-ecological systems (Blank and Gavin, 2009; Smallwood and Beckley, 2012; Arias and Sutton, 2013). In fisheries management, deterrence-based approaches have traditionally been used to tackle non-compliance. However, sufficient monitoring and enforcement are often limited and prohibitively costly in recreational fisheries (Cooke et al., 2013).

Understanding compliance behavior of recreational fishers is thus of great policy and management relevance. In response to this, behavior change initiatives that are not based solely on deterrence methods are beginning to be proposed and implemented to improve compliance (Battista et al., 2018; Mackay et al., 2018). Compliance is typically framed as a binary issue, wherein fishers are either compliant or not, with substantial research directed at measuring and identifying compliance (Honneland, 1999; Sutinen and Kuperan, 1999; Thomas et al., 2016; Bergseth et al., 2017). Increasingly, attention has focussed toward understanding the drivers and motivations of compliant and non-compliant behaviors (Boonstra et al., 2017) with several theories being proposed to explain why individuals engage in compliant behaviors (Bottoms, 2002).

For example, instrumental theories suggest that the decision of whether to comply or not is based on self-interested calculations about the expected costs and benefits of compliance, and that non-compliance occurs because the cost outweighs the benefits (Becker, 1968). Rules and regulations for recreational fishing are traditionally designed and implemented based on the assumption that fishers are instrumental actors (Sutinen and Kuperan, 1999) with reported instances of improved compliance with more enforcement (Gigliotti and Taylor, 2004). Normative theories, on the other hand, argue intrinsic values, such as an individual's perceptions of the legitimacy and fairness of rules, are crucial to fishers' decisions about compliance (Nielsen, 2003; Nielsen and Mathiesen, 2003; Grimes, 2006; Viteri and Chávez, 2007). In accordance to this theory, there are cases of high compliance where there is weak enforcement and low penalties due to established normative behavioral drivers (Sutinen and Kuperan, 1999; Gezelius, 2002, 2003).

In addition to instrumental and normative drivers, the literature suggests that psycho-social characteristics of individuals, such as attitudes, personality traits, and specific values toward the good in question, are important factors determining the patterns in individual compliance behavior (Nielsen, 2003). Key psycho-social characteristics that have been attributed to compliance behavior are social norms, such as morality and social reputation (Milner-Gulland and Rowcliffe, 2007; Challender and MacMillan, 2014; Arias, 2015). There are several examples drawn from fisheries as well as wider literature that build a strong case for the application of social norms in

fisheries compliance management (Kuperan and Sutinen, 1998; Sutinen and Kuperan, 1999; Thomas et al., 2016). For example, empirical studies of norm conformity show that focusing people on an existing norm is an important step toward compliance (Cialdini et al., 1990; Reno et al., 1993). Another psycho-social characteristic influencing compliance behavior is expectation of others' compliance behavior as it reflects social perceptions (Bergseth and Roscher, 2018). Expectations about others' choices have been found to significantly predict one's own choice (Bicchieri and Xiao, 2009; Bova et al., 2017). Often expectation of others' compliance behavior will reflect an individual's own behavior. The expectation of others' behavior is regularly over-estimated, for example fishers who poach may also overestimate the prevalence of poaching (Berkowitz, 2005; Rimal and Real, 2005; Bergseth and Roscher, 2018).

Other psycho-social characteristics are ecological values and personality types. Environmental ethics literature suggests that having strong ecological values should render high compliance rates where non-compliance would result in some form of environmental degradation (Brennan and Lo, 2002; Nuyen, 2011). Broadly, ecological values and attitudes are key drivers of environmental behavior which relevant for non-compliance issues related to fisheries (Dunlap and Van Liere, 1978; Stern and Dietz, 1994; Ones et al., 2015). The relationships between personality types and compliance behaviors is not prevalent in fisheries compliance literature. However, personality types, such as openness, extraversion and neuroticism, have been linked with rates of policy violations (McBride et al., 2012) within other compliance literatures. Compliance and co-operation, on the other hand, has been linked to agreeableness (Digman and Takemoto-Chogk, 1981; Graziano and Eisenberg, 1997; Graziano et al., 1997). Finally, individuals' risk preferences have been found to be correlated with compliance with fisheries regulations (Brick et al., 2012; Girardin et al., 2017).

The overall aim of this study is to examine what psycho-social characteristics of individuals are associated with responses to instrumental and normative management incentives in a recreational fisheries context. While there is literature reviewing and testing some of the characteristics mentioned relating to compliance behaviors in fishing and non-fishing contexts, there is a gap in the literature exploring these characteristics concurrently within a controlled experimental setting. To achieve this aim, we conducted a laboratory-based common pool resource economic experiment in which participants faced four hypothetical fishery scenarios where compliance is measured in terms of whether participants exceed a catch limit. The fishing scenarios use a combination of normative and instrumental incentives to encourage compliance behavior with a catch limit. Building on the results of Mackay et al. (2019) which presents the results for each of the four scenarios comparing the normative and instrumental incentives, here we examine both consistency and variation in behavior across the four scenarios. In doing so we can isolate the effects of an instrumental and normative incentive in both a low deterrence and a high deterrence context. The implication of such a study will contribute to the gap in identifying if there are any patterns in psycho-social characteristics for those who are consistently compliant, those

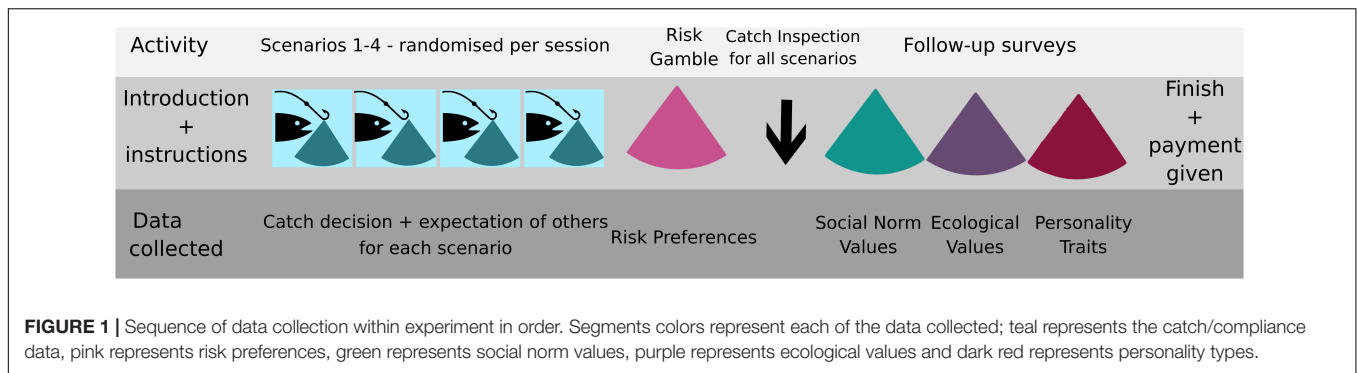


FIGURE 1 | Sequence of data collection within experiment in order. Segments colors represent each of the data collected; teal represents the catch/compliance data, pink represents risk preferences, green represents social norm values, purple represents ecological values and dark red represents personality types.

TABLE 1 | Specifications of the fishery scenarios [adapted from Mackay et al. (2019)].

Fishery scenario	Level of deterrence (instrumental incentive)	Normative message included (normative incentive)	Regulation reminder statement
Scenario 1	5%	No	There is a catch limit of TWO (2) fish. There is a 5% chance that you will come across an inspector on your fishing trip who will be checking if you are within the catch limit.
Scenario 2	5%	Yes	There is a catch limit of TWO (2) fish, but according to last year's data the average fisher chose to catch only ONE (1) fish. There is a 5% chance that you will come across an inspector on your fishing trip who will be checking if you are within the catch limit.
Scenario 3	20%	No	There is a catch limit of TWO (2) fish. There is a 20% chance that you will come across an inspector on your fishing trip who will be checking if you are within the catch limit.
Scenario 4	20%	Yes	There is a catch limit of TWO (2) fish, but according to last year's data the average fisher chose to catch only ONE (1) fish. There is a 20% chance that you will come across an inspector on your fishing trip who will be checking if you are within the catch limit.

who free-ride, and those who are influenced as intended by improving compliant behavior for different incentives.

MATERIALS AND METHODS

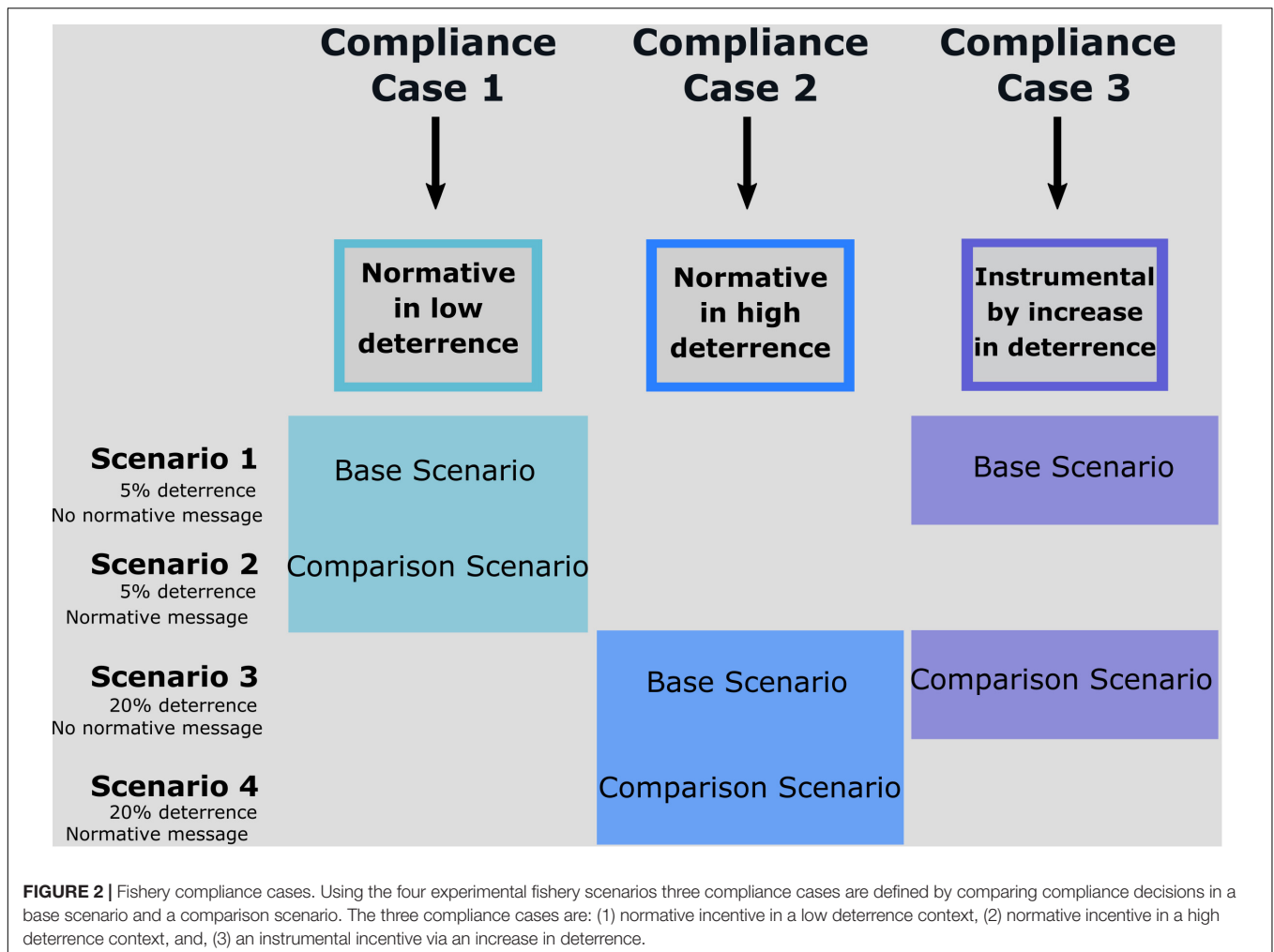
Compliance Decision Data Collection

We collected compliance decision data by running an economic experiment in which student participants faced four hypothetical scenarios in a recreational fishery context (Figure 1). The experiment was run for 20 sessions with 120 student participants (i.e., 6 students × 20 sessions) at the University of Tasmania, Australia from 12 May to 2 June 2017. At the start of each session, participants were provided an information sheet and consent form, in accordance with ethics approval from the Tasmania Social Sciences Human Research Ethical Committee (Ethics Ref: H0016420). The experiment was designed to reflect the common pool resource context of recreational fishing with groups of six anonymous participants fishing individualistically from the same resource. This design is a standard static common pool resource game used in economic experiments (Cardenas, 2011; Castillo et al., 2011). For more detail on the experimental process and design please see Mackay et al. (2019).

For each session, a group of six participants earned money by ‘catching fish’, which reflects the enjoyment fishers receive from going fishing. The amount they earned was based on how many

fish they decided to catch and the group total catch. Specifically, as each person caught more fish they earned more money, however, as the group’s total catch increased *ceteris paribus*, the individual’s reward for catching additional fish decreased. The payoff function is detailed in **Supplementary Appendix A**. To measure compliance, we set an individual catch limit of two fish, but each fisher had the option to catch up to five fish in each fishing scenario. Catch equal to or below the catch limit was categorized as compliant and catch higher than the limit was non-compliant.

We encouraged compliance with the catch limit using a combination of two management incentives, specifically an instrumental (i.e., level of deterrence) and a normative incentive (i.e., social norm message), resulting in four scenarios (Table 1). These were delivered through regulation reminders prior to catch decisions for each scenario. The instrumental management incentive was applied by setting the probability of having the catch inspected at either 5 or 20% to create low and high levels of deterrence. If inspected and found to have caught more fish than the limit, the participant received a payoff of zero. The normative management incentive was framed around a descriptive social norm. The norm depicted the catch of a typical fisher in a hypothetical fishery and was given alongside the reminder of the catch limit and level of deterrence (Table 1). The exact wording of the normative message was; “according to last year’s data the average fisher chose to catch only ONE (1) fish.” The experiment



is a within-subject design in which each participant took part in all four fishery scenarios. To mitigate the potential ordering effect, the order of the scenarios was randomized for each session.

In this study, our interest is in understanding the association between individual's psycho-social characteristics and their response to management incentives aimed at improving compliance outcomes. Specifically, we draw on the fishery scenarios to define three compliance cases, each comprising a base scenario and a comparison scenario in which either a normative or instrumental incentive is applied (Figure 2). For compliance case 1, we compare behaviors with and without a normative incentive in a low deterrence context (Scenario 1 and Scenario 2 in Table 1). For compliance case 2, we compare behaviors with and without the normative incentive in a high deterrence context (Scenario 3 and Scenario 4 in Table 1). The third compliance case observes the influence of an increase in deterrence without the normative incentive (Scenario 1 and Scenario 3 in Table 1).

Compliance Response Groups

We constructed the categorical compliance response variable based on participants compliance decisions within the base

scenario and comparison scenario (Figure 3A) resulting in four nominal categories, namely; (i) the *compliers*, (ii) the *free-riders*, (iii) the *incentivized*, and (iv) the *non-compliers*. First, the compliers are those who were consistently compliant for both base and comparison scenarios. The free-riders are those who were compliant in the base scenario and non-compliant in the comparison scenario. The participants who behaved this way are named the free-riders as they have responded to the incentive in an unintended way, possibly in an attempt to maximize payoff on the assumption that others will comply in response to the management incentive resulting in their own increased catch yielding a higher return. Third, the incentivized, who were non-compliant in the base scenario and compliant in the comparison scenario, are named as such as they have responded as intended to the management incentive. The final group, the non-compliers, were consistently non-compliant across both scenarios. Each of the four compliance response groups are potentially characterized by different psycho social-factors which is shown conceptually in Figure 3B) and is the hypothesis empirically tested in this study to answer the overall research question.

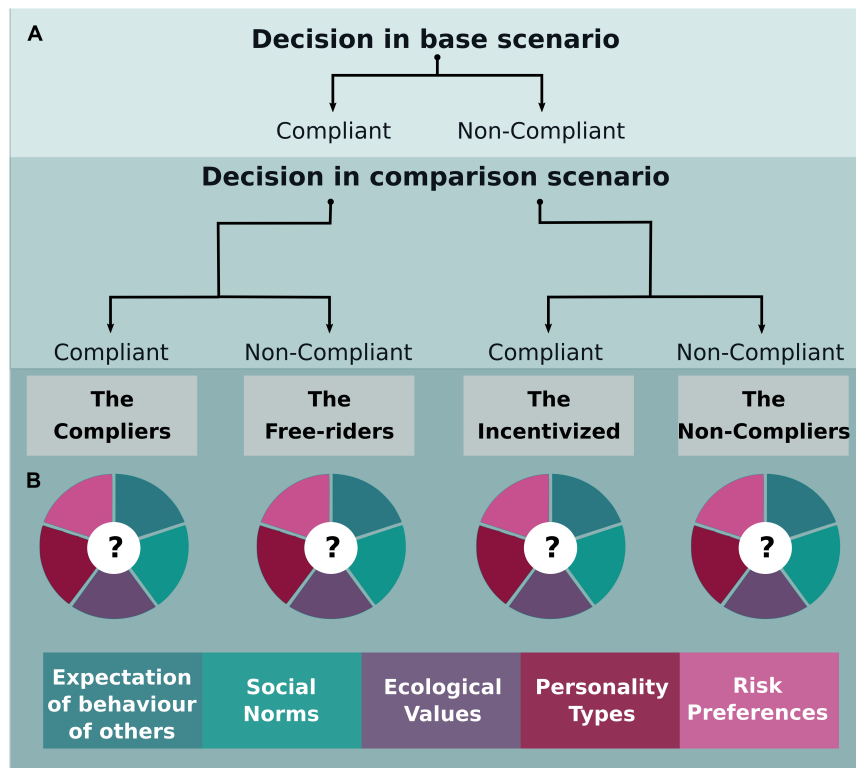


FIGURE 3 | Conceptual model of the research procedure. **(A)** Compliance decisions made in the base and comparison scenarios define the four compliance response groups (the compliers, the free-riders, the incentivized, and the non-compliers). **(B)** The research aims to identify a pattern in the five psycho-social characteristics of individuals in the four compliance response groups.

TABLE 2 | Distribution of the number of participants within the four compliance groups for each of the compliance cases.

Compliance response group	Compliance response		Compliance case		
	Base scenario	Comparison scenario	(1) Normative in low deterrence	(2) Normative in high deterrence	(3) Instrumental by increase in deterrence
The compliers	Comply	Comply	30	63	33
The free-riders	Comply	Non-comply	7	11	4
The incentivized	Non-comply	Comply	19	15	41
The non-compliers	Non-comply	Non-comply	64	31	42

The number of members in each compliance response group varies for the three compliance cases (Table 2). When the normative incentive is applied in a low deterrence context, the non-compliers formed the largest group (64). When the same normative incentive was applied in a high deterrence context, the largest group (63) were the compliers. The free-riders are the smallest group (<10%) across all three compliance cases. Individuals may respond either consistently or differently to different management incentives. For the compliers, 28 out of the 120 participants were consistently compliant across all compliance cases, whereas 27 of the 120 were consistently non-compliant. The incentivized and the free-riders were less consistent across the three compliance cases, only 2 out of the 120 people were consistent free-riders for all three compliance incentives, and none were consistently incentivized.

There is a chance that the order in which the scenarios were played will influence the responses and consequently the compliance response groupings. For example, the comparison scenario could come before the base scenario for each of the cases due to the randomized order participants played the game. Therefore, to account for any ordering effect within these groupings we checked the representativeness of the full data set with two sub-samples. We did this by examining whether there is a statically significant difference in the proportion of each compliance response group for the full sample and the sub-samples. The first sub-sample comprised of data from the first two scenarios played and only the responses that were in the order of base scenario then comparison scenario were included (i.e., scenario 1 followed by scenario 2 would be included as data for case 1, scenario 3 followed by

TABLE 3 | Summary of psycho-social characteristics.

Variable		Definition	Description	
			Low scores	High Scores
Expectation of behavior of others	Base scenario	An in-time expectation of others' behaviors as a measure of social perceptions	Expect few others to exceed catch limit (other are mostly compliant)	Expect many others to exceed catch limit (others are mostly non-compliant)
	Comparison scenario			
Social norms		Measure of the extent in which people believe in and value social norms	Low belief in and value of social norms	High belief in and value of social norms
Ecological values	Rejection of human exemptionalism	Rejection that humans are exempt from the constraints of nature	Regards the world in terms of human values and experiences	Regards the world in terms nature-centered system of values
	Environment-alism	Concerns for environmental protection and improvement of the health of the environment	Low concern for the environment	High concern for the environment
Personality type	Agreeableness	Taxonomy of personality traits	Analytical/detached	Friendly/compassionate
	Conscientious-ness		Easy-going/careless	Efficient/organized
	Extraversion		Solitary/reserved	Outgoing/energetic
	Neuroticism		Secure/confident	Sensitive/nervous
	Openness		Consistent/cautious	Inventive/curious
Risk preferences		The attitude people hold toward risk	Risk averse	Risk seeking

The possible range for expectation of behavior of others is 0–5, social norms is 14–70, each personality type is 0–10 and risk preferences is 1–5. The two variables of ecological values are the PCA scores.

scenario 4 would be included as data for case 2, scenario 1 followed by scenario 3 would be included as data for case 3). The second sub-sample comprised data from all four scenarios but only responses that were in the correct order were included (i.e., if a comparison scenario came before a base scenario it would not be included). These comparisons show that there is no statistical difference between either of the sub-samples and the full data set, suggesting that the randomized order of scenarios did not have an effect on responses and therefore compliance response groupings. The proportions for each of the sub-samples and the results of the proportional comparison statistical tests are found in **Supplementary Appendix B**.

Psycho-Social Data

In addition to the compliance decisions that participants made in the economic experiment, we collected information for each participant's psycho-social makeup that might be associated to their compliance decisions based on a review of the literature. The timing of data collection is shown in **Figure 1**. The psycho-social characteristics considered in this study were (1) expectation of behavior of others, (2) social norms, (3) ecological values, (4) personality types, and (5) risk preferences. A description of the variables relating to each of the five psycho-social characteristics is provided in **Table 3**.

Expectations of Behavior of Others

In the experiment, and for each scenario, participants were asked about their expectation of the number of others they thought would not comply. They were asked this question at the same time as they determined the number of fish they were going to catch. Specifically, we asked "How many of the others in the

group do you think will exceed the catch limit?" We used this data to create two variables that capture in time expectations of others' behaviors in both the base scenario and comparison scenario for each fishery compliance case.

Social Norms

Participants were asked 14 questions on a 5-point Likert scale that make up the Social Norms Espousal Scale (SNES) proposed by Bizer et al. (2014). This survey is used to assess individual differences in the extent to which people believe in and value social norms. Within this survey participants are asked to rate the extent to which the statements were characteristic of them. The statements are framed generally around the importance and influence of social norms (e.g., statement 1: I go out of my way to follow social norms). Individual question scores are summed and the total is ranked on a scale representing participants' values on a low to high value of social norms scale.

Ecological Values

The New Ecological Paradigm (NEP) is a 5-point Likert scale survey to measure the environmental concern of people. We used the revised version proposed by Anderson (2012), which was originally developed by Dunlap and Van Liere to assess "primitive beliefs' about the nature of the earth and humanity's relationship with it" (1978, p. 427). The NEP scale is made up of 15 statements, within which three questions represent each of the five hypothesized facets of an ecological worldview, namely (i) reality of limits to growth, (ii) anti-anthropocentrism, (iii) the fragility of nature's balance, (iv) rejection of human, and (v) possibility of an ecocrisis (Dunlap et al., 2000). The intention of the survey is to develop a scale of ecological

values from low ecological paradigm/high social paradigm to high ecological paradigm/low social paradigm. However, this scale is only recommended for use when the result of one question is consistent with the results of the remaining questions (i.e., have a high corrected item total correlation). The responses were varied and therefore we did not use the summed scores from the survey. Instead, we processed the scores for each of the five hypothesized facets of an ecological worldview using a Principal Component Analysis (PCA) to reduce the number of ecological values variables from five (one per facet) to two. The first component (which explained 45.2% of the data) was defined by one of the five facets; “rejection of human exemptionalism.” Human exemptionalism represents the belief that humans are different to all other animal and exempt from the constraints of nature, and the world is interpreted more in terms of human values and experiences (Wallhagen and Magnusson, 2017). The second component (which explained 20.7% of the data) was defined by the other four hypothetical facets. We summarized the four facets to represent environmentalism. Individual loadings on these components were used as two variables representing ecological values in our model.

Personality Types

A widely recognized and accepted taxonomy of personality traits is the “Big Five” (John et al., 1991). These five broad traits are: agreeableness (*analytical/detached* vs. *friendly/compassionate*), conscientiousness (*easy-going/careless* vs. *efficient/organized*), extraversion (*solitary/reserved* vs. *outgoing/energetic*), neuroticism (*secure/confident* vs. *sensitive/nervous*), and openness (*consistent/cautious* vs. *inventive/curious*). The Big-Five-Inventory was first presented by John et al. (1991) as a self-reported assessment to measure the five traits. In this study, we used a 10-item version of the Big-Five-Inventory (Rammstedt and John, 2007). Unlike the measures for social norm and ecological values the scores for personality type are not additive, and so we formed five variables based on their scores for each of the five personality traits.

Risk Preferences

In addition to the common pool resource game, participants were asked to undertake a paid experimental exercise in which they chose from a range of gambles to elicit their risk preferences. We used the Eckel-Grossman Risk Task (Eckel and Grossman, 2002) which is an established way of elucidating risk preferences. Participants were asked to undertake the paid gamble in which they chose one of six possible gambles which all have the same 50/50 chance of winning as an assessment of risk attitudes. The gambles range from a safe bet with guaranteed but lower payoff, to a higher risk gamble with a larger payoff. Gambles range from risk averse to risk neutral to risk seeking.

Compliance Decision and Psycho-Social Data Analysis

To understand which of the psycho-social characteristics are related to the four compliance response groups, we

used a multinomial (MNL) regression. We estimated a separate model for each of the three compliance cases (Figure 2) to capture the change in participants’ decisions in response to either normative or instrumental incentives. Each of the three models includes all of the psycho-social variables as independent variables. Specifically, for each compliance case k ($k = 1,2,3$), we model the probability that individual j belongs to compliance response group m ($m = 1,2,3,4$) conditional on the psycho-social characteristics of the individual, that is:

$$p_{jkm} = \text{Prob}(y_{jk} = m) = F_{km}(x'_j\beta) \quad (1)$$

where y_{jk} is an indicator variable that takes value one if individual j belongs to compliance response group m and zero otherwise. F_{km} is the cumulative distribution function which lies between zero and one and adds up to one over m ; i.e., $\sum_m p_{jkm} = 1$ (i.e., each individual must belong to one of the response groups). In equation (1), the psycho-social characteristics of individual j is denoted by x_i and β is a vector of the corresponding parameters. We used the multinomial logistic model to estimate the parameters in (1), thereby the cumulative distribution function is given as:

$$F_{km}(x'_j\beta) = \frac{1}{1 + \sum_{m=2}^4 \exp(x'_j\beta_{km})}, m = 1 \quad (2)$$

$$F_{km}(x'_j\beta) = \frac{\exp(x'_j\beta_{km})}{1 + \sum_{m=2}^4 \exp(x'_j\beta_{km})}, m = 2, 3, 4 \quad (3)$$

We set the compliers as the baseline group ($m = 1$) as the compliers represent the behavior that we want to emulate (i.e., it reflects the desired compliance behavior of recreational fishers under all management incentives). Given the baseline compliance response group, the log-odds for all other groups relative to the baseline group can be calculated as a linear combination of the psycho-social factors, such that:

$$\ln\left(\frac{\text{Prob}(y_{jk} = m^-)}{\text{Prob}(y_{jk} = 1)}\right) = x'_j\beta_{km^-}, m^- = 2, 3, 4 \quad (4)$$

Therefore, the signs and statistical significance of each parameter β_{km^-} indicate whether a change in the psycho-social factor makes an individual’s membership to the compliance response group m^- more or less likely relative to the baseline group (i.e., compliers). For example, a positive and significant coefficient for a characteristic for one of the compliance response groups would suggest a higher probability of an individual being part of that group. Given the number of independent variables included in the model (Table 3), the multicollinearity between each psycho-social factor is of potential concern in the regression analysis. We calculated the correlation coefficients and confirmed that the correlation between social norms, ecological values and risk preferences is relatively low (< 0.25). Where a correlation coefficient was higher than 0.25 for expectation of behaviors of others and personality type, the

model results were checked to ensure the multicollinearity did not confound results.

RESULTS

Expectation of Behavior of Others

Among all the psycho-social factors, expectation of behavior of others in the base scenario was the most frequent significant variable in explaining individuals' membership in the compliance response group for both the instrumental and normative incentives (Table 4). For the non-compliers, the coefficient was positive and significant for compliance cases 1 and 3, indicating that those who have less faith in others to comply with the catch limit in the base scenario are more likely to be non-compliers. Expectation of behavior of others in the base scenario was consistently significant and positive for the incentivized group for all the three compliance cases. Conversely, for free-riders, expectation of others in the base scenario was significant for compliance case 2, indicating that those who have less faith in others to comply with the catch limit in the base scenario are less likely to be free-riders.

Expectation of others' behavior in the comparison scenario was only significant for compliance case 2 (Table 4). This result was found for the non-compliers and the free-riders. For the non-compliers group, the coefficient was positive and significant, suggesting those who have less faith in others to comply in the comparison scenario are more likely to be in the non-compliers group, reflecting their own behavior as they are non-compliant in this scenario. For free-riders -who were compliant in the base scenario, and non-compliant with the incentive- the result was positive and significant, indicating that those who have less faith in others to comply with catch limit with the management incentive applied are more likely to be in this group. Expectation of others in the comparison scenario was not significant for any management incentive for the incentivized group. This suggests that in the case of a management incentive having the desired effect, the expectation of others is no longer correlated with an individual's own behavior within the comparison scenario.

Social Norms

The estimated coefficient of social norms was not significant for the non-compliers or the free-riders for any compliance case (Table 4). The estimated coefficient of social norms was positive and only significant for the incentivized for compliance case 3, suggesting that those who have a high value of social norms are likely to be non-compliant when deterrence is low but compliant with high deterrence. The coefficient of social norms was not significant for the incentivized for the normative message incentives in either a high or low deterrence context which means there is no association between the value of social norms and the influence of a normative message on compliance behaviors.

Ecological Values

For the cases where human exemptionalism and environmentalism is a significant predictor variable, the

direction of the effect is negative, indicating that those with high ecological values are less likely to be part of the response groups they were significant for (Table 4). For compliance case 3, the coefficient of rejection of human exemptionalism was significant for all response groups and environmentalism was significant for two response groups, respectively. These results suggest that those with high ecological values are less likely to be part of the groups responding in a way other than complying with an increase in deterrence, which infers compliers have high ecological values. By contrast, rejection of human exemptionalism was not significant for any group for compliance case 1 and for only one group for compliance case 2. This suggests that the link between human exemptionalism and responses to a normative management incentive is weak. Likewise, environmentalism was significant for non-compliers for case 1 and not significant for any groups for case 2, suggesting that the link between environmentalism and a response to a normative management incentive is also weak.

Personality Type

The "Big Five" personality traits that are significant in this analysis all have a negative coefficient (Figure 4). This means that those who have these personality traits are more likely to be the compliers (i.e., baseline group). The personality traits that are significant, however, vary across both compliance cases and the compliance response group. For example, those with agreeableness, conscientiousness or extraversion as personality traits are less likely to be non-compliers in response to either a normative or an instrumental incentive (Figure 4). In response to the normative incentive (in compliance cases 1 and 2) extraversion and openness were significant for the incentivized and the free-riders, respectively, indicating that those with these personality traits are less likely to be part of these groups and more likely to be the compliers. Finally, in response to the instrumental incentive, the coefficient of conscientiousness was significant and negative again indicating those with this personality trait are more likely to be compliers than the incentivized.

Risk Preferences

Risk preference was significant in explaining respondents' compliance response to both the normative and instrumental incentives (Table 4). For non-compliers, risk preference was significant and positive for all compliance cases, suggesting that those who are risk seeking are more likely to be non-compliers regardless of the management incentive applied. Risk preference was also significant and positive for the incentivized for compliance case 2, suggesting that those who are risk seeking are more likely to be in this group, which may explain why they were non-compliant in the base scenario. Risk preference is significant for the free-riders for compliance case 3. There are fewer significant results for compliance case 1 (normative in low deterrence) compared to the other compliance cases, which may reflect that the risk of being caught in this context is the lowest and therefore not a strong predictor for the incentivized or the free-riders.

TABLE 4 | Multinomial model results on responses to normative and instrumental incentives.

Psycho-social characteristic		Compliance Case 1 Normative in low deterrence			Compliance Case 2 Normative in high deterrence			Compliance Case 3 Instrumental		
		Non-compliers	Free-riders	Incentivized	Non-compliers	Free-riders	Incentivized	Non-compliers	Free-riders	Incentivized
Expectation of behavior of others	Base scenario	0.941***	-0.173	0.895***	0.311	-0.785*	0.441*	1.108***	0.219	0.965***
		(0.001)	(0.676)	(0.004)	(0.118)	(0.071)	(0.066)	(0.000)	(0.637)	(0.000)
	Comparison scenario	0.221	0.542	-0.42	0.461*	1.244***	0.239	0.23	0.542	-0.246
		(0.387)	(0.215)	(0.131)	(0.059)	(0.006)	(0.438)	(0.322)	(0.184)	(0.325)
Social norms		0.068	-0.011	0.052	0.022	0.08	0.04	0.072	0.024	0.081*
		(0.120)	(0.865)	(0.318)	(0.516)	(0.139)	(0.427)	(0.123)	(0.851)	(0.067)
Ecological values	Rejection of human exemptionalism	-0.257	0.003	-0.369	-0.043	-0.096	-0.438*	-0.479*	-1.267**	-0.498**
		(0.244)	(0.993)	(0.149)	(0.812)	(0.746)	(0.084)	(0.064)	(0.036)	(0.037)
	Environmentalism	-0.629**	-0.305	-0.407	-0.05	0.229	-0.075	-0.725**	-0.106	-0.607*
		(0.047)	(0.545)	(0.227)	(0.848)	(0.572)	(0.830)	(0.038)	(0.888)	(0.064)
Personality type	Agreeableness	-0.496**	-0.16	0.002	-0.091	-0.288	0.104	-0.189	0.04	-0.342
		(0.029)	(0.606)	(0.992)	(0.607)	(0.260)	(0.641)	(0.428)	(0.940)	(0.119)
	Conscientiousness	-0.525**	0.108	-0.305	-0.109	0.321	0.068	-0.578**	-0.406	-0.504**
		(0.014)	(0.757)	(0.187)	(0.496)	(0.238)	(0.749)	(0.017)	(0.413)	(0.024)
	Extraversion	-0.009	0.118	-0.433**	-0.2	0.187	-0.175	-0.427**	-0.36	-0.26
		(0.958)	(0.666)	(0.039)	(0.155)	(0.384)	(0.345)	(0.035)	(0.365)	(0.165)
	Neuroticism	0.111	0.122	0.156	-0.17	-0.071	0.326	0.044	0.422	0.103
		(0.520)	(0.651)	(0.423)	(0.246)	(0.729)	(0.126)	(0.812)	(0.398)	(0.534)
	Openness	-0.142	0.219	0.067	0.003	-0.487*	0.33	0.083	0.696	-0.058
		(0.444)	(0.475)	(0.758)	(0.983)	(0.056)	(0.123)	(0.689)	(0.132)	(0.763)
Risk preferences		0.467**	-0.215	-0.149	0.438***	0.146	0.611**	0.650***	1.401**	0.335
		(0.020)	(0.508)	(0.518)	(0.008)	(0.545)	(0.014)	(0.004)	(0.044)	(0.103)
Constant		0.366	-3.732	-0.528	-0.938	-4.388	-11.432***	-1.515	-14.034	0.803
		(0.905)	(0.444)	(0.884)	(0.741)	(0.331)	(0.008)	(0.662)	(0.154)	(0.799)
McFadden's pseudo-R2			0.331			0.214			0.308	
Log-likelihood			-91.47			-110.00			-99.86	
AIC			254.947			292.002			271.729	
Likelihood ratio test (p-value)			2.943e-07***			0.002725**			4.975e-07***	
Number of observations		64	7	19	31	11	15	42	4	41

This table reports the estimates of the coefficients and p-values in parentheses for the three compliance cases. The baseline compliance response group is the compliers. Significant coefficients are bolded, and significance level are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

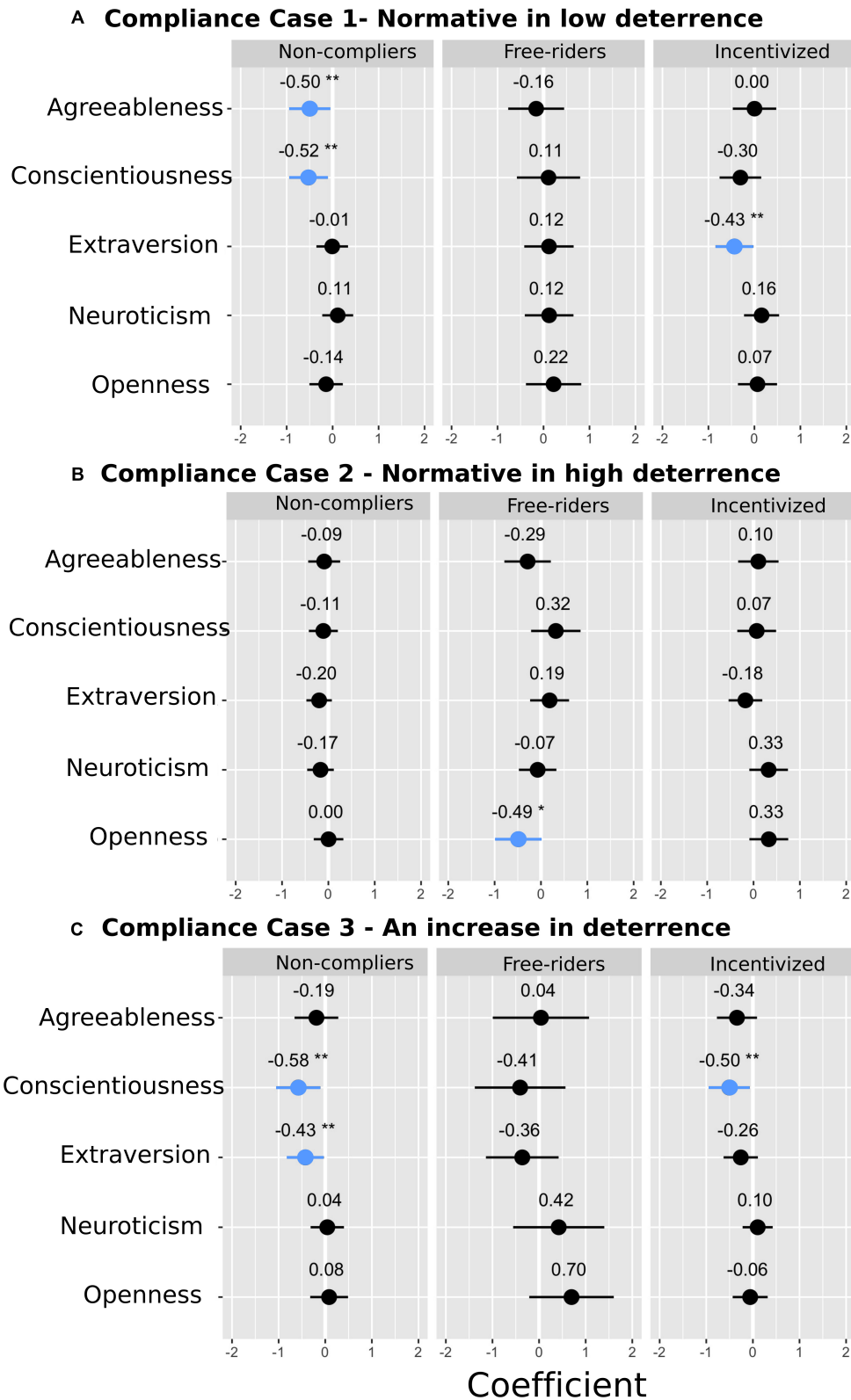


FIGURE 4 | Multinomial logit model results for personality types for non-compliers, free-riders, and the incentivized for **(A)** compliance case 1: normative message in low deterrence, **(B)** compliance case 2: normative message in high deterrence, and **(C)** compliance case 3: an increase in deterrence. Coefficients are included, and error bars indicate standard error. Significant coefficients are highlighted in blue, and significance level are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Full regression results are reported in **Table 4**.

DISCUSSION

While we know that in fisheries people make trade-off decisions between following or breaking rules, it is of interest to determine how people respond to different management incentives. Accurately understanding the different responses to instrumental and normative incentives and highlighting the psycho-social patterns within these responses is highly relevant for fisheries policy. In our laboratory-based economic experiment, in which participants faced four hypothetical fishery scenarios to provide the controlled setting to measure behavioral responses and to remove any potential confounding influences, we were able to shed light on this issue. While this study is framed around a recreational fisheries context, the compliance problems faced for other natural resources (Keane et al., 2008) are similar and potentially similar policy opportunities (as discussed below) may apply. In this paper, we first identified patterns in compliance behavior. The pattern reveals a group of people who are consistently compliant, a group who are consistently non-compliant, a group who respond counterintuitively, and a group who are incentivized to become compliant (as intended by the management incentive). In this paper, we further explored how the pattern in compliance behavior is associated with five psycho-social factors, three of which (perceptions of behavior of others, social norms, and risk preferences) have separately been explored within the fisheries compliance literature, while two factors (ecological values and personality types) had yet to be explored. While information about these two latter factors is limited within the fisheries compliance literature, our results suggest that they are relevant predictors for individuals' compliance response to different management incentives.

To summarize the findings, we combine results for individual factors into umbrella factors to conceptually present the results in **Figure 5**. For example, the umbrella factor *expectation of others' behavior* combines the results of base scenario and comparison scenario, *ecological values* represents both rejection of human exemptionalism and environmentalism and *personality types* includes all five personality factors. The shading of the segments indicates that at least one of the included factors for the umbrella factor is significant (but not necessarily all of them). The aim of this study was to compare the role of psycho-social characteristics of individual fishers in explaining responses to an instrumental and normative management incentives. Each of the umbrella factors is statistically significant in explaining compliance behavior in at least one compliance case and for at least one of the three compliance response groups (**Figure 5**). For example, one consistent result across both the normative and instrumental incentive was the relationship between risk preferences and non-compliance. The *expectation of others' behavior* was also the most frequently statistically significant factor (in 7 of the 9 cases¹ – dark green shaded segment in **Figure 5**).

¹There are a total of nine cases, three response groups (compared to the "compliers") and three compliance cases.

Broadly we see that more psycho-social factors were statistically significant in explaining the behavior of non-compliers and the incentivized compared to the free-riders. Individual's membership in the free-riders is the hardest to predict based on the five psycho-social factors. This may be due to the low number of observations for this group and therefore the results for this group must be interpreted with care. Moreover, we can see that more psycho-social factors explain behavioral responses to an instrumental incentive than a normative incentive (**Figure 5**). Ecological values, for example, was consistently a significant predictor for responses to an instrumental incentive but not for either of the normative incentives. The results suggest that there is a relationship between having high environmental values and acting consistently compliant because the relationship between ecological values and all other response groups (non-compliers, free-riders, and the incentivized) was negative and significant. That is to say, the compliers have higher environmental values than any other group in response to an instrumental incentive, suggesting that compliance behavior could be encouraged by increasing environmental values and concern. These results are consistent with the behavioral literature suggesting a link between high environmental values and pro-environmental behavior (Nuyen, 2011; Ones et al., 2015).

Social norms was only significant for the incentivized for the instrumental incentive. Social norms was expected to be a significant predictor, especially for the incentivized in response to the normative incentives. However, we find that social perceptions of others' behaviors are more effective at representing the implicit expectations of an individual. The results for expectation of others' behavior suggests that when participants are non-compliant they think others are also exceeding the catch limit. This behavior, also known as false consensus or pluralistic ignorance, can lead to misperceived norms and reinforce non-compliant behavior (Berkowitz, 2005; Rimal and Real, 2005). Targeting these misconceptions results in a more accurate normative feedback with expected improved compliance (Bergseth and Roscher, 2018). This can be achieved through highlighting pro-compliance perceptions and norms of fishers as well as reporting consequences of non-compliant behavior (Bova et al., 2017; Bergseth and Roscher, 2018). This could resemble social punishment through shame and moral unacceptance of non-compliance as well as traditional deterrence such as fines (Thomas et al., 2016; Mackay et al., 2018). The SNES survey is intended to assess individual differences in the extent to which people believe in and value social norms, however, from our results it was related to the response to the instrumental incentive. Although instrumental incentives are expected to crowd out social or moral norms (Kroneberg et al., 2010; Barile et al., 2015), we find that high social norms value complements the effectiveness of the instrumental compliance incentive.

There were differences in behavioral responses to an instrumental incentive and a normative incentive for different personality traits. For the instrumental incentive introversion was inferred for non-compliers for the case of an increase

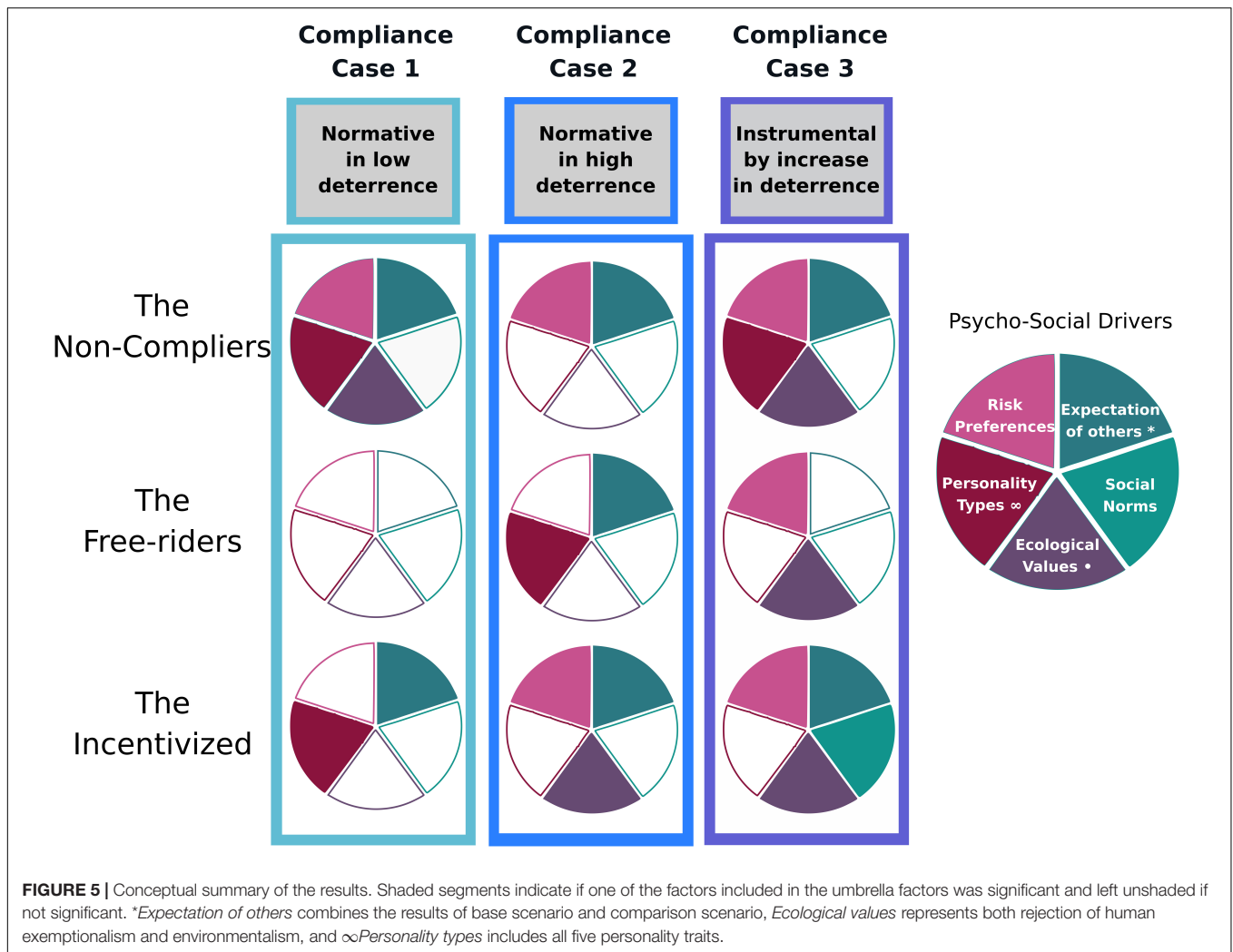


FIGURE 5 | Conceptual summary of the results. Shaded segments indicate if one of the factors included in the umbrella factors was significant and left unshaded if not significant. **Expectation of others* combines the results of base scenario and comparison scenario, *Ecological values* represents both rejection of human exemptionalism and environmentalism, and ∞*Personality types* includes all five personality traits.

in deterrence. Non-compliant behavior has been found to be associated with introversion but only when combined with high neuroticism (Gudjonsson et al., 2004), however, neuroticism was not a significant personal trait in our results. The results also indicated a low likelihood of being non-compliant or the incentivized in response to an increase in deterrence for those with high conscientiousness. Low conscientiousness is associated with impulsivity (Sharma et al., 2014). This suggests that impulsivity may be related to non-compliance when there is a low chance of being caught but it is over shadowed when there is a higher chance of being caught.

Low conscientiousness is also linked to deviousness (Salgado, 2004), which may explain why the trait is found to be associated with those who are non-compliant in response to the normative incentive in a low deterrence context. However, we did not find this result for the normative incentive in a high deterrence context, suggesting that the risk of being caught may overshadow the tendency to be devious. The only personality type that was significant for normative incentive in high deterrence was openness. Specifically, our result suggests

that those who are open are unlikely to be free-riders for the normative incentive in a high deterrence context. This may infer that free-riders have low openness as part of their personalities. A low score for openness represents a consistent and cautious personality which would be unexpected for the free-riders as they become non-compliant and at risk of a penalty. This result is somewhat counterintuitive, but may be associated with the low number of observations for this group.

For normative incentive in a low deterrence context, personality types were more frequently statistically significant. The results for non-compliers for this management incentive infer low agreeableness and low conscientiousness. People with low agreeableness tend to be less cooperative and more competitive in groups (Graziano and Eisenberg, 1997), which may explain the non-compliant behavior as participants may be acting competitively to make more money in the experiment. The results may reflect that the compliers are more agreeable which has been linked to prosocial and altruistic behaviors (Graziano et al., 1997). Introversion is expected to correlate with compliance behavior since a typical introvert is depicted

as a responsible person who is expected to be compliant (Gudjonsson et al., 2004). Consistent with the expectation, the results suggest introversion is associated with the incentivized for the case of normative incentives in low deterrence. This suggests that introversion is correlated with compliant behavior for a normative incentive and non-compliers for an instrumental incentive.

Future Research

In this study, we explore what psycho-social characteristics of individuals are associated with responses to instrumental and normative management incentives in a recreational fisheries context, yet there are some caveats to consider when interpreting the results.

First, we use a controlled environment via an economic experiment with student participants, which is useful for minimizing potential confounders. However, WEIRD (western, educated, industrialized, rich, and democratic) participants made up the study sample and are sometimes criticized as not being representative of the general population (Levitt and List, 2007; Loomis, 2014). No difference in behavioral patterns or overestimations of social preferences were found between student and non-student samples in other studies (Janssen et al., 2011; Exadaktylos et al., 2013; Falk et al., 2013). Therefore, the policy implications that can be drawn from these findings can contribute toward improving compliance management since a better understanding of recreational fishers' behavior can reduce unintended outcomes of management interventions (Pine et al., 2009) and better predict and assist how recreational fisheries adapt to changing environments and evolve to maintain resilience and sustainability on a global scale (Arlinghaus et al., 2013). In fact, the heterogeneity of fishers is thought to be a key ingredient of the complex dynamics of recreational fisheries and key for better management (Johnston et al., 2010; Post, 2013). We do recognize that different demographics in a fishery or alternate natural resource context may result in different conclusions. For example, an area for further research not within the scope of this study would be to examine the influence of socioeconomic characteristics and their interaction with psycho-social characteristics. For example, dependency on fishery/resource (Karper and Lopes, 2014), scale of corruption (Akpalu and Mohammed, 2013), and socioeconomic inequalities and mortality risk (Pepper and Nettle, 2017) -that leads to making more present-orientated behaviors rather than future-orientated behaviors- are key domains worth exploring in terms of compliance responses that is applicable across resource and location context.

Second, while we find that the normative message in the experiment changed behavior, a normative expectation can be strengthened on the belief that others think they should or have an obligation to conform to the norm (Bicchieri and Xiao, 2009). We envisage that future work can explore the use of normative messages that are not only based on what the wider group is doing but where the message suggests there is a consciousness of what is accepted by others to strengthen the normative expectations (Reno et al., 1993). We also acknowledge

that there are a number of alternative psycho-social drivers to explore in relation to compliance responses. For example, while we found links between personality traits that are linked to impulsivity, it may be worth exploring the link between behavior and impulsivity directly (Maccallum et al., 2007). Additionally, the role of self-control has been explored in the trade-off between short term temptation to be selfish and long term pro-social behavior (Martinsson et al., 2010), which would be highly applicable to natural resource use and actions impacting the global climate.

Finally, there are several findings from this study and while we have highlighted the findings that we determined to be the most novel within the fisheries compliance literature, we acknowledge that there are many dimensions to the results and a number of interesting results were not developed in the discussion. For example, while some results were as expected such as the link between high environmental values and pro environmental behavior there is an opportunity for more research in to the less expected and more specific associations such as between expectation of others and specific personality types and risk preferences. There scope for more research investigating interacting psycho-social characteristics which will add richness to the discussion of compliance behavior.

CONCLUSION

People respond differently to management incentives and often they respond in a way that is contradictory to expectation. While there are different instrumental and normative incentives that can be used to influence compliance behavior, the aim of this study was to explore the association between individual psycho-social characteristics and compliance responses. We explored five psycho-social factors: expectations of others' behavior, social norms, ecological values, personality types, and risk preferences. Our results highlight there are different psycho-social factors associated with certain compliance response behaviors. For example, risk seeking is associated with people who can be categorized as non-compliers. There are certain behaviors that are harder to predict, for example for people who behave contrary to the compliance incentive, who we labeled free-riders. We acknowledge findings outside the laboratory experimental context and fishery example may vary from these conclusions, but we offer a number of policy suggestions based on the results of our findings, such as emphasizing the risk of non-compliance and using compliance campaigns that target encouraging environmental concerns. The findings underline that there is significant heterogeneity in the associations between psycho-social make-up and compliance behaviors. Knowledge of this behavioral relationship can progress fisheries management toward increased innovation by encouraging the management of the individual fisher rather than the average fisher. In the context of managing people the whole may not be greater than the sum of the parts,

as modifying behavior requires nuance and specifics rather than generalities and ambiguity.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Tasmania Social Sciences Human Research Ethical Committee (Ethics Ref: H0016420). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MM conceived, developed and designed the study, led data collection activities, led data analysis and wrote the manuscript. EP contributed to the design and data analysis and contributed input into the writing of the manuscript. SJ contributed to the development of the study and provided input into the writing of the manuscript. SY contributed to the design and development of the study and provided comment on draft versions of the manuscript. HS contributed to the development of the study and provided comment on draft versions of the manuscript.

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All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by the Centre for Marine Socioecology-student funding for experimental costs and publication fees and Tasmanian School for Business and Economics-student research grant.

ACKNOWLEDGMENTS

We would like to thank the student participants for taking part in the experiment, and Emma Crow and Sue Abel for their help running the finances and logistics for the experiment. We would also like to thank the Tasmanian School of Business and Economics and The Centre for Marine Socioecology for the funding provided to conduct this study. We would like to thank Shane Richards for his statistical advice. We thank Drs. Sarak Kraak and Katell Hamon for their incredibly useful comments and suggestions on earlier drafts.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fmars.2020.579213/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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