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Australian residents' attitudes toward pro-environmental behaviour and climate change impacts on the Great Barrier Reef

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Climate change and associated environmental impacts are increasingly important issues. Effective communication with residents of coastal communities is critical to mitigate and adapt to changing conditions; however, this can be a challenging feat without an understanding of attitudes toward pro-environmental behaviour. Drawing on three dimensions of the Theory of Planned Behaviour, this paper: (1) explores the Australian public's perceptions of climate change impacts on the Great Barrier Reef; (2) segments respondents into homogenous groups based on their environmental attitudes; and (3) profiles the emergent segments using managerially-relevant indicators. Study findings illustrate that respondents can be organised into five distinct segments according to their attitudes toward pro-environmental behaviour that could potentially stem climate change-related impacts. These segments perceive a variety of threats to the health of the Great Barrier Reef ecosystem, underestimate the performance of behaviours that help to mitigate impacts and face a variety of internal and external constraints on behavioural engagement.

Keywords: perceptions of climate change; environmental attitudes; marine protected areas; theory of planned behaviour

1. Introduction

Climate change is widely recognised as a global conservation concern that poses potentially irreversible threats to conditions in the natural environment, human populations, and economies (IPCC 2007, Solomon *et al.* 2009). The accelerating rates of human-induced impacts have called for increased attention to mitigation strategies (Canadell *et al.* 2007, Stroeve *et al.* 2007) and over the past two decades in particular, efforts have been directed towards understanding the adaptation and vulnerability of systems influenced by the earth's changing climate (Stern 1992, O'Brien and Leichenko 2000, Hughes *et al.* 2003, Pielke *et al.* 2007, Adger *et al.* 2009, Aakre and Rübbelke 2010). Past research has suggested that people are generally familiar with climate change despite a limited understanding of its processes, and express concern regarding associated environmental degradation, albeit relatively

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less pronounced than responses to other relevant issues (O'Connor *et al*. 1999, Lorenzoni and Pidgeon 2006, Whitmarsh *et al*. 2011).

Given generally high levels of climate change awareness, recent work has called for interdisciplinary approaches to understanding biophysical impacts and the human dimensions of climate change (Moser 2010). One avenue for social science research builds on the idea of 'pro-environmental behaviours', which are actions that minimise negative human-caused impacts on the environment (Stern 2000a). Research on public attitudes and behaviours regarding climate change has helped decision makers anticipate involvement in mitigation strategies and predict how receptive people may be to evolving policies (Stern 2000b). Encouraging the adoption of climate change-friendly behaviour is critical to help curb negative environmental impacts, increase resilience of social-ecological systems, and contribute to a more informed public living near coastal ecosystems.

Behavioural responses to climate change impacts are manifest in perceived risks that threaten individual and societal values. In this context, values reflect what people consider to be desirable or preferable conditions (Rokeach 1973). Actions that minimise impacts often stem from values (Dessai *et al*. 2004, Adger *et al*. 2009), reflect the institutions that govern risks (Ostrom 2005), and can be partially predicted using measures of environmental attitude (Stern 1992). Past research has argued that adaptations to climate change should be facilitated by invoking behaviour that benefits the environment, bearing in mind the unintended consequences of drawing public attention away from other relevant issues (Weber 2006). A stronger understanding of environmental attitudes that shape human behaviour is warranted to achieve both mitigation and adaptation to changing climate conditions across regional contexts (Bardsley and Rogers 2011) and over time (Stern 1992).

Climate change research grounded in the social and behavioural sciences is particularly important in the context of the Great Barrier Reef (GBR) where climate change impacts are among the most pressing long-term challenges facing the health of ecological communities and economies (GBRMPA 2009). Climate change, in combination with other pressures, has already caused substantial changes in the GBR, and current predictions indicate continued climate-related degradation into the future (Hughes *et al*. 2003). To meet the associated challenges, the Australian government created a Climate Change Action Plan (CCAP) to develop strategies that reduce human influences on the GBR (GBRMPA 2007, Johnson and Marshall 2007). The CCAP identified understanding and managing the human dimensions of climate change as high priorities for the GBR (Lynch *et al*. 2009). The present study answers this call by examining attitudes toward pro-environmental behaviour regarding climate change impacts on the GBR, and by providing information on how perceptions vary across various segments of the Australian public.

2. Conceptual background

Early attitudinal research in the 1970s positioned behaviour as a direct response to knowledge and awareness, leading to the assumption that educational efforts would directly increase pro-environmental behaviour. However, more recent scholarship has recognised a discrepancy between individuals' attitudes and the extent to which they engage in pro-environmental behaviour, referred to as the 'value-action' gap (Burgess *et al*. 1998). This gap exists because the relationship between attitudes and actual behaviour is shaped by a number of political and social factors (Blake 1999),

such as personal values (Stern *et al*. 1999), normative pressures (Needham 2010) and constraints (Fielding *et al*. 2008). Extensive research has attempted to understand the value-action gap, although uncertainty remains concerning individuals' responses to situations in which knowledge and awareness are high (Kollmuss and Agyeman 2002).

There are a number of theories that have underpinned previous research efforts to better understand pro-environmental behaviour. The moral norm-activation model is one conceptual framework that draws on the idea of social altruism to understand normative influences that shape human behaviour (Schwartz 1977). Another approach that examines human behaviour in the context of environmentalism is the value-belief-norm (VBN) theory, which posits a causal relationship among underlying value systems, beliefs / worldviews and personal norms (Stern *et al*. 1999). Three components of the VBN theory are used to predict intention to engage in behaviour, which is a relatively reliable estimate of actual behaviour.

The Theory of Planned Behaviour (TPB) also informs understandings of the gap between environmental attitudes and behavioural tendencies (Ajzen 1985, 1988). This model assumes people are guided by rational decisions that take into consideration behavioural consequences (Bamburg and Möser 2007). Similar to other models, TPB implies a causal relationship between attitudes and intended behaviour, whereby outcomes can be predicted using measures of environmental attitudes consisting of behavioural responses to objects, outside social pressures and perceived abilities to take action. In the full TPB model, these three dimensions are anteceded by beliefs and are hypothesised to positively influence behavioural intention. This theory holds explanatory power and provides a valid measure of environmental attitudes (Armitage and Conner 2001).

The first dimension of the TPB model measures an individual's general attitude, and is defined as an evaluative reaction reflecting beliefs about the behaviour (Oskamp 1977). For example, someone living near the GBR may want to do their part to reduce negative impacts on the environment. Consequently, a general attitude toward walking rather than driving to work might be formed. In weighing the pros and cons of this behaviour, the individual will consider various outcomes (e.g. reduced carbon emissions, improved physical health), and depending on the likelihood and importance of each outcome, form a broad response toward the specific action of walking to work.

The second dimension of the TPB model consists of subjective norms, or the extent to which individuals feel obligated to behave in particular ways owing to the expectations held by others. When an individual performs a particular behaviour, he or she holds the general belief that it is socially acceptable and/or advantageous in some way. In other words, an individual will feel responsible to perform behaviours according to outside opinions that influence what he or she does. In this sense, someone may choose to engage in climate change-friendly actions such as walking to work if other people who are considered important value this behaviour.

The final TPB dimension is perceived behavioural control, which refers to an individual's belief about their ability to perform a specific behaviour based on their capabilities and the external forces that can influence choice (Staats 2003). Walking to work, for example, might not be performed if the conditions are not practical (e.g. the distance is too far to walk), opportunity does not allow (e.g. the individual encounters unexpected obstacles such as road construction), or the individual does

not immediately realise that the goal is attainable (e.g. the distance seems too far until the individual is physically fit). Thus, the degree of control an individual believes he or she has over a specific behaviour interacts with behavioural intentions and actual behaviour (Armitage and Conner 2001).

The TPB model has been extensively applied in attitudinal research across various contexts (Armitage and Conner 2001, Bamburg and Möser 2007). For example, Ajzen and Driver (1992) used TPB to predict involvement in recreation activities. The authors found that the three TPB dimensions predicted behavioural intention and exerted relatively strong influence on different leisure behaviours. Fielding *et al*. (2008) assessed environmental activism and group memberships using TPB and, consistent with past research, found that positive attitudes and strong subjective norms successfully elicited an intention to engage with environmental organisations. Hinds and Sparks (2008) also found utility in the TPB model, and observed that the three TPB dimensions accounted for over half of the variance in predicting behavioural intentions to engage in environmental activities. In each of the studies mentioned above, the TPB model demonstrated good explanatory power with respect to predicting behavioural intention and subsequent behaviour.

In this paper, the TPB model was adapted to explore heterogeneity in Australian residents' attitudes toward pro-environmental behaviours that help mitigate climate change impacts on the GBR. The purpose, however, was not to formally test the full TPB model for predicting climate change-related behaviour. Instead, the TPB dimensions of general attitudes, subjective norms and perceived behavioural control were used as a guiding framework because: (a) these measures of environmental attitudes aligned with the study objectives; and (b) allowed alternative predictors of pro-environmental behaviour to be incorporated. Using the TPB dimensions, respondents were segmented into homogenous groups. The emergent segments were then profiled using four validation variables. Thus, this paper has three primary objectives: (1) provide an overview of how Australian residents perceive climate change impacts on the GBR and offer insight into their attitudes and behaviours related to these issues; (2) segment Australian residents based on their environmental attitudes and behaviours that influence climate change; and (3) profile segments using perceived threats to the health of the GBR, intended and reported behaviours and behavioural constraints. These analyses were designed to assist managers with their effort to target subgroups of the population and develop programmes aimed at increasing public involvement in climate change mitigation and adaptation strategies.

3. Methods

3.1. Study context

The ecosystem of concern in this study was the GBR, which extends approximately 2,300 km along the northeastern coast of Australia in the state of Queensland, encompassing approximately 345,950 square km of both state and federal waters (Figure 1). This multi-use protected area hosts one of the most biologically diverse ecosystems in the world, including an expansive network of coral reefs, continental islands, coral cays, and an abundance of marine life (GBRMPA 2007, 2009). Interconnected within these habitats are other ecological communities such as mangroves, seagrass beds and sponge gardens, which create extraordinarily diverse conditions (Johnson and Marshall 2007). In addition to protecting high levels of

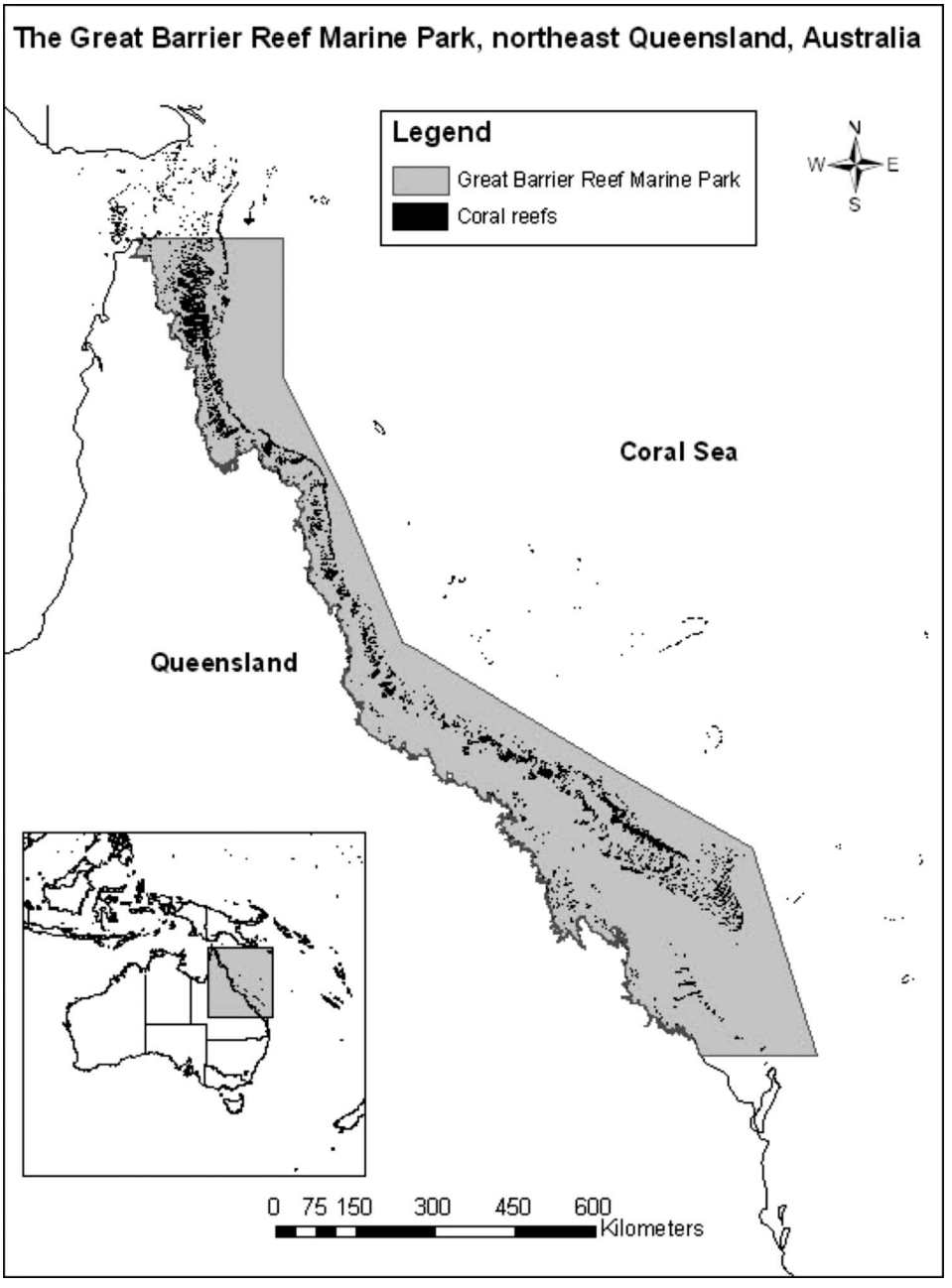

Figure 1. Study context of the Great Barrier Reef Marine Park, Australia.

biodiversity, the GBR Marine Park (GBRMP) fosters a range of values and meanings among stakeholders (Vanclay and Higgins 2008, Wynveen *et al.* 2010) and serves as a driving force for the economy of the state of Queensland, through the tourism and fishing industries, and the entire country (Day 2002). Management of the area involves multiple layers of government agencies that work in co-operation,

although it is primarily managed by the commonwealth (federal) government agency the Great Barrier Reef Marine Park Authority (GBRMPA).

3.2. Survey administration

A survey instrument was designed by the study team in consultation with the GBRMPA. The survey was designed to gain a better understanding of the Australian community's attitudes and behaviours regarding climate change and the GBR. Questions about general climate change knowledge, attitudes and behaviour were adapted from previous climate change surveys (Colmar 2003, The Climate Institute 2008); questions specific to the GBR were designed specifically for this study. The survey was pre-tested (and modified accordingly) with a sample of 100 individuals prior to being administered.

The target population for the survey was individuals aged 18 years and over residing within 50 km of the Great Barrier Reef Marine Park coastline, and individuals residing within the Sydney, Melbourne and Brisbane Statistical Metropolitan Areas. For sampling purposes, the study area was stratified into eight regions. A target sample size of 200 individuals from each of the eight regions was set. Individuals in the study area were surveyed by telephone in November 2008. A random sample of telephone numbers within each region was drawn from the electronic white pages and from the database of active household telephone numbers maintained by Roy Morgan Research (Brisbane, Australia). Up to six attempts were made to contact each sampled phone number before replacing it with an alternative number. Surveying was terminated in each region when the regional quota of 200 completed surveys was reached.

Upon contacting a sampled household, surveyors asked to speak to the youngest adult male household member. If the youngest male was not available, the youngest female was requested. This sampling procedure was used to correct for age and gender bias typically associated with random telephone surveys. In total, 10,057 households were contacted resulting in 1,623 completed surveys (Sydney, $n = 200$; Melbourne, $n = 200$, Brisbane, $n = 200$; Cape York, $n = 200$; Far Northern Queensland, $n = 206$; Northern Queensland, $n = 202$; Central Queensland, $n = 202$; Southern Queensland, $n = 213$). Approximately 90% of those contacted individuals who declined to participate did so prior to being informed of the content of the survey, suggesting that non-response was not related to the survey focus. Australian Bureau of Statistics population estimates by age and gender were used to assess the data for age and gender bias. Results suggest that the study data slightly over represent males (by approximately 5%) and slightly under represent individuals under 35 years of age (by approximately 8%).

3.3. Analyses

To measure the three TPB dimensions, beliefs about the impacts of climate change on the GBR were assessed by asking respondents to rate the impact (on a five-point scale ranging from 'strongly decrease' to 'strongly increase') of climate change on the health and use of the GBR. Subjective norms were measured by asking respondents to rate their level of agreement (on a five-point scale ranging from 'strongly disagree' to 'strongly agree') with a series of statements about their obligations to help protect the GBR from climate change impacts. Perceived behavioural control was measured

by asking respondents to rate their level of agreement with a series of statements about the perceived influence they believed they had in reducing the impact of climate change on the GBR.

Confirmatory factor analysis (CFA) was used to test the structure of the three-factor solution underlying the TPB dimensions (Anderson and Gerbing 1988). This statistical strategy was adopted because it deductively tested the hypothesised relationships regarding the adapted TPB model. In total, seven items were dropped from the analysis due to low factor loadings (lambda < 0.5) or cross loading. Mean value scores from the three dimensions were entered into a cluster analysis (K-means) in SPSS version 18. This procedure assigned respondents to homogeneous groups based on patterns of responses across the three dimensions. The most appropriate cluster solution was selected according to the distinction among clusters, proportionality and the analysts' informed judgement (Aldenderfer and Blashfield 1984).

The segments that emerged from the cluster analysis were then examined across four validation variables that provided insight into perceptions held by respondents assigned to each subgroup: (1) potential threats, (2) behavioural intentions, (3) actual behaviour, and (4) constraints. This stage of the analysis helped to distinguish among the emergent segments (Kotler *et al.* 2002, Jun *et al.* 2009). First, potential threats to the health of the GBRMP were measured on a scale ranging from 1 (no threat at all) to 4 (major threat) using 10 items that captured social (e.g. recreation, tourism, indigenous uses), commercial (e.g. fishing, shipping, coastal development), and environmental (e.g. climate change, water quality) threats. Second, behavioural intentions were assessed by asking respondents what actions they would undertake in the next 12 months to reduce the impact of climate change on the GBR. Third, actual behaviours were examined by asking respondents if they had taken action to reduce the impact of climate change over the past 12 months. From the two lists of 14 equivalent items, summative scores were computed to indicate the total number of intended and reported pro-environmental behaviours undertaken by survey respondents. Finally, constraints to engaging in pro-environmental behaviours assessed why respondents did not do as much as they would like to help reduce the impact of climate change on the GBR. Respondents reported their levels of agreement with seven statements measuring internal (i.e. subjective factors) and external (i.e. objective factors) constraints that prevented engagement in pro-environmental behaviours on a scale that ranged from 1 (strongly agree) to 5 (strongly disagree) (Tanner 1999, Sutton and Tobin 2011).

3.4. Socio-demographics

Just over half (54%) of survey respondents were male. The average age was between 40 and 44 years. Approximately one-third (32%) had achieved less than a high school diploma (i.e. graduated from primary school or secondary school) and 21% had attained a high school diploma. Few respondents (6%) had attended some form of trade school, 18% had earned some post-secondary education and 23% were college graduates. A total of 40% of respondents earned an annual income greater than AUD$100,000, 30% earned between $50,000 and $100,000, 10% earned between $30,000 and $49,999, and 10% earned less than $30,000. Only 4% reported being of Aboriginal or Torres Strait Islander descent, 80% were born in Australia

and 95% spoke English as a first language. The average household size was just over three people.

4. Study findings

4.1. Environmental attitudes and behaviour

Using TPB as a guiding framework, the first study objective was to assess respondents' attitudes and pro-environmental behaviour related to climate change impacts on the GBR. The three-dimensional structure (i.e. general attitudes, subjective norms, perceived behavioural control) of TPB was verified using a CFA model (Table 1). The χ^2 value was statistically significant likely owing to the sample size ($\chi^2 = 197.093$, df = 51). Several other indicators illustrated a good fit between the implied and fitted covariance matrices, including the root mean square error (RMSEA = 0.042) (Steiger and Lind 1980), comparative fit index (CFI = 0.986) (Bentler 1990) and non-normed fit index (NNFI = 0.982) (Tucker and Lewis 1973). All factor loadings were greater than 0.50 (Hair *et al.* 1998), ranging from 0.56 to 0.76. Study findings illustrated agreement with statements measuring the three TPB dimensions. In other words, respondents thought climate change would decrease the health of the GBR ecosystem, felt personal and social responsibility toward taking action, and believed they were capable of making changes to reduce climate change impacts.

Table 1. Australian residents' attitudes, subjective norms and perceived behavioural control (n = 1,623).

	Factor loadings	Mean	SD
Attitudes[a,c]		3.86	0.75
The overall health of the Great Barrier Reef	0.70	3.90	1.00
The natural beauty of the Great Barrier Reef	0.76	3.93	0.95
The ability of the Great Barrier Reef to support populations of fish and wildlife	0.71	3.82	1.03
The enjoyment people get from visiting the Great Barrier Reef	0.70	3.72	1.05
The ability of the Great Barrier Reef to support sustainable fisheries	0.63	3.92	1.02
The ability of the Great Barrier Reef to support sustainable tourism	0.67	3.73	1.04
The amount of coral on the Great Barrier Reef	0.68	3.99	0.95
Subjective norms[b,c]		2.47	0.96
I feel personally obligated to help reduce the impact of climate change on the Great Barrier Reef	0.75	2.59	1.15
I would feel guilty if climate change had a negative impact on the Great Barrier Reef	0.57	2.64	1.27
People like me should do everything they can to reduce the impact of climate change on the health of the Great Barrier Reef	0.67	2.19	1.09
Perceived behavioural control[b,c]		2.25	1.02
If everyone took action, we could reduce the impact of climate change on the Great Barrier Reef	0.56	1.95	1.15
I have the ability to help reduce the impact of climate change on the Great Barrier Reef	0.69	2.54	1.20

Notes: [a]Mean score value is on a scale ranging from 1 (strongly increase) to 5 (strongly decrease).
[b]Mean score value is on a scale ranging from 1 (strongly agree) to 5 (strongly disagree).
[c]Fit indices: $\chi^2 = 197.093$; df = 51; RMSEA = 0.042; NNFI = 0.982; CFI = 0.986.

4.2. Respondent segmentation

The second study objective entailed segmenting respondents into homogenous groups using a K-means cluster analysis. Collectively, the TPB dimensions estimated in the first study objective were used as a basis to perform the cluster analysis, such that the emergent segments would hold distinguishable degrees of general attitudes, subjective norms and perceived behavioural control related to climate change impacts on the GBR. Five distinct segments were identified within the survey population (Table 2). No significant differences existed among segments based on number of days per year visiting the GBR, household size, income, or ethnicity (i.e. Aboriginal or Torres Strait Islander). However, several distinguishing items were identified, including education ($X^2 = 55.74$, df = 16, $p \leq 0.05$), gender ($X^2 = 35.56$, df = 4, $p \leq 0.05$), birthplace in Australia ($X^2 = 20.65$, df = 4, $p \leq 0.05$), English as a first language ($X^2 = 15.84$, df = 4, $p \leq 0.05$), and average age ($F = 24.07$, $p \leq 0.05$).

Table 2. Average attitudinal scores for five segments of Australian residents that live near the Great Barrier Reef.

	Cluster 1 (n = 160)	Cluster 2 (n = 199)	Cluster 3 (n = 423)	Cluster 4 (n = 210)	Cluster 5 (n = 631)	F stat
Attitudes[1] (mean, SD)	3.18 (0.51)^{ac}	4.21 (0.63)^{ab}	4.04 (0.47)^{abc}	2.63 (0.54)^{abc}	4.21 (0.46)^{ac}	503.24*
Subjective norms[2] (*M*, SD)	3.99 (0.70)^{a}	3.39 (0.73)^{a}	2.80 (0.51)^{a}	2.20 (0.64)^{a}	1.67 (0.44)^{a}	809.35*
Perceived behavioural control[2] (*M*, SD)	4.14 (0.62)^{a}	3.50 (0.62)^{a}	2.17 (0.47)^{a}	1.95 (0.47)^{a}	1.51 (0.45)^{a}	1169.53*

Notes: [1]Mean score value is on a scale ranging from 1 (strongly increase) to 5 (strongly decrease).
[2]Mean score value is on a scale ranging from 1 (strongly agree) to 5 (strongly disagree).
Like superscripts indicate significant differences at $p \leq 0.05$.
*Significant at $p \leq 0$ .001.

Cluster One (n = 160) reported a relatively high average score on the general attitude items (M = 3.18 out of 5), indicating that individuals in this cluster were concerned with climate change impacts on the health of the GBR. However, *Cluster One* had the highest reported values for subjective norms (M = 3.99) and perceived behavioural control (M = 4.14), suggesting that respondents in this segment did not feel normative pressures nor believe their actions would influence climate outcomes. Three items differed significantly between *Cluster One* and the other groups in terms of socio-demographics. *Cluster One* included older respondents, in that the majority (75%) were 45 years of age or above, and there were relatively more males (i.e. 73% were male) and natives (i.e. 86% were born in Australia).

Cluster Two (n = 199) had the highest general attitude score (M = 4.21), reported high levels of subjective norms (M = 3.39), and high perceived behavioural control (M = 3.5). Similar to *Cluster One*, this segment had strong and positive attitudes, yet did not feel socially obligated to reduce impacts nor believe they were in control of behavioural outcomes. Two socio-demographic characteristics helped to distinguish this segment from the others, in that this segment included one of two groups containing the significantly lowest percentage (75%) of Australian born residents, and one of the highest average age brackets.

Cluster Three (n = 423) ranked third in response to items measuring the TPB dimensions, including general attitudes (M = 4.04), subjective norms (M = 2.8) and perceived behavioural control (M = 2.17). Individuals in this segment felt positively about the environment, had a relatively strong sense of social obligation and felt in control of their behaviour. Many of the socio-demographics that helped to identify *Cluster Three* were consistent with the larger sample; however, the items that varied significantly included a younger than average age (i.e. 52% were 45 years or older while nearly 30% were between the ages of 18 and 34) and birthplace (i.e. this segment contained more Australian born residents).

Cluster Four (n = 210) reported the lowest attitude scores (M = 2.63), low levels of subjective norms (M = 2.20), and low perceived behavioural control (M = 1.95). Compared to the other groups, individuals in *Cluster Four* did not believe climate change negatively influenced the GBR, felt socially obligated to reduce climate change impacts and believed they were in control of behavioural outcomes. With respect to socio-demographics, this segment differed significantly in terms of low levels of education (i.e. 72% received a high school diploma or less and 28% had some college education), a large proportion (10%) of non-native English speakers, and were of a younger average age (i.e. 54% over 45 years of age and 29% were between 18 and 34).

Finally, *Cluster Five* (n = 631) reported the other highest attitude score (M = 4.21) (along with *Cluster Two*), and reported the strongest level of agreement with items measuring subjective norms (M = 1.67) and perceived behavioural control (M = 1.51). Respondents in this segment strongly believed climate change was decreasing the health of the GBR ecosystem, were influenced by normative pressures, and felt in control of behaviour that would reduce negative climate change impacts. Members of this cluster were significantly younger than the aggregated sample, in that 50% were 45 years of age or above and 29% were younger than 34, and contained slightly more females than males (i.e. 52%).

4.3. Validation of segments

The third study objective compared across segments using four sets of validation variables. First, the aggregated sample perceived most threats to the health of the GBRMP to be problematic, with the exception of recreation, tourism and indigenous use-related impacts. The second and third sets of validation variables measured intended and reported behaviours, respectively. The majority (76%) of respondents in the aggregated sample performed at least one action in the previous 12 months and most (60%) reported that they were either moderately or very likely to undertake some action in the subsequent 12 months to reduce the impact of climate change. The most common behavioural intentions included use of energy efficient products (M = 0.42), turning off lights or appliances when not in use (M = 0.38) and recycling (M = 0.33). The most frequently adopted actual behaviours that had occurred in the previous 12 months fell into the categories of other (e.g. recycling, reducing water usage) (M = 0.15), reducing power, energy and/or electricity use (M = 0.12) and reducing car usage and/or driving less (M = 0.07). Finally, constraints were compared across the five segments to determine why members of each subgroup were not doing as much as they would like to reduce climate change. For the aggregated sample, approval from friends and family (M = 4.13), belief that actions would have any impact (M = 3.48), costs (M = 3.39), and understanding the climate change problem (M = 3.33) were the most important factors that intervened between desired and actual levels of engagement

with GBR climate change reduction and mitigation. Conversely, there was low relative concern with time (M = 2.94), other priorities (M = 2.83), and not knowing what else to do that would be helpful (M = 2.45).

This study validated the five segments by examining the similarities and differences among the perceptions of respondents assigned to each subgroup. According to the perceived levels of threats to the health of the GBRMP, study findings illustrated significant differences ($F = 73.93$, $p \leq 0.05$) (Table 3). *Cluster One* (M = 2.33) and *Cluster Two* (M = 2.78) perceived fewer threats than did *Cluster Three* (M = 2.93), *Cluster Four* (M = 2.92), and *Cluster Five* (M = 3.08). *Cluster Three, Cluster Four*, and *Cluster Five* were relatively most concerned with threats such as commercial fishing, shipping, recreational use, water quality, and coastal development.

Table 3. Average levels of perceived threats to the health of the Great Barrier Reef Marine Park (GBRMP) reported by five segments of Australian residents.

Survey item *M* (SD)	Total	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	F stat
Commercial fishing in the GBRMP	3.35 (0.81)	3.01 (1.00)^{a}	3.19 (0.86)^{b}	3.38 (0.79)^{ab}	3.23 (0.85)^{c}	3.50 (0.70)^{abc}	15.40*
Recreational fishing in the GBRMP	2.56 (0.86)	1.99 (0.89)^{a}	2.35 (0.81)^{ab}	2.57 (0.80)^{abc}	2.62 (0.87)^{ab}	2.75 (0.83)^{abc}	29.84*
Recreational activities such as snorkelling or diving on the reef	2.20 (0.82)	1.88 (0.91)^{a}	2.16 (0.80)^{a}	2.15 (0.79)^{ab}	2.23 (0.88)^{a}	2.31 (0.77)^{ab}	9.69*
Shipping on the GBRMP	3.26 (0.85)	2.58 (1.10)^{a}	3.20 (0.83)^{ab}	3.27 (0.79)^{ac}	3.37 (0.83)^{a}	3.42 (0.74)^{abc}	34.45*
Declining quality of the water from land run-off into the GBRMP	3.39 (0.81)	2.62 (0.98)^{a}	3.23 (0.90)^{ab}	3.44 (0.76)^{abc}	3.33 (0.81)^{ad}	3.63 (0.61)^{abcd}	58.89*
Coastal development along the GBRMP	3.29 (0.82)	2.62 (0.97)^{a}	3.23 (0.88)^{ab}	3.29 (0.79)^{ac}	3.16 (0.85)^{ad}	3.51 (0.66)^{abcd}	43.10*
Tourism in the GBRMP	2.66 (0.83)	2.22 (0.94)^{a}	2.60 (0.82)^{ab}	2.64 (0.82)^{ac}	2.68 (0.81)^{a}	2.81 (0.76)^{abc}	17.56*
Climate change or global warming	3.45 (0.84)	2.29 (1.06)^{a}	3.21 (0.90)^{ab}	3.53 (0.70)^{abc}	3.35 (0.88)^{ad}	3.76 (0.51)^{abcd}	129.87*
Indigenous hunting in the GBRMP	2.31 (0.94)	2.13 (1.07)^{a}	2.10 (0.92)^{b}	2.24 (0.88)^{c}	2.56 (0.94)^{abc}	2.37 (0.92)^{ab}	8.58*
Recreational boating in the GBRMP	2.59 (0.85)	2.10 (0.92)^{a}	2.43 (0.81)^{ab}	2.59 (0.83)^{a}	2.75 (0.89)^{ab}	2.71 (0.80)^{ab}	20.82*

Notes: Mean score value is on a scale ranging from 1 (no threat at all) to 4 (major threat).
Like superscripts indicate significant differences at $p \leq 0.05$.
*Significant at $p \leq 0$ .001.

The second and third sets of validation variables measured intended and reported behaviours, respectively (Table 4). Variation across segments was assessed using a One-Way ANOVA with a Tukey *post hoc* procedure. The segments reported performing more of the pro-environmental behaviours than suggested by their intentions.

Table 4. Summative scores for behavioural intentions and reported behaviours among five segments of Australian residents.

	Total	Cluster 1 (n = 160)	Cluster 2 (n = 199)	Cluster 3 (n = 423)	Cluster 4 (n = 210)	Cluster 5 (n = 631)	F stat
Behavioural intentions	0.62 (0.88)	0.52 (0.67)	0.60 (0.79)	0.47 (0.68)[a]	0.66 (1.08)	0.69 (0.91)[a]	2.67*
Reported behaviours	1.61 (1.13)	1.31 (1.03)[a]	1.38 (0.93)[b]	1.57 (1.11)[c]	1.46 (1.00)[d]	1.78 (1.22)[abcd]	6.49*

Notes: Like superscripts indicate significant differences at $p \leq 0.05$.
*Significant at $p \leq 0$ .05.

Table 5. Average perceived constraints that prevented five segments of residents from engaging in pro-environmental behaviours that would help reduce the impact of climate change on the Great Barrier Reef (n = 1,623).

Survey item *M* (SD)	Total	Cluster 1 (n = 160)	Cluster 2 (n = 199)	Cluster 3 (n = 423)	Cluster 4 (n = 210)	Cluster 5 (n = 631)	F stat
You don't have time	2.94 (1.10)	2.92 (1.28)	3.08 (1.09)	2.83 (1.07)	2.74[a] (1.04)	3.03[a] (1.12)	3.62*
You don't know what else you can do to help	2.45 (1.00)	2.50 (1.04)	2.27 (1.00)	2.43 (0.99)	2.34 (0.92)	2.52 (1.03)	1.99*
Doing more would cost too much money	3.39 (1.03)	3.40 (1.22)	3.13[a] (1.09)	3.36 (0.93)	3.22[b] (1.12)	3.50[ab] (1.02)	4.36*
You don't believe the things you could do would have any impact	3.48 (1.01)	2.73[a] (1.21)	2.95 [b] (1.13)	3.33[abc] (0.99)	3.23[ad] (1.04)	3.80[abcd] (0.86)	34.00*
Your friends and family would not approve	4.13 (0.68)	3.97 (0.81)	4.07 (0.75)	4.21[a] (0.58)	3.89[ab] (0.81)	4.19[b] (0.65)	7.93*
You don't really understand the climate change problem	3.33 (1.11)	3.12 (1.31)	3.06[a] (1.21)	3.29[b] (1.06)	3.01[c] (1.09)	3.51[abc] (1.08)	9.32*
You have more important priorities in your life	2.83 (2.83)	2.66 (2.66)	2.58[a] (1.07)	2.59[b] (1.00)	2.86 (1.10)	3.01[ab] (1.06)	9.57

Notes: Like superscripts indicate significant differences at $p \leq 0.05$.
*Significant at $p \leq 0$ .001.

Respondents faced barriers that prevented them from taking action to minimise human-caused impacts on the GBR (Table 5). A One-Way ANOVA and Tukey *post hoc* test assessed the mean differences across the five segments according to perceived constraints. The average scores for the summative total of all survey items differed among groups ($F = 23.66$, $p \leq 0.01$). Specifically, *Cluster One* ($M = 3.02$), *Cluster Two* (3.05) and *Cluster Four* ($M = 3.04$) felt least constrained, whereas *Cluster Three* ($M = 3.15$) and *Cluster Five* ($M = 3.38$) felt most constrained.

5. Discussion

Global climate change has profound implications for the characterisation of future conditions. This study offers several insights into environmental attitudes toward behaviour that could shape these changing conditions in the context of the GBR. Respondents are segmented into five homogenous groups and then profiled using measures of perceived threats to the health of the GBRMP, intended and reported behaviours and constraints to engaging with climate change in a way that would help minimise environmental impacts. This research sheds lights on how the Australian public perceives the climate change issue so that managers can more easily increase awareness, encourage the adoption of pro-environmental behaviour and target individuals within a heterogeneous survey population.

5.1. Environmental attitudes and behaviour

Environmental attitudes can be measured using the three dimensions of TPB, including general attitude toward an object (i.e. the GBR), subjective norms and perceived behavioural control (Ajzen 1985). These three dimensions provide insight into respondents' intentions to engage in behaviour that shapes climate change impacts on the GBR. Building on past research (e.g. Lorenzoni *et al*. 2007, Fielding *et al*. 2008, Whitmarsh *et al*. 2011), the present study elucidates the complexities underlying a gap that exists between environmental attitudes and engagement in pro-environmental behaviour (Burgess *et al*. 1998, Stern 2000a, Kollmuss and Agyman 2002). Study findings illustrate awareness and concern attributed to climate change impacts threatening the health of the GBR (Lorenzoni and Pidgeon 2006, Nilsson *et al*. 2010). The Australian residents selected for this research recognise the importance of taking action and feel morally obligated to mitigate and adapt to climate-related impacts. Although there may be a limited understanding of processes that underpin climate change (Whitmarsh *et al*. 2011), respondents believe they are capable of contributing to efforts that minimise changing environmental conditions.

5.2. Respondent segmentation

The five emergent segments vary considerably in their attitudes toward climate change impacts. One of the segments, *Cluster Five*, contains over half of the survey respondents. Given its size and potential for representing a significant portion of Australian residents, this segment reflects a critical part of the population. It should be noted that the majority view held by individuals in *Cluster Five* maintains favourable attitudes toward climate change and concern with environmental issues. However, other segments emerged in the analysis, pointing to heterogeneity in the sample and potentially the broader Australian public. Managers charged with implementing climate policies should identify how to direct resources in ways that are appealing to these various segments. For example, results from the respondent segmentation presented in this paper could be helpful when developing strategies for communicating with a diverse population of Australian residents.

Cluster One and *Cluster Two* could be targeted in similar ways. Respondents in both of these segments feel strongly about the environment; however, they are not as

influenced by social norms and perceive less control over behavioural outcomes than respondents from other subgroups. *Cluster One* and *Cluster Two* may benefit from educational efforts that encourage collective action to mitigate climate change impacts on the GBR. To maximise behaviour change, managers seeking to increase conservation-related behaviour may also consider emphasising the ease and accessibility of actions such as recycling and reducing energy consumption.

Cluster Three and *Cluster Five* could be targeted in similar ways, because these respondents maintain positive general attitudes and agreement with items measuring subjective norms and perceived behavioural control. These two segments represent a portion of the Australian public that would be particularly receptive to climate change-friendly management strategies, especially individuals assigned to *Cluster Five*. Members of these two segments may respond favourably to current and/or future policy changes that promote the protection of natural resources to minimise human-caused impacts on the GBR.

Cluster Four should be targeted in ways distinct from the other segments. *Cluster Four* does not feel as strongly about the environment, acts in accordance with social pressure and feels control over pro-environmental behaviours. These respondents are least concerned with the health of natural resources and least likely to engage in pro-environmental behaviour. Managers will likely face the greatest challenges to reach this segment because concern about climate change and its severity is lowest within this subgroup. Developing more positive associations with the GBR through increased involvement in environmental activities would encourage respondents to engage in pro-environmental behaviour, considering their high ratings of survey items measuring subjective norms and perceived behavioural control.

5.3. Validation of segments

The final objective of this study validated segments using four sets of variables that held relevance for management decision-making, including perceived threats, intended behaviours, reported behaviours, and constraints. Findings reveal heterogeneity in environmental attitudes toward climate change impacts on the GBR. As such, outreach efforts should be tailored toward smaller and more homogenous groups of Australian residents (Jun *et al*. 2009, Needham 2010).

First, similarities and differences exist among segments according to perceived threats facing the health of the GBR ecosystem, and specifically the GBRMP. *Cluster Three, Cluster Four*, and *Cluster Five* share agreement with survey items measuring both subjective norms and perceived behavioural control, suggesting that social obligation to reduce climate change impacts and relatively strong beliefs that individual actions make a difference, will boost responsiveness concerning the importance of perceived threats to the GBRMP. In other words, individuals willing to assume responsibility for mitigating climate change will perceive more severe impacts to the GBR. Alternatively, these three clusters are more sensitive to threats because respondents are of a younger age. It could be that younger respondents are more perceptive of degradation because of familiarity with on-site conditions through participation in particular activities such as nature-based recreation and/or marine pursuits at the GBRMP (Moscardo *et al*. 2001). However, these findings contrast past research by O'Connor *et al*. (1999), suggesting that older males are more likely than younger females to support political efforts that address climate change.

The second and third sets of validation variables – intended and reported behaviours – indicate that survey respondents intend to engage in pro-environmental behaviours such as reducing energy use, recycling and using public transportation. The comparison between intended and reported behaviours illustrates that behavioural engagement is underestimated, in that all groups report doing more than is indicated by behavioural intentions. In other words, respondents report more climate change-friendly actions taken during the previous year than intended. Assuming intended behaviour indicates actual behaviour, it may be that habits and/or social norms are making such behaviours automatic and respondents consequently do not realise their level of engagement. This finding is contrary to past research that suggests people perform fewer pro-environmental behaviours than expected (Loomis and Richardson 2006). These results may be linked to the measurement approach taken to assess intended and reported behaviours, in that the two lists of survey items could have elicited different responses; intended behaviours assessed actions that would reduce the impact of climate change on the GBR whereas actual behaviours were in reference to more general climate change actions.

Finally, the five emergent segments face barriers that prevent engagement in pro-environmental behaviours. These barriers reflect the underlying knowledge, beliefs and value-systems that limit personal and social action to prevent climate change impacts on the GBR (Sutton and Tobin 2011). In this study, respondents do not do as much as they would like with respect to minimising climate change impacts because friends and family do not approve, respondents doubt the impact of individual effort, are concerned with financial costs, and do not understand the problem. *Cluster Five* faces the greatest level of constraints relative to the other segments; however, respondents in this group would be receptive to management efforts to help overcome barriers based on their generally positive attitudes toward the environment, responsiveness to normative pressures and belief that actions could avert the consequences of human-induced impacts.

Study findings provide insight into how managers can further minimise the value-action gap through engagement efforts that help people negotiate constraints (Tanner 1999). The long-term consequences of climate change need to be apparent for people to overcome constraints; however, this can be a difficult feat in shifting political climates and given the slow-evolving nature of associated impacts (Stern 1992). For many people, climate change is not perceived as having direct and noticeable impacts to future conditions (Lorenzoni and Pidgeon 2006), which could be problematic for engaging the public. This is further complicated by the interpretation of climate science and the mediation of social norms, personal values and contextual factors that shape perceptions of environmental conditions (Lorenzoni *et al.* 2007). Current and forthcoming international-level responses to reduce climate change impacts (e.g. IPCC 2007, UNFCCC 2009) will need to rely on individual actions and perceived abilities to overcome constraints. Despite the complexities associated with climate research, future work should adopt inter-disciplinary approaches to understand social-psychological processes that influence public engagement in mitigation and adaptation strategies.

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