Full length article

Plastic action or distraction? Marine plastic campaigns influence public engagement with climate change in both general and engaged audiences

Yolanda L. Waters [a,b,*], Kerrie A. Wilson [a], Angela J. Dean [a,b]

[a] *Centre for the Environment, School of Biology and Environmental Science, Queensland University of Technology, Brisbane, QLD 4000, Australia*
[b] *School of Agriculture and Food Sciences, The University of Queensland, St Lucia, QLD 4072, Australia*

A B S T R A C T

Climate change poses a key threat to marine ecosystems globally. Yet, contemporary discussions on marine conservation and individual action tend to focus on small lifestyle changes such as reducing plastic use. Some question whether campaigns that target "low impact" behaviours such as those related to plastic distract from broader sustainability goals such as mitigating climate change. However, others suggest that promoting simple behaviours may cause "behavioural spillover", where simple behaviours influence the adoption of additional and potentially more impactful behaviours. Across two experimental surveys (N_1 =581, N_2 =572), in the context of the Great Barrier Reef, we test whether messages targeting plastic behaviours can influence the adoption of a range of climate-related behaviours, from reducing personal emissions to urging local representatives to take action on climate change. We find that messages which focus on plastic pollution can potentially lead to an increase in climate behaviours, particularly when past behaviours are made salient. However, we find no positive effects for already engaged audiences. Our findings suggest caution when developing plastic messaging strategies for reef conservation when behavioural spillover is the central goal.

1. Introduction

The ocean is on the verge of several major tipping points and adopting widespread action to avoid them is critical [28]. This includes engaging individuals and communities in behaviours that contribute to the protection of vulnerable marine ecosystems. But, how to build effective public engagement with marine conservation issues and motivate action, particularly given the multiple threats facing marine environments, is a significant policy challenge.

Many environmental behaviour change campaigns are based on the premise that simple actions can serve as a gateway to higher impact behaviours (behaviours with a larger systemic impact to build public acceptance, support and demand for government policies and interventions) [53]. Indeed, they often focus on promoting the adoption of simple, lifestyle behaviours (e.g., recycling, 'saying no to straws'). However, while lifestyle behaviours can be impactful when performed at scale [13,16], critics fear that focussing on such behaviours may distract individuals from adopting additional higher-impact behaviours, and undermine support for larger systemic changes [26,45,65]. For example, in a study exploring household energy behaviours in Japan,

Werfel [65] found that people who perceived household behaviours to be of high importance were less likely to support a tax on carbon, due to the perception that sufficient progress was being made. There are a range of examples where there may be competition between encouraging different types of actions around marine conservation. Though climate change is now seen as a major environmental issue among the public [31], more visible environmental issues such as plastic pollution and litter still dominate discourse for marine environments [30,36,37]. Subsequently, though climate change poses a major threat to oceans, most community engagement in marine conservation focuses on plastic reduction [51] with many overestimating the potential for reducing plastic pollution to solve environmental problems [11,30,57]. Stafford and Jones [51] argue that this may serve as a distraction from other marine issues (referred to as "plastic distraction").

It is presently unknown whether personal investment in plastic-reduction behaviours distracts from or supports the wider systemic changes needed to conserve marine ecosystems. This is an important knowledge gap because: (1) individuals taking "modest" actions to address plastic pollution may become complacent when it comes to addressing other environmental issues such as climate change, and (2)

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an increasing number of government policies to address plastic pollution, such as plastic bag bans, may distract from the fact that other environmental issues are being neglected [51]. However, it is also possible that focusing on plastic may act as a gateway for broader conservation action [20,58]. In this study, we address this gap by exploring how information which promotes engagement in plastic reduction behaviours influences engagement in a broader range of marine conservation behaviours.

1.1. Theoretical framework – behavioural spillover

Behavioural spillover describes the process by which the adoption of one behaviour affects the probability of adopting a second, either related or unrelated, behaviour [39,54,59,8]. This may occur as: positive spillover, whereby the adoption of one behaviour *increases* the likelihood of adopting a second behaviour, or negative spillover, whereby the adoption of one behaviour *decreases* the likelihood of adopting a second behaviour [39,59]. Both experimental and real-world spillover effects of pro-environmental behaviour have been observed [39]. For example, in a meta-analysis of experimental spillover studies, Maki et al. [39] find that overall, the adoption of one behaviour can increase intentions to adopt another, particularly when behaviours are similar. Beyond experimental settings, Poortinga et al. [49] examined the impact of a single-use plastic bag charge in Wales and report that a decrease in plastic bag use also led to an increase in broader policy support (also see [55] for similar results in England). Similarly, Nash et al. [44] present a series of personal accounts where the adoption of one behaviour led to another within the domains of waste, conservation and consumption-related behaviours across Brazil, China, and Denmark. Negative spillover effects have also been described, for example Tiefenbeck et al. describe how reductions in water use in response to a water-saving campaign led to increases in electricity use (e.g., [56]). However, reporting of spillover in real-world settings has been limited [8].

Though the spillover pathway is commonly described as a causal pathway where an intervention triggers behaviour 1, which then leads to the adoption of behaviour 2 [21,8], this is challenging to recreate in experimental settings. Rather than induce behaviour 1, experimental spillover studies often use a method called 'behavioural priming'. These studies design spillover interventions which draw attention to past and existing behaviours, and then assess the effect of this on secondary behaviours. For example, research exploring general household behaviour has shown that compared to control, information reminding people of their past or existing engagement in actions such as recycling can lead to the adoption of additional behaviours [35,61].

Another key element of spillover research involves exploring the potential mechanisms by which engaging in one behaviour can influence adoption of another behaviour. It is argued that engaging in a behaviour has the potential to strengthen self-perceptions about capacity to act (self-efficacy) which then can strengthen perceived capacity and intentions to engage in other behaviours [5]. Similarly, engaging in environmental behaviours can strengthen the sense that one is an environmental person (environmental self-identity), which then increases motivation to engage in a second behaviour to avoid cognitive dissonance [19,52]. For example, in experimental studies, messages that make existing behaviours salient may be paired with information that seeks to strengthen these self-perceptions. Messages such as "You're an environmental person, therefore if you do X, you should probably also do Y" [35,67] target one's environmental *self-identity*. Similarly, *self-efficacy* may be targeted using messages such as "It's easy, you can do it. You can make a difference" [35]. However, if one perceives themselves as already having done enough or done their fair share, they may be *less* likely to take additional action, known as *contribution ethic* ([54,53], though [35] find that it may enable spillover in some contexts).

1.2. Applying spillover theory to conservation messaging

Of increasing interest to environmental behaviour researchers is whether interventions or campaigns that promote one set of behaviours (e.g., plastic reduction behaviours) can be designed to also influence other types of behaviour (e.g., climate-mitigation behaviours), thus "widening" the potential for behavioural change (i.e., increasing net impact) [15]. For example, in an experimental study Lanzini and Thøgersen [34] found that given additional elements (e.g., verbal encouragement such as "we can all make a difference"), interventions targeting "green" purchasing behaviours could also influence the adoption of other everyday pro-environmental behaviours such as recycling and saving water. Van der Werf et al. (2014) also found that hypothetical messages about difficult behaviours (e.g., purchasing an electric vehicle) that made past behaviours salient and targeted self-identity (e.g., Imagine you have bought an electric car…) lead to stronger preferences for sustainable products. Other studies have found similar effects, suggesting the potential for message elements such as behavioural priming to enhance the potential for positive spillover (e.g., [17,35]).

Another question that is important for spillover research and conservation messaging is whether the effects vary with different audience characteristics. In general, much research indicates that effectiveness of conservation messaging can vary across different audiences [10,41]. This may also be the case for spillover-informed research. For example, in an experimental study Truelove et al. [60] manipulated university students into either recycling or throwing away a plastic water bottle (or control), after which they were presented with a proposal for an on-campus green fund and asked if they would support it. The study found that for participants on the progressive end of the political spectrum (likely more engaged in environmental issues), recycling behaviour led to a decrease in support for the green fund whereas the same was not found for conservative participants [60]. Other studies also find that priming self-identity has little to no effect on individuals who are already engaged or used to performing general pro-environmental behaviours [17,18]. This raises the question about whether the effectiveness of conservation messages designed to create spillover differs between highly engaged audiences and the general public. Overall, behavioural spillover remains under-researched and more research is needed to uncover its potential for widespread environmental behaviour change [40].

1.3. Plastic messaging, climate change, and the Great Barrier Reef

The Great Barrier Reef (GBR) is the world's largest coral reef system comprising of nearly 3000 individual coral reefs, 900 islands and more than 1500 species of fish and other unique species. However, with the increasing frequency of mass bleaching events driven by marine heatwaves, the health and future of the GBR is now at risk [9]. The recent State of the Environment Report 2021/2 finds the reef to be in "*in poor condition and deteriorating due to climate change and cumulative pressures*" [9]. Indeed, without immediate action on climate change (i.e., significantly reduced greenhouse gas emissions), as much as 99% coral cover on the GBR could be lost by mid-century [4].

More than 76% of Australians recognise climate change as one of the greatest threats to the GBR and agree with statements that Australians should be responsible for protecting it [23]. Yet, when it comes to taking action for the reef, rather than adopt measures to reduce greenhouse gas emissions, there is a tendency for the public to consider plastic-reduction behaviours [11]. Likewise, contemporary discussions on reef conservation and individual action regularly focus on small, socially acceptable behaviours such as reducing plastic use [47]. Despite the need to address multiple environmental threats simultaneously [25,3,43], reducing plastic pollution and mitigating climate change often compete for public attention in the reef conservation space [20]. However, it is not clear whether messages focusing on certain threats augment or undermine the

effectiveness of others.

There is very little data available that examines whether focusing on plastic is in fact a distraction or an opportunity for promoting more action. Here, using the Great Barrier Reef as a case study, we test whether a spillover informed communication strategy can help widen the impact of plastic campaign messages to encourage the adoption of climate-mitigation behaviours. We also explore the mediating role of identity, self-efficacy, and contribution ethic, and whether spillover effects differ between general and engaged audiences.

2. Methods – Study 1 (national representative sample)

2.1. Participants and procedure

Participants over the age of 18 years and currently residing in Australia were invited to participate online via a social research company (PureProfile, ISO 20252:2019 Market, Opinion and Social Research). The required sample size to detect a small effect size was calculated a priori as n = 140 per group (total of 560 across 4 groups). Quotas were set to collect a representative sample of Australians based on age, gender, and state of residence. An online 10-minute survey was administered during May/June 2022 (Institutional ethics clearance #5057). Participants were offered standard incentives as per the social research company protocols.

2.2. Experimental conditions

Participants were randomly allocated to receive either one of three experimental conditions or a control condition (Table 1). A control condition was included to address common methodological limitations in spillover studies [21,39,8]. Each message ranged from 160 to 200 words and was presented in a simple infographic format (see Supplementary Materials for full message conditions). Quality checks (e.g., attention checks, trap questions) were also included throughout the survey to ensure high quality data [63]. Randomisation checks revealed that age, gender, state of residence, voting preference, visits to the GBR and previous experience in marine biology and/or conservation were similar across groups (Table S1b).

2.3. Outcome variables

Climate behaviour intentions were measured by asking respondents "In the next 3 months, how likely are you to perform the following behaviours?" (1 – not at all likely, 6 – extremely likely). A list of eight climate behaviours covering a range of behavioural categories (e.g., personal, social, and civic behaviours) were presented (Table 2). Factor analysis using principal components analysis (varimax rotation, Bartlett's test of sphericity, $\chi^2 = 3013.36$, p < 0.001) revealed a single factor (Cronbach's $\alpha = 0.92$; mean = 3.36).

*Actual behaviour (*in situ*)* was measured by offering participants the option to calculate their personal carbon footprint and to sign an online petition. Participants were invited to open a link on each of these options. Actual behaviour was binary coded for analysis (0 = none, 1 = clicked at least one).

2.4. Mediating variables

All mediator items were measured using a 1–6 scale where 1 = strongly disagree, and 6 = strongly agree (Table S4).

Reef identity was measured using a scale developed by the authors in Waters et al. [64] (Cronbach's $\alpha = 0.84$; mean = 3.55). Rather than measure one's environmental identity, as is common in spillover research, in this study we aimed to measure the extent to which individuals incorporated the Great Barrier Reef (and what it represents) into their sense of self (referred to herein as reef identify).

Self-efficacy was measured by asking participants to respond to three

Table 1
Description and number of participants in each experimental condition (Study 1).

Experimental condition	Shorthand	Message content	No.# participants
1 Plastic (behaviour primer + information)	*primer*	Participants were asked "Which of the following behaviours have you done AT LEAST SOME OF THE TIME in the past week…" Behaviours listed included 11 common plastic-related behaviours such as "recycle plastic waste". Participants were able to select as many as possible before being shown a second screen which read "Great! You already find it easy to reduce your impact." Participants were then shown a message about plastic pollution and the GBR (same as condition 2 – see below).	136
2 Plastic (information only)	*plastic*	Information about plastic pollution and the Great Barrier Reef, including a call to action and a slogan "Save the reef. Say no to plastic".	148
3 Climate change (information only)	*climate*	Information about climate change and the Great Barrier Reef (adapted from [64]), including a call to action and a slogan "Together we can protect the reef".	159
4 Control (neutral message)	*control*	General information about World Heritage sites. No call to action or mention of the Great Barrier Reef.	138
Total			**581**

Table 2
Climate behaviours used to measure intentions.

Climate behaviour intentions	Mean
In the next 3 months, how likely are you to perform the following behaviours? (1 – not at all likely, 6 – extremely likely)	
Seek out more information about climate change and how to take action	3.73
Donate money to an organisation working to tackle climate change	3.13
Consider switching to renewable energy sources	4.21
Talk positively to family and friends about the importance of tackling climate change	3.99
Make an effort to reduce personal greenhouse gas emissions	3.35
Share information that encourages others to reduce their greenhouse gas emissions	3.60
Send a letter or email to a local elected representative to urge them to take action on climate change	2.49
Make a commitment to research my political representatives and their latest position on climate change	3.22

statements: "I feel capable of helping to reduce emissions", "I have the necessary knowledge and skills to help reduce emissions" and "I am confident I can help reduce emissions" (adapted from [14]) (Cronbach's $\alpha = 0.90$; mean = 3.83).

Contribution ethic was rated by asking participants to respond to three statements "I have done my fair share to help protect the Great Barrier Reef", "I have done more than most to help protect the Great Barrier Reef", and "I have done very little to help protect the Great Barrier Reef" (reverse coded) (adapted from a single question item in [35]).

(Cronbach's α = 0.84; mean = 3.24).

2.5. Participant characteristics

Basic demographic covariates of age and gender were recorded (0 =male, 1 =not male). To measure pre-existing levels of environmental behaviour (past behaviour covariate), we asked three questions relating to general environmental behaviours including one related to household waste, one related to water conservation and one related to energy use (e.g., How often would you say you make an effort to reduce your waste? 1 – *Never*, 6 – *Always*). Participants were also asked if they had previous experience in marine biology and/or marine conservation including any training or courses (0 =no, 1 =yes).

The following characteristics were also assessed as potential moderators of message effects:

Political orientation was assessed using a 5-item scale adapted from Dean et al. [10]. Participants were asked the extent to which they agree with statements such as 'Business corporations make too much profit' and 'Stricter environmental laws and regulations cost too many jobs and hurt the economy' (reverse scored). Participants rated each item on a 5-point scale (1 =strongly disagree; 5 =strongly agree). Low scores are associated with more politically conservative values and high scores are associated with more politically progressive values. (Cronbach's α = 0.65).

Climate belief was assessed with a single question - 'Which of the following statements best represents your understanding of the causes of climate change: (1) Climate change is happening and is caused by humans, (2) Climate change is happening but it is due to a natural fluctuation in the Earth's atmosphere, (3) Climate change is not happening, (4) I don't know whether climate change is happening or not." (binary coded as 0 = does NOT believe in human caused climate change, 1 = does believe).

2.6. Statistical analysis

A series of multivariate regression-based analyses was conducted using IBM SPSS Statistics (version 28). Linear regression was used for behavioural intentions (continuous outcome) and logistic regression was used for actual in situ behaviour (binary outcome). Continuous variables were standardised for analysis. Four models were conducted for each outcome variable:

- Model 1 - Messages only (dummy coded)
- Model 2 - Messages and covariates (age, gender, past behaviour)
- Model 3 - Messages, covariates, moderators (political orientation, climate belief)
- Model 4 - Messages, covariates, moderators, and interactions between messages and moderators

To identify the optimal model, least significant predictors were iteratively removed using the using the Akaike Information Criterion and the Log-likelihood ratio. Regression assumptions for multicollinearity, autocorrelation and normality were met.

Mediation analysis was conducted using the PROCESS 4.1 Macro by Andrew F. Hayes for SPSS Statistics (available at http://processmacro.org/index.html) [27]. Mediation models included three predicted mediators (reef-identity, self-efficacy, contribution ethic), and age, gender, and past behaviour as covariates. Bootstrapping procedures with 10,000 samples were used.

3. Results – Study 1 (national representative sample)

3.1. Descriptive statistics

In total, 581 participants provided complete responses to the survey. Compared to the Australian population, the final sample had slightly higher rates of males (53.2%) and lower rates of university education (39.4%) (Table S1a). Voting preferences generally reflect current Australian voting practices and 42.3% of participants mentioned they had previously visited the GBR. Only 7.6% reported previous experience in marine science or conservation work or training (Table S1a).

3.2. Effects of message conditions on climate behaviour intentions

On average, climate behaviour intentions were slightly above the mid-point (mean=3.36 ± 1.24). Both the *primer* and *plastic* condition showed significant and positive main effects on climate behaviour intentions compared to the control (respectively, B=0.31, p = 0.01; B =0.29, p = 0.01) (Fig. 1a). These effects remained when controlling for age, gender, and past behaviour (B = 0.30, p < 0.01; B =0.27, p = 0.01) (Table 3). The *climate* condition showed no significant effects, though it started to approach significance when moderators were included in the model. No interaction effects were detected for climate belief or political orientation on any of the messages.

When examining mediation pathways, the effects of the *primer* and *plastic* condition on climate intentions were mediated by increased self-efficacy (0.28, 95% CI: 0.17 – 0.39; 0.21, 95% CI: 0.12 – 0.31) and reef identity (0.13, 95% CI: 0.04 – 0.23; 0.11, 95% CI: 0.03 – 0.21) (Table S7). Specifically, the primer and plastic conditions elicited
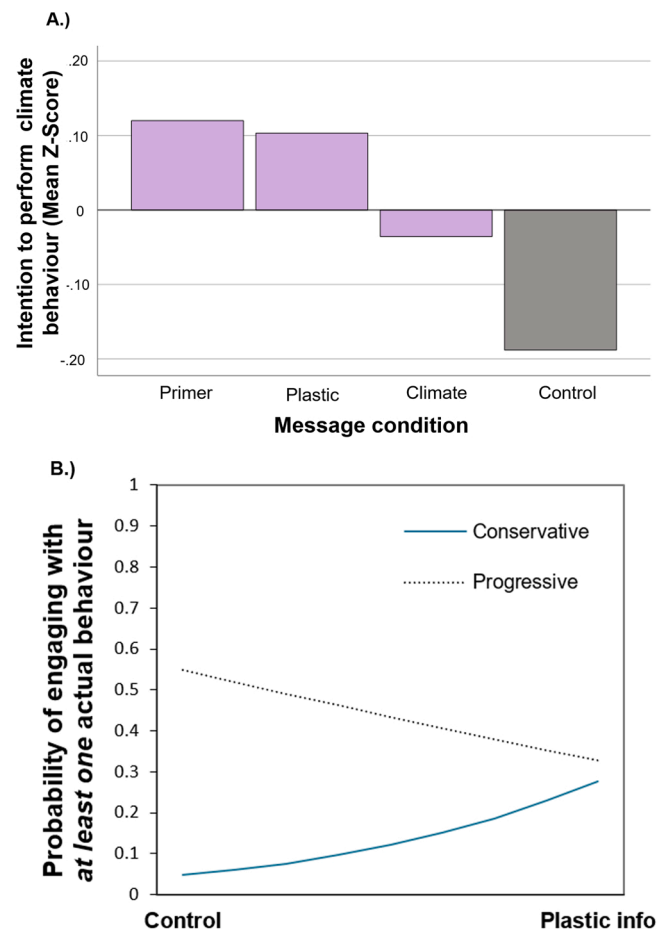

Fig. 1. Study 1 – (A) Bar graph showing descriptive results for intention to perform climate behaviours. On the Y-axis, to highlight the differences between groups, the mean scores for climate intentions were standardised as Z-scores where the mean = 0 and the standard deviation= 1, and the X-axis is divided by message condition. (B) Interaction plot shows the interaction effect between the plastic information message and political orientation. The message had a positive effect on those with more conservative political views, and a negative effect on those with progressive views.

Table 3

Mixed effects model for climate intentions (linear regression) and actual behaviour (logistic regression) – Study 1 – Australian population sample.

	Climate intentions		Actual behaviour	
	B (± SE)	95% CI	Odds Ratio (OR)	95% CI
Conditions				
Primer + plastic/GBR info	**0.30 (0.10)**	**0.09 – 0.51**	**1.96**	**1.16 – 3.31**
Plastic/GBR info	**0.27 (0.10)**	**0.07 – 0.47**	1.58	0.94 – 2.66
Climate/GBR info	0.12 (0.10)	-0.07 – 0.32	1.07	0.63 – 1.80
Covariates				
Age	**-0.18 (0.02)**	**-0.22 – (−0.13)**	**0.85**	**0.76 – 0.96**
Gender (binary)	-0.02 (0.07)	-0.15 – 0.13	0.82	0.57 – 1.19
Past behaviour	**0.47 (0.04)**	**0.40 – 0.54**	**1.92**	**1.56 – 2.37**

Note. **B** values are unstandardised coefficients where 1 unit change in the independent variable generates a change of B in the dependant variable. **OR** is the odds ratio generated by logistic regression. An odds ratio of > 1 represents a positive association between the independent and dependant variable; conversely, an odds ratio of < 1 indicates a negative association. **95% CI** = 95% Confidence Interval. *Significant values are represented in bold (p = <0.05).

stronger ratings of self-efficacy and reef identity, which in turn were associated with greater intentions to engage in climate behaviours.

3.3. Effects of message conditions on actual behaviour

Over a third of participants (34.9%) signed the petition or opted to calculate their carbon footprint. Compared to the control, only the *primer* condition showed positive main effects for actual behaviour (OR=1.82, 95% CI: 1.10 – 3.01, p = 0.02). When controlling for age, gender, and past behaviour, this effect remained (OR=1.96, 95% CI: 1.16 – 3.31) (Table 3). While the *plastic* condition approached significance with the presence of covariates (OR=1.58, 95% CI: 0.94 – 2.66), moderation analysis showed that the *plastic* condition was more effective for those who sit on the conservative end of the political spectrum, and less effective than control for individuals at the progressive end of the political spectrum (p = 0.04) (Fig. 1b, Table S4). When exploring pathways between *primer* message and actual behaviour, analysis showed that the effect of the primer condition was mediated by reef identity (0.20, 95% CI: 0.06 – 0.38), where the primer led to an increase in reef identity and subsequently an increased in situ behaviour. We also detected a negative mediation for contribution ethic (−0.30, CI: −0.57 – (−0.07)), where the primer led to an increase in contribution ethic which in turn, led to a *decrease* in in situ behaviour (Table S8).

4. Methods – Study 2 (engaged audience sample)

The purpose of Study 2 was to test whether our message conditions were likely to have the desired effect on an 'already engaged' audience. An online 10-minute survey was administered during March 2022 (Institutional ethics clearance #5057). Similar to Study 1, the sample size was calculated a priori as n = 140 per group (total of 560 for a study with 4 groups).

4.1. Participant recruitment

To target those already engaged with or interested in reef and/or marine conservation issues, the study and survey link were advertised through relevant social media pages, mailing lists, and promoted by influential individuals and organisations. This included marine conservation non-government organisations, marine science groups, ocean

advocacy and community groups, and recreational groups such as dive clubs. A media promotion package which highlighted the importance of protecting the GBR was created, and participants were offered the chance to go into a draw to win a range of "ocean positive" prizes (e.g., a rash guard made from recycled materials). Those over the age of 18 were invited to participate and prizes were only made available to those currently residing in Australia.

4.2. Experimental conditions

Experimental conditions were the same as for Study 1. Participants were randomly allocated to receive either one of three experimental conditions or a control condition (Table 4). Gender differed between the groups (χ^2 = 19.62, p = 0.02), however this was accounted for in subsequent analysis. Analysis of variance and non-parametric tests revealed that groups did not differ in terms of other key demographics (Table S1b).

4.3. Changes to survey item

The same survey items from Study 1 were used in Study 2, with adjustments. Political orientation was removed due to time limitations and to increase survey completion rates, which are often comparatively lower in social media surveys. In lieu of political orientation, we assessed voting patterns ("During the elections, who do you normally prefer to vote for?"). Voting preference was binary coded for analysis (voted for a major conservative party, 0 =no, 1 =yes). In addition, due to survey promotion via social media, we could not control people from overseas completing the survey, thus, a variable for residing in Australia was also created (0 =no, 1 =yes). Statistical analysis was conducted following the same method in Study 1. Reliability scores for scale variables can be found in Table S2.

5. Results – Study 2 (engaged audience sample)

5.1. Descriptive statistics

In total, 572 participants provided complete responses to the survey. The sample was mostly female (70%), young (52% aged between 18 and 34), living in Queensland (69%), and university educated (75%). Almost 90% of participants mentioned they have previously visited the GBR and 68% indicated they had some experience in marine biology and/or marine conservation. Participants were also more likely to vote for a pro-environmental party (The Greens) (42%) compared to the general population (Table S1a).

5.2. Effects of message conditions on climate behaviour intentions

On average, climate behaviour intentions were slightly higher than in Study 1 (mean=4.52 ± 0.92). For climate behaviour intentions, although the *primer* condition generated lower intentions (B = −0.11, approaching significance p = 0.065, Fig. 2), none of the conditions were significantly different to the control (Table 5). In addition, no significant interaction effects between conditions and moderators were observed (Table S5). When examining mediation, no significant effects were observed.

Table 4

Number of participants in each experimental condition (Study 2).

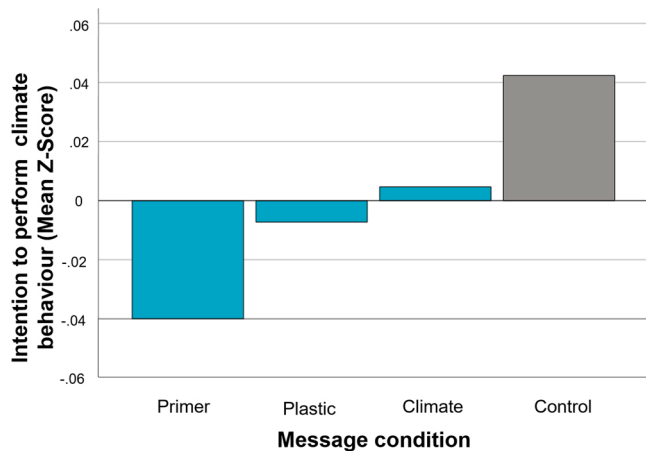| Experimental condition	Number of participants
1 Plastic (behaviour primer + information)	147
2 Plastic (information only)	139
3 Climate change (information only)	139
4 Control (neutral message)	147
Total	**572**

Fig. 2. Study 2 - Bar graphs showing descriptive results for intention to perform climate behaviours. On the Y-axis, to highlight the differences between groups, the mean scores for climate intentions were standardised as Z-scores where the mean = 0 and the standard deviation= 1, and the X-axis is divided by message condition.

Table 5
Mixed effects model for climate intentions (linear regression) and actual behaviour (logistic regression) – Study 2 – Engaged sample.

	Climate intentions		Actual behaviour	
	B (±SE)	CI	Odds Ratio (OR)	CI
Conditions				
Primer + plastic/GBR info	-0.06 (0.11)	-0.27 – 0.15	0.53	0.28 – 1.03
Plastic/GBR info	-0.01 (0.11)	-0.22 – 0.20	0.68	0.34 – 1.33
Climate/GBR info	-0.08 (0.11)	-0.29 – 0.13	0.95	0.46 – 1.96
Covariates				
Age	-0.00 (0.03)	-0.05 – 0.05	**0.77**	**0.66 – 0.90**
Gender (binary)	**0.22 (0.09)**	**0.05 – 0.39**	2.42	**1.48 – 3.98**
Past behaviour	**0.44 (0.04)**	**0.36 – 0.52**	1.35	**1.07 – 1.70**
Living in Australia (binary)	0.04 (0.20)	-0.35 – 0.44	0.46	0.15 – 1.36

Note. **B** values are unstandardised coefficients where 1 unit change in the independent variable generates a change of B in the dependant variable. **OR** is the odds ratio generated by logistic regression. An odds ratio of > 1 represents a positive association between the independent and dependant variable; conversely, an odds ratio of < 1 indicates a negative association. **95% CI** = 95% Confidence Interval. *****Significant values are represented in bold (p = <0.05)**

5.3. Effects of message conditions on actual behaviour

For actual behaviour, 84.3% of participants signed the petition or opted to calculate their carbon footprint. Though the *primer* condition showed a negative effect (approaching significance, p = 0.065, OR =0.53, 95% CI: 0.28 – 1.03), no significant main effects were detected when only the conditions were entered into the model. Overall findings remained the same when controlling for covariates (Table 5) and moderators (Table S6). No significant interaction or mediation effects were detected.

6. Discussion

Drawing on behavioural spillover theory, we investigated whether messages which emphasise existing engagement with low-impact plastic behaviours could motivate individuals to adopt behaviours related to a

wider range of marine conservation issues such as climate change. In Study 1, using a representative Australian sample, we find that plastic messaging can strengthen intentions to perform climate behaviours (both intentions and actual), particularly when past behaviours are made salient (behavioural priming). However, performing the same experiment with a different audience revealed different findings. In Study 2, we focused on individuals already engaged or interested in reef and marine issues and found that priming previous plastic behaviours had no positive effects, and non-significant trends suggest the potential for negative outcomes. This finding suggests that the potential for positive or negative spillover may vary with different audiences.

6.1. The influence of marine plastic messaging on climate behaviour

In this study, we show that plastic messages, and marine plastic campaigns more broadly, have the potential to motivate wider action on climate change. In a national sample, we found that those who received messages about plastic pollution and the GBR reported significantly higher levels of climate intentions and actual behaviour compared to the control; climate focused messages did not differ from control. Additionally, plastic messages were more effective when previous plastic reduction behaviours were made salient (behavioural priming). Plastic messaging was also particularly effective in strengthening in situ climate behaviours for political conservatives, suggesting that plastic messages may be useful in cutting through the political polarisation often associated with climate change [32,66].

However, we caution generalising these findings across audience subgroups. In engaged audiences (Study 2), we found that plastic messaging did not increase climate intentions, with non-significant trends suggesting the potential for eliciting *lower levels* of climate intentions. This potential negative spillover effect in engaged communities has been reported in previous studies (e.g., [17,18,60]). For example, Borg et al. [6] found that self-identified "plastic avoiders" and "plastic users" respond differently to media communications about plastic pollution. Namely, "plastic users" (non-engaged) showed increased behavioural intentions after viewing certain video footage, but "plastic avoiders" (engaged) did not [6]. The authors suggest this may be because the video footage influenced perceptions that plastic use, and subsequently plastic waste, is common (descriptive norms). Another explanation for the lack of positive effects in our engaged group relates to their existing engagement in plastic behaviours. It is likely that participants in our engaged sample are already frequently exposed to messages about plastic pollution and may perceive that the behaviours promoted were too easy and normative. Thøgersen and Crompton [53] and Truelove et al. [60] suggest that campaigns which target already normalised or habitual behaviours are likely to be insufficient to trigger positive spillover. Similarly, Andrews et al. [2] show that a focus on too many easy behaviours may undermine message effectiveness. Overall, these findings reiterate the importance of considering target audiences when designing conservation messages, particularly when behavioural spillover is the desired outcome.

6.2. From plastic to climate: what drives this spillover effect?

Our findings in Study 1 demonstrate that drawing attention to existing engagement in plastic-reduction behaviours and linking this with reef protection goals can strengthen reef identity and self-efficacy to motivate engagement with a broader range of behaviours. This contributes to a growing body of evidence which supports the idea that identity and efficacy beliefs, often primed through increasing the salience of past behaviours, are important drivers of spillover, particularly for more "difficult" or impactful behaviours. In the context of taking action for the reef, focusing on plastic behaviours (and plastic messages) may provide a sound basis for building identity and efficacy beliefs, compared to climate change, as plastic is a more tangible and visible threat, with strong perceived links to marine conservation [12,

51]. Interestingly, in Study 1, in addition to reef identity (positive effect), the *primer* condition also showed mediation by contribution ethic (negative effect). These opposing indirect effects are known as inconsistent mediation [27,38] and provide insight into the complex relationship between interventions and behaviour. Despite having opposite effects, both mediation pathways are consistent with our theoretical framework (i.e., reef identity positively associated with behaviour, contribution ethic negatively associated with behaviour). However, interpreting this result is complicated. Though Hayes (2022) describes several methods to help determine which effect is strongest or most "important", these methods are not suitable for binary outcomes, as used in this study. We note that while the total effect of the *primer* condition on actual behaviour is overall positive, the negative mediation indicates that that both reef identity and contribution ethic have the potential to enable or limit spillover in response to behavioural priming. As a result, when applying these approaches, we recommend emphasising elements that appeal to identity (e.g., in our case, the iconic nature of the reef) and avoiding statements which may make people perceive they have done more than others, which may reduce behavioural engagement [1].

6.3. Implications for marine conservation practice and policy

Drawing on our findings, we make several recommendations for practitioners who hope to broaden the impact of their communication campaigns that promote conservation behaviours. First and foremost, we echo previous research that emphasises the importance of tailoring and testing message effects for different audiences [33,7]. In this case, we urge caution when developing spillover-informed messaging strategies for engaged communities and suggest that for those already engaged or interested in marine issues, campaigns that target easy behaviours may be ineffective. In such circumstances, carefully constructed climate messages or messages which leverage descriptive social norms may generate more positive effects [24,62,64]. In contrast, when working with large populations, our findings highlight the potential of drawing attention to past behaviours and connecting these to broader marine conservation goals to strengthen intentions to engage in a wide range of additional behaviours. Communicators and practitioners can do this by reminding individuals of their existing engagement in easy past behaviours and linking this to marine conservation goals and relevant environmental identities (in our case, reef identity).

However, we recognise that targeting and tailoring messages for audience subgroups may not always be practical or feasible. Many conservation organisations (e.g., non-government organisations) are small and may have limited resources dedicated to campaigns and may not be able to run separate campaigns for different audiences. In addition, audience segmentation methods, often recommended to guide targeted and tailored messaging strategies, can be costly and difficult to interpret [29]. In these circumstances, more simple recommendations are required. For example, for organisations who distribute messages via large platforms or are able to reach wide audiences, it is possible that spillover-informed strategies that build on simple past behaviours will be more beneficial than investing in a targeted approach. It may also be valuable to take advantage of online marketing strategies (e.g., micro-targeting) or emerging social marketing literature for insight on efficient resource use and reaching potential audiences [42]. However, the best strategy to motivate engaged communities in additional behaviours remains an interesting challenge. Regardless, a deeper understanding of existing audiences is strongly encouraged.

Finally, we stress that the plastic messages constructed in this study were *specifically designed to encourage climate behaviours* based on spillover theory. In order to trigger behavioural spillover, plastic messages as part of actual environmental campaigns would also need to incorporate elements which target behaviour change. In addition to making past behaviours salient, these include highlighting marine spaces and leveraging related identities, and potentially broader concepts such as ocean connectedness [46], using collective and motivational language

(e.g., "together, we can do it"), and incorporating a public sphere call to action (e.g., "actively show support for renewable energy") [22,64]. We also recommend, if the intention is to use plastic messages to influence climate behaviour, that the link between plastic and climate change is made clear (e.g., "plastic production releases greenhouse gases into the atmosphere which fuels climate change") and that individuals are presented with a clear call to action [48,50], with specific climate behaviours, as many are unable to identify climate behaviours on their own [11,68].

6.4. Limitations and future directions

It is important to reiterate that this study did not strictly adhere to traditional spillover definitions, that behaviour 1 must lead to behaviour 2 [21]. Rather, we used the theory to guide our research inquiry about the effects of drawing on past behaviours to promote change. The outcomes we measured also focussed on behavioural intentions and in situ behaviour which, in an online study, are considered proxy measures of behaviour. Future research could observe the real-world effects of being exposed to marine plastic campaigns (i.e., not in an experimental setting) and actual behaviour. In addition, we also consider the possibility that the absence of positive effects in our engaged sample were due to ceiling effects. Though mean scores for behavioural intentions were not at the upper limit, the percentage of participants in the control condition who engaged with in situ behaviours was relatively high (87%). Future research should therefore consider selecting more difficult or uncommon behaviours when measuring intervention effects on engaged audiences.

Our findings suggest that more spillover research should be conducted in audience subgroups (rather than population or student samples) to better understand spillover effects, particularly negative effects, that may be associated with particular demographics/characteristics. With regard to spillover mechanisms, it may be interesting to explore the effect of social norms and other dimensions of social action, particularly for audience groups with strong collective identities. We also question whether conducting the same experiment with an international sample would yield similar results, particularly given our findings on reef identity and our audience being based in Australia. Rather than tap into reef identity specifically, future research could investigate the role of more globally oriented concepts such as ocean connectedness across geographically disparate audiences (Nuoja et al., 2022).

7. Conclusion

Encouraging widespread environmental action is more important than ever. Hence, environmental campaigns which promote such action, particularly those aimed at individuals and communities, must be proportional to the scale of the challenge. To effectively address marine conservation goals, behaviour change campaigns or interventions must move beyond targeting individual lifestyle choices and be strategically designed to influence a broader range of behaviours including those which aim to influence systemic change (e.g., writing to political representatives). In this study, in the context of the Great Barrier Reef, we demonstrate that carefully constructed campaigns which build on small lifestyle behaviours such as reducing plastic use have the potential to motivate behaviours related to wider marine conservation issues such as climate change. However, we also find that different strategies may be required for already engaged audiences. Our study highlights the importance of considering target audiences and incorporating behaviour change elements into conservation messaging and campaigning strategies.

CRediT authorship contribution statement

Yolanda L. Waters: Conceptualisation, Data collection, Formal analysis, Writing – original draft. **Angela J. Dean**: Conceptualisation,

Supervision, Writing – review & editing. **Kerrie A. Wilson**: Supervision, Writing – review & editing.

Conflict of interest

The authors declare no conflict of interest.

Data availability

Data will be made available on request.

Ethics Statement

This research was approved by the Queensland University of Technology Human Research Ethics Committee.

Data Accessibility Statement

All data that is permissible to share according to ethical requirements is available upon request to the authors.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2023.105580.

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