Negative emotional appeals: The effectiveness of fear and guilt communicative appeals on individuals pro-environmental behaviour and environmental concern to microplastic pollution

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Abstract

In an ever-growing 'throwaway' society, the world's oceans are coming under new and persistent pressures from anthropogenic activity. Marine plastic pollution is caused exclusively by human behaviours and decisions. Plastics, which accumulate in the ocean and degrade into brittle and ever-smaller fragments called 'microplastics', have the potential to compromise human food security and have been found in a range of items for human consumption. Microplastics also enter the marine environment directly as a result of human activity; Napper and Thompson (2016) demonstrated that as many as 700,000 microplastic fibres can enter waterways every laundry cycle. Despite this however, general microplastic awareness and concern still appears low (Rossel et al., 2015). While policies and regulation can provide an important framework for change, psychological interventions are needed to reduce negative behaviours and help protect the marine environment. Communicative appeals are one such psychological strategy that have been used for decades within health, political and environmental campaigns with varying degrees of success.

Specifically, the study used immersive virtual technology, paired with the different emotionally framed messages, to have participants experience the pathways and impacts of microplastics from laundry. Using a between-subjects design with two experimental conditions (Fear and Guilt), the effect of Negative Emotional Appeals (NEA) on individual levels of Pro-Environmental Behaviour (PEB) and Environmental Concern (EC) towards microplastic pollution, was measured. Fifty-four student participants from the University of Plymouth completed the study. VR based information surrounding microplastics and the human food chain was framed with a communicative narrative to either induce fear or guilt respectively. The dependent variable of this investigation measured individual likelihood of adopting PEB's, as well as individual levels of EC, before and after exposure to a NEA. Self-reported emotional state was also measured using the PANAS mood-scale to ensure experimental manipulation was met in each condition.

Results indicated a significant increase in participants' self-reported PEB intention and EC across several response items, after viewing the negative emotional VR appeals (across fear and guilt). There was also some evidence suggesting that guilt appeals may be more effective in increasing individual PEB intention and EC shown towards microplastic, but this finding was only approaching significance. We conclude that NEA, especially shown in a novel, immersive VR medium, has potential to increase PEB and EC related to microplastic pollution. Furthermore, some evidence supports guilt appeals being more effective than their fear counterparts. However, more research needs to be done in order to replicate these findings. Novel virtual reality technology combined with careful messaging holds great potential to help us address emerging environmental challenges that lack visibility.

Keywords: Negative Emotional Appeals, fear, guilt, Pro-Environmental Behaviour, Environmental Concern, behavioural research, Marine Microplastic Pollution, psychology

Introduction
Microplastic Pollution
Anthropogenic activity has led to the demise of countless species, habitats and ecosystems. Threats to the health of our oceans come from a plethora of human behaviours that cause obvious destruction of marine environments, and equally devastating, acute ecological dilemmas. One major threat, caused exclusively by human behaviour, is Marine Microplastic Pollution (MMP) (Pahl, Wyles & Thompson, 2017). As such, psychological and behavioural research should be at the forefront of potential solutions.

Originally, plastic was synthesised to help with wartime efforts when the mass manufacturing of assets such as transport and weaponry were in high demand. Plastic production has since increased from 0.5 million tonnes per year to 300 million tonnes in 2017 (Geyer, Jambeck & Law, 2017), growing 8.7% annually, creating a 600-billion-dollar industry (Gourmelon, 2015), resulting in the rapid transition into what is now being coined 'The plastic age' (Thompson, Swan, Moore & Vom Saal, 2009). Every year, between 4.8 and 12.7 million tonnes of plastic waste enter our oceanic systems (Jambeck et al., 2015). In-organic polymers, once in the ocean, degrade over time through surf-action and ultraviolet radiation, leading to ever smaller, more brittle fragments, which are now commonly known as 'microplastics'; plastic material >5mm (Law &Thompson, 2014). Recent research has shown how our everyday behaviours can massively contribute to MMP. Napper and Thompson (2016) demonstrated that between 130,000 and 700,000 microplastic fibres derived from synthetic materials in clothing can shed from garments and are released into the waterways each laundry cycle. These 'primary microplastics' often escape water treatment facilities and do enter the marine environment (Thompson & Napper, 2016).

To many filter-feeding faunae in the ocean, microplastics are often indistinguishable from microscopic food such as plankton. As many as 220 known aquatic species are now found to ingest microplastic (Lusher, Hollman and Mendoza-Hill, 2017), some of which eaten by humans, highlighting a 'compromise of human food security' (Barboza & Vethaak, 2018). Extreme estimates now posit annual human consumption of up to 52,000 plastic particles (Cox et al., 2019) for those with high seafood diets. Microplastics have now been found in fish, table salt, beer and tap-water. The health risks that microplastics pose to human wellbeing are still relatively unclear. Although research suggests marine life can suffer negative health impacts, international health bodies cannot currently classify microplastic as an explicit risk to human health (SAPEA, 2019). Where research suggests considerable perceived concern towards marine issues in general (Hartley et al., 2016), specific microplastic concern still appears low (Rossell et al., 2015).

Emotional Appeals
Emotions have been used for decades within political movements and media campaigns associated with health, social and environmental agendas in an attempt to increase 'desirable' behaviour and levels of awareness to an issue. Social marketers often employ emotional techniques to promote behaviours because they believe these emotional appeals to be highly persuasive (Andrews, Netemeyer, Kees, & Burton, 2014). Rogers and Deckner (1975) described emotional appeals as 'persuasive communications used to promote self-action'. Fear and guilt are frequent

NEAs utilised by campaigns (Hughman & Brotherton, 1997) as they hold a 'potent potential of influence' (Witte, 1994).

The Extended Parallel Process Model (EPPM), proposed by Witte (1992) as a forerunner to the Protection Motivation Theory (PMT) (Rogers, 1975), has been applied to both fear and guilt appeals in the context of Pro-Environmental Behaviour (PEB); behaviour that does not harm the environment but that sustains it (Steg & Vlek, 2009). The EPPM, as opposed to the more simplistic PMT, explains how individuals when faced with an appeal, will systematically and cognitively process the presented message. The first appraisal is for the perceived threat of the situation and has two components: severity and susceptibility. In the threat appraisal, if the recipient perceives the threat to be insignificant (low severity) or improbable (low susceptibility), message content or adaptive behaviour will likely be rejected. However, if the consequence is perceived as a high along with these two parallel components of threat perception, the individual will next process the content for efficacy. Again, this process contains two components: self-efficacy and response-efficacy. If the individual does not perceive an adaptive behaviour to be achievable (low self-efficacy) or effective in averting an outcome (low response efficacy), the individual will produce maladaptive responses such as denial or avoidance, commonly associated with message rejection (Witte, 1994); known as fear control. If, however, both the efficacy and threat appraisal are high, the message is more likely to be accepted, potentially leading to the adoption of the campaigns intended behaviour. In this case, the individual will initiate desirable steps to minimize personal risk against said threat. This is coined as 'danger control'.

Fear, neurologically associated with the amygdala (Adolph & Tranel, 1995), is the natural response to threat and uncertainty (Smith & Lazarus, 1993). From an evolutionary standpoint, fear is one aspect of the fight or flight response and contributes to sapient survival when faced with threat, such as predation, and is believed to evoke action in order to escape a negative situation. Rogers and Deckner (1975) aforementioned definition of fear appeals states that although fear is defined as a negative emotional state, fear arousal in an appeal context may produce positive behavioural outcomes. Fear appeals have been commonplace within public health campaigns designed at reducing undesirable social behaviours such as smoking, drinking and drug abuse (Shehryar and Hunt, 2005), with varying degrees of documented success (Brennan & Binney, 2010).

The relationship between fear and perceived threat and efficacy appears to be positively correlated (Witte, 1992), and Witte and Allan (2000) found evidence to suggest that the use of fear appeals may lead to attitudinal and behavioural modifications when individuals feel efficacious in averting an outcome. If the threat and efficacy of a situation is minimally perceived, individuals are unlikely to process the message any further (Witte, 1992). For example, one's belief that an alternative behaviour is effective in reducing the likelihood of a threat e.g., consuming microplastic, and one's beliefs about their capability to carry out this recommended behaviour, e.g. 'It would be easy to change my laundry cycle to a less plastic-emitting setting'. Witte and Allan (2000) concluded that fear is a powerful and innate emotional response to danger which may be used to influence behaviours. However, within EPPM and related models such as PMT, fear arousal is not considered the sole significant factor of persuasion. According to these cognitive-focused models, fear can influence behaviour but only slightly (Witte & Allan, 2000).

The EPPM argues that while processes such as perceived threat and perceived efficacy can lead to campaign or message acceptance, fear arousal can also likely lead to message rejection (Witte, 1992). Whereas previous literature has cited evidence for the support of fear as a principal behavioural antecedent for several years (Witte and Allen, 2000; Hartmann et al., 2014), the effectiveness of fear appeals varies greatly and research into the application of threat appeals to a PEB context is still developing.

Threat perception has also been cited as a significant predictor of PEB change (Vinning & Ebreo, 2002). Recent findings into the effect of emotional appeals in this context have indicated that fear arousal from climate-related environmental dangers can significantly increase PEB intention (Hartman et al., 2014). However, it must be noted that several studies have evidenced the effect of over-stimulating fear appeals. This may lead to fear control, as the emotion has a curvilinear relationship with action, evidenced by the inverted-u theory (Janis, 1967); stating that emotional appeal increases intention up to a certain, 'optimum' point, before overwhelming the individual and producing maladaptive responses. Witte and Allen (2000) warn that fear appeals should be used cautiously and can backfire if audiences do not hold high levels of perceived efficacy. Furthermore, alternative behaviours must be given alongside appeals to reduce the likelihood of maladaptive responses. Keller and Block (1996) revealed that highly fearful emotional appeals can produce maladaptive responses such as denial, and these defensive outlooks particularly manifest among those who feel most susceptible to a threat (Ruiter, Kessels, Peters, & Kok, 2014) and who are absent of an alternative behaviour to avoid a negative outcome.

Guilt is defined as a form of negative, self-conscious emotion with high self-accountability (Bedford et al., 2011), provoked by a violation of social or personal norms (Christiensen et al., 2004). Typically, feelings of guilt lead to a desire for individuals to reduce the negative effect by eliciting an appropriate amending behaviour (O'Keefe, 2002; Roseman, Weist & Swartz, 1994). Several studies have documented the effects of communicative guilt appeals in health campaigns and charitable donations (Hughman & Brotherton, 1997). Recently, the underlying process of guilt appeals has been further understood. Basil, Basil and Ridgway (2006) found evidence suggesting that much of the impact that guilt may have on charitable donations hinges on a feeling of personal responsibility for a negative outcome. Concerning environmental campaigns, guilt has been shown to be an important precursor to pro-environmental attitudes and aspects of PEB (Bamberg & Moser, 2007). Bamberg and Rees (2014) further emphasised the role of guilt, and specifically group responsibility by successfully motivating communities to engage in collective action towards climate change. However, this study only measures the PEB intention of community action rather than individual levels of PEB and therefore results cannot be extended to a micro-individual level.

Wonneberger (2018) tested the effectiveness of guilt message framing on PEB intention for an environmental campaign focused on rainforest deforestation. The study gathered mainly qualitative data via online questionnaires based around individual emotional and behavioural responses toward guilt appeals, in the context of measuring PEB intention; charitable donation. Evidence was found to suggest that donation intention can be significantly increased by guilt appeals for those already with high awareness towards an issue (Deforestation). However, within the design of their study, the guilt manipulation appeared indirect and didn't measure

explicit emotional appeals, which may have influenced the results, potentially weakening findings. Wonneberger (2018) concluded that guilt may be an effective tool to enhance behavioural compliance, but only when prior concern to an issue was shown. Further, guilt appeals were reported to be efficacious for those with moderate to high levels of environmental concern but may be the wrong technique to use for those reporting low concern. Where this study mainly focuses on individual differences such as pre-disposed guilt, it does provide evidence for the application of the EPPM to an environmental context. It is important to note, that similar to fear appeals, moderating the level of emotional exposure can be difficult and over-arousal can produce maladaptive responses (Passyn & Sujan, 2006). High levels of guilt arousal have demonstrated effects of reactance, resentment and annoyance (Coulter & Pinto, 1995; Okeefe, 2002), thus potentially leading to counter-arguing and discouraging the desired behaviour.

Rational
As MMP and any associated adverse health effects is exclusively down to human action, behavioural based solutions should be at the forefront of academic and applied research (Pahl, Wyles & Thompson, 2017). Especially so when public behaviour change has been shown to be a faster, more cost-effective solution than policymaking alone (Vandenbergh, 2009).

Fear and guilt were chosen in this study since both are potentially highly evocative of emotional reaction and are commonly adopted by environmental campaigns to influence behaviour. Influencing behaviour has proved important in meeting EU environmental goals (Hartley, Holland, Pahl & Thompson, 2015) and it is therefore essential to measure the effectiveness of such NEA and their effect on the audience's PEB and EC. Guilt appeals are used as readily as their fear counterparts (Hughman & Brotherton, 1997), therefore it is important to fill any gaps in the literature by applying both fear and guilt appeals to pressing environmental contexts such as MMP. Following on from Wonneberger's (2018) qualitative application of the EPPM toward PEB intention, the following quantitative study will investigate the effects of fear and guilt in relation to an environmental awareness message presented in VR, specific to MMP.

This investigation will aim to measure the effect that fear, and guilt appeals have on PEB intention and Environmental Concern (EC), with a specific focus on MMP. By using novel and direct emotional induction methods such as VR, as well as measuring PEB change and EC through self-report questionnaires, this study hopes to further the growing literature of emotional appeals in the context of PEB and follow on from Wonneberger's (2018) application of the EPPM to both fear and guilt appeals. This investigation also aims to measure the effectiveness of fear and guilt appeals on increasing individuals PEB and EC specific to MMP.
If the theory is correct, we predict that both fear and guilt-based VR appeals will significantly influence the PEB intention and level of EC reported towards MMP, as shown by responses on a self-report questionnaire. However, we predict that guilt will have a stronger effect on increasing PEB due to the evidence surrounding levels of personal responsibility predicting behaviour change (Basil, Basil & Ridgeway, 2006; O'Keefe, 2002), as well as the EPPM suggesting that fear appeals have only a small influence on actual behaviour (Witte & Allan, 2000). Furthermore, the more personally responsible an individual may feel towards an issue, is, theoretically, more likely to be influenced by a guilt appeal, and their behavioural intention

adjusted. We aim to experimentally induce fear and guilt to measure EC and behavioural changes within the context of MMP. Previous literature seems to suggest that both fear and guilt are capable of increasing PEB intention to some degree (Hartman et al., 2014; Wonneberger, 2018), given the appeals are used precisely and clear alternatives are provided. Cote et al., (2005) have also previously stated the importance of using new methods of emotional communicative appeals to increase compliance.

The experimental hypothesis are as follows:

H1: Guilt appeals will significantly increase PEB intention and EC of individuals more than that of Fear appeals.

H2: Negative Emotional Appeals (NEA) will significantly influence PEB intention and the level of EC towards MMP.

Methodology
Participants
Participants were recruited from the University of Plymouth School of Psychology participation system. 54 volunteers completed the study (*n*=54, 43=Female, 11=Male). The sample had a mean age of 20.8 (*SD*=5.21) and all participants received 0.5 participation points as a token reward for their time as part of University course credit.

Materials
The VR environment used to create the NEA within the study and to depict the flow of microplastic debris from individual-level behaviour to the human food chain was developed over an 18-month period with the support of The School of Psychology technical office. The VR environment was created using a combination of medias, including virtual underwater scenes that were built on a programme called Unity. Where possible, other scenes were filmed using a 360-degree camera to increase ecological validity and accurate depiction of microplastic pollution. The finalised VR used in the experiment was then presented on a wireless VR headset called Quest. As well as this, the fear and guilt message framing on each version respectively was presented through audio messages alongside the VR video framed to evoke fear or guilt. Additionally, the VR scenes were accompanied by concise 'text boxes' to further emphasise facts or phrases that had been framed to induce the target emotions. To make microplastic fibres visible to participants within the ocean environment and food products eaten by the typical family, (e.g., fish, salt, beer, water), they were highlighted within the VR where they would usually be invisible to the naked eye.

In order to induce the two target emotions (1. Fear and 2. Guilt) in the respective conditions, audio was shown alongside the VR appeal. Both conditions contained identical VR videos, however the audio messages varied slightly. Messages were factually identical in each condition with the same pieces of information and statistics surrounding microplastic pollution; messages only varied in the arrangement and use of pronouns such as 'Your laundry cycle' (guilt condition) vs 'Someone else's laundry cycle' (fear condition) within the messages in order to frame fear or guilt respectively.

In turn, these were linked to potential human ingestion to show that these inorganic particles may be consumed.

A PANAS mood scale (Watson, Clark & Tellegen, 1988) was adopted within this experiment to measure the emotional state of participants pre and post VR, specifically to measure fear and guilt. This 5-point Likert scale Questionnaire contains 10 response items for the Question:

Table 1: PANAS mood-scale questionnaire.

Pre and post PANAS: *On a scale of 1-5, (1 being not at all, 5 being extremely) to what extent to do you currently feel…?*
Attentive.
Fearful.
Interested.
Guilty.
Distressed.
Upset.
Ashamed.
Active.
Alert.
Inspired.

Below, displays the PEB questionnaire and EC questionnaire created to measure comparative levels of participants PEB intention and EC. Each questionnaire was administered pre and post experimental exposure.
The three questions in each respective part of the questionnaire were presented on a seven-point Likert-scale. These six total PEB and EC response options were a subset of wider questions to be administered post VR exposure. The six PEB and EC measures in the investigation served as comparable levels of pre and post experimental exposure responses. It was not initially possible to include the full set of PEB and EC response options, as presented in the 'additional PEB and EC measures' below, as some participants may have been unaware of 'niche' information that is made clear following VR immersion.

PEB and EC comparison measure (Pre and Post VR):
On a scale of 1-7 (1 being not at all concerned, 7 being extremely concerned, 4 being neutral, and an 8th response option for 'already adopt this behaviour'), how concerned are you currently about the following:
1. Marine Plastic Pollution. *
2. Climate change. *
3. Microplastic effecting human health. *

On a scale of 1-7 (1 being extremely likely, 7 Being extremely unlikely, 4 being neutral) how likely are you to do the following:

1. Regularly use a reusable bottle or cup to reduce single-use plastic consumption. *
2. Attend a beach clean to clean up plastic litter. *
3. Stop buying clothes that contain synthetic materials (e.g., nylon). *

*Items administered in both pre and post VR exposure.

<u>*Additional PEB and EC measures (Post VR only):*</u>
On a scale of 1-7 (1 being extremely likely, 7 Being extremely unlikely,4 neutral and 8 already do this action) how likely are you to do the following:

1. Buy and use a 'Guppy friend wash bag'.
2. Stop buying clothes made from plastic-based materials (e.g., Nylon). *
3. Share information regarding these filters on social media.
4. Choose washing cycle settings that minimise microplastics, for example avoid the delicate setting.
5. Regularly use a reusable bottle or cup to reduce single-use plastic consumption. *
6. Attend a beach clean to clean up plastic litter. *
7. Research the issue of microplastic pollution in your own time.
8. Talk to friends and family about ways to minimise your plastic consumption and contribution to microplastics.

*Items included in the PEB questionnaire administered before and after VR exposure (comparative measure).

On a scale of 1-7 (1 being not at all concerned, 7 being extremely concerned, 4 being neutral), how concerned are you currently about the following:

1. Marine plastic pollution. *
2. Climate change. *
3. Microplastic in the food chain.
4. Microplastics effecting human health. *
5. Biodiversity loss in general.
6. Biodiversity loss in the marine environment.
7. Rising sea levels.

*Items included in the EC questionnaire administered before and after VR exposure (comparative measure).

The three alternative behaviours shown to participants were presented on 2 A4 printed pieces of paper (1 Single sided, & 1 Double sided) and consisted of text and images to explain the alternative behaviours, and how they can reduce individual's contribution to MPP. Facts used to create the information sheets were compiled from journalistic articles and specific product websites. These behaviours included:

1. Avoiding the delicate wash cycle setting and intent to use washing cycles that use less water as this has been shown to reduce micro-fibre shedding.
2. Investing in a 'Guppyfriend' washbag which catches any shedding fibres when used in the wash cycle.
3. Enquire about newly developed filters that can be attached to washing machines in order to catch any microplastic fibres that may enter the marine environment.

A final response option at the end of the experiment was given to participants offering additional information on MPP, if they wanted to receive it. This response option allowed participants to enter their email and acted as a potential measure of actual PEB rather than just PEB intention.

Procedure

This experiment employs a between-subjects design with two experimental conditions. The independent variable will be assumed depending on the participant being randomly allocated to condition 1. Fear or condition 2. Guilt. The dependent variables of this study measure PEB as well as EC towards both specific and general environmental issues.

After provision of signed consent and a brief introduction to the format of the investigation, participants were randomly assigned to one of two conditions; 1. Fear and 2. Guilt. Individuals then completed a PANAS mood-scale questionnaire consisting of facilitated comparative measures for pre and post experimental emotion of participants. The PANAS self-report measured the pre-experimental emotional state of individuals for later comparison and included items such as "How fearful/guilty do you feel" on a Likert-scale of 1-5, (1 not at all, 5 extremely). Next, participants completed another pre-experimental questionnaire that measured the individual's level of EC for three issues: Climate change in general, Plastic pollution in general, and microplastic effecting human health. Responses were given on a seven-point Likert-scale (1 Not at all concerned and 7 extremely concerned, with 4 indicating 'neutral' concern). Additionally, on this pre-experimental questionnaire, there were three questions measuring the baseline levels of individual PEB. Again, these questions were on the seven-point Likert scale, as previously described; an eighth response option, 'already adopt this behaviour' was included.

The three questions used in this PEB intention questionnaire, as well as the three EC questionnaire, are a subset of wider response items to be administered within questionnaires after the VR appeal exposure. It was not possible to assume that participants were aware of individual products available or had large prior understanding of microplastic pollution origins, or how to reduce it. Importantly, the three questions used in this first part of the experiment act as comparable PEB intention measures for pre/post experimental exposure as they are broader concepts that can be easily understood in lay terms. A VR presentation which depicts the flow of microplastic fibres derived from laundry cycles transiting into the oceans was then shown to participants through a wireless VR headset. Participants were seated on a chair positioned in the centre of the room on a specific mark to ensure that the VR was viewed from the same angle for each participant.

Following exposure to the VR appeal, participants were then shown a series of 3 alternative sustainable behaviours that individuals can easily be implemented into their daily lives to reduce microplastic pollution derived from their laundry habits. These were shown on printed A4 paper as brief information sheets regarding each alternative behaviour; and were shown in the same position that the VR equipment was set up. Participants were given as much time as they needed to read the three information sheets.

Participants then returned to the computer desk to once again complete the post experimental PANAS mood-scale questionnaire ensure emotional manipulation to the target condition. Following the second PANAS, participants completed another set of questions regarding their individual PEB intention. Questions refer to both environmental issues in general, as well as specific issues relating to that of MPP. These questions included the three response items administered pre-experimental exposure as well as the 6 additional questions on PEB. Again, these were Likert-scale responses on a 1 to 7 scale (as previously described), indicating 'how likely are you to adopt *x* behaviour?'. This measure also offers an eighth response option for those behaviours that individuals already adopt. However, this eighth response option was defined as a missing variable and dismissed from statistical analysis. A final questionnaire on EC was then completed. This once again included the three questions used and administered in the pre-exposure questionnaire, as well as 4 additional questions regarding EC. Again, these response options were on a Likert-scale of 1 to 7 (as previously described) and expressed current concern towards MMP.

Participants were then finally invited with the option to leave their E-mail address if they wanted to receive further information regarding plastic pollution; this served to support the self-reported PEB intention. Following conclusion of the experiment, participants were fully debriefed and provided with a paper copy of the debrief in case of any future concerns, in line with ethical standards.

Results
Manipulation check (Fear and Guilt PANAS responses):
A One-way ANOVA analysis of pre and post experimental levels of Fear showed a significant effect over time: $f(1, 520) = 19.39$, *p<.00*, however no significant increase for self-reported levels of Fear was found: $f(1, 520) = 19.39$, *p<.66*. A One-way ANOVA statistical analysis of pre and post experimental levels of guilt showed a significant effect over time: $f(3, 52) = 103.01$, *p<.001* and approaching significance for an increase of self-reported levels of guilt specifically: $f(3, 52) = 103.01$, *p<.08*.

PEB comparative analysis
Participant responses for the comparative measures of PEB were reversed before statistical analysis. This was done to ensure intuitive interpretation of results when Likert scales measuring PEB and EC were of different directions.
One-way ANOVA analysing the first DV of our study (PEB intention) found the following results. Results showed no significant effect of interaction between conditions and individuals reporting an increased likelihood of adopting the use of reusable provisions e.g., water bottles, $F(1, 23)$ 7.61 $= p<.167$. However, there was a significant main effect of time, $F(1, 23)$ 2.04 $= p<.011$.

Effect of Fear and Guilt conditions on likelihood to adopt the PEB of using reusable provisions e.g. Water bottles.
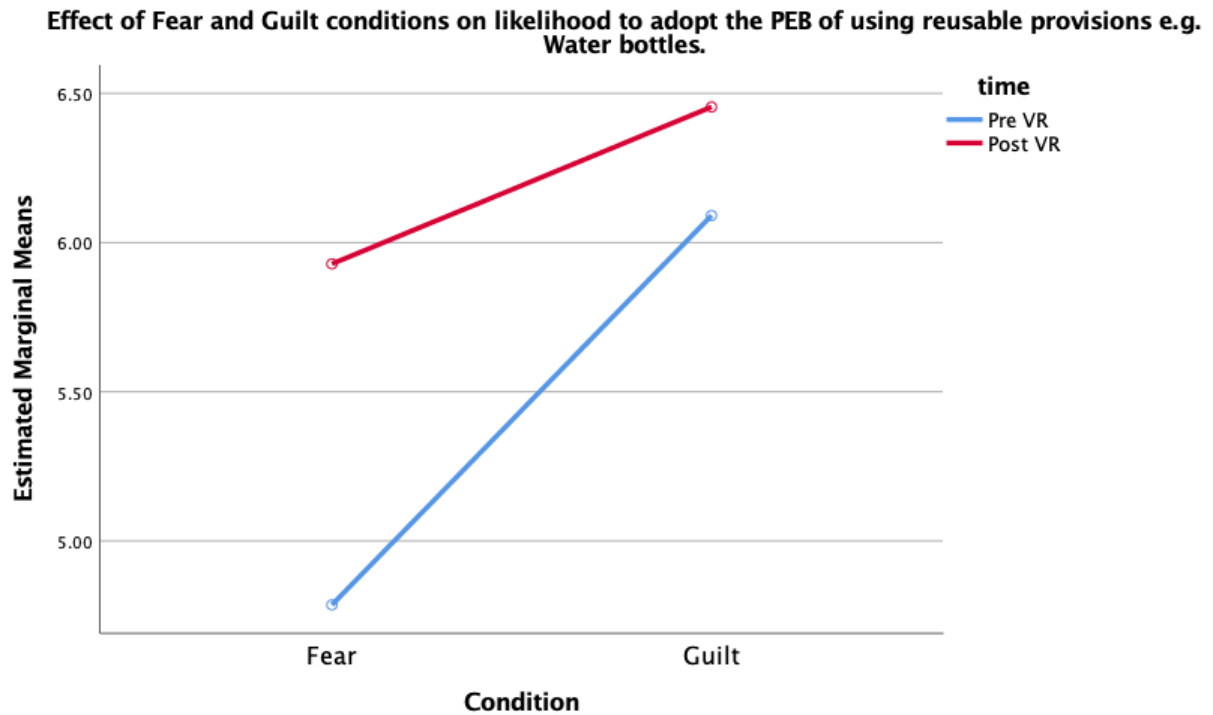

Figure 1: Effects of Fear and Guilt on PEB: Adopting reusable provisions.

The second PEB analysis for the likelihood of individuals attending a beach clean showed a significant interaction effect, $F(1, 49) = 10.92$, $p<.002$, between Fear and Guilt conditions and reported PEB intention. Descriptive means, as shown in Fig. 2, suggest that Guilt appeals were more effective than Fear appeals for increasing individuals reported PEB intention towards attending a beach clean.

Effects of Fear and Guilt appeals on likelihood to attend a beach clean.
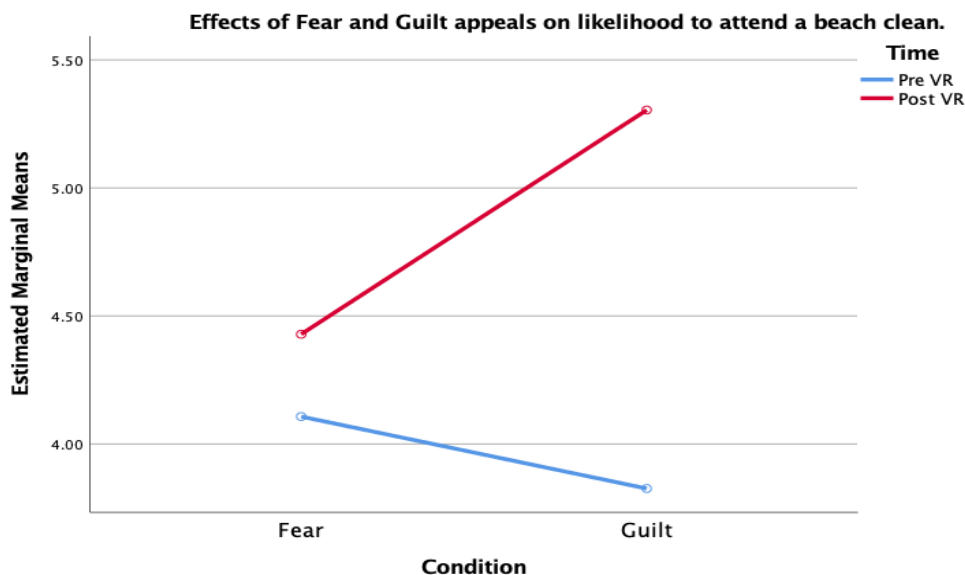
Figure 2: Effects of Fear and Guilt appeals on PEB: Attending a beach clean.

The third measure of PEB showed no significant effect of interaction between Fear or Guilt conditions and participants PEB intention to avoid the purchase of plastic-based clothing, $F(1, 52) = .023$, $p<.88$. However, results do show a significant main effect on behavioural intention over time $F(1, 52) = 16.78$, $p<.001$, in response to viewing the negative emotional VR.
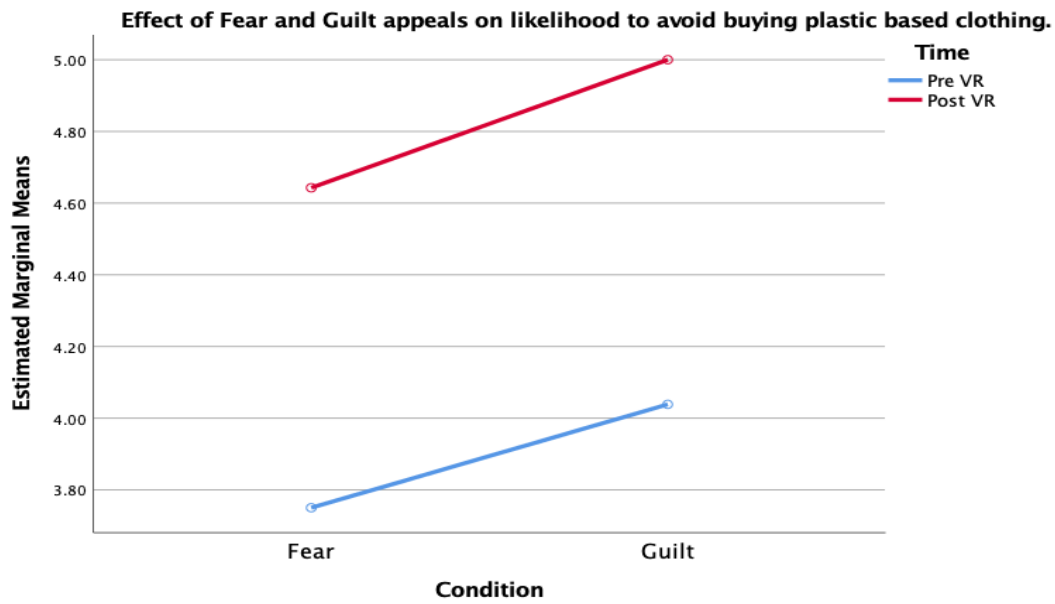
Figure 3: Effects of Fear and Guilt conditions on intention to avoid plastic clothing.

EC comparative analysis:
Results of a one-way ANOVA showed that the Fear and Guilt appeal condition had no significant effect on levels of self-reported EC towards plastic pollution, $F(1,52) = .038, p<.85$. However, there was a significant main effect over time in response to participants viewing the VR appeal. $F(1, 52) =, 23.60, p<.001$.

No significant effects were shown from Fear or Guilt appeal condition on participants self-reported levels of EC towards climate change in general, $F(1, 52) = 9.1, p<.91$.
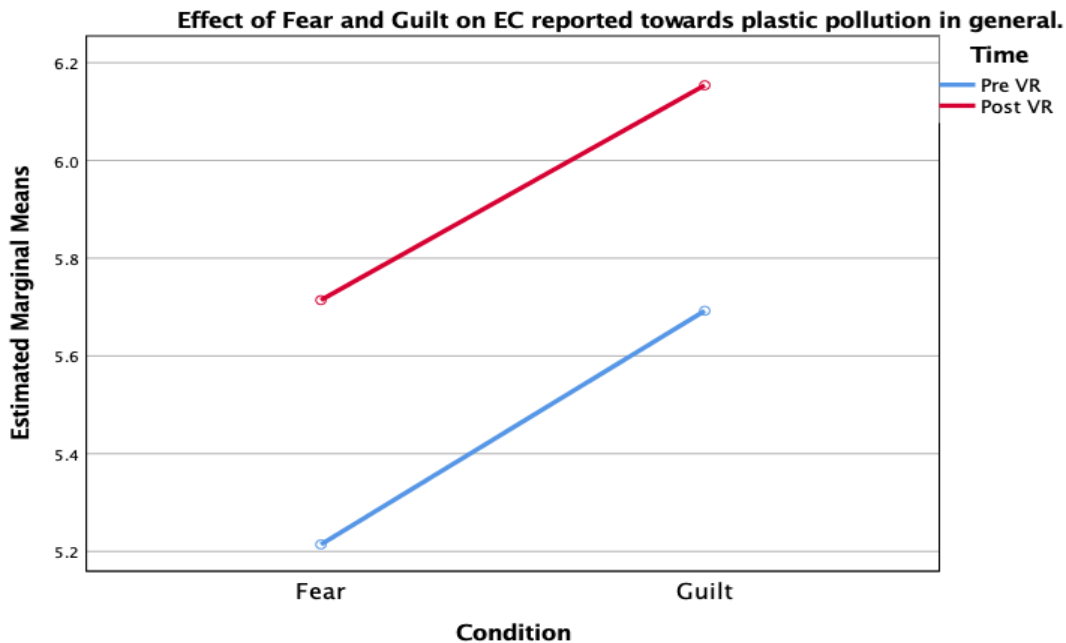

Figure 4: Effect of Fear and Guilt on individuals EC towards Plastic Pollution in general.

But again, there was a significant main effect over time in response to participants viewing the VR appeal: $F(1, 52) = .015, p<.004$.

Effect of Fear and Guilt conditions on EC towards Climate change in general.
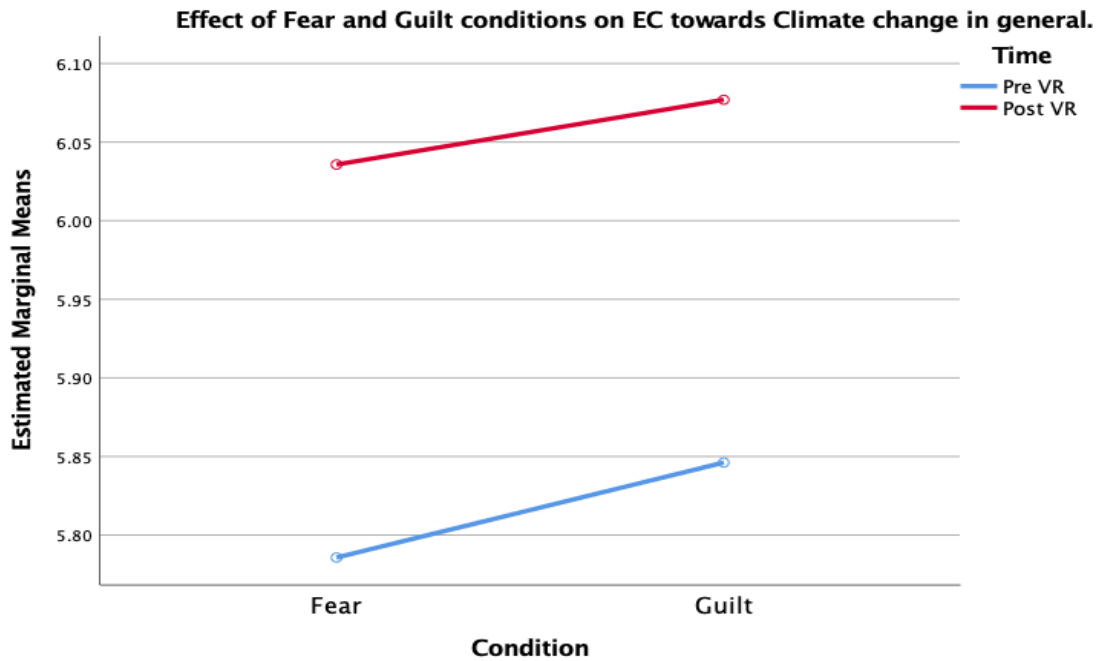
Figure 5: Effects of Fear and Guilt on reported EC towards climate change.

A One-way ANOVA showed results approaching significance for an interaction effect of Fear and Guilt conditions influencing participants self-reported levels of EC towards microplastic affecting human health, $F(1, 52) = 3.1$, $p<.085$. Means suggested a trend for Guilt having a larger effect than Fear, as shown in Fig. 6. Statistical analysis also shows a large significant main effect of time $f(1, 52) = 17.14$, $p<.001$ in response to participants viewing the negative emotional VR appeal.
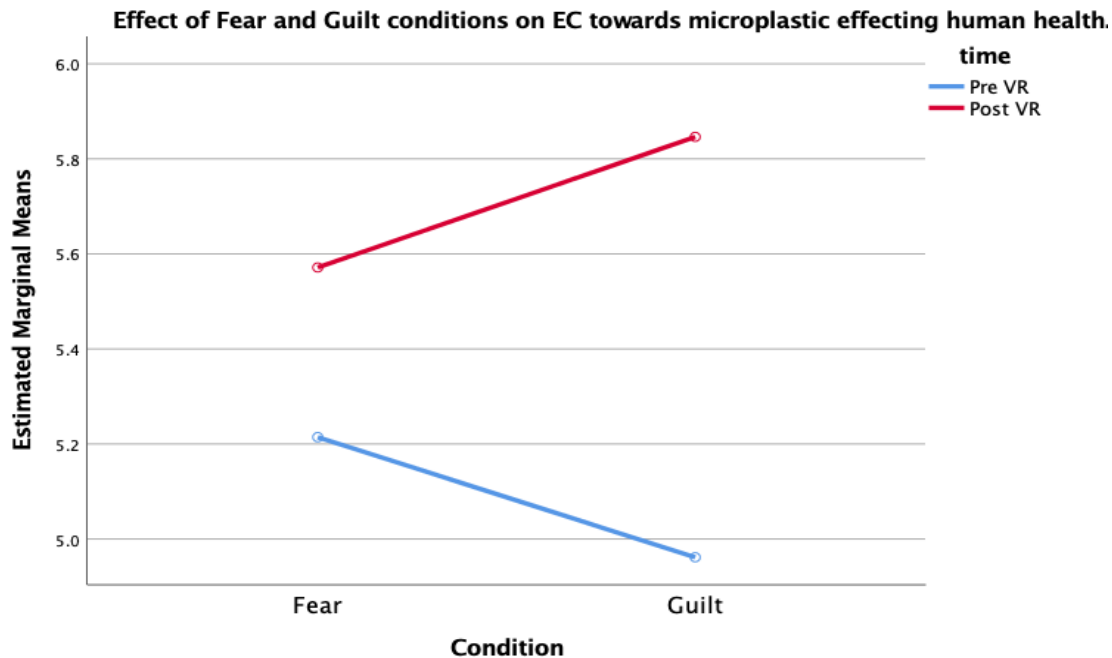
Effect of Fear and Guilt conditions on EC towards microplastic effecting human health.

Figure 6: Effects of Fear and Guilt appeal condition on individuals reported EC towards microplastic effecting human health.

Additional PEB & EC measures:
Participants who were exposed to the Fear experimental VR appeal (M=3.54, SD= 1.53) were significantly more likely to adopt the PEB of buying and using a 'Guppy-

friend washbag' than those in the Guilt appeal condition *(M=2.38, SD=.89)*, t (52) =3.3, *p<.002.*
Participants who were exposed to the Fear condition (*M*=3.39, *SD*=1.93) were significantly more likely to use social media to find out more about MPP than those in the Guilt appeal condition (*M*=2.35, *SD*= 1.67), *t* (52) =2.1, *p<.038.*

There was no significant interaction effect of Fear or Guilt conditions and likelihood to support the development of microplastic filters in washing machines, *t* (52) = 1.4, *p<.14.* There was also no significant interaction effect of conditions on intention to avoid plastic-emitting wash settings such as the delicate cycle, *t* (52) = 1.1, *p<.28.*

There was no significant interaction of Fear or Guilt conditions effecting individual's intention to talk to peers about microplastic pollution, *t* (52) = -.81*, p<.41.*
There were no significant results for an effect of Fear or Guilt appeals on levels of EC towards Biodiversity loss in general, *t* (52) = -.39, *p<.70.*
There were no significant results for an effect of Fear or Guilt appeals on levels of EC towards Biodiversity loss in the marine environment, *t* (52) = -.88, *p<.38.*
There were no significant results for an effect of Fear or Guilt appeals on levels of EC towards the threat of rising sea levels, *t* (52) = -.91, *p<.37.*

A Chi-squared analysis showed no significant influence of Fear or Guilt appeals on individuals giving their E-mail to receive further information regarding microplastic. X^2, (1, *N*=5) = 0.31, *p<.86.*

Discussion

Our results suggest that although the experimental manipulation of fear was not significant, results were approaching significance for the manipulation of guilt, suggesting that the guilt manipulation may have been successful in some, but not all trials. The VR exposure did induce a significant emotional effect in response to both fear and guilt appeals over time as shown by a test of One-way ANOVA. A significant emotional reaction in response to exposure of the VR appeal supports previous claims that novel methods of emotional induction can increase the emotional response towards a campaign message and may increase levels of EC and PEB intention (Reser & Bradley, 2017; Cote et al., 2005).
Analysis of comparable measures of individuals PEB show consistently significant results over time, demonstrating that in all three of our comparable PEB measures, individuals reported a significant increase in PEB intention after viewing the negative emotional VR appeal. This finding suggests that, in line with H2 and previous literature (Witte, 1992; Wonneberger, 2018), NEAs may be capable of increasing individual's PEB intention to MMP. In addition to this, these consistently significant results further support claims that novel methods of emotional induction within emotional communicative appeals, may be more effective in increasing PEB (Cote et al., 2005).

Not all measures of PEB intention showed significant behavioural influence from fear or guilt conditions independently. Fear and guilt appeals directly influenced individuals on only one measure of PEB intention; their likelihood to attend a beach clean, as shown by responses on PEB Questionnaire. This finding, in line with H2, suggests that NEAs can potentially increase individuals PEB intention to attend a beach clean. With regards to H1, guilt appeals appear to be more effective than fear, as shown by trends in descriptive statistics, in line with our predictions. This supports

guilt leading to an appropriate amending behaviour (Basil, Basil & Ridgeway, 2014) due to a desire to escape potential feelings of personal responsibility (Roseman, Weist & Swartz, 1994). In this case, by stating desire to attend a beach clean, individuals who potentially felt accountable for MMP may want to reduce these feelings of personal responsibility by eliciting an attempted amending behaviour. However, the manipulation of guilt in this study was only found to be approaching significance. Furthermore, these results cannot be treated as valid evidence from which explicit conclusions can be drawn. In addition to this, analysis of additional measures of PEB intention displayed opposing results. Fear appeals showed a significant influence on likelihood to adopt some PEBs e.g. 'The Guppy-friend Washbag'. This may be as a result of not recording pre-experimental responses for these measures and doing so in future may improve validity of results.
Across all three comparative measures of participants self-reported EC, analysis showed significant results for the increase of self-reported EC in response to the VR appeal. This supports our hypothesis that NEAs hold a potential power of influence (Witte, 1992; Wonneberger, 2018). Results also suggest that self-reported levels of EC towards climate change in general, were significantly higher following exposure to the VR appeal. Where there was no significant directional effect for fear or guilt, results over time do indicate that NEAs can influence individual levels of EC.

Only one measure within the comparative items of self-reported EC was found to be approaching significance for the effect of fear and guilt on EC towards MMP. Individuals stated an increase in concern for adverse health effects of microplastic ingestion, after viewing the fear and guilt-based VR appeals. This result not only suggests direct influence of NEAs on self-reported levels of EC towards microplastic issues specifically, but mean trends once more suggest that guilt appeals are more effective than fear appeals. This finding suggests that, in line with H1, guilt appeals may be more effective at increasing individuals EC. It is vital to note here, that again, this finding was only approaching significance. As such, although this does not act as explicit supporting evidence to H1, it may act as a strong indicator for the effectiveness of guilt appeals within the context of increasing EC towards MMP.

Although this investigation has found results that support our experimental hypothesis to some degree, there are limitations that must be addressed.
Since the PANAS mood scale is a self-report questionnaire, it can be difficult to assess people's emotions accurately. People can overstate or understate their experience as a result of various behavioural bias, for example, social desirability bias, which can reduce validity of results. With that being said, the PANAS self-report questionnaire does account for other, similar emotions to guilt such as shame, which can lead to 'fear control'. Shame can cause defensive behaviour and is difficult to distinguish from guilt in response to appeals (Bedford et al., 2014); easily misattributed by individuals. By including this response item, we were able to account for any potential feelings of shame, and in turn record the effects that these associated feelings have on adopting PEB towards microplastic and increasing EC. Another possible limitation to acknowledge is that of a homogenous sample. All participants were recruited from the University of Plymouth, School of Psychology, and were current students. All participants attended the same university, with a potentially similar social and place identity, reducing the validity and applicability of results as they cannot be generalised to further populations outside of the sample. Numerous studies focusing on communicative appeals commonly state an over-reliance on student samples within empirical investigations (Schultz & Zelezny,

2003). Future research may be better focused on acquiring a more diverse sample population so that the results can be generalised to wider populations and contexts. Finally, although our study did measure direct emotional appeals on PEB intention, the investigation contained no longitudinal measures. Experimental measurements often only focus on immediate short-term laboratory effects and our study may be improved by including measures of PEB maintained after the study. This would provide improve experimental validity (Antonetti, Baines & Walker, 2015). Where our research did include a measure of actual PEB (optional email response), future study may include measures of sustained PEB.

With regards to scientific applicability, firstly, as aforementioned, fear and guilt appeals are negative emotions commonly adopted by health, political and environmental campaigns to influence behaviour. Our results have contributed some significant findings that support the justification for the use of NEAs in the context of increasing PEB and EC. This is poignant where behavioural change has been shown to be an effective behavioural strategy (Vandenberg, 2009) and EU environmental goals are contingent on societal adoptions of PEBs (Hartley, Holland, Pahl & Thompson, 2015).

Where our study did not intend to prove the worthiness of VR as an effective medium of presenting emotional appeals, our results do support preceding literature that novel methods of emotional manipulation may be more effective at evoking an emotional reaction, and potentially influencing behavioural intention (Reser & Bradley, 2017; Cote et al., 2005). Future research could focus on the effectiveness of VR as opposed to other appeal mediums such as TV, radio or social media. Novel research suggests that 74% of the millennial generation are triggered with feelings of guilt when they perceive plastic materials on the coast. A further 60% reported experiencing 'Eco-anxiety' in response to seeing marine plastic debris (Keep Britain Tidy, 2019). Eco-anxiety is a relatively new concept and is defined as an anxiety disorder manifesting in response to specific man-made environmental threats often emerging in response to negative evocative stimuli e.g., fear (Nobel, 2007), alongside feelings of hopelessness. This can cause an extremely pessimistic outlook on environmental issues, as suggested by the fatalism model (Meyer & Smith, 2019), leading to maladaptive behavioural responses. It is vital to ensure that NEAs that utilise fear and guilt as emotions to influence behaviour in society, do not contribute to or trigger disorders of anxiety in the most susceptible; those absent of alternatives (Ruiter, Kessels, Peters, & Kok, 2014) or younger individuals.
It is important to state that this investigation explicitly focused on negative emotions and it may be valuable for future research to investigate the effect of positive emotions, such as hope, which has been shown to be an effective emotion to promote PEBs in an appeal context. (Nabi, Gustafson & Jenson, 2018).

Conclusions

Overall, some findings in our investigation appear to support guilt appeals influencing PEB and EC of individuals significantly more than that of fear appeals. However, as this finding is only approaching significance, we cannot draw an explicit conclusion for the effectiveness of guilt compared to fear appeals. We can conclude however, the use of NEAs is clearly capable of increasing individual levels of EC towards MMP as well as PEB intention, as shown by consistent significant results in response to experimental VR exposure in all self-report comparative measures for PEB and EC. In line with previous literature, our results suggest that novel mediums of presenting

emotional communicative appeals, such as VR, may be effective when attempting to increase PEB and EC (Cote et al., 2005), in relation to marine specific issues such as MMP.

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