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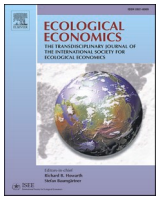

The effects of emotions on stated preferences for environmental change: A re-examination

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ABSTRACT

A large literature in behavioral science suggests that people's emotional condition can have an impact on their choices. We consider how people's emotions affect their stated preferences and willingness to pay for changes in environmental quality, focusing on the effects of incidental emotions. We use videos to induce emotional states and test the replicability of the results reported in Hanley et al. (2017). Additionally, we employ Face Reader software to verify whether the intended emotional states were successfully induced in our experimental treatments. We find that our treatments succeed in implementing the predicted emotional condition in terms of self-reported emotions but had a variable effect on measured (estimated) emotional states. We replicate the key result from Hanley et al. (2017): induced emotional state has no significant effect on stated preference estimates or on willingness to pay for environmental quality changes. Moreover, we confirm that, irrespective of the treatment assignment or emotional state - be it self-reported or measured - we observe no significant effect of emotion on stated preferences. In our data, stated preference estimates for environmental change are unaffected by changes in incidental emotions, and preference estimates are robust to the emotional state of the responder.

1. Introduction

Stated preference studies, and in particular discrete choice experiments, are frequently used to measure the economic value of environmental public goods to inform cost benefit analyses and environmental policy making (Johnston et al., 2017). The design and analysis of most stated preference studies rely on traditional economic assumptions that suggest that participants in these studies make rational choices and have stable, consistent, and complete preferences (Hanley et al., 2017; Hanley and Barbier, 2009). Only if these assumptions hold do choices in stated preference studies inform us about the welfare-relevant decisions that maximize participants' utility, which are thus consistent with the assumptions behind the traditional welfare economics foundations of cost-benefit analysis (Weimer, 2017).

However, a growing number of studies suggest that stated preferences can be influenced by "welfare-irrelevant factors", and that people's decisions are sometimes mistaken. Building on these studies, Lades et al. (2025) call for a new behavioral approach to cost-benefit analysis. For example, participants' personality traits correlate with environmental choices (Boyce et al., 2019) and the framing of discrete choice experiments can influence how much participants are willing to pay (Bergstrom et al., 1989; Boyle, 1989; Faccioli et al., 2019; Faccioli and Glenk, 2022; Hoehn and Randall, 2002; Kragt and Bennett, 2012; Notaro et al., 2024; Rolfe et al., 2002). Contextual factors defining the valuation settings influence decisions, whilst the presentation of information that characterizes a hypothetical market can also affect stated WTP (Bateman et al., 2009; Hassan et al., 2018; Matthews et al., 2017).

Standard economic welfare theory suggests that people's willingness to pay should be influenced by welfare-relevant factors only, such as income or the price of substitutes. However, when changes in variables which are not part of the standard model of choice, such as the framing or context of choices, influence willingness to pay values, then both cost-

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benefit analysis as a means of making public policy decisions, and the use of stated preference values within such a cost-benefit analysis, are challenged. For example, the willingness to pay for an environmental good might be relatively high in one choice frame, so that a cost benefit analysis suggests the policy to be implemented. With an alternative frame, however, the outcome of the cost benefit analysis might have been very different. The welfare economists' analytical tools, such as the Kaldor-Hicks criterion, are not well-suited to deal with such context dependencies (Hanley et al., 2017).

We study the impacts of one specific contextual factor – incidental emotions – in the present paper. We manipulate incidental emotions in the lab by showing participants from a student sample happy or sad videoclips and measure participants' emotional reactions in real-time using a Facereader as well as their decisions in a discrete choice experiment.

Our study is designed to test the following hypothesis:

There is no difference in the stated willingness-to-pay for the environmental good when a Happy, Sad, or No emotional state is induced.

Summarizing results, we find that showing participants happy movie clips makes them happier as measured using both Facereader and self-reports. However, the sad movie clips had a negative effect only on participants' self-reported happiness and not on the Facereader measures. We find that none of the treatments had a statistically significant effect on participants' economic choices in terms of their preference parameters. Moreover, neither 'sad' nor 'happy' emotions observed on participants' faces while they were making choices seemed to have a significant impact on their estimated preferences. The same result was found when, instead of observed emotions when choosing, we used the emotions observed while watching the film clips or at the end of the survey. The overall conclusion that emerges from our paper is thus a reassuring one in terms of the use of stated preference measures in cost-benefit analysis: in our data, incidental emotions have no significant effect on willingness-to-pay estimates.

2. Literature review, research gap and objective

Insights from behavioral science and psychology suggest that incidental emotions, such as happiness or sadness, can influence people's choices but do not have a connection to the expected payoffs from the decision at hand (Blanchette and Richards, 2010; Blanchette and Richards, 2010; Lerner et al., 2004, 2015; Loewenstein, 2000). While influencing behavior, incidental emotions do not have a direct effect on our material well-being and standard economic theory dictates, therefore, that they should not affect our decisions. Indeed, economists have long ignored the effects of emotions on decision-making despite prominent calls for more research (Damasio, 2006; Elster, 1998; Frank, 1988; Lerner et al., 2015; Loewenstein, 2000). However, this situation is changing, and Dukes et al. (2021) even suggest that behavioral research has now entered an "era of affectivism" in which the effects of emotions on cognition and behavior are core to the analysis.

2.1. The effects of incidental emotions in stated preference studies

A number of studies have analyzed the effect of incidental emotions on choices in stated preference studies specifically (see Table 1). These studies typically induce emotions such as happiness or sadness by showing movie clips (Ifcher and Zarghamee, 2011; Kirchsteiger et al., 2006; Oswald et al., 2015), pictures (Notaro and Grilli, 2022), or by asking participants to recollect a sad or happy event in their life (Myers and Tingley, 2016; Strack et al., 1985), and then follow up with the decision task (Lyubomirsky et al., 2005). For example, Araña and León (2008) show that intense emotions can increase anchoring effects in contingent valuation studies, and Araña and León (2009) use film clips to induce disgust and sadness in participants and find that these influences emotions influence stated preferences as measured in a discrete choice experiment. Sad participants were more likely to act as predicted by random utility maximization than others. Hanley et al. (2017) use video clips to make participants feel happy or sad, and find that emotional state had no effects on participants' willingness to pay for beach quality enhancement in New Zealand. Notaro et al. (2019) find tourists' preferences and willingness to pay for management of Alpine landscapes were influenced by their self-reported emotional state in a latent class model using choice experiment data. Notaro and Grilli (2022) find that lower levels of induced fear (through a re-assuring picture) lead to increased willingness to pay for wolf conservation relative to showing people a more "worrying" image. Overall, these studies imply that incidental emotions might have an influence on the values that stated preference researchers estimate and communicate to policy makers.

Table 1
Overview of papers on emotions and decision making.

Study	Sample	How were the preferences measured
Stated preference studies		
Araña and León (2008)	Resident population	Artefactual field experiment
Araña and León (2009)	Resident population	Artefactual field experiment
Hanley et al. (2017)	Student	Lab experiment
Ibanez et al. (2017)	Student	Lab experiment
Johnson and Tversky (1983)	Student	Lab experiment
Kessler et al. (2021)	NBC Sports subject pool (focus groups)	Lab in the field experiment
Kirchsteiger et al. (2006)	Student	Lab experiment
Myers and Tingley (2016)	Student	Lab experiment
Notaro and Grilli (2022)	Tourists in Trentino, Italy	Face-to-face survey
Notaro et al. (2019)	Tourist sample in Terza Sponda, Italy	Discrete Choice Experiment, Lab in the field experiment
Other contexts		
Drouvelis and Grosskopf (2016)	Student	Lab experiment
Fiala and Noussair (2017)	Student	Lab experiment
Ifcher and Zarghamee (2011)	Student	Lab experiment
Ifcher and Zarghamee (2014)	Student	Lab experiment
Kugler et al. (2020)	Student	Lab experiment
Lerner and Keltner (2001)	Student	Lab experiment
Lerner et al. (2004)	Student	Lab experiment
Lerner et al. (2013)	Study 1: Student Study 2: Web-based nationwide sample Study 3: Student	Lab experiment and online survey
Nygren et al. (1996)	Student	Lab experiment
Oswald et al. (2015)	Student	Lab experiment
Stanton et al. (2014)	Student	Lab experiment
Strack et al. (1985)	Student	Lab experiment
Tan and Forgas (2010)	Student	Study 1: Lab in the field experiment Study 2: Lab experiment Study 3: Lab experiment (not explicitly revealed by the authors)
Wright and Bower (1992)	Student	Lab experiment

2.2. The effects of incidental emotions on decisions in other contexts

There is more evidence for the effect of incidental emotions on decisions in other contexts. Examples include the effects of experimentally manipulated emotions on time preferences (Ifcher and Zarghamee, 2011; Lerner et al., 2013), risk preferences (Johnson and Tversky, 1983; Lerner and Keltner, 2001; Loewenstein, 2001; Nygren et al., 1996; Wright and Bower, 1992), overconfidence (Ifcher and Zarghamee, 2014), gambling (Stanton et al., 2014), productivity (Oswald et al., 2015), and pro-environmental behavior (Lange and Dewitte, 2020). There is also a large, related literature on pro-social behavior (Drouvelis and Grosskopf, 2016). Results in some areas are not conclusive: inducing emotions did not change generosity or prosocial behaviors in all studies (Drouvelis and Grosskopf, 2016; Fiala and Noussair, 2017; Ibanez et al., 2017; Kessler et al., 2021; Kirchsteiger et al., 2006; Lane, 2017; Tan and Forgas, 2010).

2.3. Research gaps in this literature

An important limitation of many of these studies is that the emotional state the participants were in when making their choices was self-reported. For most studies, no objective data are available on whether the emotion induction (the experimental treatment, for example) was successful. A related limitation is that the emotional state in these studies is often measured after, but not during, the choice process. For instance, Araña and León (2009) first ask subjects to watch film clips, write down how they felt about the clips, and then complete the main experiment. Only after the main experiment did they ask respondents to reflect on their emotions when watching the films. Even though a survey might be rather short, it is quite possible that the emotional state may not entirely be as described by such self-assessments. People find it very difficult to predict or recall emotional states (Wilson and Gilbert, 2003) and the imposed emotional state may have changed as the participant progressed through the survey due to (a) simply the passage of time, and/or (b) the effects of participating in the survey itself. Indeed, emotions can change over time from the beginning to the end of a decision-making process (Lerner et al., 2015; Notaro and Grilli, 2022). Taking a survey regarding one's emotional state might also make one's state more negative (Kugler et al., 2020).

2.4. This paper's objective

To overcome these limitations, the present paper re-tests the results found in one of the earliest stated preference studies that tested for the effects of incidental emotions (Hanley et al., 2017), using an identical experimental procedure with a new sample of participants, but with additional measures of respondents' emotional states based on Facereader technology. Our objective is thus:

2.4.1. Objective

Re-test published results on the effects of incidental emotions on decisions in stated preference studies while extending the analysis with improved measures of emotions.

Re-testing (or replicating) experimental results is a valuable exercise in the context of the so-called "replication crisis" in economics and psychology (Maniadis et al., 2017; Maxwell et al., 2015). Based on this desire to re-test the Hanley et al. findings, we use exactly the same sad/happy treatments (movie clips) and choice experiment used in that paper in the present study. To extend the previous results, we estimated people's objective emotional states over time as the experiment proceeded, in addition to collecting data on self-reported emotional status, as per Hanley et al. (2017). To do this, we filmed participants (with their consent) and analyzed the videotapes with Facereader software designed to track emotional states, as explained below. This approach provides continuous estimates of happiness, surprise, disgust, sadness, fear, neutrality and overall emotional valence. Therefore, we can estimate the initial emotional state induced by the movie clip, as well as the emotional state at the exact time when participants complete the stated preference choice tasks – to the extent that emotional condition is reflected by facial expressions.

To achieve our objective, the paper tests three research questions:

1. Are participants' decisions in the stated choice experiment influenced by watching sad or happy movie clips?
2. Are participants' decisions in the stated choice experiment correlated with their emotions as observed by the Facereader?
3. Are participants' decisions in the stated choice experiment correlated with their stated emotions while watching the movie clips?

3. Materials and methods

The experiment was conducted at the Waikato Experimental Economics Laboratory at the University of Waikato, New Zealand between November 2018 and March 2019. A total of 298 participants participated in the study across 22 sessions. Table 2 summarises their demographic and beach-use characteristics. Participants were recruited university wide and managed using the Online Recruitment System for Economics Experiments (ORSEE).[1] Some participants may have participated in previous economics experiments, but none had prior experience with choice experiments, or the emotion inducement methods employed. Each participant only participated in a single session of the study, so that we used a between-subject design. The experiment was implemented using the z-Tree software package.[2] All interaction and decision-making of participants took place via a computer within privacy barriers. Therefore, stimuli outside the experimental design were minimized. The time required to complete the experiment varied across participants. However, each session concluded when the last person finished their tasks to avoid distraction. Participants were asked to wait quietly until the experimenter announced the conclusion of the session, upon which all participants simultaneously left the laboratory. On average, each session lasted approximately 45 min including the instructional period and participant payments. Participants were paid 20 NZD for their participation. The complete survey experiment is available in the Appendix.

Identically to Hanley et al. (2017), our design consisted of three treatment conditions based upon the target emotional state induced: Happy, Sad and Neutral. In order to induce the emotional state, the participants watched a series of short movie clips, which were approximately 6–7 min in length. We used these particular movie clips as they have been shown in previous research to effectively evoke the specific emotion (Feinstein et al., 2010; Gross and Levenson, 1995; Schaefer et al., 2010), and were the same movie clips used in Hanley et al. Details of the movie clips used are presented in Table 3.[3]

The main procedural difference between our study and Hanley et al. (2017) is the assessment of the participants' emotional states. Hanley

Table 2
Demographic and beach-use characteristics of study participants.

Variable	Mean ± SD or % ($N = 298$)
Female / Male	58.7 % / 41.3 %
Age (years)	25.7 ± 7.1 (range 16–61)
Beach trips per year	13.2 ± 27.5
Distance to usual beach (km)	75.7 ± 73.5
Main activity at beach	Hang-out 64 %, Swimming 25 %, Surfing 3 %, Boating 2 %, Other 6 %

[1] For a description of the ORSEE program, see Greiner (2004).
[2] See Fischbacher (2007) for a discription of z-Tree.
[3] The movie clips are available at http://tinyurl.com/hnr3jnt

Table 3
Movie clips used in the experiment.

Emotional State	Clip Title	Duration	Total Duration	Description
Happy	Ladder 49	1:18	6:14	Man finds out that his wife is pregnant
	Love Actually	2:21		Man proposes to woman
	Love Actually	1:19		People meeting loved ones at an airport
	Indiana Jones	1:16		Children return home to parents
	Stock Market Report	1:30		Woman reports on the stock market
	Golf Grip Video	1:51		Man describes how to grip a golf club
Neutral	Abstract Painting	1:06	5:53	Woman describes acrylic painting techniques
	Antiques Auction	1:26		Man describes items sold at an antiques auction
	The Champ	2:42		Child experiences his hero's death
Sad	Born on the 4th of July	1:59	6:42	Man injured from war has returned home and it is distraught
	Forest Gump	2:01		Man is at the graveside of his love

et al. relied solely upon self-reporting. More specifically, upon completion of the choice experiment, participants were asked to reflect upon their emotional state during the presentation of the movies. Participants were asked: "While I was watching the film I felt… 1 = sad (bad), 4 = neither happy nor sad (neither bad nor good), 7 = happy (good)." In our experiment, we also elicited self-reported emotional states via questions at the end of the choice tasks. The questions asked the participant to reflect back to their emotional state while watching the movies:

"*Can you tell us how you felt like when watching the film clips?*

While I was watching the film I felt… 1 = sad, 4 = neither happy nor sad, 7 = happy."

Moreover, we asked about the participants' current emotional state:

"Finally, can you tell us how do you feel now?

I feel… 1 = sad, 4 = neither happy nor sad, 7 = happy."

These responses are our estimates of stated emotional condition which are directly equivalent to the measures used in the original Hanley et al. (2017) paper. We also asked participants to indicate whether they felt bad/good, relaxed/tense, and not aroused/aroused but do not analyze answers to these questions here.

In addition to the elicitation of self-reported emotions, we filmed the entire experiment and used the Noldus FaceReader™ software to measure the conformity of six basic universal emotions (Ekman et al., 2013). The video is recorded at 30 frames per second and at each frame FaceReader reports the conformity of a subject's facial expressions, on a scale of 0 to 1, to those associated with six basic emotions: happiness, sadness, anger, fear, disgust, and surprise. FaceReader can detect emotions as effectively as trained human observers (Kuderna-Iulian et al., 2009; Lewinski et al., 2014; Terzis et al., 2010). It is capable of accurately classifying both intended and unintended emotions (Bijlstra and Dotsch, 2011; Den Uyl and Van Kuilenburg, 2005), but only captures observable changes in face movements. The synchronization of the stimuli in z-tree and the facial expression was established using the MuCap program (Doyle and Schindler, 2015). The average emotions are then calculated over a specified time interval of interest.

Statistical significance of each treatment- and emotion-specific interaction was assessed using standard *z*-tests (coefficient / standard error). In addition, we conducted a likelihood-ratio (LR) test comparing the full RP-MXL specification that includes the interactions with an otherwise identical model in which the interaction means were constrained to zero. The LR statistic, 2*(LL_full – LL_restricted), is asymptotically χ^2-distributed with degrees of freedom equal to the number of constrained parameters.

4. Stated preference choice experiment

Embedded within the experimental design described above was a stated preference choice experiment, which replicated that used in Hanley et al. (2017). The choice experiment asked participants to make choices over alternative beaches on the North Island of New Zealand which the participant could choose to visit on a future occasion. The beaches were described in terms of three environmental attributes and a travel cost (travel distance) from their home. The three environmental attributes were:

- water quality at the beach, described in terms of the impacts from variations in pollution loadings from human sewage and farmland run-off on faecal coliform counts and algal blooms;
- clarity of the water at the beach, described in terms of sediment levels in the water, mud deposited on beaches and the spread of mangroves preventing easy access to the water;
- fish populations in coastal waters, focussing on species relevant to local recreational use (e.g. snapper).

Each of these environmental attributes could take one of three possible levels, all described qualitatively. Participants were told that improvements in any of the three environmental attributes could be achieved by changing catchment management practices, but that the default outcome would be a continued decline in quality. Detailed information was provided to respondents on how to interpret the levels used for each attribute (eg fish populations), so that each respondent understood the difference between a "high" and "low" attribute level. *Travel distance* was respondent-specific. Immediately before the choice task each participant stated the one-way distance to the beach they visit most often (see Table 2 for summary statistics). Five attribute levels were then generated by applying −50 %, −25 %, 0 %, +25 %, and + 50 % multipliers to this baseline, rounding to the nearest 5 km. This pivot design tailors the distance attribute to individual experience while preserving maintaining sufficient variation for model estimation. Using a Bayesian efficient design, we generated 8 choice cards per participant (see an example in Fig. 1). Note that due to the test-re-test objective of this paper, we made NO changes to the design of the choice experiment compared to the Hanley et al. (2017) paper.

The procedures of each session were as follows: (1) As participants arrived at the laboratory, they were free to choose any computer terminal to use during the session. (2) At the start of the experiment, the experimenter provided a brief welcoming statement and emphasized the requirement of no interaction or communication allowed between participants throughout the experiment. (3) The experimental program was initiated simultaneously for everyone, and the camera was turned on. Participants were told that the camera was turning on and asked to wait for 15 s before the survey appeared. (4) The participants first answered basic demographic questions (e.g. area of study, where are they from, gender, date of birth and zip code) followed by a series of questions associated with New Zealand beaches (e.g. how often do you go to the beach, how far is the beach most visited and main activity at the beach). (5) After these initial questions, the movie clips were played. Each participant was provided a set of headphones to allow for individualized and private viewing. (6) Upon completion of the movie clips, participants were sequentially provided the choice experiment question cards. (7) Lastly, the participants were sequentially asked to self-evaluate their emotional state while watching the movie clips and their current emotional state. (8) The camera was switched off and the experiment concluded once everyone had finished the survey questions. Participants that finished early were asked to wait quietly until the experimenter announced the experiment was completed for everyone. Participants

Variable	Mean ± SD or % (N = 298)
Female / Male	58.7 % / 41.3 %
Age (years)	25.7 ± 7.1 (range 16–61)
Beach trips per year	13.2 ± 27.5
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Fig. 1. Examples of choice cards.

were paid as they exited the laboratory (there was no link between the amount paid to each participant and their responses during the experiment: all participants were paid the same as a show-up fee).

Participants' stated emotions were elicited using a 7-point Likert scale. The intensity of our physiological measure of expressed emotions was indicated by Facereader on a scale from 0 to 1 using a proprietary algorithm. Participants' preferences for the three environmental attributes of beach quality and travel costs were estimated from their responses in the discrete choice experiment included in the survey.

We analyze the choice data within the random-utility framework. A conditional (multinomial) logit (MNL) model provides the baseline, assuming identical preferences and i.i.d. extreme-value errors (McFadden, 1974). To capture unobserved taste heterogeneity we adopt a random-parameters mixed logit (MXL; Hensher and Greene, 2003; McFadden and Train, 2000). Attribute coefficients are specified as continuous random variables; their means are allowed to shift with our key explanatory variables—dummy indicators for the Sad, Neutral and Happy film treatments (Model 1) or the continuous FaceReader / self-reported emotion measures (Models 2 and 3).

All models are estimated by maximum simulated likelihood with 10,000 scrambled Sobol draws per respondent (Czajkowski and Budziński, 2019). The resulting parameters yield (i) mean marginal utilities, which translate into willingness-to-pay measures for the beach attributes, and (ii) their standard deviations, which summarise preference heterogeneity across the sample.

Full mathematical details and the likelihood expressions are provided in Online Materials.

5. Results

To assess whether the film treatments successfully induced the intended emotional states, we examined both self-reported ratings and facial-expression data from FaceReader. Participants classified themselves as sad, neutral, or happy using a 7-point scale. During the film clips, 61 % of participants in the Sad condition reported feeling sad, while 56 % of those in the Happy condition reported feeling happy. Nearly all participants in the Neutral group rated themselves as emotionally neutral. These effects faded by the end of the experiment, as expected. FaceReader valence (happy – sad) followed the same directional pattern, with average values of −0.18 (Sad), −0.26 (Neutral), and − 0.07 (Happy) during the movie clips. However, absolute values were low and inter-group differences were insignificant, suggesting that while participants likely *felt* the intended emotion, it was not always strongly expressed in facial features. Full distributions and supporting statistics are provided in the online materials.

In the following analysis, we examine the survey and physiological data from the experiment to answer our three research questions, i.e., to determine whether (i) the treatments, (ii) the observed emotions, and (iii) the stated emotions influence participants' economic decisions and their preference parameters. We estimated the utility function parameters using the following explanatory variables for the means of the random parameters, where each model aims to answer one of the three respective research questions:

- Model 1: Dummy variables for 'sad' and 'happy' treatments which allow us to compare the mean estimated utility function parameters across experimental treatments, with the neutral movie clips as the baseline.
- Model 2: Continuous measures (0 to 1) of participants' observed 'sad' and 'happy' emotions, as recorded by FaceReader software, which allows us to test whether the mean estimated utility function parameters are associated with *observed* 'happy' and 'sad' emotions.
- Model 3: A measure (on a scale of 1 to 7, normalized to a mean of zero and a standard deviation of one) of participants' self-reported emotional states, which allows us to test whether the mean estimated utility function parameters are associated with *self-reported* emotions.

The results are presented in Table 4.

The estimated coefficients presented in Table 4 represent utility function parameters. They do not have direct interpretations, but their signs and relative magnitudes reflect the relative importance of beach characteristics and the influence of explanatory variables. Focusing first on general preferences for beach attributes in the neutral condition in Model 1, when holding observed emotions constant at their mean in Model 2, and when holding stated emotions constant at its mean in Model 3, we observe that participants show a strong preference for improved water quality and a somewhat weaker, though still significant, preference for better fish populations. Beaches with worse sediment issues or those located further away (incurring higher travel costs for participants) were less favored, as indicated by the negative and significant coefficients for these attributes.[4] As expected, we noted considerable preference heterogeneity, evidenced by relatively high and significant standard deviations for each environmental attribute.

Including interactions of the means of random parameters associated with specific attributes enables us to test whether treatment and/or incidental emotions influenced inferred preferences. Model 1 includes two dummy variables for the 'sad' and 'happy' treatments (compared to a 'neutral' reference). We find that none of the treatments significantly affected participants' economic choices in terms of their stated preference parameters.

Similarly, in Model 2, neither the 'sad' nor 'happy' emotions observed on participants' faces while making choices had a significant impact on their stated preferences. Nore that this outcome was consistent, whether we measured emotions during decision-making, while watching film clips, or at the end of the survey.[5]

Finally, in Model 3, we considered participants' stated emotions as interactions of the means of random parameters. Here too, we found no significant effects of participants' stated emotions on their economic choices. This result was the same whether the emotions were stated at the end of the survey or during the movie viewing.[6]

For all interaction terms the associated z-statistics were $|z| < 1.60$ (all $p > 0.10$), indicating no statistically significant treatment or emotion

[4] The ratios of the estimated coefficients represent marginal rates of substitution of different attributes – the rates at which participants were willing to trade one attribute for another, while keeping their utility level constant.

[5] The results of the models presented here as well as all additional models mentioned are available in the online supplement to this paper, available at http://czaj.org/research/supplementary-materials.

[6] The exact question asked to participants was "Finally, can you tell us how do you feel now?" and used the same 7-point Likert scale responses.

Table 4
Stated Preferences for Beach Characteristics, including the Interactions of Mean Preferences with the Experimental Treatments, Observed, and Stated Emotions – Results of the RP-MXL Model.

	Model 1 – Analysis of treatments				Model 2 – Analysis of observed emotions				Model 3 – Analysis of stated emotions		
	Mean in 'neutral treatment' (s.e.)	St. Dev. (s.e.)	Interactions of Mean 'sad' treatment	'happy' treatment	Mean assuming average observed 'sad' and 'happy' measures (s.e.)	St. Dev. (s.e.)	Interactions of Mean 'sad' (choice)	'happy' (choice)	Mean assuming average stated emotion (s.e.)	St. Dev. (s.e.)	Interaction of Mean 'sad-happy' (movie)
Status quo (alternative specific constant)	0.41 (0.31)	2.11*** (0.21)	−0.55 (0.43)	−0.59 (0.42)	−0.19 (0.25)	2.16*** (0.21)	−0.02 (2.43)	0.80 (0.87)	0.10 (0.35)	2.16*** (0.21)	−0.05 (0.10)
Water quality	1.52*** (0.15)	0.82*** (0.11)	−0.01 (0.20)	0.02 (0.19)	1.53*** (0.12)	0.83*** (0.12)	−0.70 (1.15)	0.27 (0.41)	1.45*** (0.15)	0.83*** (0.11)	0.03 (0.04)
Sediments	−1.05*** (0.15)	0.99*** (0.09)	0.23 (0.20)	0.10 (0.19)	−0.93*** (0.11)	1.02*** (0.10)	1.11 (1.13)	−0.20 (0.40)	−0.82*** (0.15)	1.01*** (0.10)	−0.04 (0.04)
Fish populations	0.20* (0.11)	0.55*** (0.08)	0.23 (0.15)	0.12 (0.14)	0.29*** (0.08)	0.58*** (0.09)	−0.89 (0.87)	0.25 (0.31)	0.35*** (0.12)	0.57*** (0.09)	−0.01 (0.03)
- Distance (100 km)	−1.06** (0.44)	1.29*** (0.20)	0.50 (0.43)	0.71 (0.46)	−0.79*** (0.29)	1.60*** (0.16)	−2.35 (4.28)	0.25 (0.70)	−0.93** (0.39)	1.48*** (0.20)	0.08 (0.08)
Model diagnostics											
LL at convergence	−2071.53				−2037.33				−2078.59		
LL at constant(s) only	−2609.41				−2564.66				−2609.41		
McFadden's pseudo-R^2	0.2061				0.2056				0.2034		
Ben-Akiva-Lerman's pseudo-R^2	0.4331				0.4329				0.4318		
AIC/*n*	1.7630				1.7639				1.7648		
BIC/*n*	1.8357				1.8376				1.8253		
n (observations)	2384				2344				2384		
r (participants)	298				293				298		
k (parameters)	30				30				25		

Notes: *, **, *** represent statistical significance at the 0.1, 0.05 and 0.01 level, respectively. Standard errors in parentheses. For log-normally distributed parameters (-Distance) the mean and standard deviation of the underlying normal distribution are provided. The analysis of observed emotions is based on 5 fewer respondents for whom emotions were not correctly observed.

effects on mean preferences. A likelihood-ratio test of the joint hypothesis that all interaction means equal zero yields LR($k = 10$) = 16.68, $p = 0.08$; LR($k = 10$) = 6.24, $p = 0.7947$; LR($k = 5$) = 2.56, $p = 0.7674$) for Models 1, 2 and 3 respectively, confirming that adding the interaction terms does not improve overall model fit.[7]

The consistent signal from all three models is thus that variations in incidental emotions have no significant impact on stated preferences for environmental attributes. A treatment-level comparison confirms that the emotion manipulation succeeded (FaceReader valence and the 7-point sad-happy rating both differ across clip sets; see footnote 8) while preference estimates remain statistically indistinguishable across treatments. Comparing this to the original results in Hanley et al. (2017), that paper found ".. *no emotional treatment-driven statistical differences in preference(s)*". This held whether the researchers considered the effects of being in the "sad" or "happy" treatment (ie, which set of film clips people saw), or whether their self-reported sad/happy status is used instead as an explanatory variable. Thus, the results of our new study are in accordance with the results of the original paper.

6. Discussion

The literature exploring the impact of emotions on Willingness-to-Pay and preferences is expanding, raising important questions about the reliability of Stated Preference (SP) measures in cost-benefit analysis. Emotional influences on SP assessments could potentially undermine their validity for informing policy decisions, which traditionally rely on rational economic choices which do not depend on contextual factors deemed irrelevant to economic decision-making in the standard model. The influence of emotions on environmental choices is garnering increasing academic interest, particularly because it challenges traditional interpretations and applications of stated preference measures in cost-benefit analyses. Our paper replicates and extends the findings of Hanley et al. (2017). Consistent with this earlier research, the results confirm that participants prefer beaches with better water quality, more robust fish populations, fewer sediments, and lower travel costs. Importantly, similarly to the earlier study, we observed no impact of emotional conditions or emotion treatments on participants' stated preferences for changes in the environmental qualities of New Zealand beaches. This paper can thus be viewed as a simple replication of the results reported in

[7] To verify that the three emotion measures capture a common underlying affect, we compared (i) treatment assignment, (ii) FaceReader valence (*happy – sad*) during the clips (*val_movie*) and during the eight choice screens (*val_choice*), and (iii) the 7-point *sad → happy* self-rating elicited immediately after the clips (*sad_happy*). An ANOVA confirmed that *val_movie* varies strongly across treatments ($F(2, 290) = 20.0$, $p < 0.001$). Across all participants *val_movie* correlates positively with *sad_happy* (Pearson $r = 0.21$, Spearman $\rho = 0.25$; both $p < 0.001$). Within treatments the correlation remains significant for Happy ($r = 0.23$, $p = 0.017$) and is indistinguishable from zero for Sad ($r \approx 0$). A Fisher-*z* test shows the two correlations do not differ ($z = 1.63$, $p = 0.10$). An ordered-probit regression of *sad_happy* on both FaceReader measures (controlling for treatment dummies) yields significant coefficients: $+2.03 \pm 0.39$ for *val_movie* and -1.53 ± 0.43 for *val_choice* (both $|t| > 3.6$, $p < 0.001$). These results demonstrate that induced, observed and stated emotions move in the same direction, albeit with moderate concordance – exactly what one would expect from related but not identical constructs. Hence the null effect of emotions on preferences is unlikely to be driven by measurement mismatch. Full details are provided in the online supplement.

Hanley et al. (2017), in which we corroborate their finding that incidental emotions do not influence stated preferences or willingness to pay. However, our paper extends this earlier work, by additionally measuring participants' emotions by employing Facereader technology to objectively measure emotions over time, rather than relying just on (i) which treatment participants were allocated to and (ii) their self-stated emotional condition. Facereader technology provided continuous, objective data on participants' emotions while watching the movie clips, during the discrete choice experiment, and at the conclusion of the experiment. We found that these objectively-measured emotions also had no discernible effect on stated preferences (Model 2), which aligns with the findings from self-reported emotions (Model 3), and the random allocation of participants to treatment condition (Model 1).

Despite these null results concerning the effects of emotion treatments on stated preferences—consistent with findings by Hanley et al. (2017)—it is worth noting that emotions induced by short video clips may not affect stated preferences for certain types of goods. Our focus was on changes to coastal water quality. Another reason for the limited generalizability of our results is the sample of university students as this group is not representative of the general public.[8]

Emotional states have been demonstrated to influence behavior in various other decision-making contexts, such as supporting wildlife conservation or protecting Alpine landscapes, as noted by Notaro et al. (2019) and Notaro and Grilli (2022) – although here the authors used pictures to induce emotions, rather than valuation-context-independent films. A possible explanation is that the nature of the choices in these other studies may inherently evoke stronger emotional responses compared to choices about beach quality. Importantly, in both the present study and the Hanley et al. (2017) study, the materials used to induce emotional states were not connected with the environmental good being valued. We also note that the use of observed emotional condition in the present paper perhaps fails to deliver a significant change in stated preferences because our procedure fails to induce strong enough emotions which can be picked up by the Facereader. We lack empirical evidence to support this speculation; but note findings by other researchers that Facereader seems better at picking up positive compared to negative emotions; and does not always out-perform self-ratings or personal ratings of others. For example, Küntzler et al. (2021) found that Facereader did a poor job of categorizing reactions to movie clips based on fear, whilst Burgess et al. (2023) found it to perform worse than manual coding of facial expressions in parents reacting to their children's behavior, particularly for negative emotions.[9] Furthermore, Face Reader can only measure the six basic universal emotions: Happiness, Fear, Anger, Disgust, Surprise, and Sadness. There is consensus that these emotions have characteristic facial expressions. Other emotions cannot be distinguished by facial expressions and other measurement tools, such as questionnaires or other physiological measurement devices are required. Thus, we cannot rule out the possibility that other emotions might influence valuations for the good we have studied, only that the six basic universal emotions do not affect them.

Our results also speak to the practical question of how much emotion measurement is "enough". (i) If the sole aim is to test whether an exogenous stimulus shifts preferences, reporting the randomised treatment is adequate—*provided* the manipulation has been validated previously. Still, a single Likert item costs almost nothing and documents that the manipulation worked in the current sample, so we recommend retaining one or two self-report questions as a manipulation check. (ii) Continuous facial-expression tracking delivered richer process data but, once treatment and self-reports were accounted for, explained no additional variation in preferences. Hence expensive biometric tools are **not necessarily a prerequisite** for credible welfare estimates or reliable experimental controls when the emotions are incidental to the valuation task. Laboratories that already own such equipment may still benefit from the high-resolution data, but researchers designing new studies can possibly rely on low-cost measures that suffice in contexts similar to ours.

Looking forward, several paths appear promising for further research. Firstly, the intriguing relationship between treatment and objective emotional measures suggests a need for deeper investigation into how emotions are induced and measured in experimental settings. It may be beneficial to explore if different methods of emotion induction, or varying contexts of decision-making, might reveal more about the subtleties of emotional effects on economic choices for the environment. Second, expanding the scope of studies to include a broader range of environmental and personal factors could help in understanding the conditions under which emotions might influence economic decisions. Future studies could test, for example, whether the effects of incidental emotions on stated preferences depends on whether the environmental good is of high or low emotional value (e.g. sea horses vs. sea grass) in explicit mediation analyses. Since policy-relevant cost benefit analyses are typically conducted with representative samples, it would also be important for future work to test whether the results hold with other samples. Third, follow-up work might consider situations in which we might expect emotional factors to have a particularly strong effect. These might include policy decisions for which there is a strong partisan or cultural divide, such as permitting logging in an area containing endangered species or in which the environmental damage has a very strong and direct effect on the participant, such as the building of a power plant or the destruction of a wetland located very close to their home.

Finally, employing longitudinal studies could provide insights into the persistence of emotional effects over time, offering a more dynamic understanding of how emotions impact stated preferences.

In conclusion, while our study supports the view that incidental emotions do not significantly sway stated preferences in environmental settings, the observed results suggest that the interplay between emotions and economic decisions is complex and merits further exploration.

CRediT authorship contribution statement

Yilong Xu: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Mikolaj Czajkowski:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nick Hanley:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Leonhard Lades:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Charles N. Noussair:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Steven Tucker:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

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Declaration of competing interest

The authors are aware of no conflict of interest which is relevant to the research reported in this paper.

[8] Because the sample consists of university students with a mean age of 26 years (Table 2), we did not estimate absolute WTP levels, as they are not relevant and should not be generalised to the wider population; our focus is on relative treatment effects.

[9] Lewinski et al. (2014), tested how well Facereader identified the emotions in two databases of faces exhibiting different emotions. The accuracy rate was 96 % for Happiness, while for the four negative basic emotions, the accuracy rates ware Fear (76 %), Sadness (96 %), Anger (76 %), and Disgust (91 %)

Appendix A. Appendix

A.1. Experimental Script, Emotions 2

Thanks for coming along today. We are going to ask you to undertake a few tasks and answer some questions about yourself, and also to watch a short film.

These sessions are being run as part of research being undertaken by the Economics Department at the University of Waikato.

All of your responses will be treated confidentially – we will not disclose individualized data to anyone outside the research team.

1. What are you studying?
2. Where are you from?
3. Are you Male or Female?
4. When were you born?
5. What is your zip code?

A movie specific to the treatment condition was presented to the subjects.

We'd now like you to watch some short film clips.

Beach Preference Questions:

We now want to ask you some questions about the New Zealand coast. Many of us enjoy a visit to the beach, whether to go surfing, swimming, or just hanging out. Many people also enjoy fishing and boat trips.

1. How often do you usually go to the beach? __ trips/year
2. How far is the beach you visit most often? __ km
3. What is your main activity at the beach?
   a. surfing
   b. swimming
   c. boating
   d. just hanging out with friends and family,
   e. other ___ (what)

In what follows, please think about your visits to a beach for a similar purpose.

Introduction to Choice Experiment:

The state of the environment can affect people's experiences during such visits, and may be one of the factors determining which beaches they choose to visit. Most of these environmental conditions – such as water quality – are partly determined by how we manage our coastal areas (for example, how much money is spent on pollution control).

Imagine that you have decided to take a day trip to a beach in this area, and are thinking about where to go. On the next screens, you'll see a number of hypothetical options. We'd like you to make a choice in each case about which beach you'd prefer to visit. Whilst there are many factors determining where you might want to go, these options are all concerned with the environmental conditions at different beaches. Another important factor is obviously how far you would have to travel, so you will see some information in the choice sets about this too. You can assume that it is safe (and fun!) to surf or swim at all of these beaches.

For example, you might be asked to choose between these options:

	Beach A	Beach B	Neither
Water quality	poor	good	
Sediments	high levels	medium levels	If these were my only alternatives, I would not want to visit either of these beaches and would stay at home or do something else (not beach-related) instead.
Fish populations	declining	increasing	
How far from where you live?	X – 25 % km	X + 25 % km	
I would choose:	☐	☐	☐

Here, we asked you to choose to visit beach A, beach B or stay at home.

Beach A and B are described by these environmental conditions:

Water quality;

Sediments;

Fish population, and;

How far away the beach is from where you live.

We'll now tell you a bit more about these factors.

Definition of Water Quality:

WATER QUALITY is important so that we can swim safely without getting sick, keep the animals and plants that live in the sea healthy and to keep the sea looking beautiful. Water entering the coastal zones is affected by human wastes and can be laden with nutrients and other contaminants from farmland. If we take no further action, with a growing population and reduced effectiveness of infrastructure over time, water quality will get worse. This may cause more beach closures (due to pollution by "coliforms" or algal blooms) in certain places. However, if we increase our efforts we will be

able to maintain water quality to the current standards we experience (likelihood of beach closures remains similar to the present) and further efforts could actually see an improvement in water quality (reduced risks of beach closures, no algal blooms and healthier waterways).

In the choices below, you will find that water quality might take one of 3 levels:

- Poor water quality – high levels of nutrients, algal blooms likely
- Good water quality
- Very good water quality – nutrient levels are greatly reduced, algal blooms very unlikely

How would you evaluate the water quality at the beach you visit most often?

o Poor water quality – high levels of nutrients, algal blooms likely
o Good water quality
o Very good water quality – nutrient levels are greatly reduced, algal blooms very unlikely

Definition of Sediments:

SEDIMENTS affect the way we experience the coast, from the clarity of the water (how far down you can see) to underfoot conditions. Changes in land-uses mean that sediment arriving in our harbours and estuaries has increased. This has caused a muddying of many shores and high levels of turbidity that result in the water being murky and unattractive. If we take no further action, sediment will continue to accumulate at the coast and areas of muddy sediment will increase (in coverage and in muddiness). In some places, this will result in further expansion of mangroves. While we can't entirely remove the sediment problem, it is possible to reduce its impacts. With an increased effort in storm-water management areas, we may also be able to improve on the current situation, leading to cleaner, bluer water) and less muddy shores.

In the choices below, you will find that sediment levels might take one of three levels:

- High levels of sediment – water is very cloudy, beaches become muddy
- Medium levels of sediment
- Low levels of sediment - water is very clear, beaches stay sandy

How would you evaluate the sediment levels at the beach you visit most?

o High levels of sediment – water is very cloudy, beaches become muddy
o Medium levels of sediment
o Low levels of sediment - water is very clear, beaches stay sandy

Definition of Fish Populations:

FISH POPULATIONS: many people like to go fishing, for example for snapper. Others like to just know that there are healthy fish stocks in the sea. How good fish stocks are depend on how the coastal environment is managed. Right now, fish populations are under pressure from over-fishing and from water pollution. We can take actions to reduce these pressures, but unless we do so, stocks might continue to decline.

In the choices below, you will find that fish populations might take one of three levels:

- Declining – fish populations are falling due to too much pollution and too much fishing
- Stable
- Increasing – there are healthy and expanding fish populations of fish such as snapper.

How would you evaluate the fish populations at the beach you visit most often?

o Declining – fish populations are falling due to too much pollution and too much fishing
o Stable
o Increasing – there are healthy and expanding fish populations of fish such as snapper.

The Eight Choice Experiment Questions Asked Sequentially.

Now, we would like you to go through each of the following 8 choice sets, and in each case choose one option which you like best. At any point in time, you can click on any of the beach characteristics to go back and look again at what they mean.

[The following is an example of a choice task that a subject may have faced.]

	Beach A	Beach B	Neither
Water quality	poor	poor	If these were my only alternatives I would not want to visit either of these beaches and would stay at home or do something else (not beach-related) instead.
Sediments	medium	high	
Fish populations	declining	stable	
How far from where you live?	120 km	120 km	
I would choose:	☐	☐	☐

Emotion Elicitation Questions:

Can you tell us how you felt like when watching the film clips?

1. While I was watching the film I felt…1 = sad, 4 = neither happy nor sad, 7 = happy.
2. While I was watching the film I felt…1 = bad, 4 = neither bad nor good, 7 = good.
3. While I was watching the film I felt…1 = relaxed, 4 = neither tense nor relaxed, 7 = tense.
4. While I was watching the film I felt…1 = not-aroused, 4 = somewhat aroused, 7 = aroused.

[New Page].

Finally, can you tell us how do you feel now?

1. I feel …1 = sad, 4 = neither happy nor sad, 7 = happy.
2. I feel …1 = bad, 4 = neither bad nor good, 7 = good.
3. I feel …1 = relaxed, 4 = neither tense nor relaxed, 7 = tense.
4. I feel …1 = not-aroused, 4 = somewhat aroused, 7 = aroused.

The Experiment Concluded.

THANKS! THAT IS THE END OF THE EXPERIMENT.

Please wait quietly until everyone has finished.

THE EXPERIMENTER WILL THEN CALL YOU BACK ONE AT A TIME TO PRIVATELY PAY YOU THE $20 PARTICIPATION FEE.

Data availability

Data will be made available on request.

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