# Is WTP an attitudinal measure? Empirical analysis of the psychological explanation for contingent values

Anthony M. Ryan [a], Clive L. Spash [b,c,*]

[a] The Australian National University, Canberra, Australia
[b] Socio-Economics Department, WU, Vienna University of Economics and Business, Norbergstr. 15, UZA4, 1090 Vienna, Austria
[c] Department of International Environment and Development Studies, Noragric, Norwegian University of Life Sciences, Ås NO-1432, Norway

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## ABSTRACT

Contingent valuation has been given a psychological interpretation, by Kahneman and colleagues, that claims willingness to pay bids represent psychological attitudes rather than personal economic valuations. Evidence reported here shows the need to qualify the role of this attitudinal explanation. In contradiction to the attitudinal hypothesis, the decision to bid zero or positive appears to represent a complex psychological appraisal. Furthermore, evidence of bid clustering on currency denominations implies fundamental differences concerning how people respond to a monetary scale. Whether interpreted as charitable contributions or imprecise welfare estimates there are serious implications for how economists interpret and use stated preference responses.

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## 1. Introduction

The Contingent Valuation Method (CVM) is a controversial but commonly applied hypothetical market approach for placing a monetary value on an actual or proposed environmental change. Anomalies in CVM survey results and numerous problems relating to design choices led to the early recommendation of best practices guidelines (Cummings, Brookshire, & Schulze, 1986; Mitchell & Carson, 1989). The results of CVM studies have then been justified as having the potential to be valid representations of a reliable and unbiased 'true' monetary valuation when survey design and administration is consistent with 'state of the art' practice (e.g., Bateman et al., 2002). Truth in this context is typically a reference to revealing the fully preformed preferences of the general public. The most renowned attempt at developing such guidance involved a panel, including two Nobel economic prize winners, convened by the National Oceanic and Atmospheric Administration

* Corresponding author at: Socio-Economics Department, WU, Vienna University of Economics and Business, Norbergstr. 15, UZA4, 1090 Vienna, Austria. Tel.: +43 31336 5422; fax: +43 31336 705.
    E-mail address: clive.spash@wu.ac.at (C.L. Spash).

(Arrow et al., 1993). Such best practice approaches to CVM contend that, under the right design conditions, if you ask a member of the public "What is the maximum you would be willing to pay for environmental improvement X", participants will readily provide a meaningful response that reflects their personal monetary valuation of the proposal and can be taken as representing the welfare they would gain. This approach assumes that people are not only capable of comparing the utility of the status quo with the utility of a proposed change, but are also able to estimate to the point of indifference how much money they would be willing to spend in order to purchase the benefits that they, or their household, would derive from such a proposal. The greater the perceived net benefit of the proposal, the more respondents should be prepared to pay. Thus, a positive willingness to pay (WTP) bid is taken to represent the exchange of money for positive welfare benefits.

A form of this traditional economic approach has been termed the "purchase model" by Kahneman and colleagues (Kahneman & Ritov, 1994; Kahneman, Ritov, Jacowitz, & Grant, 1993; Kahneman, Ritov, & Schkade, 1999). The purchase model was originally developed to describe the motivation to acquire personal benefits, but can be taken more generally as a characterisation of an economic approach where consequences for an individual or household causally influence evaluations of an act or behaviour. Theoretical concerns (e.g., free-riding, incommensurability, non-economic values) and empirical anomalies (e.g., hypothetical bias, anchoring bias, insensitivity of scope, weak income effect) have raised questions about whether using such a model to interpret the motives behind payments towards the supply of public goods is appropriate. These problems appear especially relevant for CVM surveys asking participants about their willingness to make a general contribution towards an environmental cause.

CVM practitioners working on environmental valuation have been particularly concerned about possibilities for hypothetical bias (Cummings, Harrison, & Rutstrom, 1995; Foster, Bateman, & Harley, 1997; Murphy, Allen, Stevens, & Weatherhead, 2005; Murphy & Stevens, 2004). Typically, hypothetical WTP bids have been found to be higher than actual payments made for the same change in supply of a public good. Hypothetical bias has been found to be prevalent when participants lack market experience with respect to the object or entity being subject to the CVM, and this has led some to suggest that experience in markets makes people more "rational" (List, 2001; List & Gallet, 2001). Of course this rather begs the question as to what is rational and the role of the CVM practitioner in changing behaviour. Spash (2008a) notes that practitioners have been keen to design features into CVM surveys that are intended to make respondents conform to the expectations of the standard economic model. For example, 'cheap talk' scripts have been developed to reduce hypothetical bias (Cummings & Taylor, 1999; Murphy, Stevens, & Weatherhead, 2005). This reflects a general concern to minimise what is deemed to be behaviour deviating from the neoclassical economic model and encourage optimisation (Johnson & Swallow, 1999).

An alternative approach to understanding the shortcomings of CVM is to examine WTP responses from the participant's perspective and take their responses as valid on their own terms. Research in this direction typically concludes that CVM responses are the product of more than one motive (Brown, Champ, Bishop, & McCollum, 1996; Schkade & Payne, 1994; Spash, 2000a, 2000b, 2006). Some researchers then, once again, respond by developing techniques for validating and bounding bids (e.g., Ajzen, Brown, & Carvajal, 2004; Champ & Bishop, 2001; Champ, Bishop, Brown, & McCollum, 1997), which can lead to segregation of the respondents regarded as offering non-economic values (Spash, 2008a). However, others have concluded that multiple motives imply the need for value pluralism. This has encouraged questioning the philosophy behind current economic methodologies and proposing alternatives such as social multiple criteria analysis (Martinez-Alier, Munda, & O'Neill, 1998) and deliberate monetary valuation (Spash, 2007; Spash, 2008b). Consistent with this interpretation, Kahneman et al. (1999, p. 204) point out that "the valuation of environmental goods is far from the core of economic discourse".

Kahneman and colleagues propose a new interpretation of WTP under CVM which they contrast with the purchase model. They label this alternative theoretical approach the "contribution model" and assert that it is a psychologically more plausible interpretation of a hypothetical monetary offer to pay towards the provision of a public good. The contribution model portrays positive WTP bids under the CVM as being motivated by the perception that a positive environmental proposal forms a good cause that needs supporting (Kahneman & Ritov, 1994). Respondents are deemed to be fully aware that any monetary amount that they personally offer will be insufficient to realise the type of societal projects to which CVM is applied (Kahneman & Ritov, 1994; Kahneman et al., 1993). The contribution model posits that the spirit of donation, rather than benefit acquisition, is the primary motivation underlying a positive WTP response. Instead of consequentially assessing the costs and benefits of outcomes, people are regarded as being concerned with taking positive action to address a social or public policy problem. Respondents holding a belief that an action is "right" may even be willing to give more than those making a judgement of support based on consequences (Spash, 2000a, 2006). In this way, the contribution model denies that a positive WTP bid is representative of the welfare benefits accruing to an individual from an environmental improvement, and instead suggests that some people may pay towards social and environmental changes from which they expect to derive no personal utility.

While many economists acknowledge that actual donations towards public goods under CVM are not fully demand revealing the inferences made by Kahneman and colleagues' contribution model are far more damning. The core component of the contribution model which concerns us here is that in a CVM survey, rather than assessing the worth of public goods provision, participants are offering a donation that simply reflects their psychological attitudes towards the proposed change. Other authors have suggested that while attitudes can be one of the motives that influences CVM responses to proposals concerning public goods there are several other possible influences—including income, economic purchase motives, perceived control, norms and different ethical motives (see for example Ajzen et al., 2004; Brown et al., 1996; Schkade & Payne, 1994; Spash, 2006; Spash et al., 2009). However, Kahneman & Ritov (1994, p. 28) put forward an exclusive attitudinal hypothesis when they state that "WTP is a measure of attitude on a scale of hypothetical dollars". They believe that "a

favourable attitude to an object is usually correlated with favourable attitudes to actions that will protect that object from harm, or restore it if it has been harmed" (Kahneman & Ritov, 1994, p. 7), and suggest that a positive WTP bid represents a favourable attitude supporting a proposed societal change. They go on to draw upon Andreoni's (1989) warm glow hypothesis and state that "an individual who has a favourable attitude to a cause derives utility from contributing to it" (Kahneman & Ritov, 1994, p. 8)[1]. Kahneman et al. (1999, p. 207) further clarify this by explaining that "attitudes can be expressed on a scale of dollars, as well as on rating scales". This attitudinal hypothesis predicts that WTP responses will correlate with a range of attitude measures in social psychology. The more positive an attitude towards an environmental change the greater should be the stated WTP, although Kahneman et al. (1999) also argue that the WTP monetary scale is a psychometrically inefficient measure of attitudes. If the attitudinal hypothesis is empirically valid, then this would support Kahneman and colleagues claim that CVM should be replaced by psychometrically superior attitudinal scales (Kahneman & Ritov, 1994; Kahneman et al., 1993).

Although papers by Kahneman and colleagues on the contribution model have been highly cited, and in many respects influential, the attitudinal hypothesis that underpins this model has not yet been adequately examined. The importance of this paper resides in the examination of the claim that CVM purely measures attitudes. In the next section, we review the role of attitudes and the evidence for interpreting WTP as an attitudinal measure. In doing so we explain how the empirical evidence (i.e., the headline method) used to support the attitudinal hypothesis has been both deficient and inadequate. Section 3 outlines our own research design and explains how the approach used in the current study is able to offer more valid conclusions than the previous studies conducted by Kahneman and colleagues about the relationship between attitudes and WTP responses. Section 4 then reports empirical tests using two open-ended CVM datasets. The results partially undermine and partially support the intuition behind the attitudinal hypothesis and are discussed in Section 5. While the empirical work presented does not offer a direct test of the contribution model we discuss implications of our findings and stress points where relevant inferences may be drawn. This also indicates avenues for further research.

## 2. Psychological attitudes and the attitudinal hypothesis

This paper examines whether WTP bids are the result of just an attitudinal assessment or whether other factors are being considered by respondents. Psychologists conceptually distinguish attitudes from other psychological variables. Attitudes are defined as being an evaluative tendency, which can be favourable or unfavourable (Eagly & Chaiken, 1993, 2007).

The theory of planned behaviour (TPB) identifies attitudes as being only one out of three main influences on behavioural intentions (Ajzen, 1991, 2001), the others being subjective norms and perceived behavioural control. Subjective norms and perceived behavioural control are defined as being non-attitudinal psychological variables that are posited to independently influence behavioural intentions above and beyond the influence of attitudes. For example, a study by Ajzen et al. (2004), on a small convenience student sample, found that subjective norms and perceived behavioural control provided additional explanatory variance to attitude scales in explaining offers to donate to a university scholarship fund for needy students. If these non-attitudinal psychological variables are found to have an independent and significant relationship with WTP responses from CVM surveys, then this would suggest such surveys are measuring a broader psychological evaluation than offered by an attitudinal assessment. Yet non-attitudinal psychological variables have been absent from studies that have specifically examined the attitudinal hypothesis.

Evidence supporting the attitudinal hypothesis is primarily based upon three published journal articles that administered the headline method (Kahneman & Knetsch, 1992; Kahneman & Ritov, 1994; Kahneman et al., 1993). The headline method asks participants to assess a list of approaches to public policy problems.[2] While some of the participants assess the proposals on a WTP scale, other participants respond on an attitudinal scale. For each scale the list of public policy proposal are ranked according to their mean or median scores. A rank correlation assessing the degree of similarity in the ordering of the public policies—based on mean/median scores of attitude scale and WTP—is then reported. As shown in Table 1, the headline method studies have reported some very strong rank correlations between WTP and a number of single item attitudinal scales.[3] Kahneman et al. (1999) also note supporting results from an experimental study by Kahneman, Schkade, and Sunstein (1998) that employed the headline method to look at punitive damages in a product liability case. Furthermore, Payne, Bettman, and Schkade (1999) found high rank correlations between attitudinal measures and stated WTP using a similar design.

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[1] Warm glow is a term that has recently become ambiguous. Andreoni's (1989) original use of the term referred to people receiving utility from the act of giving regardless of the consequences of that giving. However, Christie (2007) uses it as an explanation for hypothetical bias, where "warm glow" refers to people receiving utility from pleasing an interviewer.

[2] Public policy issues in these studies actually cover a much broader range than found in typical CVM studies and they are not specified in the same way (i.e., as detailed marginal changes from a status quo position). In Kahneman and Ritov (1994), for example, 37 problems are presented including: threats to animal species (American elk, ferrets, elephants, marine life), threats to plant species (coral reefs, mushrooms, pine trees), ecological damage (wetlands, climate change in third world, automobile pollution, toxic spills), culture (historic buildings) public safety (lighthouses, earthquake safety) and public health (powerlines causing leukaemia, increase in anaemia, skin cancer in farmers). The issues are presented as headlines, in which a brief description of a problem is followed by a single sentence describing a proposed intervention e.g., "THE PEREGRINE FALCON IS THREATENED BY POLLUTION. Intervention: Support special program to protect the Peregrine falcon."

[3] Note, single item scales ask one question and are inferior to multiple items scales which allow for factor analysis and more rigorous statistical testing. Multiple item scales are generally regarded as more robust in social psychology.

**Table 1**
Reported rank correlations from three headline method studies.

| Study and scale | Correlation with WTP |
|---|---|
| Kahneman and Knetsch (1992) | |
| Moral satisfaction (Group 1) | 0.78 |
| Moral satisfaction (Group 2) | 0.62 |
| | |
| Kahneman et al. (1993) | |
| Rating of political support for intervention | 0.75 |
| Rating of personal satisfaction expected from making a voluntary contribution of time or money to the intervention | 0.79 |
| Rating of how upsetting it would be to read the story announce by the headline or to watch the item on television | 0.52 |
| Rating of the importance of the problem | |
| Kahneman and Ritov (1994) | |
| Rating of political support for intervention | |
| WTP | 0.84 |
| % WTP[a] | 0.82 |
| N (WTP)[b] | 0.81 |
| | |
| Rating of personal satisfaction expected from making a voluntary contribution of time or money to the intervention | |
| WTP | 0.84 |
| % WTP[a] | 0.80 |
| N (WTP)[b] | 0.88 |
| Rating of the importance of the problem | |
| WTP | 0.76 |
| % WTP[a] | 0.66 |
| N (WTP)[b] | 0.83 |

[a] Percentage of positive responses.
[b] WTP response for each individual divided by the mean contribution from that individual.

Kahneman and Ritov (1994) note the importance of investigating the mean scores of a specific proposal because many public decisions are based on aggregated data and average CVM scores are used by economists rather than individual scores. However, the literature presented in Table 1 also claims that the high rank correlations are indicative of a psychological process operating at an individual level. Based on the rank correlations the authors have concluded that attitudinal scales and WTP are almost interchangeable measures of the same attitude, with the rank correlations being interpreted as representing "an idealised subject" or person (Kahneman et al., 1993).

Nickerson (1995) has criticised such an approach, arguing that an intrinsically within-respondent hypothesis cannot be tested by correlation analysis based on means or medians, except in some special and restricted cases. A more appropriate hypothesis test would be to simultaneously collect attitudinal ratings and a WTP value from each respondent. Nickerson (1995) describes the headline study approach as an example of a subtle and insidious methodological problem known as "cross-level inference". This is defined as instances where data are organised or aggregated in one way, but the conclusions drawn from the analysis of those data assumes that the data are organised or aggregated in some other way. A good example of cross-level inference is the following quote by Kahneman et al. (1993): "our main finding was that correlations between the rankings of environmental issues by different response measures were high suggesting that the WTP to make a personal contribution of money, support for political action and a simple rating of the importance of the problem are almost interchangeable measures of the same attitude" (p. 314). Nickerson (1995) demonstrates that there is no necessary mathematical relationship between the correlation of the group means and the mean within-respondent correlation.

Monin and Oppenheimer (2005) provide a simple example that demonstrates the dangers in mixing-up correlated averages with averaged correlations. Table 2 displays the scores of two judges who each rate four stimuli: a–d on two separate dimensions A and B. The within-respondent level proposed by Nickerson (1995) correlates the two dimensions for each of

**Table 2**
Disjunction between rank and within-respondent correlations. *Source*: Monin and Oppenheimer (2005).

| | | Stimulus | | | | |
|---|---|---|---|---|---|---|
| | | a | b | c | d | |
| Judge 1 | Dimension A | 0 | 2 | 4 | 6 | |
| | Dimension B | 6 | 2 | 4 | 0 | $r = -0.80$ |
| Judge 2 | Dimension A | 6 | 2 | 4 | 0 | |
| | Dimension B | 0 | 2 | 4 | 6 | $r = -0.80$ |
| Mean scores | Dimension A | 3 | 2 | 4 | 3 | Rank = +1.00 |
| | Dimension B | 3 | 2 | 4 | 3 | Within-respondent = −0.80 |

the judges and reports a strongly negative correlation ($r = -0.80$). In contrast an approach, analogous to the headline method, which correlates the rankings of mean scores for each of the four stimuli, reports a perfect positive rank correlation ($r = +1.00$). While Monin and Oppenheimer's example of cross-level inference is extreme, this clearly explains why the onus of proof lies with Kahneman and colleagues to demonstrate that within-respondent correlations can be extrapolated from their rank correlations of the 'average' or 'idealized' respondent. Kahneman and Ritov (1994) comment that while they are aware that Nickerson considers cross-level inference to be a serious concern they do not. Kahneman et al. (1999) suggest that any major differences between rank correlations and within-respondent correlations will be due to the group scores being dominated by a few individuals. They point out that the headline studies assessed the effects of standardising the data of each individual and conclude that the data set did not contain atypical patterns of responses that would be indicative of individuals behaving inconsistently with the rank correlation conclusions. However, even if there are no worrisome outliers, there may still be fundamental differences between how people respond to WTP scales and attitudinal measures.

Kahneman and colleagues argue that a WTP monetary scale is psychometrically a measure of attitudes, and a poor one. The headline studies demonstrate the statistical inefficiency of the open-ended WTP scale by analysing: (i) the variance between the different issues that are presented, (ii) the variance associated with individual differences and (iii) the noise variance. A good scale should be able to differentiate between issues, but should also have a low variance between individuals and a low noise variance. Kahneman et al. (1993) and Kahneman and Ritov (1994) find the proportion of problem-related variance to be larger for their attitudinal scales, while the variance for individual differences was much larger for the WTP scale. Based on this evidence, they propose that attitudinal scales are statistically more efficient than the WTP scale. Kahneman and Ritov (1994) and Kahneman et al. (1999) claim that the poor properties of the WTP scale are due to: (i) a lack of common modulus[4] and (ii) the distribution of WTP responses.

That a monetary scale fails to provide respondents with a common modulus is regarded as leading to large differences between individuals as to how a monetary scale is interpreted. The modulus that each WTP participant uses is claimed to be arbitrary. Context effects in CVM questionnaire design are argued to lead not only to individual differences in the evaluation, but also to individual differences in the money expression of this evaluation. Attitudinal scales, on the other hand, are regarded as being bounded, psychologically meaningful, response scales. Kahneman et al. (1999) suggest that most people have an intuitive and common understanding of the meaning of the attitudinal response scales administered by psychologists. For example, that most people would have a basic agreement on the difference between "extremely important", "very important", "moderately important", "not very important" and "not at all important". Survey participants are argued to share a common definition as to what constitutes a certain response range. Kahneman and Ritov (1994) suggest that as a result attitudinal measures should replace WTP questions when the goal is to assess the value of public project proposals. They suggest that a money value could be assigned to an attitudinal score based on reference to a standard scale.

Kahneman et al. (1999) also point out that most open-ended WTP distributions have a large positive skew that degrades the statistical efficiency of the scale. They comment that logarithmic transformations improve the statistical efficiency of the monetary scale. An explanation as to why open-ended WTP scales are positively skewed is that the coins and notes of monetary systems increase exponentially. For example, the UK has four denominations of exponentially increasing pound notes in circulation: £5, £10, £20, £50. Requesting monetary expression of environmental values may encourage a WTP response that reflects the standardised currency amounts because people are unaccustomed to thinking about environmental proposals in terms of monetary values. Studies have found that certain WTP numbers are significantly over-represented amongst valuations elicited from the general population (Whynes, Frew, Philips, Covey, & Smith, 2007; Whynes, Philips, & Frew, 2005). Hertwig, Hoffrage, and Martignon (1999) argue people are unable to make valuations based on the full continuum of a monetary scale and therefore rely on a few numbers. This suggests that rather than responding on an arbitrary continuous scale, as proposed by Kahneman et al. (1999), many participants may only consider a WTP valuation that is based upon a handful of numbers. If denominations from the monetary system are over-represented in WTP response distributions, this would suggest a lack of variation in how people interpret the monetary scale rather than a large arbitrary variation (as suggested by Kahneman and colleagues).

While the research and analysis reported next will not specifically examine Kahneman and colleague's contribution model a couple of points are worthy of note. First, if bids cluster on fixed currency amounts then this could be taken as behaviour consistent with the contribution model (i.e., that positive WTP bids under the CVM are offered in the spirit of a donation rather than being a consequentially evaluated acquisition of benefits). However, in order for this to be taken as supportive of the model requires affirmation of the additional hypothesises that charitable contributions tend to be fixed amounts (e.g., standard currency denominations) disconnected from the specifics of a cause for fund raising (e.g., I always give £5 to a worthy cause). This is not something we test here. Second, the headline studies only empirically examine the rank correlation between attitudes pertaining to a specific proposal and WTP. If WTP is simply a measure of attitudes then there should also be a strong positive relationship between WTP and general attitudes towards environmental protection. This would support the hypothesis that WTP represents a contribution to a good cause rather than an evaluation of the specific benefits associated with a particular environmental project.

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[4] A common modulus refers to the scale being formally standardised for all participants. This term is borrowed from the field of psychophysics, which is where Kahneman began his research career. Psychophysicists are interested in how an individual experiences a sensation (e.g. the intensity of a sound). Common practise in psychophysics' experiments is to administer participants with a specific standard stimulus (the modulus) and then ask them to assess other stimuli relative to the standard stimuli.

## 3. Research design and method

The current study investigates the attitudinal hypothesis by means of a within-respondent design, analysing two datasets from different open-ended CVM surveys.[5] The first is from a study that asked CVM participants their maximum willingness to pay into a trust fund dedicated to transforming a farm site to a wetland for a variety of species. The second is from a study that asked the maximum WTP as an increase in electric utility bills to improve the biodiversity of a catchment subject to hydro-electric schemes. Both payment mechanisms and other basic design features are typical of those used in CVM studies. More details on the case studies are given below. Our objective is to examine whether WTP responses are explicable as a quantitative summary of attitudes about an environmental proposal. If this proposition is not supported Kahneman and colleagues are unjustified in arguing that CVM simply produces a psychometrically inferior attitudinal scale.

Participants in each of the CVM studies were administered a WTP question and attitudinal scales. One of the administered scales measured specific attitudes about an environmental change proposal, while another scale measured general attitudes about environmental protection.[6] In each study participants were presented with a single environmental change proposal. Therefore, unlike the headline method studies, conclusions are not based upon the hypothesis of process continuity that proposes errors and biases affecting quick intuitive judgements should also affect more slowly formed judgements (Kahneman & Ritov, 1994). Data was collected from representative samples without monetary incentives to participate, unlike some of the headline method studies. Finally, rather than measuring attitudes with a single item, robust multiple item attitudinal scales were administered. The methodology and samples used are therefore better suited than the headline method studies to investigate the attitudinal hypothesis.

The attitudinal hypothesis is tested by examining whether there is a strong within-respondent relationship between attitudinal scales and WTP. Kahneman and Ritov (1994), noting the findings by McFadden and Leonard (1992), point out that the propensity to make positive contributions and the size of these contributions may be essentially independent characteristics of respondents. Brown et al. (1996) also note that most of the explanatory power of the independent variables in explaining open-ended WTP could be attributed solely to the binary distinction between a $0 payment and a positive payment. They posit the possibility that the more difficult task required of open-ended (compared to dichotomous choice) responses causes additional, or random, factors to play a role in determining WTP. We therefore separately investigate whether attitudinal measures are able to predict: (i) the two bid-type classifications of zero and positive, and (ii) the amount offered by positive bidders.

In addition, we test whether the psychologists' definition of attitudes, as an evaluative tendency which can be favourable or unfavourable, is broad enough to be able to adequately define WTP as an attitudinal scale. The hypothesis here is that there is more to WTP responses than purely an attitudinal measure. We therefore employ factors from the TPB, as discussed in Section 2, which represent non-attitudinal psychological variables. Two aspects of the TPB are then added, namely, subjective norms and perceived behavioural control.

The psychological scales were all administered after participants responded to the WTP question. The theory of cognitive dissonance (Festinger, 1957), which suggests that people prefer to avoid inconsistencies, would predict that these psychological responses should be closely aligned with WTP responses. The need for people to demonstrate consistency in their responses should increase the likelihood of there being a strong correlation between WTP and the attitudinal scales.[7]

Several scales are able to measure attitudes about environmental protection. The TPB model recommends a scale measuring specific attitudes towards a behaviour. In addition, two general attitudinal measures were employed. First is the "beliefs supportive of environmental action" (BSEA) scale, which is a statistically superior interpretation of the awareness of consequence scale items originally developed by Stern, Dietz, and Kalof (1993). Confirmatory and exploratory analysis conducted by Ryan and Spash (2010, in press) on three datasets supported the BSEA interpretation over the awareness of consequence interpretation put forward by Stern and colleagues. The BSEA scale assesses whether a respondent believes that environmental protection is beneficial (e.g., "Environmental protection will provide a better world for me and my children"), or whether a lack of action to protect the environment has costs (e.g., "Pollution generated here harms people all over the earth"). The second is the Political Action (PA) scale (Stern et al., 1993). The PA scale asks participants whether they would partake in political action supporting various environmental causes (demonstrating, signing a petition, refusing a job at a company harming the environment, volunteering to work for nature conservation). If both specific attitudes regarding a

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[5] CVM practitioners are able to choose from an assortment of different question modes, such as an open-ended format, a dichotomous choice format, bidding games and payment cards. What constitutes a well-designed CVM, however, is still debatable (see Spash 2008a). While close-ended formats are widely administered in the United States, open-ended formats have been noted to be superior in some respects. For example, Brown et al. (1996) found open-ended WTP to be less susceptible to the hypothetical bias than the closed-ended WTP. Champ and Bishop (2001) argue that (i) open-ended formats are easier to validate than dichotomous choice, (ii) referendum based dichotomous choice formats can promote confusing language that would not be considered best practise for a CVM study, and (iii) open-ended payment mechanisms may seem more credible than referenda mechanisms in making a choice about small-scale goods. Furthermore, Brown et al. (1996) claim that closed-ended formats are even more susceptible to hypothetical bias than open-ended formats because they encourage attitude based "yea-saying". Therefore if the open-ended monetary scale is found to be primarily a measure of attitudes dichotomous choice formats should also be primarily an attitude measure.

[6] The cognitive hierarchy model of human behaviour suggests that specific attitudes should have a more direct relationship with behavioural intentions than general attitudes (Fulton, Manfredo, & Lipscomb, 1996).

[7] At the same time we note that scale items were mixed and surveys administered to respondents by interviewers. Both these factors limit the time and ability of interviewees to consciously or strategically control their personal survey response.

CVM proposal and general environmental protection attitudes are found to positively correlate with WTP for an environmental improvement, then this would support the hypothesis that positive WTP bids are motivated by general contributory and political motives rather than representing an assessment of the specific economic benefits to be derived from the proposal.

We represent the hypothesis more formally by the following equations:

$$\text{Log}[\text{Pr(positive bid)}/\text{Pr(zero bid)}] = X_0 + X_1 A_1 + X_2 A_2 + X_3 \text{SN} + X_4 PBC + \varepsilon \tag{1}$$

$$\text{Positive WTP amount} = X_0 + X_1 A_1 + X_2 A_2 + X_3 \text{SN} + X_4 \text{PBC} + \varepsilon \tag{2}$$

In Eq. (1), "Pr(positive bid)/Pr(zero bid)" refers to the probability participants offer a positive rather than a zero bid, while in Eq. (2), "Positive WTP Amount" refers to the positive bid amount i.e., excludes zero bidders. $X$ are the coefficients, $\varepsilon$ is the error term, $A_1$ and $A_2$ are different environmental attitudes, SN represents subjective norms and PCB perceived behavioural control. The attitudinal hypothesis would be supported in Eq. (1) if $X_1$ and $X_2$ are highly significant while $X_3$ and $X_4$ are moderately significant or insignificant. In Eq. (2), due to the posited poor psychometric properties of the monetary scale, the attitudinal hypothesis would predict that $X_1$ and $X_2$ be moderately significant, while $X_3$ and $X_4$ should be insignificant.

The datasets were collected from two different CVM surveys designed to measure two different environmental proposals which were actually being considered by community planners. Both surveys were administered by a market research company employing a stratified random sampling procedure. Market research representatives recruited participants by door-knocking designated locations. Each market research representative verbally administered consenting participants in a face-to-face interview which involved the presentation of a case study scenario that outlined the environmental proposal in need of funding. The final versions of the surveys were based upon pretesting and stakeholder consultation.

### 3.1. Study 1 overview

Seven hundred and thirteen UK residents were recruited for Study 1. Participants were asked to consider a proposal regarding the possible purchase by an existing regional charity of a one square mile site in Eastern England currently used for crop farming. They were told the charity was interested in transforming the farming site into a wetlands site, with a major aim stated as providing a sanctuary for endangered species of birds such as Bewick's swan, the pintail, and gadwall. A request was made for a one-off payment to a charitable trust fund established specifically for the project, with participants being asked the maximum they would be "willing to pay as a one-off contribution to the trust fund to help create an extra square mile of wetland in The Fens". The focus on the behaviour of participants willingness to respond to the monetary scale meant 218 participants were excluded because they either chose the 'don't know' option or refused to provide a response to the WTP question. 495 participants were classified as giving a WTP bid (207 positive bids and 288 zero bids). Study 1 also administered two general environment protection attitudinal measures which were responded to on a 4-point scale. These were the PA scale and the BSEA scale (see Appendix A). The PA scale reported a Cronbach $\alpha$ of 0.65.[8] The BSEA scale reported a Cronbach's $\alpha$ of 0.83.

### 3.2. Study 2 overview

One thousand and sixty nine Scottish residents were recruited to participate in a CVM survey assessing a proposal for the Tummel catchment region in Scotland. The introduction of a conservation biology flow regime from dammed lochs was being considered in order to mimic a more natural flow for some rivers. The aim of the proposal was to restore the diversity and abundance of species and habitats in the river catchment. Increasing river flows from the hydro-system would potentially reduce electricity generation and increase costs for the hydro-power companies. Such costs would then be transferred to electricity consumers. The WTP question asked participants: "What is the maximum additional amount you would be willing to pay each quarter on your electricity bill over the next year to restore biodiversity in the river Tummel and its surrounding area from 14% to 70%?". In the current analysis 336 participants were excluded, answering 'don't know' or refusing to respond to the WTP question. 733 participants were classified as WTP bidders (322 positive bidders and 411 zero bidders).

In Study 2, participants were administered two attitude scales. The first was the BSEA scale administered in Study 1. The BSEA scale for Study 2 was answered on a 7-point scale and reported a Cronbach's $\alpha = 0.88$. The second assessed specific attitudes about the benefits arising from paying more for electricity in order to fund the Tummel catchment scheme and the likelihood of such benefits. This scale was designed according to TPB considerations (Ajzen, 2006) and asked seven paired questions or items developed by Spash et al. (2009) (see Appendix A). One of the paired items asked participants to assess whether a proposed outcome for the project is good or bad (e.g., "Enhancing water quality in the Tummel area is [1 = extremely bad; 7 = extremely good]"). The other paired item asked participants to assess the likelihood of the proposed outcome (e.g., "Paying more for electricity to restore biodiversity will enhance water quality in the Tummel area [1 = extremely likely; 7 = extremely unlikely]"). The attitude score for each item pair was based on a product score. The TPB attitude scale reported a Cronbach's $\alpha$ of 0.88.

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[8] Cronbach's $\alpha$ is a statistic used to measure the internal consistency or reliability of a multiple item psychometric scale. As a basic rule of thumb, psychometric scales that report a Cronbach's $\alpha$ of 0.70 or higher are considered to have good reliability.

Participants were also asked paired TPB subjective norm items developed by Spash et al. (2009), see the Appendix A, which were based on assessing beliefs about the expectations of significant others. One of the paired items asked if the significant other expected them to offer a positive WTP bid (e.g., "My friends would think that I [1 = should; 7 = should not] pay more for electricity to preserve biodiversity in the Tummel area"). The other paired item asked the degree to which the respondent felt pressured by the significant other (e.g., "Generally speaking, how much do you want to do what your friends think you should do?"). The subjective norm score for each item pair was based on a product score. The TPB subjective norm scale reported a Cronbach's $\alpha$ of 0.73. A large portion of the study did not have children, a partner or parent who was alive. A decision was made to average the score over the questions that were answered. If a participant answered only 4 pairs of questions, their total score was divided by 4. If only three pairs were answered the total score was divided by 3. Twenty participants who answered only 2 or less pairs of items were treated as missing data. Participants were also asked a perceived behavioural control item about their ability to pay ("I can easily afford to pay more for my electricity") on a 7-point scale.

## 4. Results

As is usually the case, the open-ended WTP distributions for Study 1 and Study 2 demonstrated a large positive skew. To improve the normality of the distribution, positive bids were transformed using the log (WTP + 1) formula, which resulted in the LNWTP variable. In Study 1 the maximum WTP bid was £200, which was transformed to a value of 5.3 (just over 3 standard deviations from the mean LNWTP value). In Study 2, the maximum WTP bid was £300, which was transformed to a value of 5.7 (just under four standard deviations from the mean LNWTP value).[9] Table 3 displays the summary statistics for the PA, TPB and BSEA scales, as well as WTP responses.

For both studies large correlations between the attitude scales were found. In Study 1 the correlations between the PA and BSEA scale was 0.57, while in Study 2 the correlation between the TPB attitude scale and the BSEA scale was 0.53. This supports the speculation that both attitude scales measure an underlying latent attitude variable. Table 4 displays the correlations between the psychological scales and the three indicators of WTP. The "zero or positive bid" variable forms a point biserial correlation with the psychological scales.[10] The results present in Table 4 clearly indicate that attitudinal scales had a strong relationship with the dichotomous "zero or positive bid" variable, while also demonstrating that the "zero or positive bid" variable had a highly significant correlation with perceived behavioural control and subjective norms. In contrast, the correlation between LNWTP for positive bids and the attitude scales were not found to be high. Three of these correlations were only significant at a 0.05 level, while one was not significant. For the non-attitudinal scales, LNWTP for positive bids had a significant relationship with perceived behavioural control at a 0.05 level, and did not have a significant relationship with subjective norms.

A logistic regression was run to test the influence of psychological variables in predicting WTP bid type (positive or zero). Table 5 displays the results of the logistic regression for both Studies 1 and 2. For both Studies 1 and 2, all of the independent variables were simultaneously included in the logistic regression model. In both cases, all of the psychological scales (attitudinal and non-attitudinal) were found to have a highly significant and independent contribution to predicting whether participants offer a positive or a zero bid. The Nagelkerke $R^2$ and $\chi^2$ suggest a good model fit for a logistic regression based on only attitudinal measures (Study 1), and an even better model fit for a logistic regression based on combined psychological variables, which included attitudinal and non-attitudinal measures. These findings were unaffected by an additional analysis that included socio-economic variables.[11]

An Ordinary Least Squares (OLS) regression was run to analyse the influence of attitudes to LNWTP for positive bids, as shown in Table 6. For both studies all of the independent variables were simultaneously included in the OLS regression model. The overall model for Study 1 was not found to be significant, $F(2180) = 2.44$, $p > 0.05$. The overall model for Study 2 was significant at a 0.05 level, $F(4299) = 2.99$, $p < 0.05$, but not at a 0.01 level. The Adjusted-$R^2$ for both models is extremely low, suggesting that attitudinal scales cannot be used to explain a significant portion of variance in the amount offered by positive bidders. Once again, these findings were unaffected by an additional analysis that included socio-economic variables.[12]

The weak correlations between attitudinal measures and WTP for positive bidders might be taken as support for the hypothesis that the monetary scale is a psychometrically poor measure. The question then is: how sensitive are people to the monetary scale? Table 7 displays the percentage of responses that correspond with a currency value. This shows that 84% of the positive bidding participants in Study 1 offered a contribution that had a corresponding currency denomination.

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[9] These maximum values are not extreme enough to be classified as being unrealistic, nor were they problematic for the analysis. Note, the results and conclusions reported next focus upon the strength of the relationship between psychological scales and LNWTP rather than an aggregated bid value calculation.

[10] The point biserial correlation coefficient is a correlation coefficient that is used when one of the variables is dichotomous. It is a special case of a Pearson correlation coefficient.

[11] We also conducted a logistic regression that included variables for education, gender and income. The sample size of these two analyses was reduced due to missing income data (Study 1 $N$ = 310; Study 2 $N$ = 504). In both Studies 1 and 2 there were no noticeable changes in the significance of the psychological scale coefficients. In both studies, the education coefficient was significant, while the income and gender coefficients were insignificant. Study 1 Nagelkerke $R^2$ = 0.27; Study 2 Nagelkerke $R^2$ = 0.47.

[12] We conducted an OLS regression that included variables for education, gender and income. The sample size of these two analyses was reduced due to missing data (Study 1 $N$ = 152; Study 2 $N$ = 250). Adding the demographic variable did not change the significance of the psychological scales. Both studies reported an increase in variance explained (Study 1 adjusted $R^2$ = 0.05; Study 2 adjusted $R^2$ = 0.08). In both studies income was a significant variable at a 0.01 level, while gender and education were not significant even at a 0.05 level.

**Table 3**
Summary statistics.

|  | N | Mean | Standard deviation | Min. | Max. |
|---|---|---|---|---|---|
| *Study 1* |  |  |  |  |  |
| PA scale | 441 | 2.79 | 0.49 | 1.0 | 4.0 |
| BSEA scale | 448 | 3.24 | 0.40 | 1.6 | 4.0 |
| Positive LNWTP | 207 | 2.36 | 0.89 | 0.7 | 5.3 |
| Bid decision (+ve = 1) | 495 | 0.42 | 0.49 | 0.0 | 1.0 |
| *Study 2* |  |  |  |  |  |
| BSEA scale | 730 | 5.69 | 0.99 | 2.2 | 7.0 |
| TPB attitude scale | 719 | 24.34 | 10.39 | 3.0 | 49.0 |
| TPB norm scale | 713 | 13.57 | 6.72 | 1.0 | 40.6 |
| TPB PBC item | 731 | 4.21 | 1.78 | 1.0 | 7.0 |
| Positive LNWTP | 322 | 2.35 | 0.88 | 0.14 | 5.7 |
| Bid decision (+ve = 1) | 733 | 0.44 | 0.50 | 0.0 | 1.0 |

**Table 4**
Correlations between indicators of WTP and psychological scales.

|  | WTP zero/positive[c] | Positive LNWTP |
|---|---|---|
| *Study 1* |  |  |
| BSEA scale | 0.34[b] | 0.01 |
|  | (N = 448) | (N = 198) |
| PA scale | 0.39[b] | 0.15[a] |
|  | (N = 441) | (N = 188) |
| *Study 2* |  |  |
| BSEA scale | 0.44[b] | 0.12[a] |
|  | (N = 730) | (N = 321) |
| TPB attitude scale | 0.54[b] | 0.09[a] |
|  | (N = 719) | (N = 314) |
| TPB norm scale | 0.34[b] | −0.01 |
|  | (N = 713) | (N = 310) |
| TPB PBC scale | 0.36[b] | 0.12[a] |
|  | (N = 731) | (N = 321) |

[a] Significant at the 0.05 level (2-tailed).
[b] Significant at the 0.01 level (2-tailed).
[c] Point biserial correlation.

**Table 5**
Logistic regression of WTP bid type on psychological scales.

|  | B | SE B | $e^B$ |
|---|---|---|---|
| Study 1[b] |  |  |  |
| Constant | −8.05[a] | 1.07 | 0.00 |
| BSEA scale | 1.22[a] | 0.34 | 3.38 |
| PA scale | 1.37[a] | 0.30 | 3.92 |
| Study 2[c] |  |  |  |
| Constant | −8.43[a] | 0.73 | 0.00 |
| BSEA scale | 0.62[a] | 0.12 | 1.86 |
| TPB attitude scale | 0.09[a] | 0.01 | 1.09 |
| TPB norm scale | 0.08[a] | 0.02 | 1.08 |
| TPB PBC item | 0.36[a] | 0.06 | 1.43 |

[a] Significant at the 0.01 level (2-tailed).
[b] $N = 410$; $\chi^2(2) = 79.67$; Nagelkerke $R^2 = 0.24$.
[c] $N = 701$; $\chi^2(2) = 327.03$; Nagelkerke $R^2 = 0.50$.

A $\chi^2$ test found that significantly more participants presented numbers that corresponded to a currency denomination than expected by chance, $\chi^2(1) = 96.04$, $p < 0.001$. Furthermore, 64% provided a £5 or £10 estimate. A $\chi^2$ test found that significantly more participants offered a £5 or £10 bid than any other numerical option on the continuous monetary scale, $\chi^2(1) = 14.61$, $p < 0.001$.

In Study 2, a total of 67% of the positive bidding sample offered a currency based denomination for their WTP estimate. A $\chi^2$ test found that significantly more participants used currency denominations compared to any other numerical option, $\chi^2(1) = 38.96$, $p < 0.001$. In this case 48% offered either a £5 or a £10 WTP bid. However, a $\chi^2$ test found that there was no

**Table 6**
OLS regression of positive LNWTP on psychological scales.

|  | B | SE B | t-Ratio |
|---|---|---|---|
| *Study 1*[c] | | | |
| Constant | 1.95[b] | 0.61 | 3.17 |
| BSEA scale | −0.20 | 0.20 | −0.99 |
| PA scale | 0.37 | 0.17 | 2.20 |
| | | | |
| Study 2[d] | | | |
| Constant | 1.12[b] | 0.44 | 2.57 |
| BSEA scale | 0.16[a] | 0.08 | 2.18 |
| TPB attitude scale | 0.02 | 0.01 | 0.27 |
| TPB norm scale | −0.01 | 0.01 | −1.01 |
| TPB PBC item | 0.06[a] | 0.03 | 1.99 |

[a] Significant at the 0.05 level (2-tailed).
[b] Significant at the 0.01 level (2-tailed).
[c] $N = 183$; $R = 0.16$; $R^2 = 0.03$; adjusted $R^2 = 0.02$.
[d] $N = 304$; $R = 0.20$; $R^2 = 0.04$; adjusted $R^2 = 0.03$.

**Table 7**
Responses relative to currency denominations.

| | Bid category (£) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | <1 | **1** | >1 < 5 | **5** | >5 < 10 | **10** | >10 < 20 | **20** | >20 < 50 | **50** | >50 |
| *Study 1* | | | | | | | | | | | |
| (%) | 0 | **4** | 5 | **34** | 1 | **30** | 1 | **10** | 4 | **6** | 4 |
| *Study 2*[a] | | | | | | | | | | | |
| (%) | 1 | **3** | 13 | **18** | 2 | **30** | 6 | **13** | 8 | **3** | 4 |

[a] Adds to 101 due to rounding error.

significant difference in the number of participants providing a £5 or £10 bid than any other positive bid number, $\chi^2(1) = 0.45$, $p > 0.05$.

## 5. Discussion and conclusions

We believe that our within-subjects methodological design is better suited, than the headline method employed by Kahneman and colleagues, to examining the attitudinal hypothesis. Both the studies from which our data was taken employed a standard CVM survey design to request WTP for a positive environmental improvement. The surveys investigated two separate topics (converting farmland to a wetland and increasing in-stream flows from hydro-dam regulation) and had different payment mechanisms (a single payment into a trust fund and an increase in electricity bills). These studies were also administered to different populations of the general public. That consistent patterns were found across two very different studies adds to the robustness of the results.

The weak or insignificant relationship between attitudinal scales and the amount offered by positive bidders, as found in the OLS models, suggests that the monetary scale is not a sensitive measure of attitudes, supporting the argument by Kahneman and colleagues that it is a psychometrically inferior measure. Although the monetary scale is technically a continuous variable bounded by a zero, the majority of positive bidding participants in both CVM studies offered a standard currency amount, which suggests they employ a categorical rather than a continuous scale. The finding that a large portion of participants bid either £5 or £10 suggests that people are either offering very crude WTP estimations or charitable contributions.[13] Therefore the suggestion by Kahneman and colleagues that there are large arbitrary individualistic differences in how people interpret the monetary scale was not supported.[14]

If using a monetary scale results in crude estimates or standardised amounts then economists should question the ability of respondents to be able to perform an economic trade-off to the point of indifference. The amount bid by such CVM participants is, at best, a statistically inefficient or blunt measure of economic welfare benefits. If those demanding CVM studies are satisfied with a very rough estimate of how much people will volunteer to pay for an environmental project then the approach might be deemed of interest. However, presenting WTP for a good cause under the guise of being a precise economic estimate of the environmental value of an entity or change would be highly misleading.

[13] Charitable contributions are used here to designate a standard payment for a good cause; an amount given regardless of the specific consequences involved. The contention is that a standard currency amount is then acting as such a standardised payment. Clearly to be substantiated this would require further research as noted at the end of Section 2.

[14] The analyses, showing that income had a greater influence than attitudes on the amount bid by positive bidders, is also counter to Kahneman and colleagues argument—that there are large arbitrary individualistic interpretations of the monetary scale.

While the majority of positive bidders demonstrated an extreme lack of sensitivity, a minority (18% in Study 1 and 33% in Study 2) provided bids that did not reflect a standard currency amount. Thus, some participants appear more sensitive to the variance of the monetary scale, that is they may be interpreting the scale as being continuous. The monetary scale may then be statistically inefficient not only because a large number of participants are offering a standardised amount, but also because there are differences in how people address environmental change using a monetary scale. The findings here show that while differences occur, as suggested by Kahneman and colleagues, these are not arbitrary individual differences in how people respond to a monetary scale, but rather a choice between continuous and discrete scales. This does, however, then cause problems for the standard economic interpretation of stated preferences on a monetary scale.

Kahneman and colleagues argue that responses to CVM surveys, requesting a payment towards the provision of a public good, have a psychological interpretation as a social contribution or donation motivated by attitudes. The results reported here partially support this attitudinal hypothesis. Notably there was a strong relationship between attitude scales and the type of bid offered (positive or zero bid). However the significance of non-attitudinal variables suggests that the choice between offering a zero or positive bid represents a more general psychological evaluation than being just an expression of attitude. Kahneman and colleagues argue that attitudes are a concept which has a considerably broader range of application than the standard concept of economic preferences. Yet, the results of our analysis suggest that the concept of attitudes is not broad enough to adequately describe WTP response motives. Other non-attitudinal psychological variables such as norms and ability to pay appear to enhance prediction of whether a zero or positive WTP bid is offered. The significant influence of the ability to pay construct suggests that the tendency to offer a WTP bid cannot be dismissed as entirely hypothetical. Still, the studies reported here produced evidence which could be taken as supportive of the contention that WTP is a contribution, motivated by a combined mixture of favouring a good cause and fulfilling social responsibilities.

Whether WTP bids are based upon economic rather than contributory motives remains an open question. That is, the contribution model may validly describe the behaviour of some CVM participants, while the behaviour of others is more consistent with an economic model. This suggests fundamental individual differences in how participants respond. Participants interpreting the monetary scale as being continuous appear to follow the economic model in terms of behaviour consistent with making consequential trade-offs, while those focusing on standardised currency amounts may be offering a fixed payment regardless of the consequences. The latter is in accord with non-utilitarian perspectives on charitable giving (Spash, 2000a) and plural value interpretations of CVM results (Spash, 2000b). The empirical work reported here was not concerned with directly addressing this issue, but rather has questioned the sole dominance of attitudes as an explanation in either case.

Understanding more about the strengths and limitations of monetary and non-monetary scales can help guide the assessment of community perceptions regarding social and environmental proposals. There are a number of practical implications of the current study. First, the findings are consistent with many people struggling to convert their environmental values into a monetary amount. Thus, money appears to be a poor scale for summarising environmental values. Second, as the choice of a WTP bid is based upon a general psychological appraisal, rather than just an attitudinal assessment, using a procedure to obtain a monetary value from attitudinal scales, as proposed by Kahneman and colleagues, seems inappropriate. Such an approach ignores non-attitudinal factors. Converting attitude scores to a money amount based on a standardised procedure would be as blunt an approach to environmental valuation as the current CVM approach. In Kahneman, Ritov and Schkade (1999, pp. 204–205) the conclusion was that "on current evidence it is possible to accept an attitude model for hypothetical CV responses". The results presented here suggest that the attitudinal model cannot be accepted and needs to be expanded to incorporated a general psychological appraisal. In addition, the findings are consistent with people holding multiple motives when responding to the CVM request for valuing an environmental change.

Our research concludes that simply substituting attitudinal scale scores for WTP estimates is inappropriate. Of course non-monetary and attitudinal scale information can provide valid and useful information in its own right (Sauer & Fischer, 2010). Attitudinal scales can also be useful for differentiating between types of respondents and their motives (see Spash, 2000a; Spash, 2000b, 2006). At the same time there is no validity in using such techniques to identify people whose motivation for contributing under the CVM is deemed non-economic, in neoclassical economic terms, in order to exclude their environmental values from further consideration, and concentrating upon those who produce monetary responses in conformity with the posited economic model. Instead, the prevalence of mixed motives raises the need to take seriously plural values and consider how they can be taken into account in social and environmental policy.

Evaluating and representing how people perceive social and environmental changes involves more than can be obtained from an attitude scale or a stated preference monetary scale. Thus, interdisciplinary research on economics and psychology reveals that neither discipline alone has the ability to offer a full picture of human behaviour in the context of environmental valuation. This suggests looking to methods able to provide a broader context and meaning to environmental values (e.g., non-aggregated social multi-criteria analysis or forms of deliberative monetary valuation). Offering aggregated attitudinal scores or intentions to pay money, as summaries of public concern, provides little depth to our understanding and can be highly misleading. In order to inform project appraisal and public policy, approaches are required that supply a descriptively richer account of how people perceive and respond to environmental change.

## Acknowledgements

## Appendix A

*A.1. Political action (PA) attitude scale (based upon Stern et al. (1993))*

   *Item 1*: I would participate in a demonstration against companies that are harming the environment.
   *Item 3*: I would sign a petition in support of tougher environmental laws.
   *Item 4*: I would take a job with a company I knew was harming the environment.
   *Item 5*: I would never do voluntary work for nature conservation.
   *Item 6*: Environmental activists are a public nuisance whom I would never support.

*A.2. Beliefs supportive of environmental action (BSEA) attitude scale (on the development of this scale see Ryan & Spash, 2010, in press)*

   *Item 1*: Environmental protection will provide a better world for me and my children.
   *Item 2*: Environmental protection is beneficial to my health.
   *Item 3*: A clean environment provides me with better opportunities for recreation.
   *Item 4*: Environmental protection benefits everyone.
   *Item 5*: Environmental protection will help people have a better quality of life.
   *Item 6*: Tropical rain forests are essential to maintain a healthy planet earth.
   *Item 7*: The effect of pollution on public health are worse than we realise.
   *Item 8*: Pollution generated here harms people all over the earth.
   *Item 9*: Over the next several decades, thousands of species will become extinct.

*A.3. Theory of planned behaviour (TPB) attitude scale (developed by Spash et al. (2009))*

   1a. Paying more for electricity to restore biodiversity will increase the diversity and abundance of plant and animal species in the Tummel area (1 = extremely likely; 7 = extremely unlikely).
   1b. Increasing the diversity and abundance of plant and animal species in the Tummel area is (1 = extremely bad; 7 = extremely good).
   2a. Paying more for electricity to restore biodiversity will increase genetic diversity in the Tummel area (1 = extremely likely; 7 = extremely unlikely).
   2b. Restoring genetic diversity in the Tummel area is (1 = extremely bad; 7 = extremely good).
   3a. Paying more for electricity to restore biodiversity will increase river flows in the Tummel area (1 = extremely likely; 7 = extremely unlikely).
   3b. Increasing river flows in the Tummel area is (1 = extremely bad; 7 = extremely good).
   4a. Paying more for electricity to restore biodiversity will help restore the web of life in the Tummel area (1 = extremely likely; 7 = extremely unlikely).
   4b. Restoring the web of life in the Tummel area is (1 = extremely bad; 7 = extremely good).
   5a. Paying more for electricity to restore biodiversity will enhance water quality in the Tummel area (1 = extremely likely; 7 = extremely unlikely).
   5b. Enhancing water quality in the Tummel area is (1 = extremely bad; 7 = extremely good).
   6a. Paying more for electricity to restore biodiversity will teach people to think more about the environmental impacts of industry (1 = extremely likely; 7 = extremely unlikely).
   6b. Teaching people to think more about the environmental impact of industry is (1 = extremely bad; 7 = extremely good).
   7a. Paying more for electricity to preserve biodiversity will restore the Tummel area to its natural state (1 = extremely likely; 7 = extremely unlikely).
   7b. Restoring the Tummel area to its natural state is (1 = extremely bad; 7 = extremely good).

*A.4. Theory of planned behaviour (TPB) subjective norm scale (developed by Spash et al. (2009))*

1a. My spouse/partner would think that I (1 = should; 7 = should not) pay more for electricity to preserve biodiversity in the Tummel area.

1b. Generally speaking, how much do you want to do what your spouse/partner thinks you should do?

2a. My work colleagues would think that I (1 = should; 7 = should not) pay more for electricity to preserve biodiversity in the Tummel area.

2b. Generally speaking, how much do you want to do what your work colleagues think you should do?

3a. My children would think that I (1 = should; 7 = should not) pay more for electricity to preserve biodiversity in the Tummel area.

3b. Generally speaking, how much do you want to do what your children think you should do?

4a. My parents would think that I (1 = should; 7 = should not) pay more for electricity to preserve biodiversity in the Tummel area.

4b. Generally speaking, how much do you want to do what your parents think you should do?

5a. My friends would think that I (1 = should; 7 = should not) pay more for electricity to preserve biodiversity in the Tummel area.

5b. Generally speaking, how much do you want to do what your friends think you should do?

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