Public Choice for Flood Defence

A thesis submitted for the degree of Doctor of Philosophy

Division of Economics

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Declaration

In accordance with the Regulations for Higher Degrees by Research, I hereby declare that the whole thesis now submitted for the candidature of Doctor of Philosophy is a result of my own research and independent work except where reference is made to published literature. The experimental design for the knowledge, information and learning portion of this thesis (Chapter 3) was developed with Jacob LaRiviere from the University of Tennessee as part of a wider project. The subsequent statistical analysis is all my own. I also hereby certify that the work embodied in this thesis has not already been submitted in any substance for any degree and is not being concurrently submitted in candidature for any degree from any other institute of higher learning. I am responsible for any errors and omissions present in the thesis.

Candidate: _____

Katherine Hannah Simpson

Abstract

Why do we want to value the environment? Environmental assets provide a flow of goods and services over time which benefit mankind. Valuing these services contributes towards their protection and enhancement, however many of these benefits cannot be valued in traditional markets and as such rely on non-market valuation techniques. One of these is contingent valuation (CV) which directly asks respondents whether they are willing to pay for an improvement in the good or service. This thesis seeks to explore methodological issues associated with this method by undertaking a CV survey to elicit willingness to pay (WTP) for a new type of flood defence (managed realignment) on the Tay Estuary, Scotland.

One challenge for survey designers is to provide high quality, readily understandable information to mitigate bias in WTP estimates. This thesis contributes to the information provision literature by examining whether prior knowledge or new information has a greater effect on the WTP estimate when controlling for respondent experience and familiarity with the good. A field experiment was designed to test for respondent's prior knowledge; allow for varying levels of information to be presented to respondents and identify information acquisition for each respondent. Specifically tested was the notion that respondents who learn the most about the good during the survey process will have a more robust WTP estimate. Results were mixed: a causal relationship between information provision and learning was established with respondents in the higher treatment groups scoring higher in the second quiz. However, there was no relationship identified between prior knowledge, information provision and WTP. Personal motivations were the strongest predictors of WTP: those who were most concerned about flood risk and who lived closest to the proposed flood defence were willing to pay the most.

A second issue in CV is consequentiality. Carson and Groves (2007) argue that for a survey to produce meaningful information about respondent's preferences the respondent must view their responses as potentially influencing the supply of the public good. This thesis seeks add to this

relatively new literature by exploring the observable factors which may influence respondents perceived consequentiality; specifically the effects of familiarity and information. Respondents were asked to state how confident they were that the results of the survey would be used by policy makers on a Likert scale ranging from "very unconfident" through to "very confident". Results conformed to the Carson and Groves knife edge result: consequential respondents had significantly different WTP distributions compared to inconsequential and unsure respondents and were willing to pay significantly more towards the scheme. Consequential respondents also conformed the theoretical considerations of construct validity whilst inconsequential respondents did not. Respondents with more prior knowledge also appeared to be more likely to perceive the survey as consequential, although this was not consistent across all treatment groups. There is a concern that WTP and consequentiality are endogenous: respondents who want the policy to go ahead may be more likely to state the survey is consequential and state a high WTP in the hope these responses combined contribute to the policy maker's decision.

From a policy perspective the high level of support for the new scheme was encouraging and in contrast to previous findings on preferences for managed realignment. From a flood risk management perspective a "miss-match" between actual and perceived flood risk was highlighted, with many respondents stating they were not at risk from flooding when they in fact were. This is potentially concerning as respondents may not be taking adequate steps to protect their home from future flood risks.

Overall it is recognised that values derived from the CV survey form one small part of the planning process and while informative, the decision for a scheme to take place should not be based on these values alone.

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Chapter 1.
Environmental Valuation – An Introduction

Introduction

Environmental valuation now has a greater role in policy analysis thanks to international initiatives such as the Millennium Ecosystem Assessment (MEA) and The Economics of Valuing Ecosystem Services and Biodiversity (TEEB). The UK National Ecosystem Assessment provided the first comprehensive analysis of the natural environment in terms of the benefits provided to society in the UK (NEA 2011). But why do we want to value the environment? The environment provides us with environmental assets which provide a flow of goods and services over time. These benefits humans obtain from environmental assets are known as ecosystem services (MEA, 2005). There is no singular system for categorising ecosystem services although the MEA framework is widely accepted the most useful starting point, with ecosystem services considered under the broad headings of provisioning, supporting, regulating and cultural services. Provisioning services include water supply and crops; regulating services include flood defence and climate regulation and cultural services include environmental settings (MEA, 2005). It is becoming increasingly apparent that these services are being degraded due to anthropogenic stressors such as habitat destruction and climate change. Environmental valuation can contribute towards their protection or enhancement through the decision making and policy process by ensuring that environmental impacts are taken into account (Defra 2004).

The value of ecosystem services is considered within the framework of Total Economic Value (TEV) which is defined as "the gain in wellbeing from a policy measured by the net willingness to pay or willingness to accept" (Garrod and Willis 1999). The framework is summarised in Figure 1.1. Direct use values measure the resources which individuals make actual use of, for example provisioning services. Indirect use values measure the benefits obtained from supporting services, such as climate, water and pollution regulation. Option values relate the values placed on

resources which people would like the option of using in the future, for example visiting a national park which they previously visited. Non-use values include bequest, altruistic and existence values and refer to the benefits derived from knowing a resource is there for current and future generations even though we do not intend on using it.

Values for ecosystem services are derived through economic valuation techniques which attempt to elicit public preferences for the state of the environment in monetary terms. The majority of environmental goods and services lack markets which mean that non-market valuation methods are relied upon when producing value estimates for policy and project implementation (Hanley and Barbier 2009). There are three main valuation methods; production function, revealed and stated preference. Production function approaches assume that the environmental good serves as a factor of production in marketed goods which provide utility. Revealed preference methods rely on data regarding individual's preferences for marketable goods which include environmental attributes. Techniques include market prices, hedonic pricing, the travel cost method and random utility modelling. Stated preference approaches directly ask people what they are willing to pay for an improvement in an environmental good. The two main techniques are contingent valuation and choice experiments.

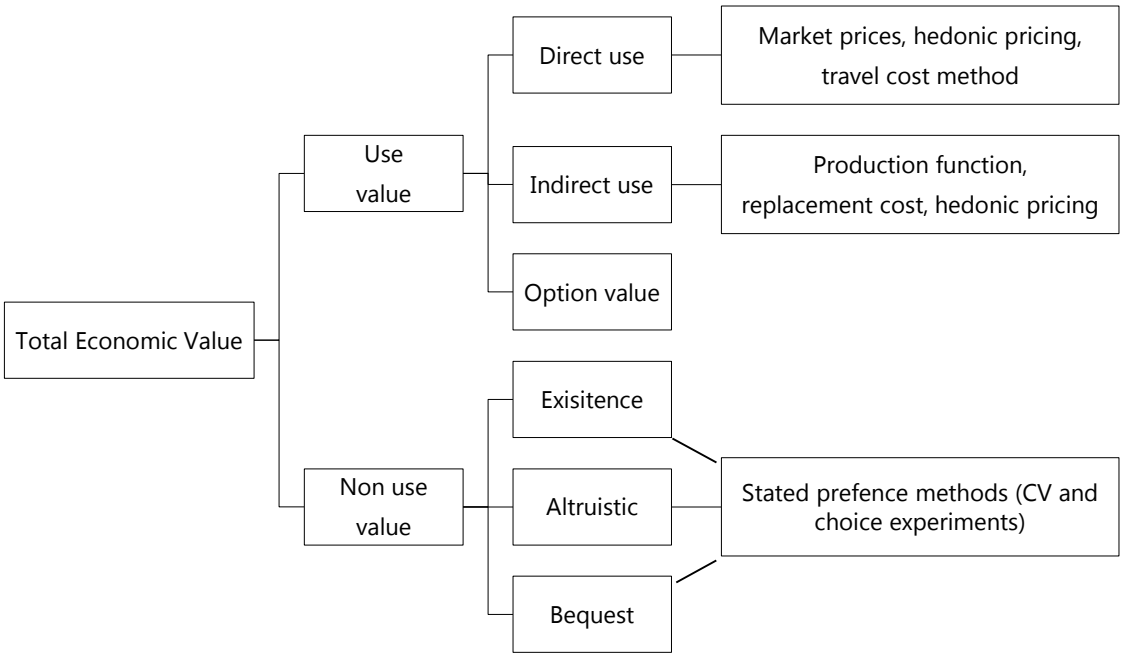


Figure 1.1: Total Economic Value framework (adapted from Defra, 2004)

This thesis is concerned specifically with the contingent valuation (CV) method and its application to project evaluation. A CV survey is developed to elicit public willingness to pay for a new managed realignment scheme (a type of natural flood defence) on the Tay Estuary, Scotland. From a policy perspective this thesis aims to provide a range of values for the proposed scheme and highlight some of the challenges faced when aggregating WTP across the population for use in a cost-benefit analysis. The remainder of this chapter will outline the CV method, including the notable developments, highlights and problems associated with it and the subsequent research questions tackled in this thesis. An overview of managed realignment is provided in Chapter 2.

Contingent Valuation

CV uses questionnaires to elicit people's preferences for a good by asking them what they are willing to pay for an improvement in the good or service (Mitchell and Carson, 1989). Hypothetical scenarios are constructed which offer different policy alternatives to the current status quo and the respondent is asked to state whether they would support an alternative policy option based on what this the new policy will provide, how this will be delivered and how much it will cost (Carson 2000). If the study is well designed and carefully pretested the answers to the survey should represent valid WTP responses. Following the recommendations of Mitchell & Carson (1989) CV surveys should consist of three key parts:

1. Respondents are first provided a detailed description of the good being valued and how it will be made available to the respondent. The market created should be as plausible as possible. Current provision of the good should be outlined, how the good will be provided, the substitutes available and the method of payment.
2. Second, values are elicited through a question which asks the respondent what they are willing to pay for the good in question.
3. Finally questions about the respondents socio-demographic are asked (age, gender and income), their attitudes towards the good being valued and their use of the good. This

information is then used in regression equations to estimate the valuation function of the good. Following the survey the WTP estimates can then be used to develop a benefit estimate.

A Brief History of Contingent Valuation

The development of CV can be divided into three main periods; early research up until the Exxon Valdez oil spill (1989); a second period (1989-1992) which covered the debates following the use CV to estimate the damages of the Exxon Valdez oil spill and the subsequent publication of the 'NOAA Blue Ribbon Panel' report, as well as the publication of the Mitchell and Carson book '*Using Surveys to Value Public Goods'* which played a key role in defining the methodology. Finally the period from 1992 until present day where CV has been accepted as a non-market valuation method, academically and politically, but with many challenges still needing to be explored (Carson 2012a; Hoyos and Mariel 2010).

The resource economist Ciracy-Wantrup (1952) first proposed the idea of a "direct interview method" in his book *Resource Conservation: Economics and Policies* to measure environmental values but it was Davis (1963) in his research on the benefits outdoor recreation where CV was first used. As discussed by Carson (2012a) it was during the 1970s where the development of the method accelerated. This included the work of Randall et al (1974) on the use of bidding games to estimate the benefits which would be realised as a result of reduced environmental damages from mining in Colorado. Smith (2009) cites this as being one of the first serious professionally administered surveys. Other notable work during the 1970s includes Hammack and Brown (1974) on hunter's WTP for wildfowling and research by Brookshire et al (1976) on the use of bidding games to estimate aesthetic damages associated with a new power plant.

As discussed in detail by Carson (2012a) one of the major stimuli to the CV debate was the *Exxon Valdez* oil spill (1989) where the American public's WTP to avoid a future spill was estimated at three billion dollars based on a large scale CV survey. Following this the NOAA Panel held a review into the method and prescribed a set of guidelines "*which the Panel believes any CV study should*

adhere if the study is to produce information useful in natural resource damage assessment" (Arrow and Solow 1993). This report, and the related papers of Carson et al (1992) *"A CV Study of Lost Passive Use Values resulting from the Exxon Valdez Oil Spill"* and Randall (1993) "*Passive-use values and CV--- valid for damage assessment"* provided the foundations for the research which took place throughout the 1990s. In opposition were Diamond and Hausman (1994) who argued that "*In short, we think that the evidence supports the conclusion that to date, CV surveys do not measure the preferences they attempt to measure*". The authors argued that problems with the embedding effect (where there is little difference in WTP despite clear differences in the quantity or quality of provision of the good) and the warm glow effect led to unreasonable estimates of WTP which were not reliable for policy analysis. The two conflicting views of the NOAA Panel and the opposition led by Diamond and Hausman encouraged a large amount of theoretical, econometric, experimental, and empirical research on CV throughout the 1990s which continues to the present day Carson (2012b). There has been a great research effort into areas such as hypothetical bias, elicitation formats, information provision and uncertainty, survey validity and scope and embedding effects, all with the aim improving the validity and reliability of the WTP estimate. An overview of these issues and key advances in research is discussed below.

Elicitation Methods

Various elicitation methods are available when asking respondents to state their WTP. These include single and double bounded dichotomous choice, payment card and payment ladder approaches. One of the first formats was the open ended question which asked respondents to simply state their maximum WTP. However this format was found to place a high cognitive burden on respondents and research showed that it resulted in a high number of protest zeros and non-response (Mitchell & Carson, 1989). The payment card approach was developed by Mitchell and Carson (1989). The payment card lists various amounts starting with £0 to a large amount and respondents are asked "What amount on this card are you prepared to pay?" A further approach is dichotomous choice (DC) which asks respondents whether they accept or reject a single take

it-or-leave-it offer for the good being valued (Boyle and Bishop 1988). An advantage of this method is that it places a lower cognitive burden on respondents compared to the payment card and open ended formats as they are not required to construct a value. The question mimics decisions in the market place with the respondent deciding to purchase or not at a set price. However the method is less statistically efficient and required a greater sample size. Hanemann et al (1991) proposed the double bound dichotomous choice (DBDC). A respondent is offered an initial value (the same as single bound DC) and if the respondent says "yes" to the initial cost amount asked, they are asked them the same question at a higher amount, and if the respondent says "no" to the initial amount, they are asked the same question at a lower amount. The DBDC format has become one of the most popular elicitation formats as it dramatically shrinks the confidence intervals around parameter estimates of the WTP distribution (Carson and Groves 2007).

The strengths and weakness of the elicitation techniques have been widely researched. Boyle and Bishop (1988) first compared iterative bidding, payment cards, and DC and concluded that all three techniques suffer from problems; payment card and DC estimates were affected by the interviewer asking the WTP questions. DC was also affected by the range of the values chosen by the researchers (known as anchoring bias) (Green et al 1998): a high mean WTP can be obtained by selecting a bid design with high anchors and conversely a low mean WTP can be found by using low anchors.

A second issue with DC is that respondents tend to overstate their values compared to open ended and payment card formats. Brown et al (1996) compared the open ended and DC methods with real payments. Results showed that when WTP was elicited using DC the percentage of "yes" respondents was greater for the hypothetical payment across all conditions compared to real payment. The DC estimated WTP was 2.5 times greater than the open ended mean WTP and the open ended format produced a more accurate estimate. Similar over-statements of WTP in DC (when compared to open ended and payment card formats) have been found by Ready et al

(1996) and Champ and Bishop (2006). This over-statement of WTP in DC formats has been contributed to yea-saying (Boyle et al 1998, Blamey et al 1999).

Open ended and payment card formats are not without their critics either. Bateman et al (1995) compared the open ended, DC and iterative bidding formats and found that DC respondents were far less uncertain about their responses than those who answered using the open ended format, although the DC payments were affected by anchoring. This result was shared by Vossler and McKee (2006) who investigated hypothetic bias and uncertainty for the four main elicitation mechanisms (DC, DC with certainty question, payment card and multiple bound DC). They found no evidence of hypothetical bias across the four mechanisms and found that DC had the smallest difference between real and hypothetical values and respondents were most certain about their values generated using the DC format. The payment card and multiple bound DC also placed a higher cognitive burden on the respondents.

Overall it would appear there is no clear cut answer for which is the best elicitation mechanism and it is the responsibility of the survey designer to choose a technique based on the strengths and weaknesses of each format, survey costs, time available and respondent familiarity with the good.

Willingness to Pay or Willingness to Accept

CV elicitation can either be phrased as willingness to pay (for a positive outcome) or willingness to accept (compensation for a negative outcome). Hausman (2012) argues that WTP and WTA should be equal and one of the fundamental flaws with CV is the continued disparities between the values elicited from each approach. In response Carson (2012b) argued that the difference in WTP and WTA is not surprising in terms of neoclassical economic theory. Differences stem from respondents reactions to the availability of substitute goods, different experiences in the level or quantity of the good and different responses to price changes (Hanley and Shogren 2005). In their research Tunçel and Hammitt (2014) updated the WTP-WTA meta-analyses of Horowitz and

McConnell (2002) and explored the differences between WTP and WTA. Similar to the findings of Horowitz and McConenell, Tuncel and Hammitt find that design features affect the difference, notably the payment method and respondent experience. Incentive compatible mechanisms also yield smaller differences. The authors note that encouragingly the differences are becoming smaller as the literature progresses citing improvements in the methodology for reducing the gap.

Data Collection and Survey Instruments

The CV survey must be administered in some way and survey modes include in-person, telephone, mail and internet. Mixed mode surveys also are possible, such as a first-stage telephone survey followed by a second-stage mail survey (Carson and Louviere 2011). Key considerations when choosing the survey mode are costs, time and assistance available (Whitehead 2006). Survey modes can also induce some level of hypothetical bias: sample frame bias, social desirability bias, avidity bias, and non-response bias. Ethier et al (2000) and Maguire (2009) provided a concise discussion of these their research papers on survey mode comparisons:

- *Sample frame bias* refers to the population that is used to draw a sample. Errors are caused when there is a divergence between the survey and the target populations.
- *Social desirability bias* occurs when individuals provide different responses in the presence of an interviewer so as to appear in a favourable light. This is a particular issue in telephone and in-person surveys.
- *Avidity bias* refers to the notion that those with a greater interest in the survey topic are more likely to respond.
- Finally, *non-response bias* refers to the composition of the sample that chose to complete the survey. If the decision to complete and return the survey is systematically related to individual attributes, the resulting sample may not accurately reflect the population being sampled.

Inferences about population values may be biased because a non-representative sample would result.

A standard in-person survey consists of an interviewer verbally asking respondents questions, although in some instances, particularly with complex designs, the interview may be computer-assisted. Carson (2000) discusses the advantages of in person surveys which include reducing the likelihood of sample selection bias, not excluding respondents with reading difficulties and providing more control over the order and manner in which survey material is presented. Disadvantages include the time and costs.

Mail surveys are considered to be one of the cheapest options but require several rounds of mailings to increase response rates. Mail surveys offer respondents longer to consider the question and also allow the use of visual aids however they suffer from problems of non-response bias and not all questions may be completed.

Internet surveys are one of the cheapest modes and the electronic format allows for quicker data handling, timers can be enabled to monitor how long a respondent spends on a certain page and the whole survey. Additional links, information and photos can be embedded, as well as survey logic which can control for what respondents see based on their previous answers. In one of the first research papers addressing the subject of internet surveys Thurston (2006) argues that the use of internet surveys will always be constrained by sampling issues: some homes do not have internet access, people could be potentially bombarded with too many internet surveys and choose not to respond, it is difficult to weight samples and certain age groups will be more likely to respond. Additionally people become "used" to answering surveys and rapid "click-throughs" which may undermine the validity of the results.

There is a wide variety of research comparing the different survey modes regarding WTP, sample selection bias and social desirability bias. Ethier et al (2000) compared telephone and mail response modes when valuing a new green electricity pricing programme. Social desirability bias

was found in the attitudinal questions for the telephone survey, however this did not carry over to the WTP estimates. In contrast Leggett et al (2003) found that in person surveys which showed social desirability bias did affect WTP with estimate: WTP was between 23% and 29% higher for face to face interviews compared to self-administered surveys. Maguire (2009) researched survey mode effects and compared responses from telephone, mail and in-person interviews for an identical survey. The telephone survey results showed evidence of social desirability bias but there were no significant differences in demographic, attitudes or WTP across the survey modes. Gong and Aadland (2011) tested for direct interviewer effects as a result of gender and race when researching WTP for recycling valuation and behaviour. It was found that respondents state higher WTP when interviewed by white or female interviewers than by non-white or male interviewers.

One of the first papers to compare internet surveys to in-person interviews was Marta-Pedroso et al (2007). There were no differences in WTP between the two surveys although the internet survey suffered from a much lower response rate. Respondents were invited to take part through email links and it was suspected that many respondents simply ignored the email. Olsen et al (2009) compared internet and mail surveys for choice experiments. There were no significant differences in WTP between the two samples although there was a difference in the scale parameters which implied mail respondents had more precise estimates than the internet sample. Lindhjem and Navrud (2011) compared internet and in-person surveys when researching WTP for increased biodiversity conservation in Norway. The researchers found little evidence of social desirability bias in both the internet and in-person surveys. There was also little difference in number of zero bids and "don't knows" between the two response modes. The authors note the results are encouraging for the future use of internet surveys in CV.

Overall it is the responsibility of the researcher to determine which the most suitable survey instrument is depending on the time and research budget available.

Reliability and Validity

Reliability measures the reproducibility and stability of the measure and this is particularly relevant when WTP is being used for policy purposes (Carson et al 2001). The preferred method of evaluating CV surveys reliability is the "test-retest" approach where the same individuals are asked to answer the same questions on two occasions (Loomis 1990). The stability of preferences is characterised by the length of time between the two surveys, the good in question and the elicitation method. In most cases the sample size is reduced for the re-test (Carson et al 2001).

Validity considers whether the instrument or set of questions measures what it is intended to measure. Kling et al (2012) provide a comprehensive overview of the main types of validity; criterion, convergent construct and content:

- Criterion validity seeks to compare the prediction from a survey to a suitable proxy which involves real payments.
- Convergent validity compares estimates from stated and revealed preference methods to see if they correlate. One of the main examples of this is the comparison of the valuation of recreational resources using CV and travel cost methods. If the values match for the expected reasons they are considered valid.
- Construct validity considers whether the WTP estimate conforms to a variety of theoretical considerations. It is expected that surveys will provide an equation which relates some indicator of the respondent's WTP to the respondent's characteristics and to characteristics of the good.
- Content validity addresses whether questions are accepted by the general public when answering surveys and also whether survey best practises are being followed.

Scope and Embedding Effects

Another challenge of the CV method are the ongoing debates regarding scope and embedding effects. The embedding effect was first raised by Kahneman and Knetsch (1992); "perhaps the most serious shortcoming of CV is that the assessed value of a public good is demonstrably arbitrary, because willingness to pay for the same good can vary over a wide range depending on whether the good is assessed on its own or embedded as part of a more inclusive package." The scope effect is where respondents are willing to pay the same amount for a good despite varying levels of quality and quantity; for example they are willing to pay the same amount to restore one hectare of wetland and 100 hectares of wetland. Diamond and Hausman (1994) argued that a scope test should be applied where mean values are compared from separate samples and if larger mean values are not found for high provisions the survey is deemed to lack validity. Heberlein et al (2005) applied the scope test to four different environmental goods; water quality, wolf populations, biodiversity and a restriction on Indian spear fishing. The authors found that when respondents knew more, had positive feelings or had more experience with part of the good they were more likely to assign higher values to the part of the good than the whole, demonstrating part-whole bias. The authors also argued that results were more likely to be valid (regardless of showing scope effects) when respondents had more knowledge and experience about the good. The authors found that their research failed to pass the conventional scope test and acknowledged this may have been a problem with the survey design but also argued that this failure may have occurred for other reasons which are compatible with economic and psychological theories.

Hypothetical Bias

One of the strongest criticisms of CV is that surveys are hypothetical in both the payment method and provision of the good in question (Lusk 2003). It is argued that respondents answer differently from how they would act in real life and this results in a significantly inflated WTP estimate compared to real payments (Murphy et al 2005b). Evidence of hypothetical bias in CV has been

well documented. Champ (2001) compared hypothetical and actual willingness to donate and found less than 50% of those who said they would donate in the hypothetical situation donated in real life. The meta-analyses of both List (2001) and Murphy (2005b) showed that WTP can be overstated by between 1.4 and 3 times the real amount. Loomis (2014) offers the most comprehensive discussion of how to mitigate hypothetical bias. Mitigation methods include e*x-ante* survey design approaches (such as consequential survey designs and cheap talk) and *ex-post* methods to adjust WTP responses (including uncertainty recording, using median rather than mean WTP for aggregation and scaling WTP based on experimental results).

In their seminal paper "*Unbiased value estimates for environmental goods: A cheap talk design for the CV method*" Cummings and Taylor (1999) introduced the idea of "cheap talk" as a means of mitigating against hypothetical bias. At the beginning of the survey a cheap talk script was used which described the bias problem and asked respondents explicitly not overstate their true WTP. Using a series of experiments the authors demonstrated that cheap talk was successful in eliminating bias for all goods where hypothetical bias had previously been identified. Cheap talk has been widely critiqued by authors including List (2001), Lusk (2003), Murphy et al (2005a), Aadland and Caplan (2006) and Silva et al (2011). List (2001) tested cheap talk in the field using auctions for sports cards and found that the script was successful in reducing bias for inexperienced consumers but not for those with experience of the market place. This finding was also shared by Lusk (2003) who explored the effect of cheap talk in a CV survey for "golden rice". Cheap talk reduced WTP for the majority of respondents but not those with a high prior knowledge of the good. Murphy et al (2005a) used cheap talk in a CV survey exploring the provision of a local public good. They found that the technique successfully reduced bias for higher payment levels but not the smaller contributions. Aadland and Caplan (2006) applied a neutral cheap talk script when eliciting WTP for a new recycling programme. In contrast to Cummings and Taylor script, the neutral script did not state that hypothetical bias resulted in over estimations of WTP. The neutral script caused respondents to state higher WTP compared to

those who did not receive the script: this was opposite to the findings of Cummings & Taylor. Silva et al (2011) also applied the neutral cheap talk script in a retail setting. In contrast to Aadland (2006) the neutral script was successful in reducing bias and hypothetical values were not statistically different from real estimates. Overall existing evidence on cheap talk is relatively mixed, with the success of reduction in bias dependent on the good in question, respondent familiarity and elicitation method.

A second approach to reducing hypothetical bias is using certainty scales which ask respondents how certain they are that they would pay the amount stated. Ready et al (1995) developed the polychotomous approach where respondents are asked on a verbal scale how certain they are that they would pay the stated amount with responses such as 'Definitely Yes', 'Probably Yes', 'Probably No' and 'Definitely No'. The authors compared this method in two CV studies; one preventing the destruction of a wetland and a second measuring WTP to prevent the loss of horse farms. A split sample design was used, one with polychotomous choice and one without. Results showed that the polychotomous choice responses had a higher yes response than the traditional dichotomous choice question although the data from the polychotomous choice was not reliable enough to be used in value estimation. The numerical scale approach was developed by Champ et al (1997) where following the valuation question respondents were asked to indicate how certain they that they would pay the stated dollar on a scale from 1 ("very uncertain") to 10 ("very certain"). They found that introducing the certainty scale provided a more robust lower bound WTP estimate for those respondents who had overstated their WTP. Welsh and Poe (1998) incorporated this approach into the payment card format with each respondent asked whether they would definitely not pay through to definitely pay for each value on the card known as the multiple bounded discrete technique. The authors found that respondents were more likely to say yes to the value when responding to a dichotomous choice question compared the open ended and payment card format.

Vossler et al (2003) compared the methods of Champ (1997) and Welsh & Poe (1998) when evaluating a new green electricity pricing program. In line with previous authors finding Vossler found that higher certainty rates lead to hypothetical answers being no different to real participation rates in the energy programme. Those who were uncertain were likely to overstate their WTP. Akter and Bennett (2013) compared the numerical and polychotomous choice certainty approach using a split sample treatment when researching household's preferences for climate change mitigation in Australia. It was found that the polychotomous choice format generated a higher proportion of 'yes' responses, particularly at higher bid levels and resulted in a higher mean WTP estimate. The scales chosen to estimate certainty also had a significant effect on preference uncertainty.

Ready et al (2001) used a follow up question to test respondent uncertainty when valuing health benefits as a result of reduced air pollution. Results showed that respondents whose WTP was elicited using the payment card format were more certain of their WTP than those answering using a dichotomous choice and allowing for uncertainty in preferences reduced the sample mean WTP. A similar approach was used by Hanley et al (2009) when valuing coastal bathing water quality improvements. WTP was elicited using a payment ladder which allowed respondents to tick all values they "definitely would be prepared to pay" and values they would "definitely not be prepared to pay" and respondents could leave a gap between the values if they were unsure. Respondent experience with the good (how long they had lived in the area and the number of trips taken) significantly influenced the uncertainty gap.

Several studies have sought to compare the different *ex-ante* approaches which deal with hypothetical bias. Blumenschein et al (2008) used a field study to compare WTP elicited from surveys with cheap talk and certainty scales to mitigate hypothetical bias compared to real payments for a new diabetes management programme. The certainty scale was the most effective approach at removing hypothetical bias and cheap talk failed to remove the bias. Morrison and Brown (2009) compared three approaches to minimizing hypothetical bias: certainty scales, cheap

talk and "dissonance minimising". Dissonance minimising offers respondents a variety of reasons why they are or are not supporting the provision of the good at a certain bid level for example, "I support the good… but I cannot afford $50". Morrison and Brown used four treatments which compared the three approaches to a real payment. The dissonance approach was found to be the most effective at reducing the bias, as well as certainty scales.

Consequentiality

In one their key papers *"Incentive and informational properties of preference questions"* Carson and Groves (2007) argue that "for a survey to produce meaningful information about respondent's preferences the respondent must view their responses as potentially influencing the supply of the public good". Additionally, the respondent needs to care about what the outcomes of those actions might be, in which case the survey is consequential.

Research considering consequentiality is in its infancy although there are several notable empirical papers. Bulte et al (2005) included a consequential treatment in their work on WTP for seal protection policies in the Netherlands. They found that including text stating the results of the survey would be considered by policy makers resulted in a significantly lower WTP than values obtained using a question which did not include this text. Similar results were found by Landry and List (2007) who explored consequentiality in a real market place (sports cards). The authors found that consequential and cheap talk treatments were indistinguishable from the real responses. More recent work has explored stated consequentiality using a Likert scale follow up question which asks respondents whether they believe the results of the survey will be shared and/or used by policy makers (Herriges et al 2010, Vossler and Watson 2013, Hwang et al 2014, Interis and Petrolia 2014 and Petrolia et al 2014). Results from these papers conformed to Carson and Groves (2007) "knife edge" result: respondents who believed the survey to be minimally consequential had a significantly different WTP distribution to the inconsequential respondents and consequential respondents were prepared to be significantly more. These results are in contrast to laboratory studies which compare CV with real payment scenarios which have shown

that when consequentiality is guaranteed, i.e. the respondents have to pay their stated amount, actual WTP decreases (Murphy and Stevens 2004). Few papers have considered what influences the degree to which the respondent believes the survey is consequential: the exception being the work of Vossler and Watson (2013) who explored what determined respondent's perceived consequentiality using probit regression analysis and found that education was the main observable influence on consequentiality.

Information Provision

Critics of CV argue that familiarity with the good is essential for providing meaningful responses to valuation questions (Carson et al 2001). CV respondents are often asked to value complex, and in many cases unfamiliar goods and it is unlikely that respondents will have well defined preferences prior to elicitation and instead preferences are constructed during the survey process (Gregory et al 1995; Gregory et al 1997). Preference construction is affected by how the respondent processes the information presented to them, which information they select and also their own prior knowledge about the good (Payne et al 2000). Schlaepfer (2008) argues that it is unlikely respondents will form consistent preferences unless the survey offers reliable contextual cues and furthermore Bateman et al (2008) argue that failing to tackle low informed respondents will lead to high variance WTP estimates. They argue that preferences can either be i) well-formed from the outset ii) learned or discovered through experience or iii) internally coherent but liable to be strongly influenced by some initial arbitrary anchor. Providing information to respondents with little prior knowledge of the good is a crucial aspect of the CV survey and Mitchell and Carson (2013) identified information provision as "amongst the most important and most problematic sources of error" in CV surveys.

Early stated preference research began to question how the quantity and quality of information provided in surveys influences both the mean and variance of the WTP estimate (Bergstrom et al 1989; Bergstrom et al 1990; Boyle 1989; Hanley and Munro 1992). Results were varied with some authors finding no statistically significant information effects whilst others found increasing

information reduced the error associated with the WTP estimate. Further work considered respondent's familiarity and experience of the good (Cameron and Englin 1997; Whitehead et al 1995) and found that more experienced and familiar users had smaller conditional variances and increased WTP.

Prior knowledge has also been shown to reduce uncertainty in the WTP estimate (Loomis and Ekstrand 1998; Tkac 1998). Hoehn and Randall (2002) argued that since respondents are heterogeneous in their prior information, the effect of new information is uneven across respondents with some respondents revising their WTP upwards and some revising it downwards. More recent work by Hasselström and Håkansson (2014) examined the differences in WTP estimates for water quality improvements as a result of detailed and "fuzzy" (less detailed) information sets. Results showed WTP differed significantly between the detailed and fuzzy information sets for the low knowledge respondents, however, more detailed information did not affect the WTP for high familiarity respondents. Recent work on the valuation of cold water corals in Norway used a quiz to examine respondent's knowledge and familiarity with the good (LaRiviere et al 2014). An eight question quiz grouped respondents into high and low knowledge following an initial presentation on cold water corals and found that more knowledge led to respondents being more consistent in their choices and those who scored above the mean were prepared to pay significantly more towards cold water coral protection. Further to this in their recent working paper using the same dataset Sandorf et al (2015) demonstrated that respondents with more knowledge were more likely to attend to the attributes in choice experiments.

Respondents also need to be motivated to process new information provided to them. Ajzen et al (1996) demonstrated that under conditions of low personal relevance, respondents fail to process information carefully and this leads to unreliable estimates of WTP. In their study on WTP for increased nature conservation in Finland, Pouta et al (2002) found that only respondents with a high motivation (as measured by whether respondents owned land or were involved in nature

conservation) processed the survey information carefully and readily understood the valuation scenario.

Jorgensen et al (2006) argued that the relationship between information provision and WTP validity is complex and only considering simple strategies such as the amount of information may not be applicable across different goods. In particular they argued that information provision may serve to raise more uncertainty in respondents, even in those who possess a high level of prior knowledge. Furthermore Provencher et al (2012) argued that respondents future expectations of the good should be considered along with additional information when examining WTP estimates. Related to this is a new idea proposed by Mitani and Flores (2014) which considers payment and provision uncertainty. They argue some surveys do not discuss the conditions for which the good will be provided and the likelihood of payment which can raise respondent uncertainty. They suggest that to mitigate the bias respondents must be informed of the payment and provision probabilities.

Overall the literature shares a common standpoint: there is a need to include information within stated preference surveys to assist preference construction for unfamiliar goods and also reduce uncertainty surrounding the WTP estimate. Recent work has shown that information effects are strongest when respondents have low familiarity or little prior knowledge of the good being valued. This highlights the importance of providing quality and readily understandable information to assist those with low knowledge in forming their preferences. Whether this information is learned by the respondent and new knowledge applied to the valuation process is relatively un-explored. Another question concerns knowledge acquisition during the survey: is knowledge acquisition equal across respondents, and if not, what affects this acquisition.

New Contributions to Literature

Overall the CV method has advanced dramatically following the recommendations of the NOAA Panel in 1993. Researchers have risen to the key methodological challenges regarding elicitation formats, hypothetical bias and more recently consequentiality in an effort to appease those who still doubt the method. Following the BP *Deepwater Horizon* oil spill in 2010, the Journal of Economic Perspectives held a symposium that revisited the "CVM debate". Here Hausman, a key critic of CV selectively reviewed the literature and scathingly stated CV had not developed over the eighteen year period, citing ongoing issues with hypothetical bias, including the information problem, divergences between WTP and WTA and the scope and embedding problem in his paper *"CV from Dubious to Hopeless"* (Hausman 2012). In contrast Kling et al (2012) provide a balanced but overall positive view on the subject with suggestions on future research including a focus on consequentiality. Haab et al (2013) offers his thoughts on the debate in and concludes "we are in complete agreement with [Carson 2012] the time has come to move beyond endless debates that seek to discredit CV and to focus instead on making it better." He suggests further research into the incentive properties of questions and behavioural influences in line with Kling et al. Furthermore, Carson et al (2014) argue that consequentiality in CV should be a major focus for survey designers and that a well-designed consequential survey should overcome the problems associated with hypothetical bias. As a result this thesis concentrates on the methodological issues of information provision, respondent learning and consequentiality in CV surveys. The thesis seeks to answer the following questions:

- Do respondents learn the additional information presented to them during CV surveys?
- Does prior knowledge or new information have a greater effect on the WTP estimate when accounting for respondent experience and familiarity with the good?
- Are there differences in the WTP estimate between respondents who think the survey is consequential and those who do not?

- Do respondent characteristics and/or survey designs features have a greater influence on stated consequentiality? Furthermore does information provision and familiarity have an impact on stated consequentiality?

The main contributions of this thesis from a survey design perspective are:

- An empirical analysis of the effect of prior knowledge, new information and learning on WTP estimates.
- An empirical analysis of the effects of perceived policy consequentiality on WTP and whether information and prior knowledge has a significant effect on this.

The main contributions of this thesis from a policy perspective are:

- An examination of respondents understanding of flood risk management in the Tay Estuary, Scotland. In particular their attitudes towards flood risk, current and future defences and their understanding of managed realignment.
- A consideration of what influences the aggregation of willingness to pay estimates and which predicted values may the most suitable for cost-benefit analysis.

Outline of the Chapters

Chapter 2 introduces the concept of managed realignment as a form of flood defence, including a review of the relevant economic, environmental and policy literature. The literature review provides the reasoning behind valuing managed realignment using a CV survey. The case study site is introduced and an overview of the survey method. Descriptive statistics are used to analyse public perceptions of flood risk, current and future flood defence options and managed realignment. Recreational use of the proposed managed realignment scheme is explored. Finally WTP is elicited using three regression models (OLS, Tobit and Interval) to determine which would be the most suitable model to be used for the remainder of the thesis.

Chapter 3 focuses on the "information problem" which is relevant to both CV and choice experiments. The effects of prior knowledge, new information and learning on WTP estimates are

explored, as well as the influence of personal experience and motivation. A detailed description of the field experiment used to test for learning and information provision is provided. Interval regression analysis is used to determine which survey variables have the greatest effect on WTP. Also considered is the framing effect of taking a quiz at the start of a survey.

Chapter 4 explores one of the most recent research areas in stated preference: consequentiality. Using the same CV survey, respondents WTP for managed realignment is assessed by their perceived policy consequentiality as measured by a Likert Scale question. This chapter contributes to the existing literature by examining whether prior knowledge and varied information have an effect on perceived consequentiality. This is analysed using a multinomial logit model with perceived consequentiality as the dependent variable.

Chapter 5 concludes by considering the policy implications of the research findings; specifically which estimates should be used for aggregation when undertaking cost-benefit analysis for a new managed realignment scheme.

Chapter 2.
Public Willingness to Pay for Managed Realignment on the Tay Estuary, Scotland

Introduction

Coastal planners are increasingly recognising the need for alternative forms of flood defence (French 2006). Under current climate change predictions, sea levels, storminess and coastal erosion are all set to increase and maintaining the traditional 'hold the line approach' is no longer viewed as the optimum flood defence option that it once was (Garbutt et al 2006; Turner et al 2007). Whilst hard engineered defences will need to be maintained for towns and industrial areas, economically, it is rarely justified to maintain hard defences along dynamic, open coasts. UK expenditure on hard defences is predicted to increase to £200 million per annum by 2030, a 60% increase on current spending levels (Committee on Climate Change 2013). Environmentally, hard defences are unsustainable as they contribute to coastal squeeze. Hard defences restrict the natural migration of intertidal habitats inland, reducing these habitats to narrow strips along the coast (Doody 2004). In response to these issues Defra (England & Wales) and more recently SEPA (Scotland), have recognised the need to consider natural flood management as part of their Flood Risk Management Strategy (Ledoux et al 2005; SEPA 2012).

Natural flood management works with natural hydro-geological and morphological processes to manage the sources and pathways of flood waters and involves the alteration, enhancement or restoration of natural features and characteristics (UK Government 2011). Managed realignment is once such natural flood management option at the coast. This approach involves breaching existing coastal defences, allowing previously reclaimed land to be subjected to tidal flooding and allowing the natural processes of inundation, erosion and accretion to take place (French, 2006). Managed realignment reduces the costs of hard defences by making use of the storm buffering capacity of intertidal habitats such as mudflats and saltmarshes (King and Lester 1995; Ledoux et

al 2005; Moller et al 1999). It is now accepted that managed realignment is one of the most cost-effective options for strengthening coastal defence. It is estimated that allowing managed realignment to take place on 10% of the English coastline by 2030 will save between £180 and £380 million in reduced maintenance and avoided construction costs compared to hold the line approaches (Committee on Climate Change 2013). To date managed realignment has been used at several sites along the east coast of England including the Blackwater Estuary (Essex), Freiston Shore and Brancaster West Marsh (Norfolk) and the Humber Estuary (Yorkshire) (Luisetti et al 2011; Myatt et al 2003a; Myatt et al 2003b; Myatt et al 2003c). In Scotland, one managed realignment scheme has been undertaken at Nigg Bay, Cromarty Firth (Tinch and Ledoux 2006).

Whilst the main policy driver for managed realignment has been flood defence, it also offers the opportunity to restore wetland habitats which have been lost through coastal squeeze and other anthropogenic stressors such as land reclamation (McLusky and Elliott 2004). Many intertidal areas are now protected under the UK Biodiversity Action Plan and the EU Habitats and Wildbirds Directives (Council Directive 92/43/EEC, Council Directive 2009/147/EC) and managed realignment is viewed as an important technique in restoring these wetland areas (Garbutt et al 2006). Restoration also offers additional ecosystem service benefits including carbon sequestration, nursery and spawning grounds for fisheries and recreational activities, as well as contribution to biodiversity through the provision of roosting and foraging sites for internationally protected waterbirds (Luisetti et al 2011).

A challenge for policy makers is valuing the additional non-market benefits which arise from managed realignment (NEA 2011). A meta-analysis of 190 wetland valuation studies found the majority of studies valuing flood defence used market based approaches such as replacement cost (Brander et al 2006). One drawback of such approaches is that they fail to take into account the value of the additional ecosystem services. In England, several studies have been undertaken to value the additional benefits of managed realignment. Turner et al (2007) undertook cost-

benefit analysis for a variety of managed realignment scenarios for the Humber Estuary, England. Benefits valued included carbon sequestration and general habitat creation benefits whilst costs included capital costs of realignment and forgone agricultural incomes. Habitats were valued using the results generated by the meta-analyses of Brander et al (2006) and Woodward and Wui (2001). Turner et al (2007) concluded that managed realignment would be more economically efficient than hold the line over longer timescales (greater than 25 years) but also urged that greater stakeholder inclusion is needed when planning sites with complex trade-offs. Related to this was the work of Andrews et al (2006) who analysed the biogeochemical value of managed realignment in the Humber Estuary in terms of increased carbon sequestration and reduced metal contamination. Results showed that sediment burial at the site resulted in a saving of £1000 $^{a-1}$ in avoided clean-up costs for copper contamination. Luisetti et al (2011) furthered this work by considering the recreational and fish nursery benefits of managed realignment for the Humber and Blackwater estuaries. Using a choice experiment the recreational value of saltmarsh at the Blackwater Estuary was estimated to be worth between £4,429,000 and £6,430,000 per annum. Similar to the finding of Turner et al (2007), Luisetti et al concluded that valuation plays a small but vital role in the planning of new managed realignment schemes but stakeholder participation also plays a key role in the planning process.

Previous UK studies which have valued the additional benefits of managed realignment have not fully captured public preferences for the schemes. A challenge for coastal planners is communicating the flood defence benefits of managed realignment to the general public and local stakeholders (SEPA 2012). Historically, coastal protection has typically been hard engineered structures which have portrayed the view to the general public that the boundary between land and see is fixed rather than dynamic and this has led to local residents being opposed to managed realignment schemes which appear to "give land to the sea" (Coates et al 2001; French 1997). There is an increasing need to engage with local residents throughout the schemes development and study public perceptions of managed realignment schemes (Ledoux et al 2005). Surveys for

the Freiston Shore, Orplands and Brancaster managed realignment schemes sought to gain an insight into residents understanding of flooding, their perceptions of managed realignment and which issues they considered important (Myatt et al 2003a; Myatt et al 2003b; Myatt et al 2003c). Results for the Brancaster project highlighted that the majority of respondents felt they were at risk from flooding, although in reality only a "few properties are vulnerable to flooding at present" and over 60% of respondents considered the "effectiveness of managed realignment" to be a very important issue. Myatt et al concluded that local residents should be involved in the discussion of managed realignment and have direct inputs into decision making. This engagement is even more crucial in Scotland where there is requirement for SEPA raise public awareness of flood risk and future flood defence schemes (Scottish Government 2011). Thus when looking to implement a new managed realignment scheme it is essential to understand local stakeholder's attitudes towards flood defence and flood risk, and also consider the drivers behind these attitudes.

The aim of this paper is to explore public preferences for a proposed managed realignment site on the Tay Estuary, Scotland. A contingent valuation survey was designed and administered which allowed the exploration of two main issues:

1) What do local residents currently understand about flood risk management in the Tay Estuary?
2) Are local residents willing to pay towards a managed realignment scheme?

Initially, the study investigates local stakeholder's awareness of current flood risk management in Scotland and their knowledge of managed realignment in line with work of Myatt et al (2003 a,b,c). Secondly, respondents perceived flood risk is explored and compared to their actual flood risk to further examine local stakeholder's awareness of flood risk. Thirdly, possible future recreational use of the site is explored and finally willingness to pay (WTP) for the proposed managed realignment scheme is estimated using three different regression models.

The case study for the project was at Newburgh on the Tay Estuary, Scotland (Figure 2.1). At the time of planning the research project no detailed plans of the managed realignment scheme were available and a fictional site was created for the purposes of the project based on the Fife Shoreline Management Plan[1]. Subsequently, SEPA released details of proposed natural flood management areas and the site valued for this study coincides with the area proposed at Newburgh (SEPA 2015).

Figure 2.1: Location of the proposed managed realignment site

[1] The Fife Shoreline Management plan is available online at http://www.fifedirect.org/minisites/index.cfm?fuseaction=page.display&pageid=C040877C-B767-3F71-8454BE5167C5BC58&siteID=C03E446A-0241-A6A5-7462DD169B215841. Last accessed 10/8/2015.

Methodology

Empirical Approach

Contingent valuation (CV) was used to explore public preferences and attitudes towards the proposed managed realignment scheme. CV is a stated preference technique which uses questionnaires to create a realistic, but hypothetical market, for respondents to indicate their WTP for a change in an environmental good (Mitchell and Carson 1989). Scenarios are constructed which offer different policy alternatives to the current status quo. The respondent is asked to state whether would support an alternative policy option depending on what the new policy will provide, how this will be delivered and how much it will cost (Carson 2000).

Respondent WTP can be elicited in a variety ways including open ended (where the respondent is asked to provide the interviewer with a point estimate of their WTP), through a bidding game (individuals are asked whether they would be willing to pay certain amount or not with the values raised and lowered depending on the previous answer), through discrete choice (respondents are asked simple yes/no questions) and finally via a payment card or ladder where respondents are asked to choose a value from the range presented on the card (Haab and McConnell 2002). As discussed by Boyle and Bishop (1988) each format has its strengths and weaknesses, with bidding game estimates subject to starting point bias and payment card and dichotomous choice (DC) influenced by the values initially chosen by the interviewer. For this survey a payment ladder format was used. This was chosen to increase the statistical efficiency gains relative to the DC format and lower the cognitive burden placed on respondents which is associated with the open ended format (Mitchell and Carson, 1989). Values on the ladder ranged from £0 to £150, with values increasing in £5 increments from £0 to £20 and then in £10 increments thereafter. The values were chosen based on feedback from initial focus groups. There was also an option to tick "I am prepared to pay more than £150 per annum".

The statistical analysis was conducted in STATA (version 14). There are a variety of estimation procedures available for estimating WTP from payment card data, three of which were used and compared in this paper (OLS, Tobit and Interval). The Tobit model, or censored regression model, is designed to estimate linear relationships between variables when there is either left or right censoring in the dependent variable (UCLA: Statistical Consulting Group 2015). For WTP surveys left hand censoring is appropriate as it takes into account respondents who are not prepared to pay towards the scheme. It is recognised estimates from both the OLS and Tobit model can result in a biased average valuation as the expected values between the upper and lower bounds of the payment cards are unknown (Cameron and Huppert 1989). Interval regression can overcome this issue by using the lower and upper bounds of the value chosen on the payment card (Haab and McConnell 2002). For this survey, respondents were asked to tick the highest value they were prepared to pay towards the scheme. However, their true value may lie between the highest bid they chose and the next highest amount, for example, the respondent ticked £100 and the next highest was £110. In this case their true value may lie between £100 and £110 and these bounds can be used in the interval regression estimation.

In CV surveys there is an expectation that respondent's experiences with the good in question, personal motivations, their socio economic status and the distance they live from the site will all affect WTP (for examples see Cameron and Englin 1997; Kniivila 2006; LaRiviere et al 2014; Whitehead et al 1995). Experience in this case was whether a respondent had been flooded, whilst personal motivations were their perceptions of flood risk and whether they believed current flood defences were adequate enough to protect their home. Dummy variables for whether a respondent had been flooded (yes=1, no=0), whether the respondent believed they were at risk from flooding (yes=1, no=0) and whether they worried about existing flood defences (yes=1, no=0) were included in the regression analysis. Additionally, perceived risk and worry were interacted. There was an expectation that those respondents who feel they were at risk and were most worried about current flood defences would be prepared to pay the most towards the

scheme. Distance bands were also included as dummy variables in the model ranging from "at site" through to "over 20 miles" from the site. There was an expectation that residents of Newburgh would be prepared to pay the most towards the scheme as they would receive direct flood defence benefits. To account for socio-demographics, age, income, gender, property ownership and whether a respondent belonged to an environmental group were also included. Variables for the length of time spent on the survey and time spent on the WTP question were included to analyse whether there was an effect from some respondents "rushing" through the online survey and potentially clicking at random. Variables used in the estimation process are outlined in Table 2.1. The model specification is outlined in Equation 2.1.

$$WTP_I = b_0 + \ b_1 FLOODRISK \ + b_2 WORRIED + b_3 FLOODRISK * WORRYIED + b_4 HOMEFLOOD \ + + b_5 INCOME + b_6 GENDER + b_7 PROPERTY + b_8 ENV \ + b_9 DISTANCEBAND \ + b_{10} SURVEYTIMER \ + b_{11} WTPTIMER \ + \varepsilon_I \quad (2.1)$$

Table 2.1: Variables used in the estimation process

FLOODRISK	Statement questions response "My property is at risk from flooding" (0= strongly disagree, disagree or unsure no, 1=strongly agree or agree)
WORRIED	Statement questions response "I am worried the current flood defences are not adequate enough to protect my home" " (0= strongly disagree, disagree or unsure no, 1=strongly agree or agree)
HOMEFLOOD	Home has been flooded (0=no, 1=yes)
INCOME	Household income ranging from under £15,000 to over £100,000 per annum (six categories, midpoint of each category used in estimation process)
GENDER	Gender (female=0, male=1)
PROPERTY	Whether a respondent owns the property or not (0=no, 1=yes)
ENV	Member of an environmental group (0=no, 1=yes)
DISTANCE	Distant respondent lives from the site (0= at site, 1= less than 10 miles, 2= 10-20 miles 3=over 20 miles)
SURVEYTIMER	Time spent on survey
WTPTIMER	Time spent on WTP question

Survey Design

The survey was designed following the recommendations of Carson (2000). Initially a focus group was held to review the introductory quiz questions and payment card. This was followed by a pilot survey with participants from Newburgh (where the scheme was proposed) and 50 people responded. The final survey was conducted throughout 2013 and survey participants were randomly selected from the Scottish Phone Directory. Only people living within the local authorities affected by the flood defence scheme were selected to take part. In total 4000 households were contacted by mail and invited to take part in an online survey. A reminder card was sent two weeks after the first contact attempt. Of 4000 people contacted, 749 people completed or partially completed the online survey with 593 responses completed in sufficient detail to be used in the analysis. It is recognised that this response rate is relatively low and this increases the likelihood that the sample will not be representative of the local population. Self-reported socio-demographic characteristics are compared with Scottish Neighbourhood statistics as part of the analysis.

The online survey was organised as follows: respondents first received an introductory text outlining the purposes of the survey, who would be using the results and why. In line with the recommendations of Carson and Groves (2007) and Vossler and Watson (2013) regarding consequentiality in stated preference surveys, it was made clear that the survey results would be shared with relevant policy makers and would be taken into consideration when planning future flood prevention schemes. Respondents were then asked to complete a nine question quiz. This was used to determine what individuals already knew about existing flood defence and flood risk, as well as managed realignment. Respondents were then given information about the process of managed realignment, flood risk in their local area and the possible additional ecosystem service benefits of managed realignment (the phrase ecosystem services was not used in the survey) to help inform their preferences (Table 2.2).

Table 2.2: Additional information provided in the survey

In the Tay Estuary and Montrose Basin approximately 4% of homes lie within a floodplain.
Each year the Scottish Government makes £42 million available to support local authorities' flood prevention and coastal protection programmes.
Historically, the main form of flood defence in Scotland has been hard engineered structures such as sea walls, rock armour and groynes.
Managed realignment schemes can deliver a greater level of protection against coastal flooding than traditional sea defences alone
Coastal wetlands increase the spawning ground available for fish due to the development of saltmarsh habitats.
Coastal wetlands create new saltmarshes and mudflats which provide food sources for a wide variety of wildlife.
Land needs to be made available to create a managed realignment site. This involves purchasing land at a fair market price, and it most cases this is agricultural land.
Under the European Habitats and Wild Birds Directive, the Scottish Executive has a legal duty to protect and enhance coastal wetlands in the Tay Estuary and Montrose Basin, as these wetlands are home to internationally important water bird populations.
In the Tay and Eden estuaries, the shelduck population has declined in recent years due to the loss of its coastal habitat, as a result of coastal erosion.

The managed realignment scenario was then detailed, including a map of where the scheme would take place, how many homes would be protected and the length of time before the defences would be completed. The status quo scenario of continued hard defences was also included. The cost of the project was outlined and respondents were told that increases in council tax would fund the scheme. Council tax was a plausible payment vehicle as local authorities are responsible for funding flood defence in Scotland. Respondents were then presented with the payment card ranging from £0 to £150 and asked to tick all the amounts the household was willing to pay towards the scheme. Following this respondents were given information on the potential recreational activities which would be available at the managed realignment site including walking, dog walking, bird watching and fishing. Respondents were asked how often they think they would visit the site and which activities they would undertake. A series of debriefing questions followed, including statement questions regarding perceived flood risk,

whether respondents felt flood risk was increasing and whether the current defences were adequate enough to protect their home. Finally respondents were given a set of socio-demographic questions.

Results

Sample Characteristics

Self-reported socio-demographic characteristics were compared with Scottish Neighbourhood Statistics for the Fife, Dundee and Perth & Kinross local authorities (Table 2.3). 60% of responses were from the Fife local authority, with 26% from Dundee and 13% from Perth & Kinross. Analysis revealed that the sample was not fully representative of the local population. The largest age groups (40- 9 years, 50-59 years and 65 and over) were well represented in the survey whilst the youngest age group (18-29) was under represented (9% of sample compared to 22% in population). Males were also over represented in the survey (58% compared to 47%). 63% of respondents worked full time compared to 50% of the overall population. The modal income group was £20,000–£39,000 which was similar to the median income of the local authorities (£26,000). Over 80% of the sample owned their own homes compared to the Fife average of 64%. The online survey enabled the use of page timers. The mean survey time was 24 minutes. Respondents were not able to "click back" through the survey, or leave the page without restarting the full survey. The mean time spent on the WTP question was 82 seconds.

Table 2.3: Descriptive statistics for socio-demographic variables

Variable	Percentage of Sample
Income	
Under £15,000	13.78
£15,000 - £19,000	12.11
£20,000-£39,000	32.99
£40,000-£69,000	25.68
£70,000-£99,000	9.60
Over £100,000	5.85
Male (dummy)	58.25
Education (dummy)	
Secondary school	20.04
Sixth form/College	24.75
Undergraduate Degree	25.74
Postgraduate Degree	29.47
Environmental group membership (dummy)	33.4
Local Authority (dummy)	
Fife	60.13
Perth & Kinross	13.44
Dundee	26.43
Age	
18-29	9.39
30-39	15.46
40-49	18.40
50-59	23.87
60-64	10.18
65 and over	22.7
Economic Activity (dummy)	
Employed	63.53
Unemployed	36.47
Property Status (dummy)	
Property owner	82.32
Other	17.68
Distance Bands	
At site	16.52
Less than 10 miles from site	2.86
Between 10 and 20 miles from site	32.60
Over 20 miles from site	48.02

Knowledge of Current Flood Risk Management

Analysis revealed the majority of respondents were poorly informed about flood risk management and the mean quiz score was 3.05 (*SE*=0.08) (Figure 2.2). Respondents knew the least about the "numerical" questions (questions one and two) relating to flood risk and government flood defence spending. Respondents appeared to be familiar with historical flood protection measures (question three), although as expected, less respondents were aware that managed realignment could deliver a greater level of flood protection compared to traditional defences (question four). Surprisingly over 50% of respondents knew wetlands were important spawning grounds for fish (question six) although far fewer were aware that wetlands provided an important food source for wildlife (question five). 45% thought brownfield land would be used for the managed realignment site, compared with 21% who correctly knew that in most cases agricultural land is used. Respondents were relatively unfamiliar with the legal obligations regarding wetland protection (question nine) although almost 50% were aware that erosion was the main cause of decline for waterbird populations (question eight). Overall it appeared respondents were unfamiliar with flood risk management issues in the Tay Estuary.

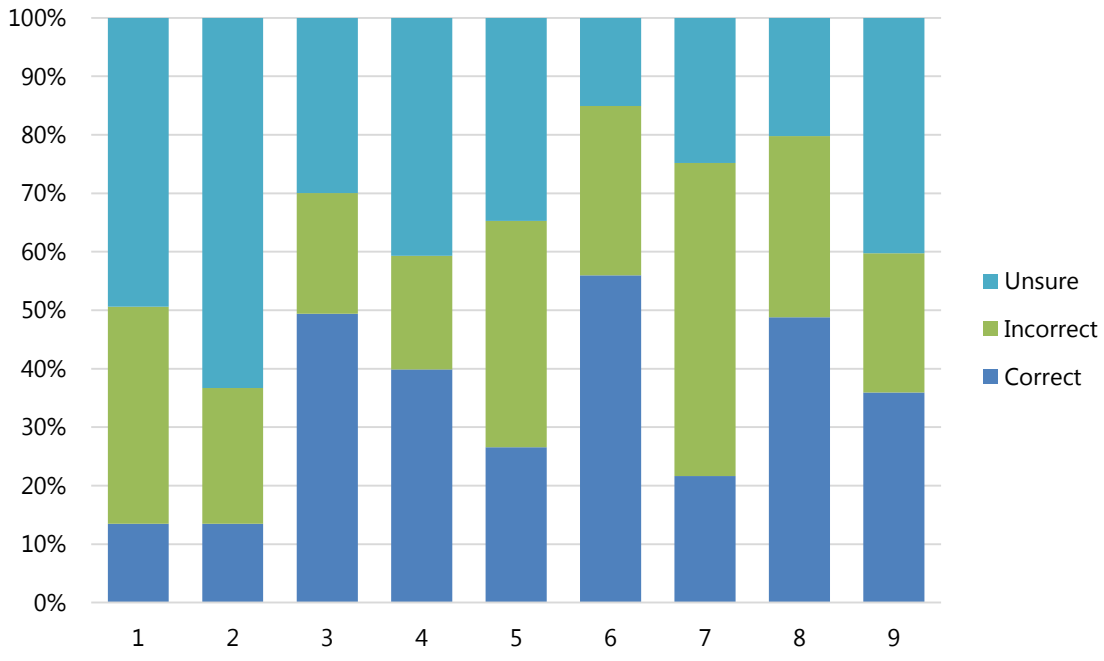


Figure 2.2: Responses to the flood risk management quiz

Flood Risk Awareness

The survey follow up questions revealed that approximately 18% of respondents felt they were at risk from flooding, 29% felt that flood risk was increasing and 23% were worried that the current flood defences were not adequate enough to protect their home. Over 67% of respondents felt that it was the council's responsibility to maintain and fund flood defences (Figure 2.3).

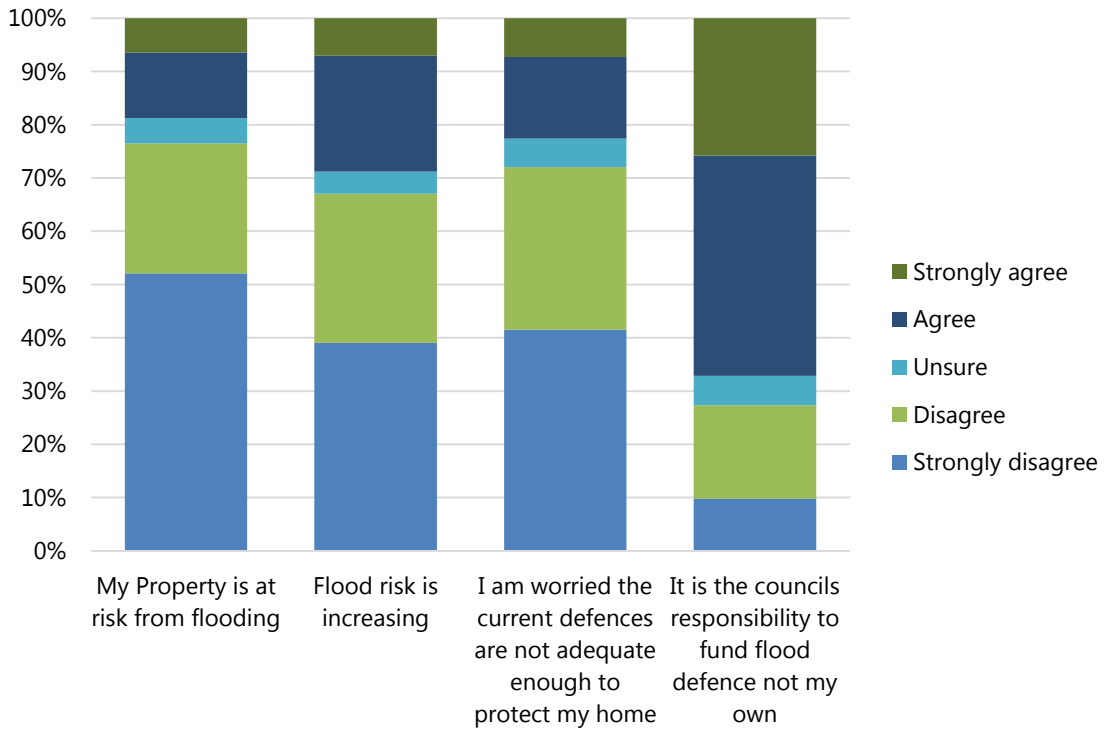


Figure 2.3: Responses to the four flood risk awareness statement questions

Respondent's postcodes were compared to SEPA flood risk maps in ArcGIS to determine whether the resident lived on a coastal or fluvial floodplain. Overall, 26% of respondents lived on a floodplain, 8 percentage points higher than the number of respondents stated they were at risk from flooding. This suggests that some respondents are unaware of the flood risks they may face. Additionally, 55% of those who were mapped as living on the floodplain either disagreed, strongly disagreed or were unsure that they were at risk from flooding (Figure 2.4). Similar figures of unawareness have been recorded in other UK wide flood risk surveys (Burningham et al 2008;

Defra and Environment Agency 2004). Despite the lack of flood risk awareness 68% of the sample had some level of insurance against flooding.

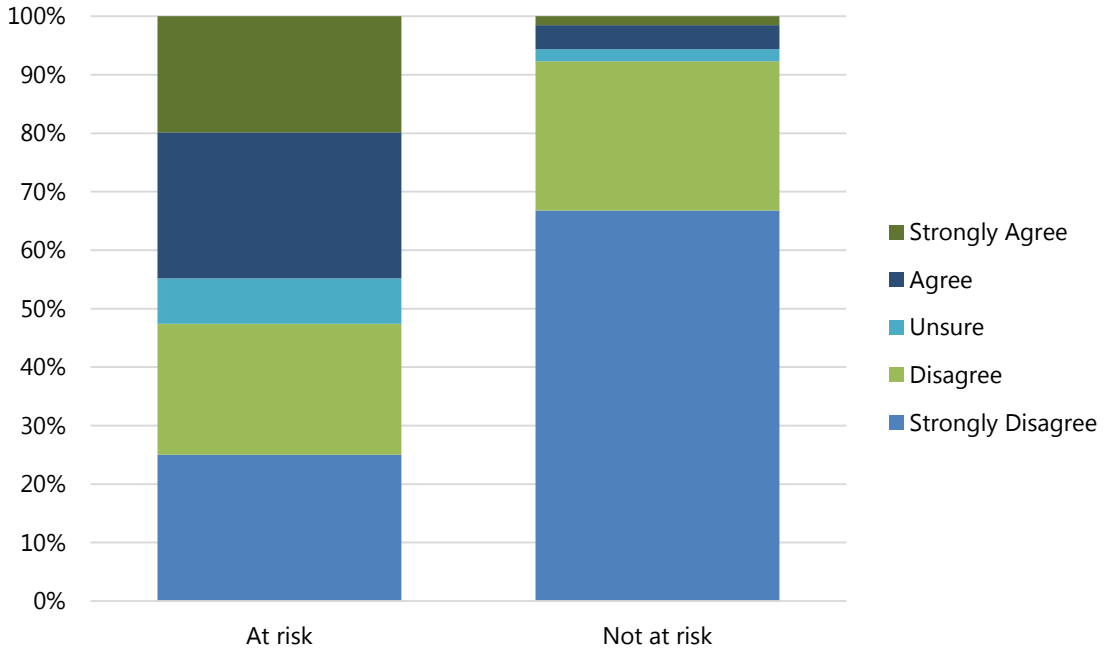


Figure 2.4: Comparison of perceived risk from flooding: at risk respondents and those not at risk

Mann Whitney tests were used to compare the flood risk statement responses between Newburgh residents and respondents from elsewhere (Table 2.4). Responses were significantly different indicating that the Newburgh residents were more concerned about flood risk, current flood defences, increased risk from flooding and flood defence funding. Care should be taken when interpreting this result: the survey included a map of "at risk homes" for Newburgh and it could be that those respondents stating they were aware of their flood risk and/or were worried were not prior to receiving this information.

Table 2.4: Descriptive statistics and Mann Whitney results for flood risk attitudes

Flood Risk Statement Questions	Sample	Mean	SD	Z-score	p-value
My property is at risk from flooding					
Newburgh	75	2.52	1.50	-4.94	<0.01
Elsewhere	378	1.71	1.12		
The flood risk to my property is increasing					
Newburgh	75	2.77	1.52	-3.65	<0.01
Elsewhere	378	2.07	1.24		
I am worried the current defences are not adequate					
Newburgh	75	2.80	1.55	-4.67	<0.01
Elsewhere	378	1.90	1.13		
It is the councils responsibility to fund flood defence					
Newburgh	75	3.86	1.08	-1.91	<0.10
Elsewhere	378	3.48	1.34		

Recreational Use of the Newburgh Managed Realignment Scheme

Respondents were asked about their possible future recreational use of the Newburgh managed realignment scheme. The most popular activity at the site would be walking, with 20% of respondents stating they would visit the site at least once per week for this activity, followed by 10% of people visiting to walk their dog. Birdwatching and fishing were far less popular with over 80% of respondents stating that they would never visit the site for these activities. Potential future use was analysed by distance the respondent lived from the site (Figure 2.5). As expected those living in Newburgh would be most likely to visit the site, with over 60% stating they would visit the site at least weekly to walk. Surprisingly 18% of Newburgh respondents also said they would visit the site at least weekly for birdwatching. Overall there was a clear distance decay relationship in the number of anticipated visits for each activity with those living furthest away unlikely to visit the site. Less than 20% of those living over 20 miles away stated they would visit the site for walking at least monthly, 10% for dog walking and less than 5% for fishing and birdwatching.

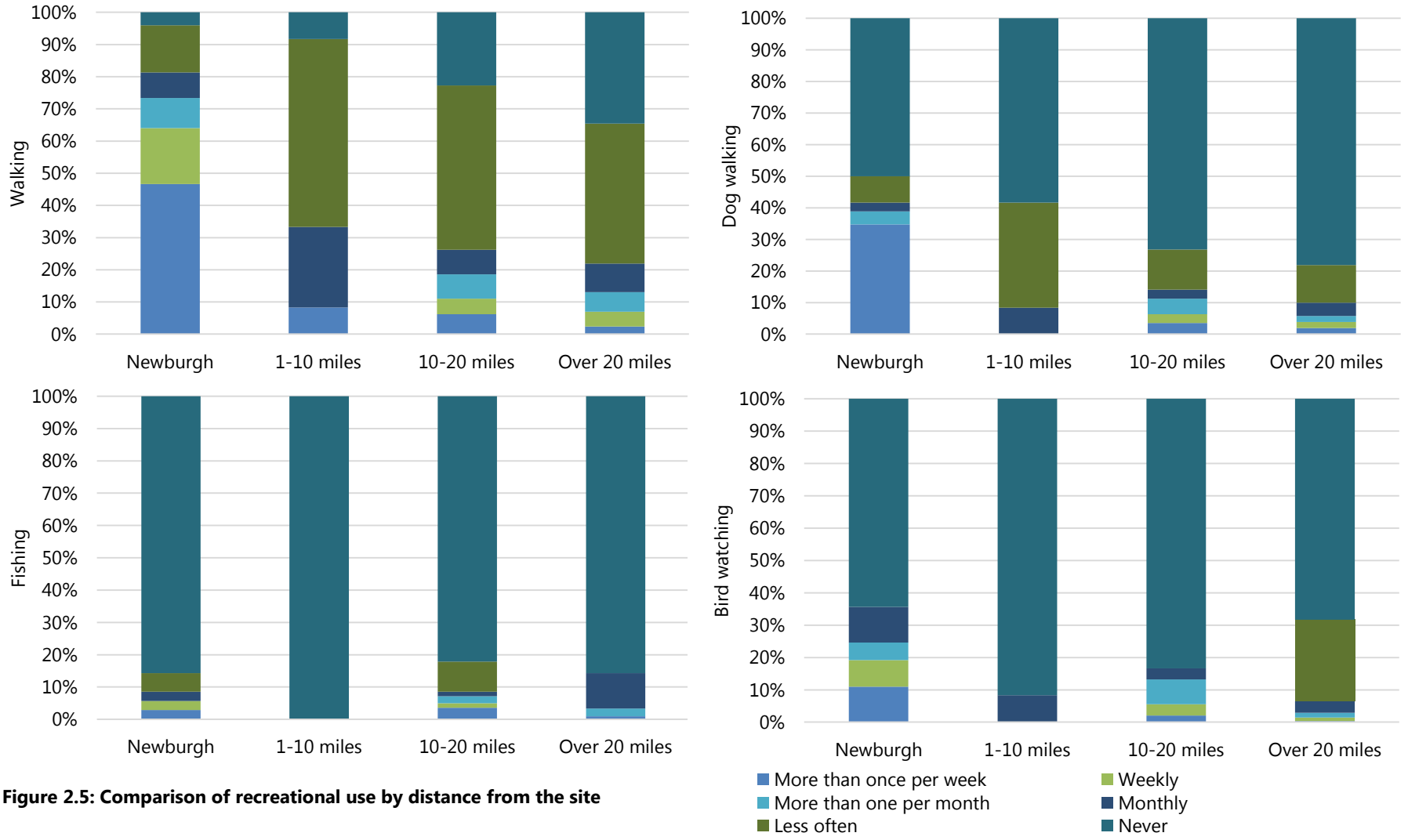


Figure 2.5: Comparison of recreational use by distance from the site

Willingness to Pay

The majority of respondents (82%) were prepared to pay towards the managed realignment scheme. The main reasons for not being prepared to pay were not being able to afford to contribute (26%) and believing it is the Scottish Government's responsibility to fund flood defence (27%). The histogram of WTP highlights that WTP is downward sloping and there is non-trivial anchoring around £50, £100 and £150 pounds (Figure 2.6). The sample mean WTP was £43.02 per household per annum (*SD*= 43.15).

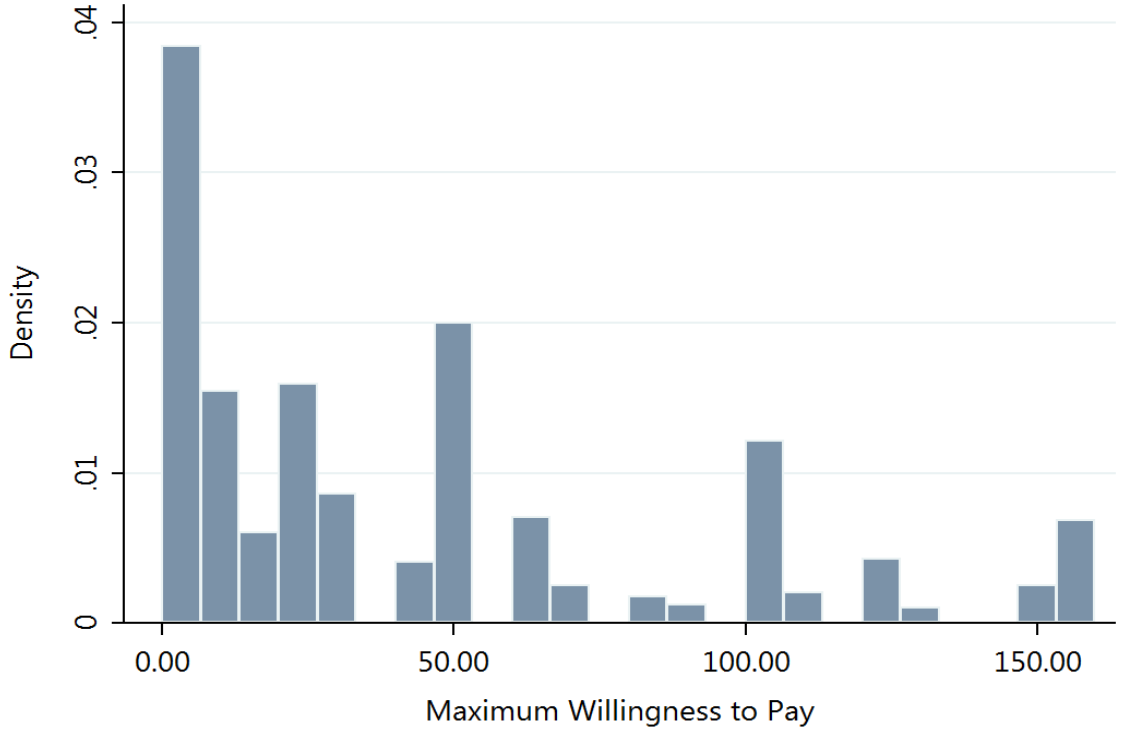


Figure 2.6: Histogram of WTP for all subjects. N = 593

Table 2.5 compares the coefficient estimates for three different regression models which considered which variables influenced household WTP for managed realignment. Coefficient estimates were higher for the Tobit model compared to the Interval and OLS regression models. Comparing the AIC, BIC and Log likelihood estimates across the three models indicates that the Interval regression model had a better model fit.

Perceived flood risk and worry about existing coastal defences had the strongest effect on WTP. Respondents who felt most at risk from flooding and were worried about existing defences were prepared to pay between £33.95 and £35.73 more per annum compared to those respondents who were not worried or felt they were not at risk. Surprisingly respondents who had been flooded previously were not willing to pay more than those who had not been flooded.

Respondents who lived closest to the site were prepared to pay the most and a distance decay relationship was established. Respondents living over 10 miles away from the site were prepared to between £20 and £22 less than those living closest to the site. This was expected as these respondents are unlikely to receive direct flood defence benefits from the new scheme. There was no significant difference between respondents living over 10 miles from the site and those living over 20 miles from the site.

In line with previous stated preference surveys income was a significant determinant of WTP with those on higher incomes prepared to more towards the scheme. For example, a respondent in the highest income band (over £100,000) was, on average, prepared to pay between £35.36 and £41.18 more per annum than a respondent in the lowest income band. The increase however was nonlinear, with respondents in the £40,000-£69,000 income band prepared to pay less than those in the £20,000-£39,000 income band.

The predicted mean WTP from the three regression models were:

- OLS: £39.35 (*CI* =£37.32 - £41.39)
- Tobit: £34.50 (*CI* =£32.21- £36.80)
- Interval: £42.63 (*CI* = £40.57 - £44.69)

This value increase to £73.17 (*CI*= £68.42 - £77.94) if the respondent was worried about flooding (Interval model) and increased to £86.95 (*CI*= £82.12 - £91.74) per annum if the respondent was worried and lived in Newburgh (Interval model). These results are consistent with previous

managed realignment surveys but lower than wetland values derived through meta-analysis. A meta-analysis of wetland CV studies by Brouwer et al (1999) found mean WTP for wetland regeneration was £83.65 (£131.60[2]) per household per year. English Nature (2001) applied this value to managed realignment and derived a household WTP of £20 per household per year (£30.10[1]) for England and Wales. Further wetland values for flood defence have been calculated by Woodward and Wui (2001) with values calculated as $159 per hectare (1990 values) and $50 per hectare (1995 values) respectively (£224 and £56.77[1]). More recently, Defra and Environment Agency (2005) assessed respondent's WTP to avoid health impacts associated with flooding and mean WTP values for flooded and at risk respondents were between £150 and £200 per household per year respectively (£282 and £211.89[1]). Overall the values estimated in this survey are more conservative than previous UK valuation studies.

[2] Current value adjusted for inflation and currency conversion

Table 2.5: OLS, Tobit and Interval regression results: willingness to pay for managed realignment (Equation 2.1)

VARIABLES	OLS		Tobit		Interval	
Flood risk variables						
My property is at risk from flooding (agree or strongly agree)	-6.16	(10.91)	-6.33	(12.68)	-6.16	(10.90)
I am worried that the current flood defences are not adequate enough to protect my home (agree or strongly agree)	10.24	(7.36)	13.50	(8.43)	11.02	(7.36)
Interaction: risk (0) and worried (0)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Interaction: risk(1) and worried (1)	34.22**	(13.74)	35.73**	(15.84)	33.95**	(13.73)
My property has been flooded (yes)	6.11	(7.63)	7.18	(8.79)	6.02	(7.63)
Socio-Demographic Characteristics						
Newburgh resident (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Less than 10 miles from Newburgh	-13.05	(11.45)	-13.24	(13.22)	-13.10	(11.45)
Between 10 and 20 miles from Newburgh	-20.50***	(5.72)	-22.37***	(6.61)	-21.01***	(5.72)
Over 20 miles from Newburgh	-19.70***	(5.53)	-20.26***	(6.37)	-20.01***	(5.53)
Member of an environmental group (yes)	13.05***	(4.12)	15.80***	(4.75)	13.42***	(4.12)
Gender (male)	10.85***	(3.76)	11.67***	(4.38)	11.00***	(3.76)
Income: less than £15,000 (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Income: £15,000 - £19,000	10.94	(6.99)	17.35**	(8.23)	11.56*	(6.99)
Income: £20,000-£39,000	17.28***	(5.86)	22.79***	(6.94)	17.51***	(5.85)
Income: £40,000-£69,000	12.44**	(6.16)	19.11***	(7.27)	13.21**	(6.15)
Income: £70,000-£99,000	25.34***	(8.09)	31.60***	(9.44)	25.30***	(8.08)
Income: Over £100,000	35.96***	(9.95)	41.18***	(11.57)	35.36***	(9.94)
Property owner (yes)	-2.13	(4.93)	-2.91	(5.73)	-2.41	(4.93)
Time spent on survey (seconds)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Timer spent on WTP question (seconds)	0.03	(0.03)	0.04	(0.04)	0.03	(0.03)
Predicted WTP estimates	39.35	(1.04)	34.50	(1.18)	42.63	(1.04)
Constant	25.21***	(7.87)	13.16	(9.31)	28.04***	(7.86)
lnsigma					3.62***	(0.03)
sigma			42.29***	(1.63)		
Observations	436		436		436	
AIC	4411.04		3876.31		3003.09	
BIC	4484.44		3953.79		3080.57	
Log Likelihood	-2187.53		-1919.16		-1482.55	

Notes: predicted WTP estimates calculated using predict command in Stata for only those respondents used in the estimation process

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Discussion

This paper aimed to explore public preferences for a proposed managed realignment site at Newburgh on the Tay Estuary, Scotland. Eliciting preferences through a CV survey allowed the identification of respondents WTP towards the managed realignment scheme and also which factors influenced their WTP. Future possible recreational use of the site was also explored. Additionally, local residents understanding of flood risk management, including what they already knew about the costs and benefits of managed realignment was analysed alongside their perceived and actual risk of flooding.

Firstly, results of the initial quiz highlighted that respondents were relatively uniformed about current flood risk management in their area. Whilst the majority of respondents recognised the main type of coastal defence, far fewer were aware of the percentage of homes at risk from flooding and the current flood defence expenditure. Respondents also knew very little about the additional costs and benefits of managed realignment. This highlights the importance of providing information about managed realignment prior to undertaking the valuation exercise as the full costs and benefits may not be readily understood or known by the general public. Encouragingly, the quiz revealed that over 40% of respondents felt that managed realignment had the potential to deliver a greater level of protection than traditional coastal defences. This is in contrast to previous findings where it is widely discussed that the general public have negative feelings towards managed realignment and do not see it as an adequate form of flood protection (French 2006). Overall, the results of the quiz demonstrate the need for policy makers to communicate their flood risk management policy more effectively as at currently respondents are poorly informed.

Secondly, results from the flood risk attitude aspect of the survey highlighted there is a 'miss-match' between perceived flood risk and actual flood risk in the study area. 116 respondents were mapped as being at risk from either coastal or fluvial flooding, however 64 of these did not believe

they were at risk from flooding. From a flood risk management perspective this is concerning as people may not be taking appropriate steps to protect their home, such as insurance. This has been a common finding in previous UK flood risk surveys (Defra and Environment Agency 2004; Harries 2008) Encouragingly, in the case of the Tay survey, 69% of respondents who lived on the flood plain did have some level of insurance against flood damages. Previous surveys have shown the main driver behind flood risk perceptions are respondents own experiences of flooding. Burningham et al (2008) found that for the UK those who had previous flood experience, had lived in the area for longer and were in a higher social class were all predictors of flood risk awareness. Similar results were reported by Bradford et al (2012) where flood risk awareness was strongly correlated with flood risk experience in an EU wide study. The results of this survey showed that respondents who had already been flooded were more likely to feel at risk from flooding and this reinforces findings from previous surveys that direct flood experience raises perception of flood risk, as does worry about this risk.

Thirdly, the majority of respondents were willing to pay towards the managed realignment scheme rather than maintain the status quo of existing hard sea defences. As expected, respondents in Newburgh were prepared to pay the most towards the scheme as they would receive the direct benefits of reduced flood risk. A distance-decay relationship was established with respondents living furthest from the site prepared to be the least towards the scheme. Respondents who believed they were at risk from flooding and also felt the current defences were not adequate enough were prepared to pay the most towards the scheme. This finding is similar to that of Bradford et al (2012) where worry was seen as necessary risk characteristic; an individual can be aware of a flood risk but if they are not worried about the risk it is less likely they will prepare against it. It was expected that those who had previously been flooded would be prepared to pay significantly more towards the scheme but this was not the case. Previous flood risk surveys have shown those who have been flooded are reticent to take personal responsibility

for flood protection and instead and expect scientists and regulators to manage the problem (Soane et al 2010).

It is clear that within study area there are a number of different attitudes towards flood risk and flood defences and this is something which needs to be addressed when proposing a new scheme through information campaigns and public consultation. This is already recognised as part of Flood Risk Management planning in Scotland (Scottish Government 2011), however results of this survey suggest that current communication may not be targeting the desired population. One drawback of this survey was that respondents were not specifically asked whether they were aware of existing flood risk campaigns in the area. As such a causal link between information provision and flood risk awareness cannot be concluded. It could be inferred that the lack of awareness of some respondents may be an indication that information campaigns may not be reaching the desired audience, or some people are unwilling to take on board the information provided to them.

Potential future recreational use of the site was also explored. According to Coastal Futures existing managed realignment sites in England offer a variety of recreational activities for local residents and visitors alike and this is something that could be potentially developed as part of the Newburgh scheme (Coastal Futures n.d). For example at Freiston Shore, Norfolk it was estimated that the managed realignment site brings £150,000 into the local economy and attracts 57,000 visitors a year, compared to an estimated 11,000 per annum before the breach. At Alkborough Flats on the Humber Estuary public footpaths were constructed on the site, as well as five bird hides. For Newburgh, the results highlighted the site would most likely be used by local residents for walking and dog walking, with over half the respondents claiming they would visit the site at least once per week for these activities. Those living further from the site were likely to visit far less often. Few respondents stated they would visit the site for bird watching or fishing. It is recognised that this is a very simplistic analysis of potential future use of the site.

Future work could estimate the potential recreational value of the site using a simplified form of the travel cost model (see Haab and McConnell 2002). This could use respondents predicted visitation patterns and their distance from the site (over two thirds of respondents provided their postcodes which would allow a detailed distance or travel time to be calculated).

One of the main drawbacks of this study is that values for the individual ecosystem services were not generated. CV calculates the overall WTP for the whole policy change, which providing respondents read and understood the information presented to them includes the value of the flood defence good itself, as well as the additional ecosystem service provision for wildlife and fisheries. WTP for the different ecosystem service values could have been elicited using a choice experiment. For this the managed realignment site could have been described in terms of its attributes, i.e. the different ecosystem services provided, and respondents asked to choose between different "bundles" of attributes. This would have allowed the identification of WTP for each individual ecosystem service (for more information on choice experiments see Hanley and Barbier, 2009).

Conclusion

This paper aimed to investigate whether respondents would be willing to contribute towards a managed realignment scheme on the Tay Estuary, Scotland. Specifically considered was respondent's prior knowledge of flood risk management, their attitudes towards flood risk and current coastal defences and how much they would be willing to pay towards the development of the scheme. This was achieved using a CV survey which included an initial quiz to test respondent's prior understanding of flood defence and a series of flood risk attitudinal questions.

The results showed that the majority of respondents supported the schemes development and would be prepared to pay towards the scheme. The predicted WTP was £42.64 per household per annum. Significant drivers of WTP included flood risk attitudes, income and distance from the site. From a flood risk management perspective a "miss match" between actual and perceived

flood risk was highlighted, with many respondents stating they were not at risk from flooding when they in fact were. This is potentially concerning as respondents may not be taking adequate steps to protect their home from future flood risks and in the context of this survey may have been willing to pay less as they may not have felt they would directly benefit, when in fact the opposite may be true.

Future work should further explore the possible use values associated with the scheme through additional analysis of the recreational use data, as well as calculating an aggregate WTP for the scheme and comparing it to the predicted costs of the scheme. From a regulators perspective there is a challenge of how best to communicate flood risk to those in Tayside without previous experience of flooding and increase respondents understanding of the issue. There is an expectation that increasing flood risk knowledge will increase support for the allocation of public funds towards maintaining and building new flood defences. Overall it is recognised that values derived from the CV survey form one small part of the planning process and while informative, the decision for a scheme to take place should not be based on these values alone.

Chapter 3.
Does what you know and what we tell you influence your willingness to pay for coastal flood defence?

Introduction

Contingent Valuation (CV) uses questionnaires to create realistic, but hypothetical markets, to elicit respondent's willingness to pay (WTP) for changes in environmental goods. It is one of the most widely used stated preference techniques, but also one of the most criticised (Hanley and Barbier 2009; Hausman 2012). This paper explores one of the key methodological issues when designing surveys: how much additional information should be provided to the respondent? Mitchell and Carson (1989) identified information provision as "amongst the most important and most problematic sources of error". Respondents are often asked to value complex, and in many cases unfamiliar goods. It is unlikely that respondents will have well defined preferences prior to elicitation and instead preferences are constructed during the survey process (Gregory et al 1995; Gregory et al 1997). Payne et al (2000) discusses this in terms of "architecture" where the respondent is building a set of values at the time of elicitation. These values are determined by how the respondent processes the additional information presented, which information they select and also their own knowledge about the good from memory.

Previously un-defined preferences can lead to uncertainty in respondent's valuations and unless the survey offers reliable contextual cues respondents will be unable to form consistent preferences for unfamiliar goods (Alberini et al 2003; Schlaepfer 2008). As discussed by Shaikh et al (2007) uncertainty in valuation can arise in number of ways including a lack of experience with the good, as a result of the questionnaire design (particularly in relation to hypothetical scenarios), difficulties when making trade-offs and uncertainty in the policy instrument. The WTP elicitation format can also contribute to uncertainty. Ready et al (2001) used a follow up question to test

respondent uncertainty when valuing health benefits as a result of reduced air pollution. Results showed that respondents whose WTP was elicited using the payment card format were more certain of their WTP than those answering using a dichotomous choice. Additionally, allowing for uncertainty in preferences reduced the sample mean WTP. Hanley et al (2009) valued improvements to coastal bathing water quality using a payment ladder format and found a gap between the highest amount respondents were sure they would pay and the lowest amount they were sure they would not pay.

A challenge for survey designers is to reduce this uncertainty in preference construction and providing high quality, readily understandable information is one aspect of this. Early stated preference research began to question how the quantity and quality of information provided in surveys influences both the mean and variance of the WTP estimate. Boyle (1989) in his survey on preservation of a brown trout fishery found that WTP was not statistically different across three increasing levels of information. Increased information did however reduce the variance of the estimates and reduce the number of zero bids. A similar finding was shared Bergstrom et al (1989) who found that increasing information caused small changes in bids in the expected direction, but the individual information effects were not statistically significant. Bergstrom and Stoll (1990) looked at the role of service information (which describes the possible use of the good) on WTP for wetlands protection. A statistically significant relationship was found between increasing positive service information and WTP. The authors argued that the service information provided a desirable information affect by ensuring all respondents had complete and accurate information prior to undertaking their valuations. Hanley and Munro (1992) also considered the role of service information, as well as information regarding scarcity and other characteristics. They found that the initial information regarding scarcity did increase WTP, but adding to this information set further did not have a significant impact, posing the question: how much can an individual's information set be increased before there are significant changes in WTP? Also considered in the early literature was the role of information regarding substitute and complementary

environmental goods. In their work on wetland valuation Whitehead and Blomquist (1991) found that introducing information about substitute environmental goods was found to lower WTP whilst information about compliments increased it.

Whilst early work concentrated on the role of information in surveys, later work considered respondent's familiarity and experience with the good. Whitehead et al (1995) stated that information about a resource is acquired in three ways: through personal experience on site (direct experience of the good); off-site via books, television and discussion with others; and finally some people will only acquire information via the survey alone, having no previous experience of the good. In their work on recreational trips, it was found that non users did not consider their income constraints when stating WTP whilst both on site and off site users did. The authors concluded that respondents with more familiarity have more reliable WTP estimates. Related to this was the work of Cameron and Englin (1997) who considered the respondent's information set in terms of direct experience with the good (measured by years the respondent has used the site) and found that respondents with more experience had smaller conditional variances whilst WTP increased significantly with positive experience.

As well as familiarity and experience, prior knowledge also has a role in preference formation. Loomis and Ekstrand (1998) explored respondent's uncertainty in their WTP using a Likert scale follow up question and found that prior knowledge about the good significantly reduced respondent's uncertainty surrounding their valuation estimate. Tkac (1998) used a quiz to test respondent's prior knowledge on the good being valued and found that increased prior knowledge was positively correlated with WTP although these respondents were less receptive to new information. In contrast, respondents with less prior information were more receptive to new information and this was positively correlated with their WTP. Hoehn and Randall (2002) extended this work, and found that since respondents are heterogeneous in their prior information, the effect of new information is uneven across respondents with some respondents revising their WTP upwards and some revising it downwards in response to new information. Furthermore, they also

found that if respondents treat information as redundant it has no effect on perceptions and values. More recent work by Hasselström and Håkansson (2014) examined the differences in WTP estimates for water quality improvements as a result of detailed and fuzzy information sets. The detailed set included a rich set of water quality descriptors which included exact figures and photographs and was developed by ecologists. In contrast the "fuzzy set" was produced by economists and information was presented using verbal scales (low, moderate, and high) rather than numerical scales. Results showed WTP differed significantly between the detailed and fuzzy information sets for the low knowledge respondents, however, in line with previous research, more detailed information did not affect the WTP for high familiarity respondents. Recent work on the valuation of cold water corals in Norway also used a quiz to examine respondent's knowledge and familiarity with the good (LaRiviere et al 2014). An eight question quiz grouped respondents into high and low knowledge following an initial presentation on cold water corals. LaRiviere et al found that more knowledge led to respondents being more consistent in their choices and those who scored above the mean were prepared to pay significantly more towards cold water coral protection. Further to this in their recent working paper using the same dataset Sandorf et al (2015) demonstrated that respondents with more knowledge were more likely to attend to the attributes in choice experiments.

Respondents also need to be motivated to process new information provided to them. Ajzen et al (1996) demonstrated that under conditions of low personal relevance, respondents fail to process information carefully and this leads to unreliable estimates of WTP. In their study on WTP for increased nature conservation in Finland Pouta et al (2002) found that only respondents with a high motivation, as measured by whether respondents owned land or were involved in nature conservation, processed the survey information more carefully and more readily understood the valuation scenario.

Overall the literature shares a common standpoint: there is a need to include information within stated preference surveys to assist preference construction for unfamiliar goods and also reduce

uncertainty surrounding the WTP estimate. Whether this information is learned by the respondent and this new knowledge applied during the valuation portion of the survey is relatively un-explored. Another question concerns knowledge acquisition during the survey: is knowledge acquisition equal across respondents, and if not, what affects this acquisition. It is also clear that experience, familiarity and motivation have a role in respondent's information sets and ultimately their WTP estimate. Recent work has shown that information effects are strongest when respondents have low familiarity or little prior knowledge of the good being valued. This highlights the importance of providing quality, yet readily understandable information to assist those with low knowledge in forming their preferences. This study acknowledges these as starting points and looks to further contribute the information provision literature by considering the effect of prior knowledge, additional information and personal relevance on WTP. The overall aim of the paper is to analyse whether additional information or personal relevance have a greater effect on the WTP estimate. Within this a series of questions will be explored:

1) Do respondents learn the additional information presented to them during the survey?
2) To what extent does prior knowledge and/or additional information affect respondent's WTP?
3) To what extent does personal experience and personal relevance affect WTP?

A CV survey was designed to gauge public WTP for a new flood defence scheme in Scotland. One novel aspect of the survey was that respondents were "quizzed" at the start and end of the survey to determine what they know about flood defence prior to the survey, and whether their knowledge set changed as a result of taking the survey. Information relating to existing knowledge, as well as previously unknown information concerning the additional costs and benefits of flood defence was varied across respondents. The flood defence scenario, which included cost information and detail on the number of homes which would be protected, remained constant across all respondents. Experience of the good was measured by asking

whether respondents had been flooded previously and personal relevance was measured through a series of statement questions regarding flood risk attitudes.

Background and Methods

The Study Area

The CV survey was conducted to explore local resident's attitudes towards a proposed managed realignment scheme on the Tay Estuary, Scotland. Managed realignment is an alternative form of flood defence which delivers a variety of non-market benefits, as well as protection from flooding (Luisetti et al 2011). When planning new defences there is a need to engage with the general public as there is a legacy of local residents being opposed to such schemes, with a view that managed realignment "gives land to the sea" and as such does not provide an adequate flood defence (French 1997). Early engagement within the planning process can identify these attitudes and help adjust public perceptions of schemes (Ledoux et al 2005). This is crucial in Scotland where local authorities are responsible for funding flood defence and as such any new scheme needs the support of the local residents for it to take place (Pethick 2002).

Survey and Experimental Design

The survey was designed following the recommendations of Carson (2000). Initially a focus group was held to review the introductory quiz questions and payment card. This was followed by a pilot survey with participants from Newburgh (where the scheme was proposed) and 50 people responded. The final survey was conducted throughout 2013 and survey participants were randomly selected from the Scottish Phone Directory. Only people living within the local authorities affected by the flood defence scheme were selected to take part. Initially respondents received an introductory text outlining the purposes of the survey followed by a nine question multiple choice quiz regarding flooding, flood defences and the costs and benefits of managed realignment. The quiz was developed with academics specializing in flood risk management to ensure the questions and answers were appropriate to the good in question. The managed

realignment scenario was then detailed, including a map of where the scheme would take place, how many homes would be protected and the length of time before the defences would become active. The status quo scenario of continued hard defences was also included. The cost of the project was outlined and it was made clear that increases in respondent's council tax would fund the scheme. Council tax was a plausible payment vehicle as local authorities are responsible for funding flood defence in Scotland. Respondents were then given additional information about flooding, flood protection and the additional costs and benefits of managed realignment. Household WTP was then elicited using a payment card ranging from £0 to £150 and respondents were asked to tick all the amounts the household was WTP towards the scheme. Immediately following the WTP elicitation respondents repeated the original nine question quiz. A series of debriefing questions followed, including statement questions regarding perceived flood risk, whether they felt flood risk was increasing and whether the current defences are adequate enough to protect their home, as well as a set of socio-demographic questions. A summary of the survey can be found in Table 3.1.

Table 3.1: Survey summary

Experimental Design	1. Subject begins survey (background information)
	2. Nine question multiple choice quiz
	3. Randomly assigned treatment group
	4. Managed realignment policy outlined, including costs, timescale and status quo scenario
	5. Respondents receive their additional three, six or nine pieces of information
	6. Elicit WTP for managed realignment scheme
	7. Second quiz
	8. Series of follow up questions regarding flood risk attitudes
	9. Socio-demographic questions

Embedded within the survey was the following field experiment which was designed to test for the effects prior knowledge, learning and varying levels of information in the survey:

1. After the first multiple choice quiz, the number of correct answers, as well as the specific questions answered correctly were recorded for each respondent. Respondents were grouped into their prior information types as a function of the number of correct answers: low (L), medium (M) and high (H). Prior information type L corresponds to 1-3 correct answers, type M corresponds to 4-6 correct answers and type H corresponds to 7-9 correct answers. There was also a control group who did not take the first quiz.
2. Respondents were then randomly assigned to a treatment group which related to the amount of additional information they would receive. Treatments could be low (L), medium (M) or high (H) which matched to either three, six or nine bullet points. These bullet points conveyed precise and objective information about the costs and benefits of managed realignment and corresponded exactly to one question asked on the multiple choice quiz. Respondents in the control group received all 9 pieces of information.
3. A key aspect of the design was that respondents were always given information they answered correctly before any additional information points were given as dictated by treatment. The reason for not randomly selecting bullet points was that the survey was concerned with the marginal effect of new information on learning and WTP. By restricting the bullet points shown this ensured that respondent's information sets were anchored to their treatment group and each individual only had the opportunity to receive and learn 3, 6 or 9 pieces of information. For example, assume respondent A gets questions 4 and 9 correct and are in the L *treatment*. Respondent A is type L since they only got two out of nine questions correct. Their information set would consist of two bullet points associated with questions 4 and 9 and one bullet point selected at random from the remaining seven. Furthermore, respondents with higher quiz scores are restricted to receiving equal or higher amounts of information, for example, if someone has a high information level (type H) then they will learn no new information when given the low treatment.

4. Each respondent is then summarized as a type-treatment pair depending on their first quiz score and level of information given (Figure 3.1).
5. Respondents received their additional information following the description of the managed realignment scheme and prior to undertaking the valuation exercise.
6. A second quiz was taken at the end of the survey (including those respondents in the control group).
7. Thus, at the end of the survey each respondent in a treatment group could be summarized by an initial set of quiz answers (prior knowledge set), a type-treatment pair, a treatment information set (bullet points), a WTP response, and a second set of quiz answers.

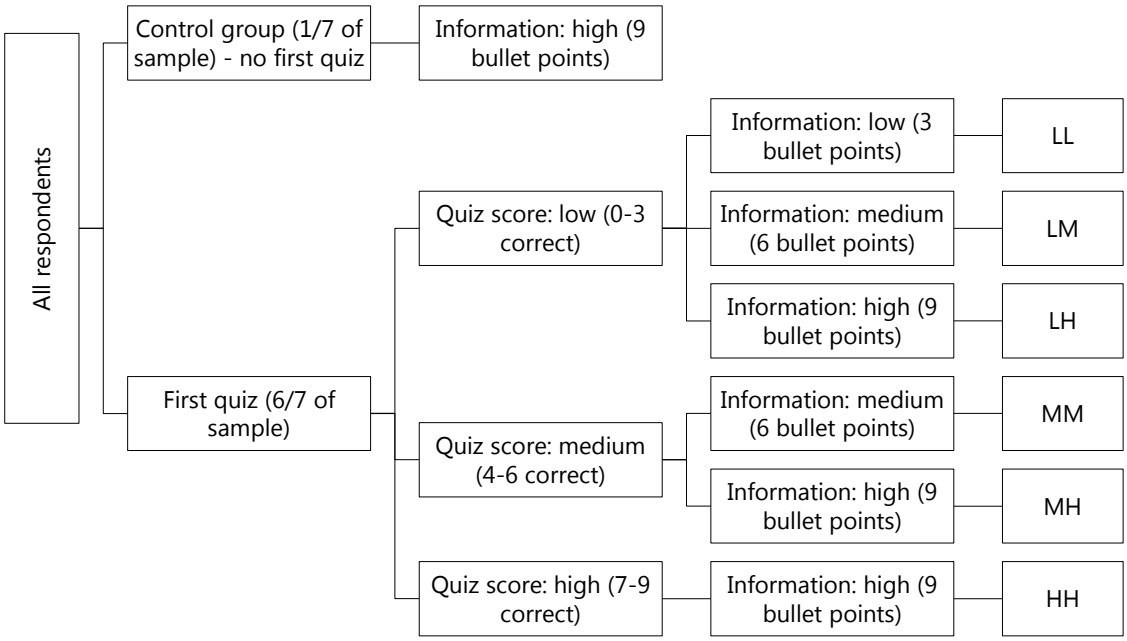


Figure 3.1 Possible type-treatment pairs with branching logic

Prior Knowledge, Learning and Quiz Score

Poisson regression was used to analyse which factors influenced respondents' first and second quiz scores. As respondents can only score between 0 and 9, the Poisson regression was the most suitable model as this model most effectively deals with count data (Gujarati 2012).

Equation 3.1 considers what respondents knew prior to the survey and explores what affects their prior knowledge. The first quiz score was the dependent variable and independent variables included socio-demographic and flood risk characteristics. There was an expectation that respondents who had previous experience of flooding, or were worried about their flood risk would score higher as they would be more aware of the issues surrounding local flood defence.

$$Score1 = b_0 + b_1 FLOODRISK + b_2 WORRIED + b_3 \text{HOMEFLOOD} + b_4 ENVGROUP + b_5 GENDER + b_6 AGE + b_7 EDUCATION + b_8 INCOME + b_9 QUIZ1TIMER + \varepsilon_I \quad (3.1)$$

Equation 3.2 explored the impact of both new and existing information on the second quiz score. The dependent variable was the second quiz score and independent variables included the six treatment groups (LL through to HH) which took into account what the respondent initially knew and how much additional information they were given. Based on the findings of Tkac (1998) and Hasselström and Håkansson (2014) it was expected the second quiz score would be greatest for those respondents with a high personal relevance to the good. There was an expectation that respondents who perceive themselves to be at risk from flooding or have been flooded previously would be more likely to take on board the additional information than for someone whom the survey has low personal relevance. Additionally, it was also expected that those who receive the most information would score the highest, thus demonstrating a causal between amount the increasing information and increased knowledge.

$$Score2 = b_0 + b_1 LL + b_2 LM + b_3 LH + b_4 MM + b_5 MH + b_6 HH + b_7 FLOODRISK + b_8 WORRIED + b_9 \text{HOMEFLOOD} + b_{10} ENVGROUP + b_{11} GENDER + b_{12} AGE + b_{13} EDUCATION + b_{14} INCOME + b_{15} INFOTIMER + b_{16} CONFIRMED + b_{17} COMPLICATED + b_{18} QUIZ2TIMER + \varepsilon_I \quad (3.2)$$

The full list of control variables for all equations can be found in Table 3.2. A further specification would have been to use "learning" as a dependent variable determined by the second quiz score minus the first quiz score. The main problem with this is that subjects who knew less to begin with have a greater opportunity to learn as they are given more new pieces of information.

Table 3.2: Control variables used in the estimation process

Information and knowledge variables	
LL, LM, LH, MM, MH, HH CONTROL	Dummy variable corresponding to the type-treatment pairs and the control group.
CONFIRMED	Statement question response "the information confirmed what I already knew about flood defence" (0= strongly disagree, agree, neutral, 1= agree, strongly agree)
AFFECTED	Statement question response "the affected my WTP decision in retrospect" (0= strongly disagree, agree, neutral, 1= agree, strongly agree)
COMPLICATED	Statement question response "the additional information was too complicated for me to think about" (0= strongly disagree, agree, neutral, 1= agree, strongly agree)
Flood risk variables	
FLOODRISK	Statement question response "My property is at risk from flooding" (0= strongly disagree, agree, neutral, 1= agree, strongly agree)
WORRIED	Statement question response "I am worried the current flood defences are not adequate enough to protect my home(0= strongly disagree, agree, neutral, 1= agree, strongly agree)
COUNCIL	Statement question response "It is the councils responsibility to fund flood defence not mine" (0= strongly disagree, agree, neutral, 1= agree, strongly agree)
HOMEFLOOD	Home has been flooded (0=no, 1=yes)
INSURANCE	Respondent has insurance against flood damages (0=no, 1=yes)
Socio-demographic characteristics	
ENV	Member of an environmental group (0=no, 1=yes)
GENDER	Gender (female=0, male=1)
AGE	Respondent age ranging from 18-29 through to 65 and over (six levels)
EDUC	Respondents education level ranging from secondary school to postgraduate degree (four levels)
ECON	Respondents economic activity (1=employed 2=not employed)
PROPERTY	Property ownership (1= own the property 2=not a property owner)
INCOME	Household income ranging from under £15,000 to over £100,000 per annum (six categories)
DISTANCE BAND	Distant respondent lives from proposed site (4 levels ranging from at site to over 20 miles away)
SURVEYTIMER	Time spent on survey
WTPTIMER	Time spent on WTP question
INFO TIMER	Time spent reading the additional information
CONFIDENCE	Statement question response "I believe the results of this survey will be used by policy makers" (1=strongly disagree through to 5=strongly agree)

Information, Personal Relevance and Willingness to Pay

Initially simple Kruskal-Wallis tests were used to identify significant differences in the mean WTP between i) respondents who took the first quiz and those who did not; ii) the prior knowledge types (low, medium or high prior) and iii) between the type-treatment pairs. Kruskal-Wallis tests involve ranking the respondents maximum WTP from lowest to highest by treatment group and if the distributions have unequal means the sum of ranks from the two samples will be different (Whitehead and Blomquist 1991). A robustness test for equality of variance was also used to test for significant differences between the standard deviations.

The interval regression model was then used to explore the influence of information and personal relevance on WTP (Equations 3.3 – 3.6). WTP was measured using a payment ladder format with respondents asked to select all values they would be willing to pay. The payment ladder increased in £5 increments from £0 to £20 and £10 increments thereafter. It was possible that respondents WTP lay between the highest value selected and the next highest value for example the respondent ticked £100 but they were prepared to pay between £100 and £110. This can be modelled using interval regression as demonstrated by Haab and McConnell (2002). Four equations were estimated:

- Equation 3.3 considered socio-demographic variables only:

$$WTP = b_0 + b_1 ENVGROUP + b_2 GENDER + b_3 EDUCATION + b_4 INCOME + b_5 DISTANCE + \varepsilon_I$$

- Equation 3.4 Included socio-demographic and personal relevance variables:

$$WTP = b_0 + b_1 ENVGROUP + b_2 GENDER + b_3 EDUCATION + b_4 INCOME + b_5 DISTANCE + b_6 FLOODRISK + b_7 WORRIED + b_8 \text{HOMEFLOOD} + \varepsilon_I$$

- Equation 3.5 Included socio-demographic and information variables:

$$WTP = b_0 + b_1 LL + b_2 LM + b_3 LH + b_4 MM + b_5 MH + b_6 HH + b_7 ENVGROUP + b_8 GENDER + b_9 EDUCATION + b_{10} INCOME + b_{11} CONFIRMED + b_{12} COMPLICATED + b_{13} AFFECTED + b_{14} DISTANCE + \varepsilon_I$$

- Equation 3.6 Included socio-demographic, information and personal relevance variables:

$$WTP = b_0 + b_1 LL + b_2 LM + b_3 LH + b_4 MM + b_5 MH + b_6 HH + b_7 FLOODRISK + b_8 WORRIED + b_9 \text{HOMEFLOOD} + b_{10} ENVGROUP + b_{11} GENDER + b_{12} EDUCATION + b_{13} INCOME + b_{14} CONFIRMED + b_{16} COMPLICATED + b_{16} AFFECTED + b_{17} DISTANCE + \varepsilon_I$$

Log likelihood ratio tests were used to explore whether including additional variables for personal relevance and information improved the model fit. Respondent experience was measured by asking whether they had been flooded or not, whilst personal relevance was measured by their responses to the flood risk statement questions and whether the respondent lived in Newburgh where the managed realignment scheme would take place. The type-treatment pairs examined the influence of prior knowledge and additional information on WTP. Two statement questions asked the respondents if they felt the information affected their WTP in retrospect and whether they felt the information was too complicated. These questions were asked directly after the WTP elicitation. These were included in the regression equation as dummy variables.

Results

Survey and Questionnaire

The survey was conducted throughout 2013 and survey participants were randomly selected from the Scottish Phone Directory. Only people living within the local authorities affected by the flood defence scheme were selected to take part. In total 4000 households were contacted by mail and invited to take part in an online survey. A reminder card was sent two weeks after the first contact attempt. Of 4000 people contacted, 749 people completed or partially completed the online survey with 593 responses completed in sufficient enough detail to be used in the analysis.

Summary Statistics and Treatment Groups

Chi-squared tests were used to explore significant differences in respondent characteristics between the low, medium and high treatment groups, as well as the control and quizzed

respondents. Results showed there were weak statistically significant differences between both the control group and type-treatment pairs for environmental group membership ($\chi^2(1) = 2.83$ $p= 0.09$ and $\chi^2 (5) = 9.58$ $p=0.09$). All other characteristics were not statistically different (at the 5% significance level) which demonstrates a broadly randomized treatment. Mean treatment group characteristics are presented in Table 3.3.

Table 3.3: Mean respondent characteristics across the three treatment groups and the full sample

Socio-Demographic Characteristics	Control	Low	Medium	High	Overall
Environmental Group Membership (dummy 0= no 1=yes)	0.25	0.23	0.34	0.34	0.29
Gender (dummy 0= female 1=male)	0.57	0.53	0.60	0.64	0.58
Age	54.55	54.23	56.30	53.64	54.75
Education (dummy range from 0 to 4)	2.77	2.59	2.62	2.70	2.65
Economic Activity (dummy range from 0 or 1)	0.36	0.40	0.39	0.33	0.37
Property ownership (dummy range from 0 to 1)	0.81	0.75	0.85	0.86	0.82
Income	49032	48675	46175	48069	47787
Distance from Newburgh (miles)	16.5	17.55	17.59	17.74	17.47
Flood Risk Characteristics					
My property is at risk from flooding (dummy 0= no 1=yes)	0.22	0.11	0.15	0.16	0.15
I am worried the current defences are not adequate enough to protect my home (dummy 0= no 1=yes)	0.25	0.16	0.18	0.21	0.19
I have been flooded(dummy 0= no 1=yes)	0.08	0.05	0.10	0.11	0.25
I know someone who has been flooded (dummy 0= no 1=yes)	0.40	0.36	0.41	0.43	0.08
Property is on the flood plain (dummy 0= no 1=yes)	0.23	0.28	0.27	0.21	0.40
Insurance (dummy 0= no 1=yes)	0.62	0.71	0.73	0.65	0.68

Table 3.4 presents the number of respondents in each of the type-treatment groups. 89 respondents were in the control group and did not take the first quiz. Only 12 respondents scored between 7 and 9 in the first quiz, and as such there are only 12 respondents in the HH treatment. Also included in Table 3.4 are mean survey response times by treatment group. The mean survey time was 25 minutes, with respondents spending on average 1 minute 20 seconds on the WTP question and 1 minute 15 seconds reading through the additional information page.

Table 3.4: Type – treatment pair observations and associated page timers

Type - Treatment Pair	Observations	Percentage	Survey Timers (mean minutes)				
			Quiz 1	Quiz 2	WTP	Information Page	Survey timer
Control	89	15.01	-	2.75	1.32	1.66	20.68
LL	151	25.46	3.3	1.66	1.12	0.52	35.96
LM	78	13.15	2.9	5.15	1.37	1.12	19.31
LH	72	12.14	4.8	1.29	1.12	1.18	16.69
MM	97	16.36	3.8	1.59	1.23	1.90	18.36
MH	94	15.85	3.5	1.96	1.52	1.42	23.52
HH	12	2.02	3.0	1.65	1.49	1.38	19.19
Total	593	100.00	3.60	2.13	1.26	1.17	24.74

Prior Knowledge, Learning and Quiz Score

Respondents scored significantly more on the second quiz compared to the first (*mean quiz 1* = 3.05, *SE* = 0.07 and mean quiz 2= 4,86, *SE* = 0.10) (Figure 3.2) This suggests that respondents did learn the new information presented to them during the survey.

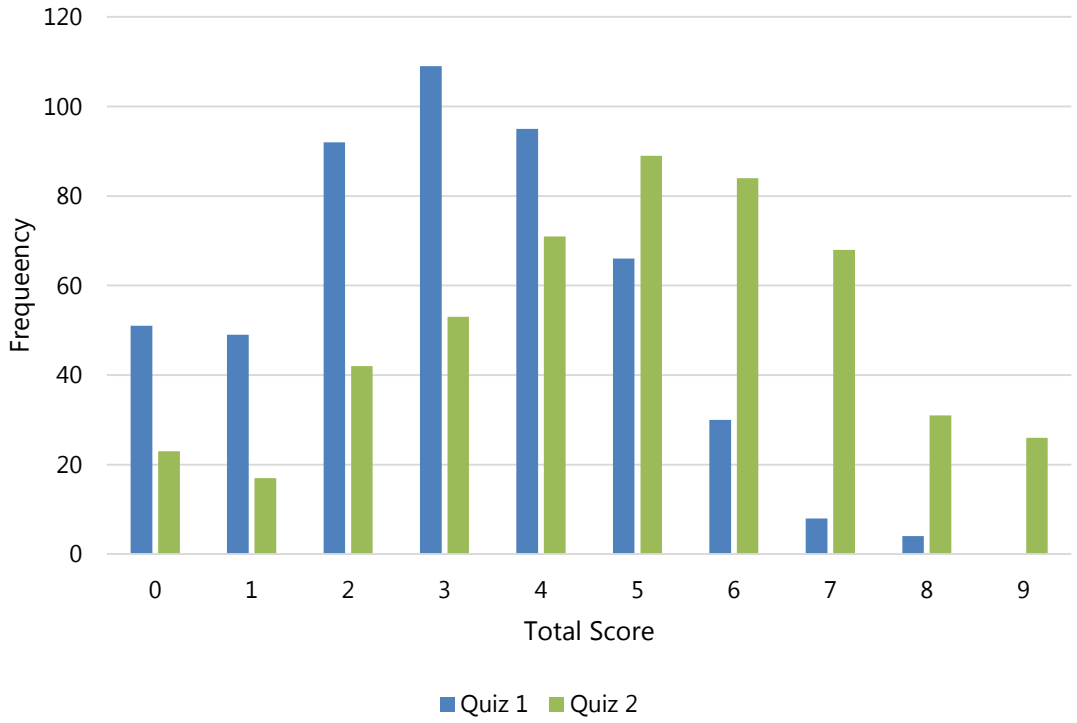


Figure 3.2: Bar chart of first and second quiz scores for treated respondents only

Results of Equations 3.1 and 3.2 are presented in Table 3.5. Equation 3.1 did not successfully predict what influences respondents prior knowledge. It was expected that those who had been flooded or were more aware of flooding would score higher, this was not the case.

Equation 3.2 considered the effect of additional information on the second quiz score. Results showed that second quiz score was dependent on information, and that increasing information between the six treatment pairs (LL through to HH) led to a higher score. The mchange command in Stata was used to report the coefficient results more intuitively (Table 3.6). All type-treatment pairs score significantly higher than the LL treatment pair, with those in the HH group scoring on average 4.16 more. The score also increased throughout the pairs with HH scoring the most, followed by MH, LH, MM, LM, LL. There were no significant differences between quiz scores for those respondents who received the medium information treatment (both MM and LM scored similar). However, the MH treatment scored significantly more than the LH treatment (1.03 more) and the HH treatment scored significantly more than the MH treatment (2.34 more) despite all three treatment groups receiving the same level of information. This suggests that learning was incomplete and that respondents did not learn all the new information presented to them.

Several of the socio-demographic characteristics also significantly influenced the second quiz score. Respondents who had postgraduate degrees were more likely to score higher compared to other education levels (1.05 more than those who went to school and 0.69 more than those with either a college or undergraduate degree), suggesting they may be able to absorb more information. Surprisingly, the respondents who had been flooded were more likely to score less than those who had not been flooded (-0.82). Interestingly, respondents who felt the information was too complicated for them to think about, on average, scored 1 fewer than other respondents. The length of time spent reading the information or taking the second quiz were not significant.

Overall the results suggest that respondents do read and learn the additional information presented to them during surveys as demonstrated by the relationship between increased

information and increased quiz score, with the relationship remaining significant when socio-demographic variables are controlled for. This learning however is incomplete with respondents not learning the full set of information provided to them. The next stage of the analysis will consider whether this additional information and whether varying this significantly affects WTP estimates.

Table 3.5: Poison regression results: respondent characteristics on prior knowledge (Equation 3.1) and treatment on learning (Equation 3.2)

VARIABLES	(1)		(2)	
Socio demographic characteristics				
Member of an environmental group (yes)	0.03	(0.07)	-0.09*	(0.05)
Gender (male)	-0.00	(0.06)	-0.01	(0.05)
Age: 18-29 (baseline)	0.00	(0.00)	0.00	(0.00)
Age: 30-39	-0.11	(0.12)	0.02	(0.10)
Age: 40-49	0.03	(0.12)	0.04	(0.09)
Age: 50-59	0.10	(0.11)	0.14	(0.09)
Age: 60-64	0.10	(0.13)	0.03	(0.11)
Age: 65 and over	0.13	(0.11)	0.03	(0.09)
Education: GCSE/Standard Grades (base)	0.00	(0.00)		
Education: Sixth form/college	0.04	(0.09)	0.07	(0.07)
Education: Undergraduate degree	0.13	(0.09)	0.08	(0.07)
Education: Postgraduate degree	0.06	(0.09)	0.21***	(0.07)
Income: below £15,000 (baseline)	0.00	(0.00)	0.00	(0.00)
Income: between £15,000 and £19,999	-0.00	(0.11)	0.04	(0.09)
Income: between £20,000 and £39,999	0.06	(0.09)	-0.05	(0.08)
Income: between £40,000 and £69,999	-0.06	(0.10)	-0.08	(0.08)
Income: between £70,000 and £99,999	-0.01	(0.13)	-0.18	(0.11)
Income: above £100,000	-0.30*	(0.16)	-0.02	(0.13)
Flood risk characteristics				
My property is at risk from flooding (S)	-0.02	(0.11)	-0.06	(0.09)
I am worried that the current defences are not adequate enough to protect my home (S)	0.16	(0.10)	0.09	(0.08)
My property has been flooded (S)	-0.05	(0.12)	-0.18*	(0.10)
Type - Treatment Pairs				
LL (baseline)				
LM			0.29***	(0.08)
LH			0.38***	(0.08)
MM			0.41***	(0.07)
MH			0.56***	(0.07)

HH			0.76***	(0.14)
The information confirmed what I already know (S)			-0.00	(0.05)
The information was too complicated for me to think about (S)			-0.18**	(0.08)
Quiz 1 Timer	0.00	(0.00)	0.00*	(0.00)
Quiz 2 timer			0.00	(0.00)
Information timer			-0.00	(0.00)
Constant	1.00***	(0.13)	1.22***	(0.11)
Observations	407		407	
Degrees of freedom	19		28	
Log likelihood	-791.02		-850.76	
Deviance goodness-of-fit	chi^2 (387) = 454.85 p=0.01		chi^2 (378) = 3568.75 p=0.75	
Pearson goodness-of-fit	chi^2 (387) = 367.41 p=0.75		chi^2 (378) = 282.80 p=0.99	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: (1) dependent variable is Quiz Score 1 and considers what influences prior knowledge. (2) dependent variable is Quiz Score 2 and considers the effect of the type-treatment on the second quiz score.
(S) denotes variable is a response to a statement question baseline (0) is strongly disagree or agree and (1) is agree or strongly agree.

Table 3.6: Results of the mchange command comparing scores between type-treatment pairs

Type-Treatment Pairs	Change	From	To
LM vs LL	1.22***	3.63	4.84
LH vs LL	1.67***	3.63	5.3
MM vs LL	1.82***	3.63	5.44
MH vs LL	2.69***	3.63	6.32
HH vs LL	4.16***	3.63	7.79
LH vs LM	0.45	4.84	5.3
MM vs LM	0.6	4.84	5.44
MH vs LM	1.48***	4.84	6.32
HH vs LM	2.94***	4.84	7.79
MM vs LH	0.15	5.3	5.44
MH vs LH	1.03**	5.3	6.32
HH vs LH	2.49**	5.3	7.79
MH vs MM	0.88**	5.44	6.32
HH vs MH	2.34**	5.44	7.79
HH vs MH	1.46	6.32	7.79

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Information, Personal Relevance and Willingness to Pay

The majority of respondents (82%) were prepared to pay towards the managed realignment scheme and the sample mean WTP was £44.77 per household per annum (*SD* = 46.21). The distribution of WTP by type-treatment pair is presented in Figure 3.3. Overall the WTP distributions appear to be broadly similar across the different treatment groups.

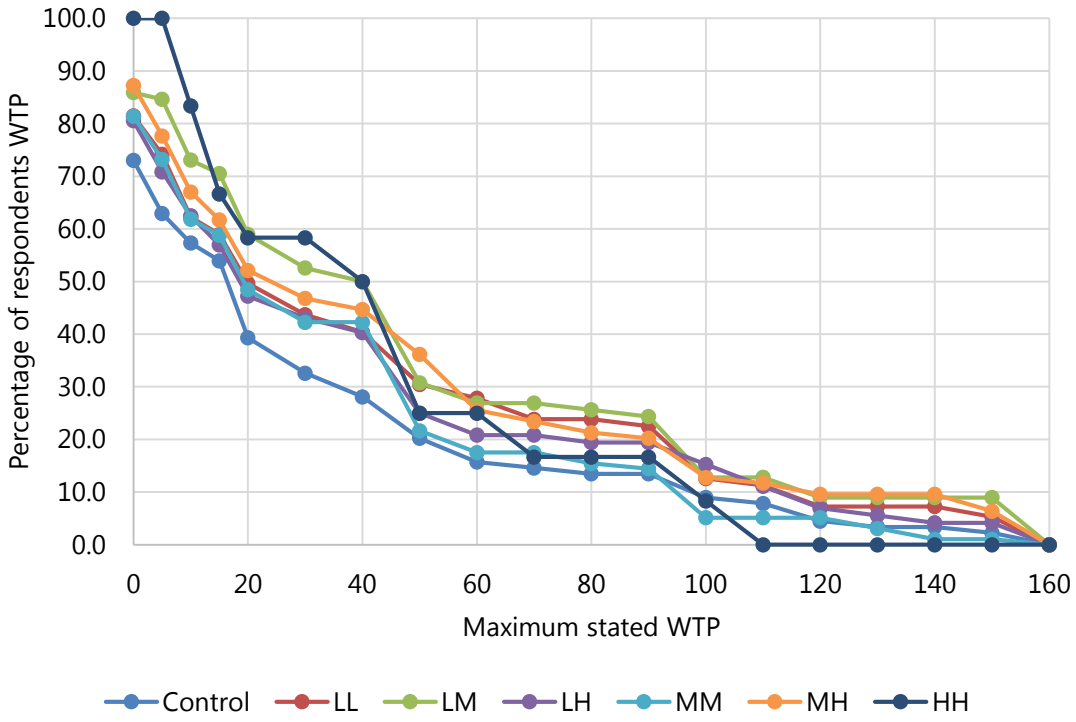


Figure 3.3: WTP distribution by type-treatment pair

The first stage of the WTP analysis was to explore whether taking the first quiz had an effect on the WTP estimates (Table 3.7). The Kruskal-Wallis test showed there were significant differences in both the number of zero bids ($H(2)= 6.20$, $p= 0.01$) and mean WTP between the respondents who took the first quiz and respondents who did not ($H(2)= 5.72$, $p= 0.02$). Kruskal-Wallis tests were also used to compare between the respondents who did not take the first quiz and only respondents who received the high information treatment. There were significant differences between the high information group and the control group in the number of zero bids ($H(2)= 2,71$, $p= 0.10$) and the mean WTP ($H(2)= 5.37$, $p= 0.02$).

Table 3.7: Effect of prior knowledge on mean WTP

	Number of Zero Bids (% of sample in brackets)	Median WTP	Mean WTP	Standard Deviation	Observations
No quiz (control)	24 (27%)	20	33.15	41.25	89
All quiz respondents	83 (16%)	30	44.77	46.21	504
High information group quiz only	26 (15%)	30	45.20	46.74	178
Total	107 (18%)	30	43.03	45.67	593

Note: all control respondents received nine pieces of information

Due to the differences identified in mean WTP between the control and treated respondents it was decided to estimate an additional regression which considered the effect of taking the first quiz on WTP (Equation 3.7). Four specifications of the model were estimated and the "predict" command in Stata was used to calculate predicted WTP following each estimation:

i. without control for taking the first quiz;

ii. with a control for taking the first quiz;

iii. on controlled respondents only:

iv. on treated respondents only.

$$WTP = b_0 + b_1 FLOODRISK + b_2 WORRIED + b_3 \text{HOMEFLOOD} + b_4 ENVGROUP + b_5 GENDER + b_6 EDUCATION + b_7 INCOME + b_8 WTPTIMER + b_9 SURVEYTIMER + b_{10} INFOTIMER + b_{11} QUIZ\ CONTROL + \varepsilon_I \quad (3.7)$$

Results from the regression analysis are presented in Table 3.8. It is clear that taking the first quiz significantly influenced WTP. In specification (ii), taking the first quiz significantly increased WTP by £13.38 per household per annum. Comparing the predicted mean WTP from specifications (iii) and (iv) shows that respondents who did not take the first quiz had a predicted mean WTP of £22.86 per annum compared to £44.79 for those who took the first quiz. This is a 58% increase in predicted WTP.

Income successfully predicted WTP across the four specifications. Respondents who worried about existing flood defences were willing to pay more, as were those respondents who lived

closest the site. These drivers will be discussed in more detail later in the analysis. The lack of significance for some variables when only control respondents are considered could be a result of reduced sample size (61) compared to the other model specifications. This highlights the need for caution when interpreting the results.

Table 3.8: Interval regression results: The effect of taking the first quiz on willingness to pay (Equation 3.7)

VARIABLES	(i)		(ii)		(iii)		(iv)	
Respondent took first quiz			13.38**	(-5.25)				
Socio Demographic Characteristics								
Member of an environmental group	12.83***	(4.18)	11.87***	(4.17)	-6.97	(11.28)	11.93***	(4.52)
Gender (male)	10.93***	(3.79)	10.52***	(3.77)	15.86*	(9.22)	9.49**	(4.13)
Education: GCSE/Standard Grades (base)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Education: Sixth form/college	-3.76	(5.55)	-3.52	(5.51)	-13.51	(13.04)	-3.33	(6.01)
Education: Undergraduate degree	2.02	(5.78)	1.88	(5.73)	10.48	(13.47)	0.62	(6.24)
Education: Postgraduate degree	-3.43	(5.44)	-2.71	(5.41)	10.79	(13.03)	-3.91	(5.91)
Income: below £15,000 (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Income: between £15,000 and £19,999	10.12	(7.09)	9.52	(7.04)	22.04	(18.47)	7.69	(7.56)
Income: between £20,000 and £39,999	16.87***	(5.91)	16.87***	(5.87)	27.28**	(13.60)	15.70**	(6.42)
Income: between £40,000 and £69,999	12.53**	(6.32)	12.89**	(6.27)	25.07*	(14.16)	11.96*	(6.92)
Income: between £70,000 and £99,999	24.29***	(8.17)	24.82***	(8.11)	-16.81	(17.14)	31.33***	(9.01)
Income: above £100,000	33.36***	(10.01)	32.60***	(9.94)	-24.20	(32.10)	35.32***	(10.54)
Personal Relevance & Experience Characteristics								
My property is at risk from flooding (S)	14.50**	(6.97)	15.66**	(6.94)	4.54	(12.46)	18.27**	(8.05)
I am worried the current defences are not adequate enough to protect my home (S)	21.10***	(6.44)	21.38***	(6.40)	25.55*	(13.76)	19.85***	(7.16)
My home has been flooded	5.25	(7.70)	4.48	(7.65)	-18.17	(18.49)	3.27	(8.55)
Distance from site: at site	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Distance from site: less than 10 miles	-11.71	(11.55)	-13.51	(11.49)			-14.06	(11.84)
Distance from site: 10-20miles	-20.76***	(5.78)	-20.40***	(5.74)	-3.16	(13.14)	-22.23***	(6.32)

Distance from site: over 20 miles	-21.11***	(5.56)	-20.93***	(5.52)	-12.56	(12.17)	-21.52***	(6.08)
Survey Timers								
Information Timer	-0.00	(0.01)	0.00	(0.01)	-0.03	(0.02)	0.00	(0.01)
Willingness to Pay Timer	0.03	(0.03)	0.03	(0.03)	0.00	(0.10)	0.03	(0.03)
Survey Timer	0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)
Constant	28.50***	(-7.91)	16.75*	(-9.10)	13.10	(-16.74)	31.79***	(-8.64)
lnsigma	3.62***	(-0.03)	3.61***	(-0.03)	3.30***	(-0.09)	3.63***	(-0.04)
Observations	436		436		61		375	
Predicted Mean WTP	42.87	(1.04)	42.87	(1.06)	28.26	(1.46)	44.79	(1.08)
Log Likelihood	-1484.22		-1480.99		-192.11		-1276.07	
Degrees of Freedom	19.00		20.00		18.00		19.00	
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

Notes: Dependant variable is upper and lower bound WTP.

(S) Denotes variable is a response to a statement question baseline (0) is strongly disagree or agree and (1) is agree or strongly agree.

(i) All respondents with no control for the taking the first quiz

(ii) All respondents with a control for taking the first quiz

(iii) Control respondents only

(iv) Treated respondents only

Prior Knowledge on Willingness to Pay

Table 3.9 presents the mean WTP of respondents grouped by their prior knowledge type. The Kruskal-Wallis test showed there were no significant differences in mean WTP between the prior information types ($H(2)= 0.69$, $p= 0.70$) and the robustness test for equality of variance showed there were no differences in the variances ($F(2,501) = 0.98$ $p = 0.37$). There was also no statistical difference in the number of zero bids ($H(2)= 1.12$, $p= 0.57$). Overall the results suggest that what respondents knew prior to the survey, as measured by the first quiz, did not affect their WTP.

Table 3.9 : Effect of prior knowledge on mean WTP

Prior Knowledge	Number of Zero Bids (% of sample in brackets)	Median WTP	Mean WTP	Standard Deviation	Observations
Low (0 – 3 correct)	54 (17%)	30.00	46.04	47.81	301
Medium (3 - 6 correct)	30 (16%)	30.00	42.74	44.38	191
High (7 or above correct)	12 (0%)	45.00	45	34.17	12
Total	83 (16%)	30.00	44.77	46.21	504

Type-Treatment Pairs on Willingness to Pay

Table 3.10 presents median and mean WTP by type-treatment pairs. There were no significant differences in mean WTP between the type-treatment pairs ($H(5)= 4.86$, $p= 0.43$) and no significant differences in the variances between the pairs ($F(5,498) = 0.801$, $p = 0.55$). There were also no significant differences in the number of zero bids ($H(5)= 2.00$, $p= 0.85$). These results suggest that the amount of information received during the survey did not affect respondent WTP.

Table 3.10: Comparison of mean WTP by type-treatment pairs

Type - Treatment Pairs	Number of Zero Bids (% of sample in brackets)	Median WTP	Mean WTP	Standard Deviation	Observations
LL	28 (19%)	20	45.17	48.12	151
LM	11 (14%)	45	51.47	48.51	78
LH	14 (19%)	20	42.01	46.52	72
MM	18 (19%)	20	37.99	39.67	97
MH	12 (13%)	30	47.66	48.51	94
HH	0 (0%)	45	45.00	34.18	12
Total	83 (17%)	30	44.77	46.21	504

Prior Knowledge, Information and Personal Relevance on Willingness To Pay

The results of the interval regression analysis to test to what extent prior knowledge, additional information and personal relevance affect WTP are detailed in Table 3.11. Considering socio-demographic variables first, income was a significant predictor across all four specifications. As expected higher income was correlated with higher WTP. Respondents in the highest income band (£100,000 or above) were willing to pay the most (between £35 and £39 more than those in the lowest band). There were no significant differences in WTP between the two lowest income bands (under £15,000 and between £15,000 and £20,000). Whether a respondent was a member of an environmental group also affected WTP by between £10 and £17.

Considering personal relevance and experience, the responses to the question "I am worried about the current flood defences" were the most significant drivers of WTP with those who were most worried willing to pay between £20 and £22 more than those who were not worried. Responses to the question "my property is at risk from flooding" also significantly affected WTP at the 10% level increasing willingness to pay between £13 and £17. Whether a respondent had been flooded or not (personal experience) did not have a significant effect which was surprising. A distance decay relationship was also established with respondents who lived at the site being

prepared to pay between £22 and £32 more than respondents who lived elsewhere. The log likelihood ratio test showed that adding personal relevance characteristics to the estimation process significantly improved model fit (*LR chi*^{2}(3 =37.79 p<0.01) when comparing Equation 3.3 with Equation 3.4.

Including the type-treatment pairs and statement question responses to the information questions (Equation 3.5) did slightly improve the model fit compared to the baseline model and the Log likelihood ratio test confirmed there was a significant difference between the two models (*LR chi*^{2}(8) = 19.65, p=0.01). However, none of the type-treatment pairs significantly influenced respondent WTP indicating that neither what respondents knew prior to the survey, or the information presented to them influenced their WTP. Interestingly, whilst none of the type-treatment pairs significantly affected WTP, the response to the question "the additional information affected my WTP in retrospect" was significant, with those agreeing or strongly agreeing to the statement willing to pay between £12 and £14 more. Additionally, in Equation 3.6 respondents who answered strongly agree or agree to the statement "the information was too complicated for me to think about" were prepared to pay £16 less than those who disagreed with this statement. These two statement questions were asked immediately after the respondents had taken the second quiz. This is an interesting result as the respondent's own reported measure of information provision and learning does significantly affect WTP estimates yet information and knowledge as measured by the researcher is not significant. This suggests a miss-match between what the respondent is perceiving to be important information and what information the researcher believes is important in the survey.

Log likelihood ratio tests were also used to compare whether the final specification which included socio demographic, personal relevance and information variables was significantly different to the other three specifications. Equation 3.6 did had an improved model fit over all three models showing that including both information and personal relevance are important when predicting WTP (*LR chi*^{2}(11) = 57.33, p<0.01).

Table 3.11: Interval regression results: information and personal relevance on willingness to pay

VARIABLES	Equation 3.3		Equation 3.4		Equation 3.5		Equation 3.6	
Socio Demographic Characteristics								
Member of an environmental group	16.29***	(4.63)	12.34***	(4.48)	13.20***	(4.64)	10.19**	(4.46)
Gender (male)	7.07	(4.31)	9.73**	(4.12)	5.40	(4.23)	8.39**	(4.05)
Education: GCSE/Standard Grades (base)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Education: Sixth form/college	0.89	(6.28)	-3.47	(6.01)	2.43	(6.13)	-2.19	(5.88)
Education: Undergraduate degree	0.81	(6.46)	0.53	(6.22)	0.66	(6.32)	0.07	(6.09)
Education: Postgraduate degree	-4.97	(6.20)	-4.01	(5.90)	-4.17	(6.07)	-3.88	(5.77)
Income: below £15,000 (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Income: between £15,000 and £19,999	3.74	(7.93)	7.82	(7.57)	2.78	(7.79)	7.76	(7.45)
Income: between £20,000 and £39,999	14.94**	(6.70)	15.63**	(6.42)	14.74**	(6.63)	16.25**	(6.37)
Income: between £40,000 and £69,999	10.07	(7.21)	11.81*	(6.90)	8.86	(7.08)	11.25*	(6.80)
Income: between £70,000 and £99,999	33.40***	(9.42)	30.46***	(8.98)	33.95***	(9.23)	30.61***	(8.81)
Income: above £100,000	39.04***	(10.85)	33.95***	(10.49)	39.72***	(10.69)	34.96***	(10.33)
Distance from site: at site	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Distance from site: less than 10 miles	-21.82*	(12.31)	-13.62	(11.83)	-23.28*	(12.12)	-13.68	(11.66)
Distance from site: 10-20miles	-31.37***	(6.36)	-22.64***	(6.30)	-32.21***	(6.37)	-22.17***	(6.33)
Distance from site: over 20 miles	-32.54***	(6.03)	-21.66***	(6.07)	-32.68***	(6.00)	-20.33***	(6.09)
Personal Relevance & Experience Characteristics								
My property is at risk from flooding (S)			17.89**	(8.05)			13.74*	(8.01)
I am worried the current defences are not adequate enough to protect my home (S)			20.00***	(7.17)			22.49***	(7.06)
My home has been flooded			3.03	(8.55)			6.37	(8.49)
Treatment Pairs								

LL (baseline)					0.00	(0.00)	0.00	(0.00)
LM					7.09	(6.66)	6.52	(6.34)
LH					0.10	(6.91)	-5.03	(6.65)
MM					-2.03	(5.83)	-4.28	(5.56)
MH					1.80	(6.04)	-0.96	(5.76)
HH					-17.03	(15.61)	-12.35	(14.98)
The information confirmed what I already know (S)					9.53**	(4.79)	4.09	(4.68)
The additional information affected my WTP in retrospect (S)					13.72***	(4.26)	12.07***	(4.07)
The information was too complicated for me to think about (S)					-10.31	(7.52)	-16.51**	(7.27)
Constant	50.19***	(8.17)	34.94***	(8.18)	44.80***	(8.50)	31.77***	(8.38)
lnsigma	3.68***	(0.04)	3.63***	(0.04)	3.66***	(0.04)	3.61***	(0.04)
Predicted WTP	46.67	(0.82)	1.08	(42.65)	0.94	(43.37)	1.14	(42.65)
Observations	375		375		375		375	
Log Likelihood	-1295.60		-1276.70		-1285.77		-1266.93	
Degrees of Freedom	13		16		21		24	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Dependant variable is upper and lower bound WTP.

Equation 3.3 considers socio-demographics as predictors only.

Equation 3.4 includes personal relevance & experience responses.

Equation 3.5 includes information characteristics.

Equation 3.6 includes personal relevance and information.

(S) denotes variable is a response to a statement question baseline (0) is strongly disagree or agree and (1) is agree or strongly agree.

Since survey timer, WTP timer and information timer were not significant in predicting WTP in Equation 3.6 they were not included in this estimation process.

From the results several conclusions can be drawn:

1. Respondents did learn the additional information provided to them during the survey and this was evident in the fact that the second quiz score was significantly higher than the first quiz score. Additionally being able to access more information lead to a higher quiz score.
2. Despite observed learning taking place, neither respondent's prior knowledge nor the additional information presented to them had a significant effect on respondents WTP. Interestingly, respondents stated use of the information, as assessed through Likert scale questions did affect WTP. This suggests that the respondent's view of additional information and information provision measured by the researcher were different.
3. Personal relevance was the main driver behind respondent's WTP with those living closest to the site, feeling more at risk from flooding and most worried about current flood defences prepared to pay the most towards the scheme.

Discussion

This paper reports the results from a novel experimental design to explore whether prior knowledge and additional information influence both respondent learning and their valuation in stated preference surveys. The design of the experiment allowed for the identification of what respondents initially knew about flood defence, allowed for variation in the level of information presented to respondents, elicited WTP for the good and identified respondent's final knowledge for the good. From the results several interesting findings emerge.

The results for learning part of the experiment showed that providing subjects with more new information caused significantly more learning in subjects. Those with access to the most new information scored the highest, whilst those anchored to lower information sets scored significantly lower. This observed learning was incomplete with the majority of respondents not learning all information presented to them. This was demonstrated by the fact the respondents in the HH treatment scored more than MH and LH respondents, and MH scored more than LH

respondents despite all respondents being given the same level of information. This suggests that the likelihood of a respondent learning new information decreased as they were presented with increasing amounts of new information, a result which is consistent with models of fatigue and demonstrates a declining marginal value of new information. The findings suggest that learning is imperfect and varies with the amount of new information presented. There is however an endogeneity concern, if a subject cares more about the topic it could be that they are willing to use more effort in order to retain the additional information provided. This was tested for by including personal relevance and motivation variables when regressing type-treatment pairs on the second quiz score. Flood risk, worry about existing defences and distance from the site did not significantly affect quiz score which suggests there was no relationship between personal motivation and learning.

The results of the valuation portion of the experiment showed that neither prior knowledge nor additional information affected respondent's valuations of the good, despite learning taking place. The result of increased information not affecting WTP mirrors the findings of both Bergstrom et al (1989) and Boyle (1989) who both found there were no significant differences in WTP as a result of varying levels of information. In contrast to their work however there was no reduction in the variance as information increased which was surprising. Furthermore, in contrast to the previous findings of Tkac (1998) and Hoehn and Randall (2002), respondent's prior knowledge of the good did not affect the valuations. The expectation that those with high prior knowledge would have the highest WTP and/or reduced variance was not realised. This finding is similar to that of Shapansky et al (2008) who explored preference construction when designing and implementing a choice experiment to elicit passive use values for forest management strategies. The survey used three treatment groups: one in which respondents were directly involved in designing the choice experiment (including the attributes and information provided); a second group who were somewhat involved; and finally a group who only answered the final survey. Results showed that there were no significant differences in preferences between those

who had been most involved in the survey design (and thus had greater prior knowledge) and those in the third treatment group who had the least prior knowledge and involvement.

A strong argument for prior knowledge and information not having a significant effect in this survey was that respondents did not use the information presented to them in the way the researchers intended. As discussed by Payne et al (2000) a fault of some stated preference surveys is that there can be a lack of information comprehension or respondents do not use information in ways expected. In this survey it is clear that respondents did understand the information presented to them as shown by the increased learning, however it would appear that the majority of respondents did not then incorporate this new information into their valuation estimates. This reasoning is more likely when respondents own statement question responses to the information provision are considered. Those who stated that the information provided to them affected their WTP did have significantly higher estimates and those who felt the information was too complicated had significantly lower estimates. These responses follow what has been previously found in the literature. This suggests a miss-match between what the respondent is perceiving to be important information and what the researcher believes is important information in the survey. The most plausible explanation is that respondents were interested in the direct information concerning the flood defence good, such as the number of homes being protected, where the scheme would take place and how it should be funded. The additional information concerning estuarine flood risk and the additional ecosystem services may have been deemed irrelevant when respondents were forming their preferences. Instead respondents were most concerned about whether their home or local area would be protected and were solely interested in the flood reduction benefits of the good. This argument is strengthened when the main predictors of WTP are considered. The main influence on WTP were respondent's personal motivations. Respondents who felt most at risk and were worried about the existing flood defences were prepared to pay most.

A drawback of this research was not including a question on preference uncertainty following the WTP question. Loomis and Ekstrand (1998) demonstrated in their work on owl conservation that respondents with a higher prior knowledge of the good were more certain about their preferences. A useful addition to this survey would have been to explore whether preference uncertainty was influenced by respondents prior knowledge or the additional information presented to them. Furthermore allowing respondents more variability in the payment card format i.e. being able to tick the amounts they are certain they would pay and being allowed to leave a gap between that and the amounts they certainly would not pay, as used by Hanley et al (2009) may have also showed difference between the type-treatment groups.

One concern of using quizzes to test for learning is that the scores are potentially a proxy for respondent's ability to retain information. Respondents who are pre-disposed to learning quicker will naturally demonstrate an increased score. This is highlighted in the result that education was a significant predictor of respondent's quiz score. As such respondents who are less inclined to learn could struggle in incorporating this new information into their preferences, hence the result of information not statistically influencing WTP. This demonstrates the need to present information as clearly and readily understandable as possible in stated preference surveys.

An increasing number of papers are using quizzes to test for respondent's prior knowledge such as LaRiviere et al (2014) and Sandorf et al (2015) in their work on cold water coral valuation. Results from this survey suggest that the initial quiz may introduce a significant framing effect which leads to an upward bias in the WTP estimates. Respondents who took the first quiz were prepared to pay £22 more on average than those who did not take the first quiz. An increase in estimated WTP of 58%. This large difference in values is concerning when estimates will potentially be used in aggregation exercises for policy making. It is however recognized that for this survey the sub-sample of controlled respondents is small and further work into the effect of taking the first quiz on WTP is warranted. At the very least researchers should look to include a control group when using initial quizzes to determine if there is a treatment affect in their survey.

Conclusions

This paper set out to explore the effects of prior knowledge, information and personal motivation on WTP for a managed realignment scheme on the Tay Estuary, Scotland. Specifically tested was the idea that providing more information allows respondents to learn more and thus they have a higher knowledge about the good; and subsequently this increased knowledge increases respondent WTP and reduces the variance associated with the estimate. Within this the effects of personal motivation and experience were also explored. This was achieved by designing a CV survey that explicitly tested for respondent's prior knowledge of the good in question; allowed for variation in information across the respondents; elicited respondents WTP and finally tested for the respondent's knowledge at the end of the survey.

Results were mixed; whilst a causal link between information and provision and learning was established, a relationship between prior knowledge, information provision and WTP was not found. Personal motivations were the strongest predictors of WTP, regardless of the level of information received by the respondent. An interesting consideration for further research would be to test whether these result are consistent with a less familiar good. Flood defence can be a highly emotive subject and hence personal relevance and motivations are the strongest predictors in this survey. However, if the good is far less familiar and hence more information is needed to inform respondents of the goods characteristics there may be a clearer causal link between increasing knowledge and WTP. For many surveys it is hard to know in advance the level of respondent familiarity with the good and also their knowledge. As such it is difficult to know how much additional information to provide to respondents. Overall the level of information provided in surveys should be decided on a case by case basis and it would appear there is not optimum level of information that can be prescribed across all surveys.

Chapter 4.
Policy Consequentiality in Contingent Valuation

Introduction

Stated preference surveys are used for the valuation of non-market environmental goods and services, for example water quality improvements and the values generated are useful in cost-benefit analysis when considering future environmental policies. In one their key papers on contingent valuation (CV) Carson and Groves (2007) argue that for a survey to produce meaningful information about respondent's preferences the respondent must view their responses as potentially influencing the supply of the public good. Additionally, the respondent needs to care about what the outcomes of those actions might be, in which case the survey is consequential. Consequentiality is now one of the central themes in stated preference research and aims to overcome the widely discussed issue of hypothetical bias. In his paper "*CV from Dubious to Hopeless"* Hausman (2012) argued that the hypothetical nature of stated preference surveys results in an upward bias in willingness to pay (WTP) with people answering very differently to how they would do in a real market situation. Several papers have identified this upwards bias including List and Gallet (2001) and Murphy et al (2005b) with the authors finding that subjects overstate their WTP between 1.3 and 3 times the real amount. Despite this authors including Carson (2012b), Haab et al (2013) and Kling et al (2012) believe that CV can reveal important insights for policy making with Kling et al suggesting that the future research agenda needs to continue exploring what makes surveys consequential and examine whether the initial evidence on this subject is consentient. Furthermore, Carson et al (2014) argue that consequentiality in CV should be a major focus for survey designers and that a well-designed consequential survey should overcome the problems associated with hypothetical bias.

Research considering consequentiality is in its infancy although there are several notable empirical papers. Bulte et al (2005) was one of the first papers to include a consequential treatment in their work on WTP for seal protection policies in the Netherlands. They found that including text stating the results of the survey would be considered by policy makers resulted in a significantly lower WTP than values obtained using a hypothetical question which did not include this text. The authors speculated that providing additional information about the policy consequences increased respondent's attention to the survey and reminded them a "serious" response was needed. Similar results were found by Landry and List (2007) who explored consequentiality in a real market place (sports cards). The authors compared four treatments; hypothetical, consequential, cheap talk and real and found that hypothetical responses were statistically different from real responses. The consequential and cheap talk treatments were indistinguishable from the real responses, although results suggested the consequential and cheap talk WTP was the upper bounds of the real payment.

Consequentiality has also been explored by comparing hypothetical responses to referendum responses. Johnston (2006) used the criterion validity test to compare choices from a stated preference survey to votes in a subsequent binding referendum on water supply in Rhode Island. The survey was designed to be consequential and have a high degree of familiarity with the subsequent referendum and the results showed no evidence of statistically significant hypothetical bias. The author suggested this finding was potentially due to the familiarity of the good, the equivalence of information provided in both the referendum and choice setting and the explicit link between the survey and the policy process. Johnston cautioned that further research is needed to examine whether these ideas can be applied to broader CV research, particularly in light of the fact this is the only known survey which directly influenced policy makers. In their work on referenda Vossler and Evans (2009) used five treatments with varying signals of how the results would be used to inform environmental policy in experimental

referenda and found that when respondents viewed their results as consequential there was no bias in the results.

Other researchers have explored perceived consequentiality using a Likert scale follow up question which asks respondents whether they believe the results of the survey will be shared and/or used by policy makers. Herriges et al (2010) employed this technique when exploring WTP for water quality improvement in the Iowa lakes. Results conformed to Carson and Groves (2007) "knife edge" result where respondents who believed the survey to be minimally consequential had a significantly different WTP distribution to the inconsequential respondents. However, when comparing the latent WTP the trend in consequentiality was less clear: inconsequential respondents were WTP -$192; barely consequential, moderately and consequential were WTP between $34 and $57 and definitely consequential respondents were WTP -$63.63. Vossler et al (2012) used a discrete choice experiment to compare elicitation mechanisms for WTP for tree plantations in Quebec. Three treatments used real payments whilst the fourth treatment used a stated preference survey. In the stated preference treatment respondents were asked "to what extent do you believe that your choices will be taken into account by public authorities?" Results showed that marginal WTP for project attributes decreased with each degree of consequentiality. Furthermore, conditioning the analysis on only respondents who were consequential showed no statistical difference between hypothetical and real payments.

One key concern with self-reported consequentiality is that in the majority of field studies, consequentiality increases respondents WTP. This in contrast to laboratory studies which compare CV with real payment scenarios and which have shown that when consequentiality is guaranteed, i.e. the respondents have to pay their stated amount, actual WTP decreases (Murphy and Stevens 2004). This was first shown Champ et al (1997) where one set of respondents were asked a contingent donation question for road removal and a second were asked for actual contributions. The estimated mean WTP in the hypothetical treatment ($46-89) was significantly greater than mean actual contributions ($9). In contrast various field studies have shown that

consequentiality increases WTP. In their work on climate change mitigation (Nepal et al 2009) showed that mean WTP for inconsequential respondents was significantly lower than those who viewed the survey as consequential (between $0.50 and $159.13 compared to between $1,121 and $3,093 respectively). Vossler and Watson (2013) found that consequential respondents were prepared to pay $27.87 for a conservation and preservation programme in Massachusetts whilst the inconsequential respondent's WTP was not statistically significant from zero. Petrolia et al (2014) used a split sample design (CV and choice experiment) to elicit WTP for wetland ecosystem service restoration in Louisiana. As part of the survey responses to two consequentiality questions were elicited; one regarding how important respondents thought their vote was and a second question asking if they thought the results of the survey would affect the actual policy. Results showed there were significant differences between the consequential and inconsequential respondents with only consequential respondents having significant coefficient estimates for the choice specific attributes. The results suggested that inconsequential respondents ignored some of the choice attributes. A second paper using the same survey showed that inconsequential respondents and those who were unsure were more likely to opt out than vote in both the CV and choice experiment (Hwang et al 2014). Furthermore, Interis and Petrolia (2014) found that failing to control for perceptions of consequentiality lowers the apparent construct validity of the instrument. Respondents who perceived the survey to be consequential were more sensitive to project attributes and confirmed to theoretical predictions. In their working paper Groothuis et al (2015) explore both payment and policy consequentiality in a survey on water conservation measures. Similar to previous papers respondents who perceive the survey as consequential are willing to pay more than inconsequential respondents.

Overall the trend in research to date has shown that controlling for consequentiality appears to reduce hypothetical bias associated with stated preference surveys although not in theoretically expected ways. Consequential respondents tend to report statistically higher WTP than inconsequential respondents, with many papers reporting "knife edge" results where even weakly

consequential respondents have statistically different WTP distributions than inconsequential respondents. Few papers however have considered what influences the degree to which respondent's perceive responses to be consequential, the exception being the work of Vossler and Watson (2013) who explored what determined respondents perceived consequentiality using probit regression analysis. The present study seeks to fulfil the gap in the literature and extend the work of Vossler and Watson (2013) by exploring which observable factors influence respondents perceived consequentiality. The paper contributes to the literature by exploring the effects of familiarity and information on stated policy consequentiality. In line with previous literature respondents were asked to state how confident they were that the results of the survey would be used by policy makers using a Likert scale ranging from very unconfident through to very confident, as well as an unsure option. The effect of perceived consequentiality on WTP was explored using a series of interval regression models, including sub-samples with only consequential respondents. Multinomial logistic regression was used to analyse factors which influence perceived consequentiality. Results highlighted that consequential respondents conform to the expectations of construct validity whilst respondents who were inconsequential did not. Respondents with more prior knowledge also appeared to be more likely to perceive the survey as consequential, although this was not consistent across all treatment groups. Additionally, a significant framing effect was noted, with respondents taking the initial quiz 12 percentage points more likely to state the survey as consequential. Overall the results confirmed previous findings that respondents who believe the survey is consequential are willing to pay more. For this survey however there is a belief that WTP and consequentiality may be endogenous and the finding of increased WTP and strong consequentiality is linked by various personal motivation characteristics. As a result caution should be applied when deciding which respondents to use for WTP aggregation based on stated policy consequentiality.

Methodology

Survey Design

The survey was designed to explore local resident's attitudes towards a proposed new flood defence scheme on the Tay Estuary, Scotland. The CV survey was designed following the recommendations of Carson (2000). Initially a focus group was held to review the introductory quiz questions and payment card format. This was followed by a pilot survey with participants in Newburgh (where the scheme was proposed) and 50 people responded. The final survey was conducted throughout 2013 and people living within the local authorities affected by the flood defence scheme were selected to take part through direct mailings. In total 4000 households were contacted by mail and invited to take part in an online survey. A reminder card was sent two weeks after the first contact attempt. Of 4000 people contacted, 749 people completed or partially completed the online survey with 593 responses completed in sufficient detail to be used in the analysis.

Respondents received a cover letter on University letterhead inviting them to take part in the online survey. The first page of the survey outlined the purposes of the survey as well as making clear the results would be shared with interested policy makers:

> *"Your thoughts will be shared with various Scottish Government departments and will be used to help inform the future plans for your local authority."*

Respondents then received information regarding future flood risk in the Tay Estuary and a short description and diagram of the principles of managed realignment as a form of flood defence. Respondents then received additional information regarding flood risk and the costs and benefits of the flood defence scheme. All respondents then received identical information about the Newburgh flood defence scheme including a map of how many homes would be protected, how long until the benefits would be realised and information about the payment vehicle (an annual increase in council tax). Respondents were reminded to consider their household budget and

were told the average council tax bill in their local area. To foster policy consequentiality, several reminder cues indicating that the results would be shared with policy makers were included on this page:

> *"The price you choose will be used to inform the local authorities and the Scottish Government when deciding future flood defence options in the Tay Estuary."*
>
> *"Remember that your preferences will be used in conjunction with costs of the scheme, when they are known, by local authorities and the Scottish Government to inform which flood defence policy is chosen."*

WTP was then elicited using the payment card format. The respondent was asked to tick all values they would be WTP ranging from £0 to £150. The payment card format was chosen based on the discussions of Mitchell and Carson (1989); payment cards reduce the starting point bias of bidding and the yea-saying associated with the referendum format but also provide a comprehensible context when making the valuation. The format also increases the efficiency gains relative to the DC format. The payment card values were determined as a result of feedback from an initial focus group discussion.

A series of debriefing questions followed, including statement questions regarding perceived flood risk and current flood defences, as well as a series of socio-demographic questions. On the final page respondents were asked *"How confident are you that the results of this survey will be used by policy makers in deciding future flood risk management in the Tay Estuary?"* with responses measured on a Likert scale ranging from "very unconfident" through to "very confident" to assess perceived policy consequentiality.

Empirical Approach

To investigate the interactions between consequentiality and respondents preferences a series of regressions were estimated using the interval regression approach. Interval regression was the most suitable approach due to the fact that WTP was collected using a payment card format. Interval regression uses both the lower and upper bounds of the value chosen on the payment card for the regression and reflects the fact that a respondents true value may lie between the highest bid they chose and next highest amount (Haab and McConnell 2002). Theoretically, there are K payments, $t_1 \ldots, t_k$ arranged in ascending order so that $t_k > t_{k-1}$. When a respondent picks payment t_k, the probability that WTP lies between t_k and t_{k+1}:

$$\Pr(choose\ t_k) = \Pr(t_k \leq wtp < t_{k+1}.$$

Responses to the payment card can be treated by specifying WTP as $WTP = \mu + \varepsilon$. If we let $\varepsilon \sim N(0, \sigma^2)$, then

$$\Pr(choose\ t_k) = \frac{1}{\sigma}\int_{(t_k-\mu)/\sigma}^{(t_{k+1}-\mu)/\sigma} \phi(z)dx,$$

which can be rewritten as

$$\Pr(choose\ t_k) = \phi\left(\frac{(t_{k+1} - \mu)}{\sigma}\right) - \phi\left(\frac{(t_k - \mu)}{\sigma}\right)$$

where $\phi\left(\frac{(t_{k+1}-\mu)}{\sigma}\right)$ is the standard normal CDF evaluated at $\phi\left(\frac{(t_{k+1}-\mu)}{\sigma}\right)$. The log likelihood function on for the responses can then be formed:

$$\ln L = \sum_{i=1}^{T} \ln(\phi\left(\frac{(t_{k+1}\,(i) - \mu)}{\sigma}\right) - \phi\left(\frac{(t_k\,(i) - \mu)}{\sigma}\right)$$

Where individual i picks payment $t_k(i)$. This is a form of an interval model in which every individual picks some payment (Haab and McConnell 2002).

Regression analysis was undertaken using Stata (Version 14) and five regression equations were estimated:

- Equation 4.1 did not include the dummy variable for consequentiality:

  $$WTP = b_0 + b_1 FLOODRISK + b_2 WORRIED + b_3 ENVGROUP + b_4 GENDER + b_5 AGE + b_6 ECON + b_7 PROPERTY + b_8 INCOME + b_9 DISTANCEBAND + \varepsilon_I$$

- Equation 4.2 included the dummy variable for consequentiality:

  $$WTP = b_0 + b_1 CONSEQ + b_2 FLOODRISK + b_3 WORRIED + b_4 ENVGROUP + b_5 GENDER + b_6 AGE + b_7 ECON + b_8 PROPERTY + b_9 INCOME + b_{10} DISTANCEBAND + \varepsilon_I$$

- Equations 4.3, 4.4 and 4.5 used the same regression as Equation 4.1 (no control for consequentiality) but were estimated using sub-samples based on respondents perceived consequentiality. Equation 4.3 used inconsequential respondents only, Model 4.4 used unsure respondents and Model 4.5 used consequential respondents.

The dummy variable for consequentiality was coded as 0=very unconfident or unconfident 1=unsure, 2=confident or very confident. Log likelihood ratio tests were used to explore whether including a control for consequentiality improved the model fit.

The same control variables were included in each regression and included respondent characteristics (age, gender, income, economic activity and property ownership), environmentalism, distance from the site and indicators for flood risk awareness (perceived flood risk and worry about existing flood defences) (Table 4.1). The inclusion of these variables allowed construct validity to be explored across the five models and assess whether the WTP of inconsequential and consequential respondents conformed to this theory. As discussed by Carson et al (2001) construct validity is assessed by the power of the explanatory variables in the regression equation. Following economic theory it is expected that income should influence WTP, with those earning the most prepared to pay the most and direct users of the good should be willing to pay more than non-users. Other variables specific to the good such as respondent's

attitudes should also be considered, in this case attitudes towards flood risk and current flood defences.

The "predict" function in Stata was used after each estimation to predict the mean WTP which could then be compared across each model.

Table 4.1: Control variables used in the willingness to pay estimation

Consequentiality	
CONSEQ	Statement question response "I am confident the results of this survey will be used by policy makers" (0=very unconfident or unconfident 1=unsure, 2=confident or very confident) (used in Model 2 only)
Flood risk variables	
FLOODRISK	Statement question response "My property is at risk from flooding" (0= strongly disagree, agree, neutral, 1= agree, strongly agree)
WORRIED	Statement question response "I am worried the current flood defences are not adequate enough to protect my home(0= strongly disagree, agree, neutral, 1= agree, strongly agree)
Socio-demographic characteristics	
ENV	Member of an environmental group (0=no, 1=yes)
GENDER	Gender (female=0, male=1)
AGE	Respondent age ranging from 18-29 through to 65 and over (six levels)
ECON	Respondents economic activity (1=employed 0=not employed)
PROPERTY	Property ownership (1= own the property 0=not a property owner)
INCOME	Household income ranging from under £15,000 to over £100,000 per annum (six categories)
DISTANCE BAND	Distant respondent lives from proposed site (4 levels ranging from at site to over 20 miles away)

In line with the work of Vossler and Watson (2013) regression analysis was also undertaken to explore identifiable factors which may be related to stated policy consequentiality. Vossler and Watson used an ordered probit model and found that having a college education and being uncertain about their vote reduced the likelihood of a respondent believing the survey to be consequential. Other variables included income, age, gender, environmental membership and charitable donations, all of which were insignificant predictors. This work extends their analysis

by considering the influence of taking a quiz at the start of the survey, familiarity with the good and additional information respondents receive.

At the start of the survey respondents were given a nine question quiz to explore what respondents initially knew about flood risk and managed realignment before taking the full survey. There is potential that the quiz had a framing effect on the perceived policy consequentiality of the survey as this included additional text re-stating that the results would be shared with policy makers:

> *"The survey will start by asking you some questions about flooding and the Tay Estuary. These questions will help us understand what you already know, and help improve how the Scottish Government and local authorities share their information with you in future".*
>
> *"These questions will help us understand what you already know, and help improve how the Scottish Government and local authorities share their information with you in future. We will then ask you to complete the survey itself."*
>
> *"Please answer the following nine questions about flood defence and the Tay Estuary to the best of your knowledge. We would really like to find out how much people know about the Tay Estuary. This will make it easier for the Scottish Government and local authorities to let you know what is taking place in your area now and in the future."*

A control group did not take the first quiz and as such it is possible to explore whether there are differences in perceived consequentiality between those who took the first quiz and those who did not.

There is also a possibility that the level of information respondents received and also what they knew prior to the survey influenced their stated consequentiality. There was an expectation that respondents who knew more about local flood risk issues would be more likely to perceive the survey as consequential: these respondents may already be aware of the planning process and judge the survey as a useful aspect of this. Furthermore, respondents who received more information during the survey may have been more likely to perceive the survey as consequential

as the survey provides them more detailed information to inform their decisions. The effects of prior knowledge and additional information were tested using a split sample design with six treatment groups. Respondents in the six treatment groups all took the first quiz, following which they were assigned to a *prior* knowledge type which could be low, medium or high based on their quiz score. Respondents were then randomly assigned to a treatment group dictating the level of additional information they would receive about the good, again this could be low, medium or high and corresponded to three six or nine pieces of additional information respectively. Each piece of additional information directly related to one of the quiz questions. Possible type-treatment pairs are outlined in Table 4.2. Those in the LL group scored the lowest in the first quiz and only received three pieces of additional information compared to those in the HH group who scored the highest and received alll nine pieces of information. The control group received all nine pieces of information. All respondents were quizzed again following elicitation of WTP to whether they had learned any of the new information provided to them. Quizzing respondents at the start of the survey, as well as varying information allows the exploration of whether prior understanding of the good, as well as new information affects whether the respondents believe the survey to be consequential or not.

Table 4.2: Possible type-treatment pairs

Treatment Pair	First quiz score	Level of additional information received
Control	No quiz	9 pieces
LL	0-3	3 pieces
LM	0-3	6 pieces
LH	0-3	9 pieces
MM	4-6	6 pieces
MH	4-6	9 pieces
HH	7-9	9 pieces

Notes: respondents can only receive "new information" once they have been given information relating to what they answered correctly in the first quiz. For example, a respondents answers two questions correctly, as such they are considered low apriori but are assigned to an M treatment group (they are considered LM). They will receive two pieces of information directly related to the two questions they answered correctly plus four additional randomly selected pieces of information.

Multinomial logistic regression was used to explore both the influence of taking the first quiz and information on perceived consequentiality. This regression method was the most suitable as consequentiality was measured using three categorical variables (inconsequential, unsure and consequential). Multinomial logistic regression is used to predict categorical placement in or the probability of category membership on a dependent variable based on multiple independent variables (Greene 2003). Two separate regressions were used:

- Equation 4.6 included all respondents and included a dummy variable for whether the respondent took the first quiz.

  $$CONSEQ = b_0 + b_1 QUIZ + b_2 FLOODRISK + b_3 WORRIED + b_4 COUNCIL + b_5 GENDER + b_6 AGE + b_7 INCOME + b_8 ENV + b_9 EDUC + \varepsilon_I$$

- Equation 4.7 only included respondents who took the first quiz and controlled for the type-treatment pairs.

  $$CONSEQ = b_0 + b_1 LL + b_2 LM + b_3 LH + b_4 MM + b_5 MH + b_6 HH + b_7 \text{FLOODRISK} + b_8 WORRIED + b_9 COUNCIL + b_{10} ENV + b_{11} GENDER + b_{12} AGE + b_{13} EDUC + b_{14} INCOME + \varepsilon_I$$

Similar to the analysis of Vossler and Watson (2013) income, age, education, gender and environmental membership were included in both models. Additionally responses to the flood risk attitude questions were also included. The full list of variables used in the estimation process can be found in Table 4.3.

Table 4.3: Control variables used in the consequentiality estimation

Quiz and Information	
QUIZ	Whether the respondent took the first quiz (=1) or not (=0)
LL, LM, LH, MM, MH, HH	Type-treatment pairs
Flood risk variables	
FLOODRISK	Statement question response "My property is at risk from flooding" (0= strongly disagree, agree, neutral, 1= agree, strongly agree)
WORRIED	Statement question response "I am worried the current flood defences are not adequate enough to protect my home (0= strongly disagree, agree, neutral, 1= agree, strongly agree)

COUNCIL	Statement question response "It is the councils responsibility to fund flood defence not mine" (0= strongly disagree, agree, neutral, 1= agree, strongly agree)
Socio-demographic characteristics	
ENV	Member of an environmental group (0=no, 1=yes)
GENDER	Gender (female=0, male=1)
AGE	Respondent age ranging from 18-29 through to 65 and over (six levels)
EDUC	Respondents education level ranging from secondary school to postgraduate degree (four levels)
INCOME	Household income ranging from under £15,000 to over £100,000 per annum (six categories)

Results

The majority of respondents (82%) were prepared to pay towards the managed realignment scheme with a sample mean WTP of £43.02 per household per annum (*SD* = 45.69). Table 4.4 presents the sample mean WTP by respondents perceived policy consequentiality. Respondents who answered either very unconfident or unconfident to the statement question "How confident are you that the results of this survey will be shared with policy makers?" are considered inconsequential; those who answered neither confident nor unconfident were categorised as "unsure" and those who answered confident or very confident were categorised as consequential. Overall 39% of the sample considered the survey to be consequential and 92% of these were prepared to pay towards the managed realignment scheme. 74% of the inconsequential respondents were willing to pay. The main reason the inconsequential respondents were unwilling to pay was that they believed it is was the Scottish Government's responsibility to fund flood defence. This was also the same for the unsure sample. By answering negatively to the consequentiality question respondents may be reaffirming their point to the researcher that they do not want to fund the scheme, believing a negative response will reduce the likelihood of the scheme taking place in the same way a zero WTP would reduce the likelihood. It is interesting that the main reason for consequential respondents not being WTP was that "they would like to but could not afford to" which suggests that these respondents did believe the survey and did consider their budget constraints. A chi-square test confirmed there was a relationship between

perceived consequentiality and whether a respondent was willing to pay towards the managed realignment scheme (X^2 (2, N = 507) = 19.34, p < .001).

Table 4.4: Mean sample willingness to by stated policy consequentiality

	Inconsequential	Unsure	Consequential
Percentage of sample	25%	36%	39%
Sample mean WTP	33.32	40.35	50.40
Standard deviation	46.46	43.46	48.12
Percentage of respondents willing to pay	74%	80%	92%

Estimation results for the interval regression exploring the influence of policy consequentiality on WTP are presented in Table 4.5. Several results emerge from this analysis. First, in line with the findings of Groothuis et al (2015), Hwang et al (2014), Interis and Petrolia (2014), Petrolia et al (2014) and Vossler and Watson (2013) the results suggest that respondents who perceive the survey to be consequential have a statistically higher WTP. Results from Equation 4.2 show that consequential respondents are prepared to pay £16.24 more per annum than inconsequential respondents. Estimating separate regressions for each subset of respondents showed predicted WTP was lowest for inconsequential respondents at £35.36 per annum (*CI* = 32.23 - 38.49) followed by those who were unsure (£43.86 per annum, *CI*= 42.00 - 45.72) and consequential respondents were WTP the most at £50.23 per annum (*CI*= 47.50 - 52.96). One possibility for the relationship between WTP and consequentiality is that there is an underlying factor which determines both responses. Potentially, respondents may believe that by stating a positive response to the WTP question this will increase the likelihood of the goods provision and in turn expressing a positive response to the consequentiality question increases this further. For this survey it is possible that "flood risk" is the underlying factor; when WTP is modelled using the sub-set of respondents (Equations 4.3, 4.4 & 4.5) respondents perceived flood risk significantly increases WTP but only for consequential respondents. It is logical that respondents who are most worried about flooding will be WTP the most and will want to increase the likelihood of the

scheme taking place. Based on this argument there is an expectation that the coefficient for "worry about existing flood defences" would only be significant for the consequential respondents, this was not the case: it was also significant for inconsequential respondents. There is a distinct possibility that there is an underlying factor influencing both WTP and consequentiality which has not been observed in this survey data.

Second, including "consequential" as a dummy variable in Equation 4.2 significantly improves the model fit compared to Model 1 (LR $chi^2(2) = 9.66$, $Prob > chi^2 = 0.01$). Unlike the finding of Vossler and Watson (2013) there were no changes in the significance of the coefficients when "consequential" was included as a dummy variable however noise was reduced around the coefficient estimates.

Third, only respondents who perceived the survey to be consequential confirm to the theory of construct validity. Following economic theory it is expected that income should influence WTP, with those earning the most prepared to pay the most and direct users of the good should be willing to pay more than non-users (Carson et al 2001). For this survey there was an expectation that flood risk attitudes would influence WTP, with those respondents most worried about defences or at risk from flooding being prepared to pay more than respondents who did not feel threatened by flooding. There was also an expectation that distance would be a significant predictor, with those living at the site prepared to pay the most. Results for Equations 4.1 and 4.2 highlight that the expected coefficients are statistically significant with the appropriate sign: higher income leads to higher WTP; strong flood risk perceptions increase WTP and respondents living closest to the site are prepared to pay the most. However, when sub-samples are modelled only the consequential respondents conform to the theory of construct validity. Results for Equation 4.3, which considers inconsequential respondents only, show income is not a significant predictor of WTP, nor is environmentalism. Flood risk attitudes do however influence WTP as does distance from the site; however the sign for distance band 1-10 miles is not intuitive with respondents in this band prepared to pay more than those living at the site. Results for Equation

4.4, which considers unsure respondents only, also show no signs of construct validity: income is again insignificant, as are the coefficients for flood risk attitudes. Distance from the site however is significant and those living furthest from the site prepared to pay the least. In contrast, results for Equation 4.5, which only models consequential respondents, conform to the theory of construct validity with income, flood risk attitudes and environmentalism all significant predictors with the expected signs. Interestingly distance is only significant for the furthest distance band with those respondents prepared to pay on average £18.86 less than those living closest to the site.

Table 4.5: Interval regression results: stated consequentiality on willingness to pay (Equations 4.1 – 4.5).

VARIABLES	(4.1) full sample		(4.2) full sample		(4.3) inconsequential sample		(4.4) unsure sample		(4.5) consequential sample	
Perceived consequentiality: strongly disagree or disagree (baseline)			0.00	(0.00)						
Perceived consequentiality: Unsure			7.70	(5.34)						
Perceived consequentiality: Strongly agree or agree			16.24***	(5.34)						
I am worried the current defences are not adequate enough to protect my home (S)	19.02***	(7.07)	20.33***	(6.99)	32.54***	(12.48)	17.17	(12.45)	24.34**	(10.40)
My property is at risk from flooding (S)	20.74***	(7.67)	18.73**	(7.59)	21.68	(16.22)	6.50	(14.00)	22.02**	(10.72)
Member of an environmental group (yes)	10.99**	(4.56)	9.73**	(4.52)	-2.07	(9.05)	8.56	(7.68)	15.37**	(6.71)
Gender (male)	9.30**	(4.12)	9.79**	(4.08)	5.22	(7.54)	2.70	(7.19)	7.34	(6.22)
Employed	4.01	(6.15)	6.23	(6.12)	11.59	(12.61)	6.76	(10.22)	-1.86	(9.30)
Age: 18-29 (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Age: 30-39	0.89	(8.97)	4.15	(8.94)	-2.96	(23.57)	6.06	(15.48)	1.06	(12.39)
Age: 40-49	-8.94	(8.63)	-7.37	(8.55)	12.62	(24.80)	-16.58	(14.65)	-8.43	(11.69)
Age: 50-59	-0.11	(8.43)	2.06	(8.37)	-6.24	(21.72)	-6.93	(14.24)	11.97	(11.73)
Age: 60-64	-2.80	(10.07)	-1.70	(9.96)	-23.63	(23.80)	-2.36	(17.36)	3.77	(13.57)
Age: 65 and over	-1.85	(9.59)	-0.27	(9.48)	-1.45	(21.30)	-12.30	(16.75)	11.00	(13.44)
Property owner	-4.79	(6.20)	-4.28	(6.14)	-8.77	(11.87)	-1.69	(11.58)	-6.03	(8.59)
Income: below £15,000 (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Income: between £15,000 and £19,999	8.78	(7.68)	7.96	(7.59)	23.61	(15.90)	-6.02	(12.39)	15.79	(11.51)
Income: between £20,000 and £39,999	18.04***	(6.70)	18.04***	(6.61)	27.34**	(11.92)	9.26	(10.79)	21.65**	(10.25)
Income: between £40,000 and £69,999	16.14**	(7.66)	15.10**	(7.57)	12.75	(15.25)	2.35	(13.40)	26.31**	(10.60)

Income: between £70,000 and £99,999	34.46***	(9.65)	34.29***	(9.52)	20.50	(19.26)	18.94	(15.23)	55.05***	(14.27)
Income: above £100,000	38.79***	(11.14)	39.56***	(11.01)	4.86	(20.92)	29.33	(19.20)	65.04***	(16.28)
Distance from site: at site (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Distance from site: less than 10 miles	-16.31	(11.93)	-18.03	(11.80)	78.74**	(36.53)	-55.51***	(18.40)	2.60	(17.04)
Distance from site: 10-20miles	-23.31***	(6.28)	-23.87***	(6.20)	-40.49***	(11.64)	-27.30***	(10.59)	-14.11	(9.15)
Distance from site: over 20 miles	-23.41***	(6.18)	-23.40***	(6.10)	-15.17	(11.59)	-27.29***	(10.39)	-18.86**	(9.18)
Constant	37.12***	(10.81)	25.25**	(11.57)	29.10	(29.04)	59.15***	(17.35)	24.21	(15.80)
lnsigma	3.63***	(0.04)	3.62***	(0.04)	3.37***	(0.08)	3.62***	(0.06)	3.55***	(0.06)
Predicted mean WTP	44.67	(1.09)	44.41	(1.13)	35.36	(1.59)	43.86	(0.95)	50.23	(1.39)
Observations	375		375		79		142		154	
Log likelihood	-1275.62		-1270.79		-274.24		-477.15		-489.51	
AIC	2593.24		2587.59		590.47		996.29		1021.02	
BIC	2675.71		2677.91		640.23		1058.36		1084.79	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Dependant variable is upper and lower bound WTP.
4.1 does not include any controls for consequentiality.
4.2 "consequential" is included as a dummy variable using a scale from 0 (inconsequential) to 2 (consequential).
4.3 restricts the sample to only those respondents who believed the survey was inconsequential.
4.4 restricts the sample to those who were unsure whether the survey was consequential
4.5 restricts the sample to those who believed the survey was consequential.
(S) denotes variable is a response to a statement question baseline (0) is strongly disagree or agree and (1) is agree or strongly agree.
Observations are restricted to the respondents who took the first quiz only to control for treatment effects.

The above analysis indicates clear differences in WTP between respondents who perceive the survey to be consequential and those who do not. As a result an attempt has been made to analyse identifiable factors which may be correlated with perceived consequentiality. Possible underlying factors include socio-demographics, flood risk attitudes, familiarity with the good in question and consequentiality cues provided in the survey. Cues provided in this survey included an initial flood defence quiz and varied levels of information across respondents.

22% of respondents who took the first quiz thought the survey was inconsequential compared to 35% of respondents who did not take the first quiz (Figure 4.1). Chi squared results revealed that there was a small significant difference in perceived consequentiality between those who took the first quiz and those who did not (X^2 (2, N = 507) = 4.79, p = 0.09).

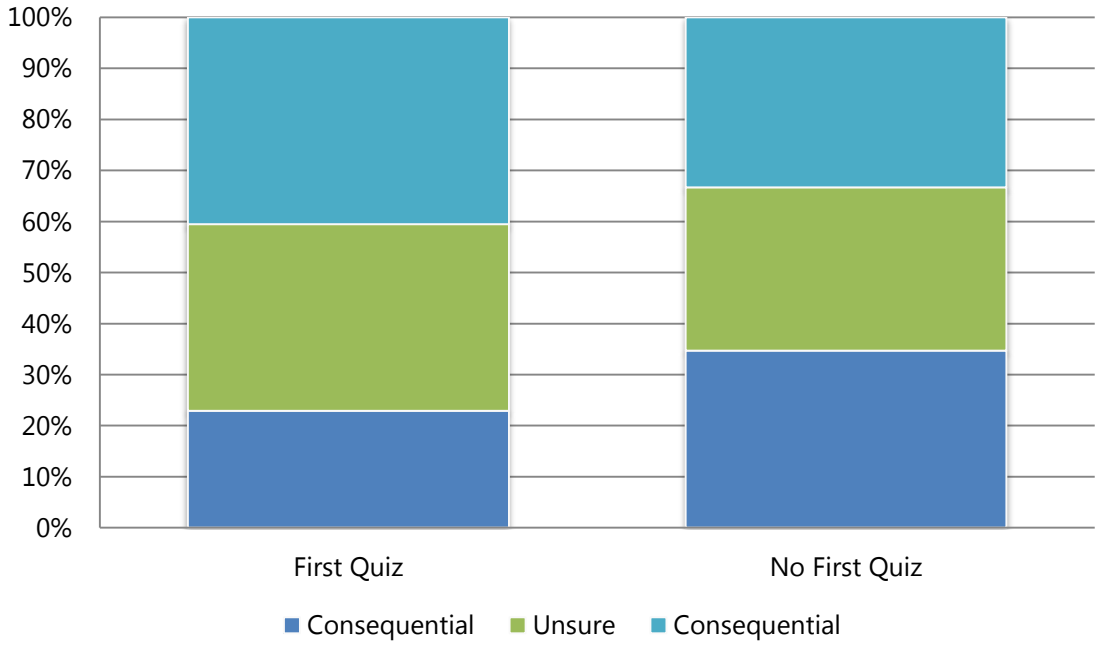


Figure 4.1: Comparison of consequentiality between respondents who took the first quiz and those who did not

Respondents who received the most information appear to be slightly more likely to perceive the survey as consequential compared to respondents who received the least information (Figure 4.2). However, chi squared results revealed that there was no significant difference in perceived consequentiality between the type treatment pairs (X^2 (10, N = 432) = 13.62, p = 0.19).

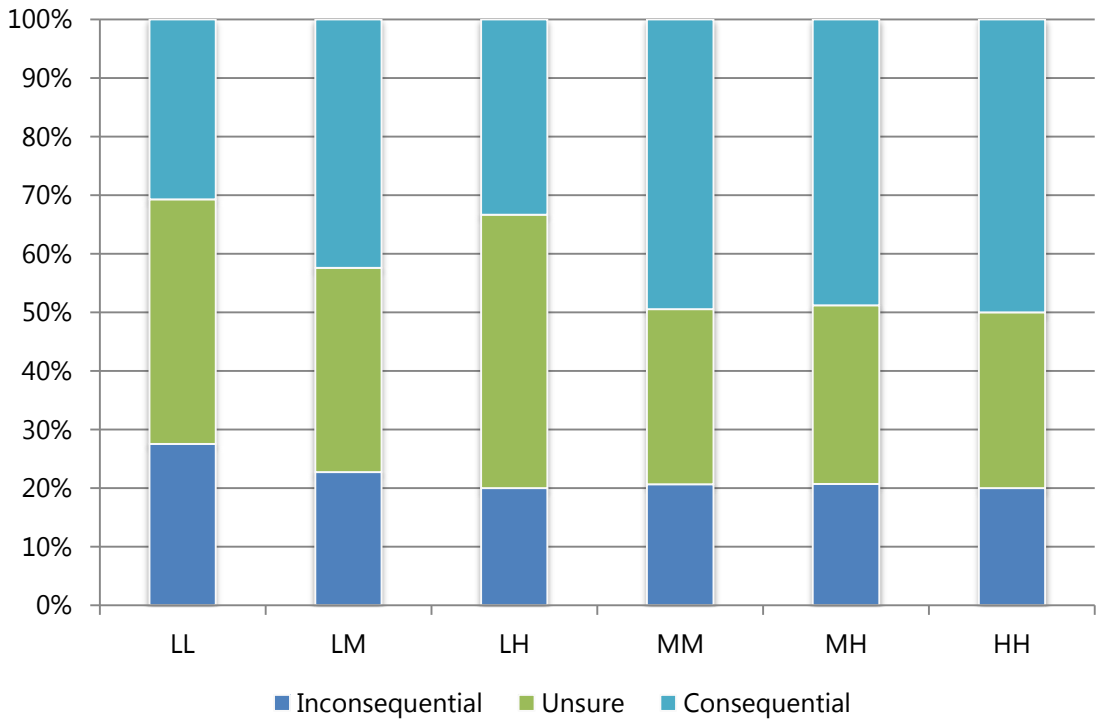


Figure 4.2: Comparison of consequential respondents between type-treatment groups

Estimation results from the multinomial logit regression exploring the influence of the first quiz, prior knowledge and information are presented in Table 4.6. The margins and mchange commands in Stata was used to analyse the results for both models more intuitively (Table 4.7) (for more detail see on margins see Long & Freese 2014).

Results from Equation 4.6 show that respondents who took the first quiz were 15 percentage points less likely to consider the policy inconsequential. However, is not possible to identify from the analysis whether it was the act of taking the quiz itself, or the script prior to taking the quiz which influenced perceived policy consequentiality. The script itself re-enforced the message that the quiz results would be used by policy makers to inform future flood awareness campaigns in the local area. Those who believed they were at risk from flooding were 18 percentage points more likely to view the survey as consequential. Similar to the findings of Vossler and Watson (2013) education was a significant predictor with those with a sixth form or postgraduate education 12 percentage points less likely to perceive the survey as consequential. The result for undergraduate education was not significant.

Results for Equation 4.7 highlighted that additional information did have a small effect on perceived policy consequentiality although the result was not consistent across all type-treatment groups. As indicated by Table 4.7 respondents in the MM and MH treatment groups were 18 percentage points more likely to perceive the survey as consequential compared to those in the LL group and 22 percentage more likely to perceive the survey as consequential compared to the LH group. However there were no significant differences between the MM and MH respondents and the LM respondents. None of the type-treatment pairs were significant predictors of "unsure" respondents.

Perceived flood risk increases the likelihood a respondent thinks the survey is consequential by 19 percentage points. Being educated to college level decreased perceived consequentiality by 19 percentage points and having a postgraduate degree decreased it by 16 percentage points. Interestingly age was also a significant predictor of consequentiality with older respondents (those in the 50-59, 60-64 and 65 and over bands) more likely to perceive the survey as inconsequential by 17, 15 and 24 percentage points respectively.

Overall the result indicate that respondent's prior knowledge about the good had a stronger effect on perceived consequentiality rather than the additional survey information. Those who knew most initially were more likely to believe the survey, regardless of how much additional information they were given. It is clear that more research is needed to confirm a causal link as the sample sizes are relatively small.

Table 4.6: Multinomial logistic regression: Respondent characteristics on stated consequentiality (Equations 4.6 & 4.7)

	Equation 4.6						Equation 4.7					
VARIABLES	Inconsequential (baseline)		Unsure		Consequential		Inconsequential (baseline)		Unsure		Consequential	
Quiz and Information Variables												
Respondent took first quiz	0.00	(0.00)	0.69**	(0.34)	0.79**	(0.34)						
Type-treatment pair: LL							0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Type-treatment pair: LM							0.00	(0.00)	0.01	(0.45)	0.58	(0.44)
Type-treatment pair: LH							0.00	(0.00)	0.36	(0.44)	0.04	(0.47)
Type-treatment pair: MM							0.00	(0.00)	-0.15	(0.40)	0.73*	(0.40)
Type-treatment pair: MH							0.00	(0.00)	0.12	(0.42)	0.88**	(0.42)
Type-treatment pair: HH							0.00	(0.00)	0.68	(1.21)	1.52	(1.18)
Flood risk characteristics												
My property is at risk from flooding (S)	0.00	(0.00)	0.01	(0.49)	0.77	(0.48)	0.00	(0.00)	0.51	(0.60)	1.19**	(0.58)
I am worried about the current defences (S)	0.00	(0.00)	0.39	(0.44)	-0.02	(0.44)	0.00	(0.00)	-0.06	(0.49)	-0.43	(0.50)
It is the councils responsibility to fund flood defence not mine (s)	0.00	(0.00)	0.68**	(0.27)	0.50*	(0.26)	0.00	(0.00)	0.69**	(0.30)	0.41	(0.29)
Socio-demographic characteristics												
Member of an environmental group (yes)	0.00	(0.00)	0.12	(0.30)	0.29	(0.29)	0.00	(0.00)	0.28	(0.33)	0.39	(0.33)
Gender (male)	0.00	(0.00)	0.08	(0.27)	-0.16	(0.26)	0.00	(0.00)	0.30	(0.29)	0.02	(0.29)
Age: 18-29 (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Age: 30-39	0.00	(0.00)	-0.83	(0.57)	-0.75	(0.54)	0.00	(0.00)	-1.22*	(0.68)	-1.22*	(0.65)
Age: 40-49	0.00	(0.00)	-0.35	(0.57)	-0.38	(0.54)	0.00	(0.00)	-0.71	(0.68)	-0.91	(0.65)
Age: 50-59	0.00	(0.00)	-0.35	(0.54)	-0.47	(0.52)	0.00	(0.00)	-0.83	(0.65)	-1.33**	(0.63)

Age: 60-64	0.00	(0.00)	-0.53	(0.62)	-0.60	(0.60)	0.00	(0.00)	-0.80	(0.77)	-1.23*	(0.75)
Age: 65 and over	0.00	(0.00)	-0.47	(0.54)	-1.03*	(0.54)	0.00	(0.00)	-0.87	(0.66)	-1.69***	(0.65)
Education: school (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Education: sixth form/college	0.00	(0.00)	0.45	(0.38)	-0.51	(0.38)	0.00	(0.00)	0.38	(0.43)	-0.65	(0.43)
Education: undergraduate	0.00	(0.00)	0.14	(0.42)	0.07	(0.39)	0.00	(0.00)	-0.03	(0.46)	-0.28	(0.43)
Education: postgraduate	0.00	(0.00)	0.84**	(0.39)	-0.03	(0.37)	0.00	(0.00)	0.77*	(0.43)	-0.21	(0.42)
Income: below £15,000 (baseline)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Income: between £15,000 and £19,999	0.00	(0.00)	0.70	(0.51)	0.66	(0.52)	0.00	(0.00)	0.55	(0.56)	0.85	(0.56)
Income: between £20,000 and £39,999	0.00	(0.00)	-0.02	(0.41)	0.12	(0.41)	0.00	(0.00)	-0.04	(0.45)	0.23	(0.46)
Income: between £40,000 and £69,999	0.00	(0.00)	-0.11	(0.46)	0.28	(0.44)	0.00	(0.00)	-0.15	(0.50)	0.51	(0.50)
Income: between £70,000 and £99,999	0.00	(0.00)	0.12	(0.60)	0.37	(0.59)	0.00	(0.00)	0.06	(0.66)	0.57	(0.65)
Income: above £100,000	0.00	(0.00)	-0.38	(0.67)	-0.26	(0.66)	0.00	(0.00)	-0.20	(0.75)	0.36	(0.74)
Constant	0.00	(0.00)	-0.77	(0.70)	-0.10	(0.67)	0.00	(0.00)	0.18	(0.75)	0.79	(0.73)
Observations	476		476		476		407		407		407	
Log likelihood	-483.63						-401.55					
AIC	1047.25						899.11					
BIC	1213.87						1091.53					
Pseudo r2	0.06						0.07					

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Dependant variable perceived consequentiality measured 0= inconsequential 1=weakly consequential 2= strong consequential
(4.6) independent variable includes whether respondent took the first quiz.
(4.77) independent variable includes the type-treatment pair (quizzed respondents only)
(S) denotes variable is a response to a statement question baseline (0) is strongly disagree or agree and (1) is agree or strongly agree.

Table 4.7: mchange results comparing likelihood of respondents perceiving the survey to be consequential by type-treatment pair

	LL	LM	LH	MM	MH	HH
LL	x	0.12*	-0.04	0.18***	0.18***	0.23
LM	x	x	-0.16*	0.06	0.06	0.11
LH	x	x	x	0.22 ***	0.22***	0.27
MM	x	x	x	x	0.00	0.05
MH	x	x	x	x	x	0.06
HH	x	x	x	x	x	x

Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Discussion

Carson and Groves (2007) argue that for a survey to produce meaningful information about preferences the respondent must view their responses as potentially influencing the supply of the public good. Additionally, the respondent needs to care about what the outcomes of those actions might be, in which case the survey is consequential. Respondents who perceive their survey responses to be at least minimally consequential face the same incentives and thus respond to the WTP to question in a similar manner, all else being equal. Strong consequentiality includes both payment consequentiality, where the respondent believes that they will have to pay towards the good, and policy consequentiality where the respondent believes the results of the survey will be used by policy makers.

This study explored policy consequentiality in a CV survey using a Likert scale question at the end of the survey to measure respondent's perceived consequentiality. In line with previous field studies on consequentiality, the main finding was that respondents who were confident or very confident that the results of the survey would be used by policy makers had significantly higher WTP (£50.23 per annum) compared to those respondents who were either unsure (£43.86 per annum) or unconfident (£35.36). This finding of increased WTP for consequential respondents is in contrast to the laboratory experiments which show that when consequentiality is ensured, i.e. respondents must pay their stated amount, WTP decreases (Murphy and Stevens 2004). As

suggested by Herriges (2010) one possible reason for this difference is that stated consequentiality in the field has mainly concentrated on policy consequentiality rather than payment consequentiality which is identified in the lab. It is recognised that a key limitation of this paper is that only policy consequentiality is considered, and for strong consequentiality to take place the survey must have both policy and payment consequentiality.

As the relationship is further established between consequentiality and WTP a natural question is whether those respondents who perceive the survey to be inconsequential should be removed from the WTP aggregation? In the case of this survey this would reduce the sample size from 593 to 200. If further restrictions were then imposed, such as only aggregating WTP for consequential respondents who would be directly influenced by the policy i.e. those living in Newburgh, this would reduce the sample to 30. This results in a significantly increased WTP of £76.50 per household per annum (*CI*=68.12 - 85.77) compared to the sample mean of £43.02 per household per annum. An argument in favour of reducing the sample used for aggregation in this survey is that only those respondents who perceive the survey to be consequential follow the theory of construct validity. This is similar to the findings of Vossler & Watson (2013) where consequentiality appears to be vital to external validity. When comparing the results of the three sub-sample WTP equations only the covariates for the consequential respondents conform to the theory of external validity. The counter argument is that removing inconsequential respondents from the aggregation will a) potentially lead to an upwards bias in the WTP estimate and b) is ethically unsound. As the majority of studies have shown that policy consequentiality leads to increases in WTP, restricting aggregation to only these respondents will lead to an upwards bias in WTP. Since it is possible that observable factors such as likelihood of the policy taking place, as well as unobservable factors maybe correlated with both WTP and consequentiality, at present it would seem hasty to start restricting samples until further research has been undertaken in the field, particularly in the realms of payment consequentiality, which to date appears to have received far less attention than policy consequentiality. More concerning from a survey ethics perspective is

that many surveys, including this one, state results will be used by policy makers when in-fact they are not, with the exception being the work of Johnston (2006), and the use of these statements seems to be readily accepted by CV practitioners. This is at least misleading to respondents and at worst could undermine the policy process, particularly for emotive issues: should we be removing respondents who in fact correctly identify the survey as being inconsequential?

Another concern is that the current trend in results that consequentiality leads to increased WTP may be due to endogeneity. Indeed, respondents who want the policy to go ahead may be more likely to state the survey as consequential and state a high WTP in the hope these responses contribute to the policy maker's decision. In this survey there is particular concern that feeling more at risk from flooding is partly correlated with stated consequentiality. This is highlighted in the results for Equation 4.5 where both worry about current defences and perceived flood risk increased WTP substantially. It is logical that respondents who are most worried about flooding are going to be prepared to pay the most to protect their home and are also the respondents keenest on the policy taking place. This finding is strengthened when the results of the multinomial logit models to test which characteristics influence perceived consequentiality are considered. One of the main significant predictors of consequentiality was whether a respondent was at risk from flooding. These results support the notion that those who are most concerned want the policy to go ahead, are more willing to believe the survey and are be prepared to pay more.

Interestingly, respondents who took the quiz were more likely to perceive the survey as consequential compared to respondents who did not. However, what cannot be ascertained is whether the quiz itself or the additional script provided prior to the quiz, which included additional policy cues, was responsible for the increase in perceived consequentiality amongst those who took the first quiz.

The results of the prior knowledge and learning part of the experiment highlighted that respondents with more prior knowledge were more likely to perceive the survey as consequential; however providing additional information to respondents with lower prior knowledge did not have a statistical influence on perceived consequentiality. The finding that those with more knowledge initially perceived the survey consequential is not unexpected: respondents who are more aware of flood risk, managed realignment and policy in their area may be more confident that the survey is genuine. In contrast those who are less familiar or interested in the topic from the outset may choose the response that was most convenient to them, i.e. inconsequential or unsure: a theory first suggested by Hwang et al (2014). There was an expectation that the respondents who received more information may have perceived the survey to be more consequential as they had more information to inform their decision: this was not the case.

Conclusion

This paper set out to explore the relationship between consequentiality and WTP and analyse which observable factors influenced stated consequentiality. Specifically tested were the influence of information and familiarity on stated consequentiality. This was achieved by using a CV survey that explicitly tested for respondent's prior knowledge of the good in question; allowed for variation in information across the respondents; elicited respondents WTP and finally asked the respondents "How confident are you that the results of this survey will be used by policy makers in deciding future flood risk management in the Tay Estuary?"

Results confirmed previous findings that consequentiality leads to increased WTP. Additionally the results highlighted a relationship between familiarity and perceived consequentiality but it was recognised that further research was needed to demonstrate a causal link. Information did not have an effect on consequentiality. The main influence on consequentiality appeared to be the respondents perceived flood risk. This raised the question that WTP and consequentiality may in fact be endogenous, and the policy consequentiality question is not necessarily being answered how survey researchers expect it to be. In particular the idea that respondents who answer

positively are those keenest on the policy taking place, i.e. those most concerned about flooding, and that by stating they are confident the results of the survey will be used by policy makers this somehow increases the likelihood of the policy taking place.

The research also raised concerns regarding the aggregation of WTP based on stated consequentiality and also the ethics of the questions itself. The trend for research at present is to focus on policy consequentiality and the idea of payment consequentiality has received far less attention. As stressed by Carson and Groves (2007) both payment and policy consequentiality equate to strong consequentiality. Further work needs to examine both elements of consequentiality, especially if in future stated preference surveys responses will be dismissed based on how respondents perceive consequentiality. Overall it is clear that more research needs to be undertaken into how respondents answer the consequentiality question and what drives these responses if Likert scale self-assessed consequentiality going to become common in stated preference surveys, especially if the answers are going to dictate the aggregation in WTP estimates.

Chapter 5.
In Conclusion – Aggregate Willingness to Pay for Managed Realignment

Introduction

This thesis has explored public willingness to pay (WTP) for managed realignment on the Tay Estuary, Scotland and how variations within the survey instrument and between respondents can affect WTP estimates. An online contingent valuation (CV) survey was developed which was used to explore survey design issues and consider relevant flood risk management policy questions. The theses aimed to answer the following questions:

- Do respondents learn the additional information presented to them during CV surveys?
- Does prior knowledge or new information have a greater effect on the WTP estimate when accounting for respondent experience and familiarity with the good?
- Are there differences in the WTP estimate between respondents who think the survey is consequential and those who do not?
- Do respondent characteristics and/or survey designs features have a greater influence on stated consequentiality? Furthermore does information provision and familiarity have an impact on stated consequentiality?

Also considered were flood risk management policy issues which included respondents understanding of potential flood defence options, their perceived and actual flood risk, attitudes towards coastal defence options and how these should be funded.

In this final chapter the key findings from this research are summarised and implications for the provision of managed realignment on Tay Estuary are identified, in particular issues regarding the aggregation of WTP.

Key Findings

Analysis in the previous chapters has identified a number of research findings. These are:

- Using a quiz to identify respondent's prior knowledge about the good, varying levels of information presented and a repeat of the quiz demonstrated that respondents do learn about the good during the survey process.
- Despite a causal link between information provision and learning being established, there was no relationship identified between prior knowledge, information provision and WTP.
- Personal motivations were found to be the strongest predictors of WTP, including respondent's attitudes towards flood risk and current flood defences. Additionally a distance decay relationship was established with respondents living at the site prepared to pay the most towards the scheme.
- Respondents who were most confident that the results of the survey would be used by policy makers were prepared to pay the most towards the scheme. This finding is consistent with previous field based papers exploring policy consequentiality, although it as at odds with laboratory based findings.
- The main influence on consequentiality appeared to be the respondents' perceived flood risk. This highlights the possibility that WTP and consequentiality may be endogenous, and the policy consequentiality question is not necessarily being answered how survey researchers expect it to be. One explanation is that respondents who answer positively to the question are keenest for the policy to take place, and that they believe that by stating positive consequentiality this somehow further increases the likelihood the policy will take place.
- From a regulators perspective a "miss-match" between actual and perceived flood risk was highlighted, with many respondents stating they were not at risk from flooding when they in fact were. This identified the challenge of how best to communicate flood risk to those without previous experience of flooding and increase respondents understanding of the issue. There is an expectation that increasing knowledge about potential flood risk will

increase the support for the allocation of public funds towards maintaining and building new flood defences.

Implications for Willingness to Pay Aggregation

Once a CV survey has obtained the correct theoretical measure of WTP for a sample of individuals, the researcher can proceed to aggregate these values to obtain the total benefits for the good being valued (Mitchell & Carson, 1989). A question for the researcher is: which of the WTP estimates are most appropriate for policy analysis when aggregating?

Analyses in the three previous chapters have identified a variety of WTP estimates as a result of different considerations within each model: Chapter 2 compared results of OLS, Tobit and Interval regression which used data from all respondents; Chapter 3 extended this analysis using only interval regression and controlled for the effects of information provision and the impact of taking the an initial quiz; and Chapter 54furthered this analysis by including policy consequentiality as a dummy variable. Table 5.1 outlines the main regression undertaken for each chapter and the key findings from each estimation.

To determine a range of suitable values for policy use one final interval regression was estimated combing the findings from the previous chapters (Equation 5.1). Included in the model are dummy variables for consequentiality (coded as 0 for inconsequential, 1 for unsure and 2 for consequential); the type-treatment pairs; personal motivation characteristics and socio-demographic variables. Variables were selected based on significant coefficients from previous models.

$$WTP = b_0 + b_1 CONSEQ + b_2 CONTROL + b_3 LL + b_4 LM + b_5 LH + b_6 MM + b_7 MH + b_8 HH + b_9 FLOODRISK + b_{10} WORRIED + b_{11} ENVGROUP + b_{12} GENDER + b_{13} INCOME + b_{14} WORK + b_{15} AGE + b_{17} PROPERTY + b_{18} DISTANCE + \varepsilon_I \quad (5.1)$$

Table 5.1: Summary of regression analyses for the Chapters 2,3 and 4 and their subsequent key findings

Equation	Key Findings
Chapter 2 $WTP_I = b_0 + \ b_1 FLOODRISK \ + \ b_2 WORRY + b_3 FLOODRISK * WORRIED + \ b_4 HOMEFLOOD \ + + b_5 INCOME + \ b_6 GENDER + \ b_7 PROPERTY + \ b_8 ENV \ + \ b_9 DISTANCEBAND \ + \ b_{10} SURVEYTIMER \ + \ b_{11} WTPTIMER \ + \varepsilon_I$	▪ Flood risk attitudes were key predictors of WTP. ▪ Whether a respondent had been flooded did not significantly affect WTP. ▪ Income, distance from the site and environmental group membership were also significant predictors. ▪ Survey timer and WTP timer did not have a significant effect on WTP.
Chapter 3 $WTP = \ b_0 + \ b_1 LL + \ b_2 LM + \ b_3 LH + \ b_4 MM \ + \ b_5 MH \ + \ b_6 HH + b_7 FLOODRISK + \ b_8 WORRIED + \ b_9 \text{HOMEFLOOD} + \ b_{10} ENVGROUP + \ b_{11} GENDER \ + \ b_{13} EDUCATION \ + \ b_{14} INCOME + b_{15} CONFIRMED + \ b_{17} COMPLICATED \ + b_{18} AFFECTED + \ \ + \varepsilon_I$ $WTP = \ b_0 + b_1 FLOODRISK + \ b_2 WORRIED + \ b_3 HOMEFLOOD + \ b_4 ENVGROUP + \ b_5 GENDER \ + \ b_6 EDUCATION \ + b_7 INCOME + \ \ b_8 WTPTIMER \ + \ \ b_9 SURVEYTIMER \ + \ b_{10} INFOTIMER \ + \ \ b_{11} QUIZ \ CONTROL + \ \varepsilon_I$	▪ The type treatment pairs (LL through to HH) did not have a significant effect on the WTP estimate or its variance. ▪ However respondents stated use of the additional information, as judged by statement question responses, did significantly influence WTP. ▪ Whether a respondent took the first quiz or not significantly influenced WTP. Those who took the first quiz were WTP £20 more on average. It is believed the quiz introduced a significant framing effect with respondents taking more notice of the additional information presented to them or believing the results of the survey would be used by policy makers. ▪ Personal motivations matter: those living at the site and most concerned about flood risk and current defences were prepared to pay the most.

Chapter 4 $WTP = b_0 + b_1 CONSEQ + b_2 FLOODRISK + b_3 WORRIED + b_4 ENVGROUP + b_5 GENDER + b_6 AGE + b_7 ECON + b_8 PROPERTY + b_9 INCOME + b_{10} DISTANCEBAND + \varepsilon_I$	▪ Including a dummy variable for whether the respondent though the survey was consequential or not significantly affected the WTP estimate. ▪ Consequential respondents were prepared to pay significantly more than respondents who thought the survey was inconsequential.

Table 5.2 presents the estimation results from the interval regression. In line with the previous analysis flood risk attitudes are the strongest predictors, increasing WTP between £14.98 and £22.39 per household per annum. Income and distance from the site are also significant with the expected signs; increasing income is correlated with increasing WTP and the further someone lives from the site, the less they are WTP for the project. Consequential respondents are prepared to pay £15.88 more than inconsequential respondents, although there was no significant difference between inconsequential and unsure respondents. From the information provision perspective, there is a significant difference in WTP between those who took the first quiz and those who did not. The use of the mchange command post-estimation showed there were no significant differences between the type-treatment pairs.

Table 5.2: Interval regression results: consequentiality, information and personal motivations on willingness to pay

VARIABLES	COEFFICIENT	
Consequentiality		
Unconfident (baseline)	0.00	(0.00)
Unsure	7.58	(4.75)
Confident	15.88***	(4.77)
Quiz and Information		
Control (baseline)	0.00	(0.00)
LL	13.88**	(5.97)
LM	18.03**	(7.09)
LH	6.71	(7.24)
MM	8.17	(6.35)
MH	11.54*	(6.51)
HH	3.79	(14.18)
Flood risk characteristics		
I am worried the current defences are not adequate enough to protect my home (S)	22.39***	(6.17)
My property is at risk from flooding (S)	14.98**	(6.66)
Member of an environmental group (yes)	12.41***	(4.02)
Gender (male)	11.16***	(3.71)
Property owner	0.12	(4.94)
Income: below £15,000 (baseline)	0.00	(0.00)
Income: between £15,000 and £19,999	8.57	(6.92)
Income: between £20,000 and £39,999	16.95***	(5.80)
Income: between £40,000 and £69,999	10.80*	(6.09)
Income: between £70,000 and £99,999	23.04***	(7.92)
Income: above £100,000	31.37***	(9.79)
Distance: at site (baseline)		
Distance from site: less than 10 miles	-13.75	(11.34)
Distance from site: 10-20miles	-20.47***	(5.67)
Distance from site: over 20 miles	-19.90***	(5.45)
Constant	10.21	(9.15)
lnsigma	3.60***	(0.03)
Observations	436	
Log likelihood	-1475.51	
AIC	2997.02	
BIC	3090.81	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Dependant variable is upper and lower bound WTP.
(S) denotes variable is a response to a statement question baseline (0) is strongly disagree or agree and (1) is agree or strongly agree.

Following the regression analysis the Stata post estimation command "predict" was used to estimate WTP based on the regression coefficients. Following this mean, median and the standard deviation of WTP were calculated for the sample and various restrictions were applied (Table 5.3). Additionally a cumulative density function was calculated showing the percentage of respondents WTP at each amount across the different model restrictions (Figure 5.1).

The unrestricted predicted mean WTP was £42.63 per household per annum (*CI*= 40.44 – 44.83) with a predicted median WTP of £38.67. Restricting this to Newburgh residents only increased the mean WTP to £68.54 per household per annum. The lowest WTP were for respondents who did not take the first quiz with a predicted mean of £31.72 per household per annum and inconsequential respondents with a predicted mean of £30.17. Restricting the sample further to respondents in the controlled sample and those who believed the survey was inconsequential reduced the estimated WTP to £20.25 per annum. The largest predicted WTP was for respondents living in Newburgh, who were in the treatment group and who believed the survey was consequential with a mean WTP of £78.95 per annum and a median WTP of £80.63 per annum.

Table 5.3: Comparison of predicted mean willingness to pay across varying restrictions

Restrictions	Mean	Confidence Interval	SD	25 %ile	50 %ile	75 %ile	Obs
Full sample	42.63	(40.44 - 44.83)	23.35	28.05	38.67	53.08	436
Newburgh Only	68.54	(62.64 - 74.45)	24.77	45.67	74.88	88.44	70
Treated respondents	44.41	(42.07 - 46.75)	23.04	29.58	39.74	54.46	375
Control respondents	31.72	(25.96 - 37.47)	22.47	19.61	28.71	42.73	61
Treated and Newburgh	71.46	(65.34 - 77.58)	23.48	51.99	77.48	88.93	59
Control and Newburgh	52.90	(34.94 - 70.87)	26.74	26.97	43.25	78.30	11
Consequential	50.22	(46.68 - 53.75)	23.55	33.58	45.02	60.10	173
Inconsequential	30.17	(26.31 - 34.03)	19.53	15.94	29.58	39.65	101
Unsure	42.31	(38.89 - 45.72)	22.02	27.93	35.94	51.26	162
Consequential and Newburgh	77.35	(70.04 - 84.66)	18.84	65.07	79.90	89.35	28
Consequential, treated, Newburgh	78.95	(70.94 - 86.96)	18.97	65.07	80.63	91.48	24
Inconsequential and control	20.25	(13.13 - 27.36)	16.05	11.01	23.66	29.85	22

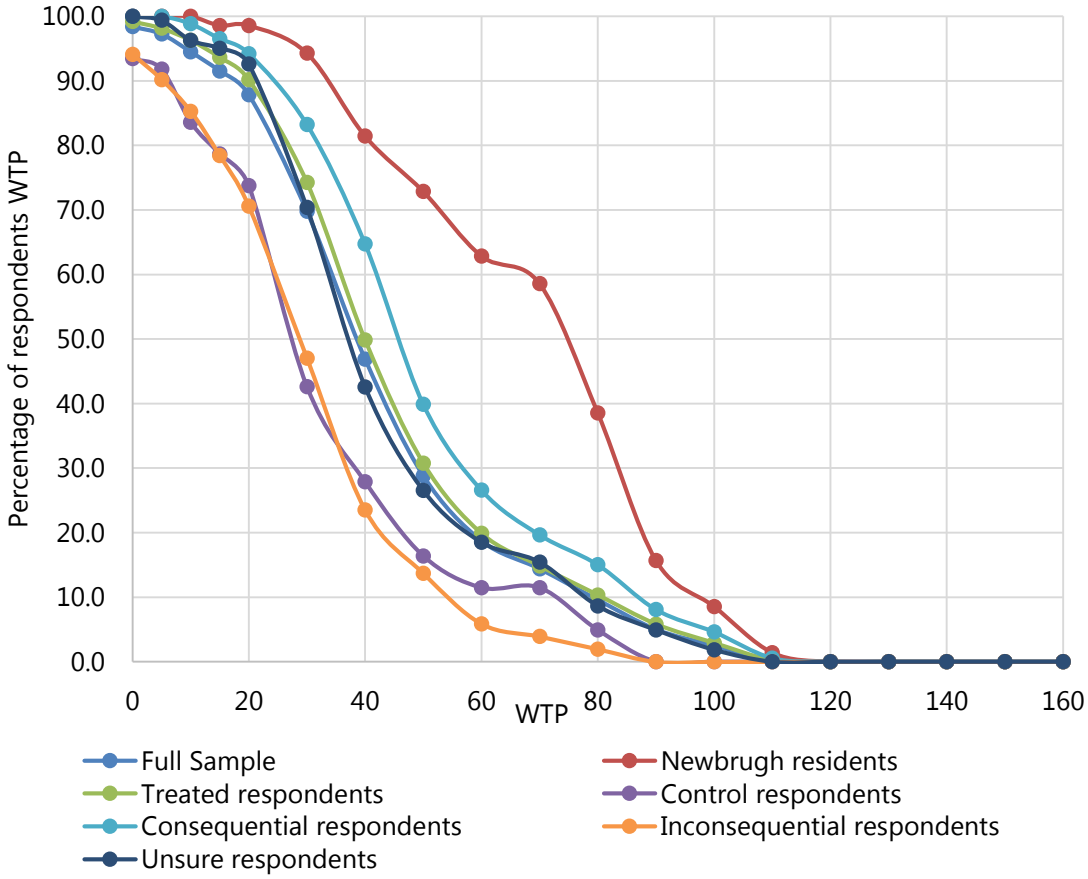


Figure 5.1: Willingness to pay distributions across varying restrictions

From Table 5.3 and Figure 5.1 it is clear that there are large difference in WTP depending on the model restrictions applied. As such a variety of values were compared for the WTP aggregation. The next question is: what extent of the market should be used in the aggregation? Bateman et al (2006) offers insights into this; should it be confined to those living in the close vicinity of the good, or extended across the region, country or even further afield? This will have implications on the appropriate level of government financing and provision. It was decided to compare aggregate WTP across three spatial scales: Newburgh residents only; the population of Fife; and those living closest to the Tay Estuary.

Initially, aggregate WTP was derived for Newburgh respondents only and scaled up to the Newburgh population (Table 5.4). Separate aggregations were calculated based on perceived consequentiality and adjusted for the framing effect of the first quiz. This population was chosen

as Newburgh residents will directly benefit from the flood defence scheme. Present value benefits were calculated using the Treasury Green book discount rate of 3.5% over a 20 year timescale (HM Treasury 2011). This timescale was chosen as this was how long the respondents were told the increase in council tax would last for. Aggregate household WTP varied between £45,887 and £107,684 with mean aggregate WTP between £77,600 and £89,000.

Table 5.4: Aggregate willingness to pay for Newburgh residents

Area	Predicted Household Annual Mean WTP	HH	Annual Aggregate WTP		
			Lower	Mean	Upper
Newburgh	£68.54 (£62.64 -£74.45)	1133	£70,967	£77,659	£84,350
Newburgh: consequential	£77.35 (£70.04 -£84.66)	1133	£79,359	£87,638	£95,916
Newburgh: consequential and treated	£78.95 (£70.94-£86.96)	1133	£80,370	£89,446	£98,523
Newburgh: consequential and control	£67.77 (£40.50-£95.04)	1133	£45,887	£76,786	£107,684

	Present Value Aggregate Benefits		
	Lower	Mean	Upper
Newburgh	£1,068,096	£1,168,802	£1,269,509
Newburgh: consequential	£1,194,394	£1,318,991	£1,443,589
Newburgh: consequential and treated	£1,209,610	£1,346,213	£1,482,816
Newburgh: consequential and control	£690,621	£1,155,663	£1,620,705

Secondly, aggregate WTP was derived respondents from the Fife Local Authority only and aggregate WTP was scaled across the Fife population (Table 5.5). This aggregation was chosen as the council tax increase to fund the scheme would take place across the whole local authority area. Predicted means from the Newburgh residents were not included and instead the conservative predicted household means from the remainder of the Fife local authority respondents were used. It was felt the using responses from Newburgh residents would significantly over-estimate the aggregate WTP as these residents only make up a very small percentage of the Fife population. A refinement to this exclusion would have been to estimate

WTP using a distance decay function. Aggregate household WTP varied between £3,736,934 and £8,371,772 with mean WTP between £4,649,564 and £7,850,805.

Table 5.5: Aggregate willingness to pay for Fife residents

Area	Predicted Household Annual Mean WTP	HH	Annual Aggregate WTP		
			Lower	Mean	Upper
Fife	£45.68 (£42.65- £48.71)	171,861	£7,329,837	£7,850,805	£8,371,772
Fife: (no at site responses)	£37.68 (£35.67 - £39.68)	171,861	£6,130,969	£6,475,618	£6,820,264
Fife: (no at site responses) consequential	£44.98 £41.60 - £48.36)	171,861	£7,148,672	£7,730,167	£8,311,662
Fife: (no at site responses) inconsequential	£27.39 (£23.71 - £31.08)	171,861	£4,074,572	£4,707,806	£5,341,041
Fife: (no at site responses) treated respondents	£39.36 (£37.42 - £41.48)	171,861	£6,400,652	£6,764,549	£7,128,447
Fife: (no at site responses) control respondents	£27.05 (£31.74 - £32.36)	171,861	£3,736,934	£4,649,564	£5,562,194

	Present Value Aggregate Benefits		
	Lower	Mean	Upper
Fife	£110,317,940	£118,158,776	£125,999,612
Fife: (no at site responses)	£92,274,341	£97,461,481	£102,648,596
Fife: (no at site responses) consequential	£107,591,302	£116,343,113	£125,094,923
Fife: (no at site responses) inconsequential	£61,324,466	£70,854,972	£80,385,503
Fife: (no at site responses) treated respondents	£96,333,207	£101,810,046	£107,286,911
Fife: (no at site responses) control respondents	£56,242,833	£69,978,399	£83,713,965

Finally aggregate WTP was calculated for households situated in census output areas adjacent to the Tay Estuary covering the Fife, Perth & Kinross and Dundee local authorities (Table 5.6). There is potential that these properties may experience flood reduction benefits as a result of the scheme. A sample aggregation was estimated, as well as aggregations controlling for treatment and consequentiality. Aggregate household WTP varied between £3,873,529 and £13,787,545 with mean WTP between £5,971,861 and ££13,097,651

Table 5.6: Aggregate willingness to pay for those living closest to the Tay Estuary

Area	Predicted Household Annual Mean WTP	HH	Annual Aggregate WTP		
			Lower	Mean	Upper
Tayside	£42.63 (£40.44 - £44.83)	294922	£11,925,560	£12,573,840	£13,222,117
Tayside: consequential	£42.31 (£38.89 - £45.72)	294922	£11,469,517	£12,477,129	£13,484,739
Tayside: inconsequential	£30.17 (£36.31 - £34.03)	294922	£7,760,796	£8,897,832	£10,034,869
Tayside: treated	£44.41 (£42.07 - £46.75)	294922	£12,407,758	£13,097,651	£13,787,545
Tayside: control	£31.72 (£5.96 - £37.47)	294922	£7,656,774	£9,353,678	£11,050,583
Tayside: inconsequential and control	£20.25 (£13.13 - £27.36)	294922	£3,873,529	£5,971,861	£8,070,190
Tayside: consequential and treated	£43.82 (£40.23 - £47.40)	294922	£11,866,048	£12,922,860	£13,979,674

	Present Value Aggregate Benefits		
	Lower	Mean	Upper
Tayside	£179,486,011	£189,242,967	£198,999,878
Tayside: consequential	£172,622,310	£187,787,418	£202,952,481
Tayside: inconsequential	£116,804,094	£133,917,095	£151,030,096
Tayside: treated	£186,743,339	£197,126,600	£207,509,861
Tayside: control	£115,238,508	£140,777,822	£166,317,135
Tayside: inconsequential and control	£58,298,669	£89,879,674	£121,460,635
Tayside: consequential and treated	£178,590,319	£194,495,896	£210,401,517

The WTP aggregation has shown that there is a great deal of difference between the present value benefits of the managed realignment scheme according to how one aggregates. Values range from £45,887 to £107,684 for Newburgh residents and between £56,242,833 and £135,999,612 when aggregated over the Fife population. This large range of values also stems from the variety of control measures from the estimation process, including the influence of taking the first quiz, varied information and consequentiality. Whilst some may view this large difference in values as a problem of the CV method, I believe that it instead highlights the importance of continuing to research these issues in CV surveys so that we can decide which control measures are important and reduce the sensitivity of the WTP estimate to these different aspects of the survey design.

From a policy perspective these estimates provide useful baselines when beginning the planning process which can then be adjusted based on the scales chosen by the policy maker. It is recognised that these values form one small part of the planning process, and whilst informative, the decision for the scheme to take place should not be based on the values presented in this research alone.

Future Research

This thesis has explored survey design issues within CV, as well as policy issues associated with flood risk management. It has shown that prior knowledge and information provision have little effect on valuations when the good is familiar, yet taking a quiz at the start of the survey to test for prior knowledge has a significant farming effect on WTP. Furthermore policy consequentiality has been shown to increase WTP although it appears there are potential problems with endogeneity regarding respondent attitudes towards the good in question. Following this work outlined below are some areas that could warrant further research.

Whilst no significant differences were found regarding prior knowledge and information provision, future work could look to repeat a similar study but for an unfamiliar good or a less emotive issue. Whilst respondent's prior knowledge of flood defence as identified by the quiz was low, flood defence is an emotive good with people's personal property at risk, and it would appear that personal motivations and attitudes feature much more strongly in WTP decision making than information provided by the researcher. It would be interesting to repeat the field experiment for a less emotive or unfamiliar good where learning affects may be much more pronounced. A further extension would be to consider the implications of prior knowledge and learning on respondents' certainty in their valuation estimate, by assessing how confident each respondent was of their stated WTP in a follow up question.

Further research is also needed into stated consequentiality, particularly if respondents will be "dropped" from the estimation process if they are seen as inconsequential. Current studies, this

thesis included have concentrated on policy consequentiality, yet Carson and Groves (2007) state that strong consequentiality includes both payment and policy consequentiality. Follow up questions asking both of these are needed within the survey and further analysis needed to test whether responses are consistent across respondents within the survey and across a variety of familiar and unfamiliar goods.

Conclusion

This thesis has explored willingness to pay for managed realignment as an alternative form of flood defence in Scotland. Key methodological issues in CV have been explored including familiarity, information provision and consequentiality and how these impact on the willingness to pay estimates. From a flood risk management perspective, results have highlighted that many individuals lack understanding and awareness of flooding in their area, something that needs to be addressed if the flooding episodes are set to increase as predicted. When investigating future flood risk options it is recognised that the values and findings from stated preference surveys form one small part of the decision making context, but are never the less useful when initially engaging with local stakeholders, and later on in the process considering the costs and benefits of the scheme.

Appendix 1: The Online Survey

PAGE 1: Welcome

The Scottish Coastal Survey

Welcome to the Scottish Coastal Defence Survey. This survey has been produced as part of a research project carried out and funded by the University of Stirling and the Marine Alliance for Science and Technology for Scotland (MASTS).

This survey investigates the future management of the Tay Estuary. If you live in the Fife, Dundee or Perth and Kinross local authority area we are interested in hearing from you.

What is the Tay Estuary Flood Defence Survey?

Researchers from the Economics Department at the University of Stirling are investigating the costs and benefits of a new type of flood defence which could be used to protect homes on the banks of the Tay Estuary from coastal flooding. As part of this project we are interested in the opinions of local residents regarding the new proposals. You may be aware that new flood defences involve a cost to households. It is therefore vital that future flood defence options are accepted by the general public. This survey gives you a chance to make your opinions heard. We would like to know what you personally would like to happen in your local area. Your thoughts will be shared with various Scottish Government departments and will be used to help inform the future plans for your local authority. You may feel that you do not live close enough to the Tay Estuary to warrant taking part, however we need responses from a wide ranging area and your thoughts are still valid.

Amazon Vouchers

As a thank you for completing the survey you will be receive a £10 Amazon Voucher. You are also being given the chance to voice your opinion about an important local issue and you may learn something new about your coastline.

About the Survey

Please ensure that you have read the information provided on the 'Privacy Information' page prior to starting the survey. All information you provide will remain anonymous and confidential. The data will be stored securely and used solely for the purpose of this research. If you wish to leave the survey at any point just close the webpage.

The survey will last approximately 20 minutes. On completion of the survey you will be asked to provide your address if you wish to receive the Amazon Voucher. Please note this will be stored separately from your survey responses.

PAGE 2

The Scottish Government and local authorities are preparing flood risk management plans for all Scottish coasts and rivers. There is a need to plan future flood defences in response to predicted increased rainfall and sea level rise. Both of these are due to our changing climate.

Certain areas of the Tay Estuary are expected to be more prone to flooding than others. This survey will focus on the town of Newburgh and the potential flood defences needed to protect the town from predicted sea level rise. New flood defences involve a cost to households. It is therefore vital that future flood defence options are accepted by the general public. We would like to know what you personally would like to happen in your local area, and your thoughts will be shared with various Scottish Government departments to help inform the future flood risk management plans.

The survey will start by asking you some questions about flooding and the Tay Estuary. These questions will help us understand what you already know, and help improve how the Scottish Government and local authorities share their information with you in future. We will then ask you to complete the survey itself. The survey should take no more than 20 minutes to answer and you will receive a £10 Amazon voucher for completing the survey.

PAGE 3: A Short Questionnaire for You

(Respondents in control group are not directed to this page) (Correct answer is underlined)

Please answer the following nine questions about flood defence and the Tay Estuary to the best of your knowledge. We would really like to find out how much people know about the Tay Estuary. This will make it easier for the Scottish Government and local authorities to let you know what is taking place in your area now and in the future.

1. In the Tay Estuary what percentage of homes are at risk from flooding?
    a. Less than 3%
    b. Between 3% and 5%
    c. Between 6% and 8%
    d. More than 9%
    e. I don't know
2. How much money is invested annually in river and coastal defence in Scotland?
    a. Between £10 million and £30 million
    b. Between £30 million and £50 million
    c. Between £50 million and £70 million
    d. Between £70 million and £90 million
    e. I don't know
3. Historically, the main type of coastal flood protection in Scotland has been:
    a. Beach replenishment and nourishment
    b. Planning regulations to limit development on flood plains
    c. Concrete sea walls and rock armouring
    d. Managed realignment
    e. I don't know

4. Managed realignment schemes have the potential to provide:
    a. A lower level of protection from flooding
    b. No protection from flooding
    c. A greater level of protection from flooding
    d. The same level of protection from flooding
    e. I don't know
5. Coastal wetlands are beneficial to fisherman because:
    a. Wetlands do not benefit fisherman
    b. Wetlands provide a food source for fish
    c. Wetlands provide spawning grounds for fish
    d. Wetlands act as a 'no take zone' thereby helping to preserve fish stocks
    e. I don't know
6. Coastal wetlands are beneficial to wildlife because:
    a. Wetlands do not benefit wildlife
    b. Wetlands are less polluted than other coastal habitats
    c. Wetlands provide a food source for wildlife
    d. Wetlands are less likely to be disturbed by humans
    e. I don't know
7. Managed realignment schemes involve the loss of land to the sea. The land most likely to be lost is:
    a. Agricultural land
    b. Residential land
    c. Disused brownfield land
    d. Seafront land
    e. I don't know

8. The Scottish Government has a legal duty to the European Union to protect coastal wetlands because:
    a. Wetlands are important recreational assets
    b. Wetlands are important fishing grounds
    c. Wetlands are important habitats for waterbirds
    d. Wetlands are important natural flood defences
    e. I don't know
9. Which of the following is one of the main causes of decline of shelduck (a waterbird) in the Tay Estuary?
    a. Commercial fishing
    b. Coastal erosion
    c. Port operations
    d. Oil spills
    e. I don't know

PAGE 4: Thank you for completing the questionnaire. On the following page you will find out more about flood defence in the Tay Estuary.

PAGE 5: Future Flood Defence

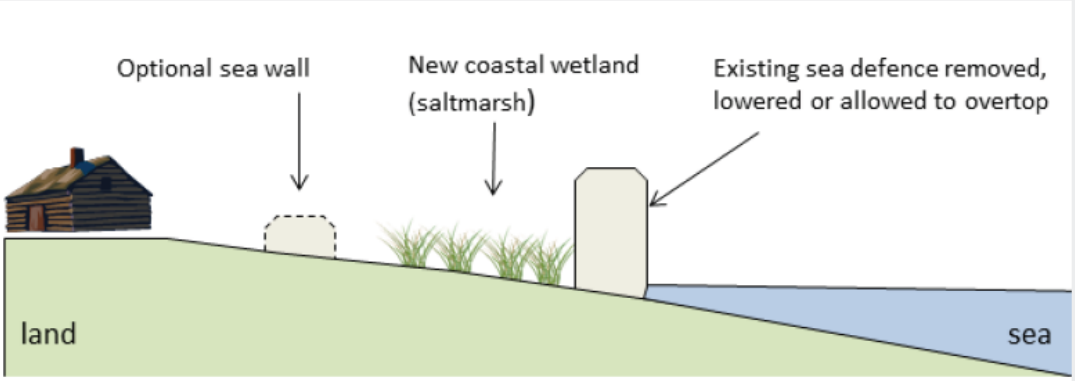
(Seen by all respondents)

Coastal flooding accounts for 29% of the overall flood risk in the Tay Estuary. Coastal flooding is caused by abnormally high spring tides and storm surges. The Scottish Government and local authorities are considering the future river and coastal defence options for the Tay Estuary as part of a commitment to deliver flood risk management plans by 2015. Managed realignment is one of the potential flood defence options for the Tay Estuary.

What is Managed Realignment?

Managed realignment is where part of the existing sea defence is removed and the area behind it is allowed to flood. This flooding creates coastal wetlands known as saltmarshes.

These coastal wetlands can protect the land against storm surges, coastal erosion and sea level rise. By allowing an area of land to flood constructed sea walls needed to protect residential areas and businesses can be shorter in height and thus constructed at a lower cost (see picture below).



An example of a managed realignment scheme

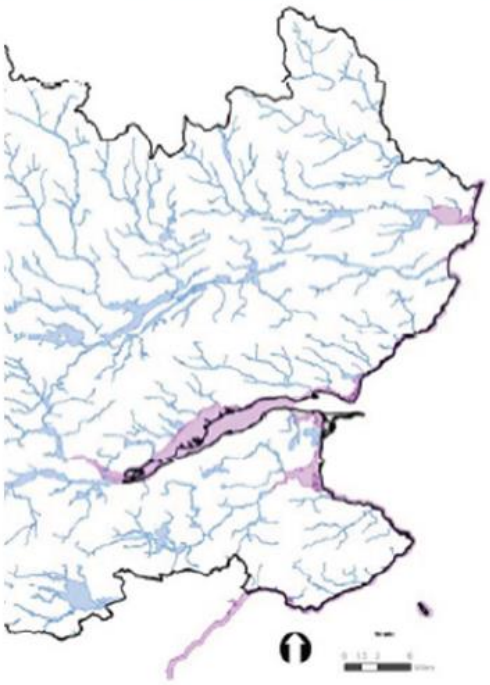
On the next page you will learn more about flood defence in Scotland and what managed realignment means for you.

PAGE 6: Some more information about managed realignment for you

(Screen captures of all 9 bullet point pieces of information, respondents were randomly allocated 3, 6 or 9 pieces)

Information 1:

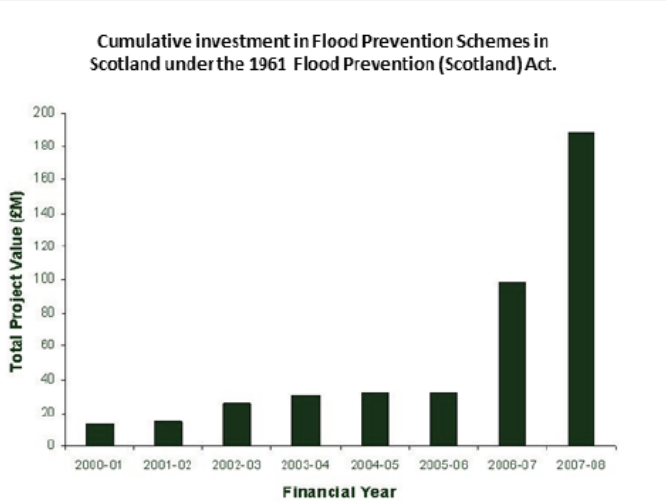
In the Tay Estuary and Montrose Basin approximately 4% of homes lie within a floodplain.



Flood risk in the Tay Estuary and Montrose Basin (Source: TAYplan Strategic Flood Risk Assessment, 2011)

Information 2:

Each year the Scottish Government makes £42 million available to support local authorities' flood prevention and coastal protection programmes.



(Source: http://www.eea.europa.eu/soer/countries/uk/freshwater-national-responses-united-kingdom)

Information 3:

ID 16

Historically, the main form of flood defence in Scotland has been hard engineered structures such as sea walls, rock armour and groynes.

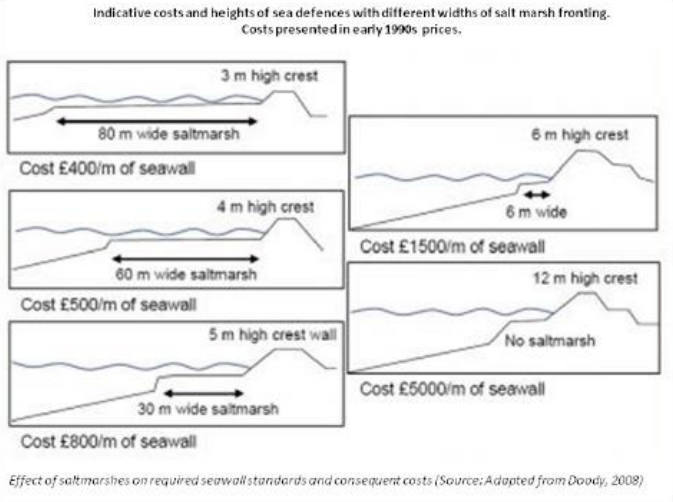
Groynes

Sea walls

Rock armour

Information 4:

Managed realignment schemes can deliver a greater level of protection against coastal flooding than traditional sea defences alone.



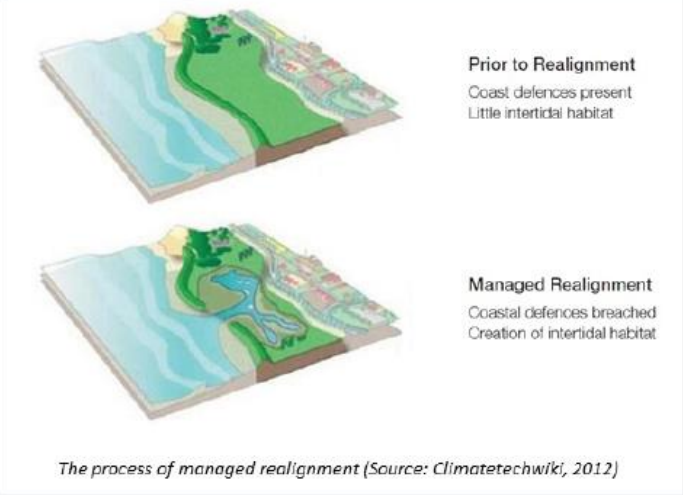
Effect of saltmarshes on required seawall standards and consequent costs (Source: Adapted from Doody, 2008)

Information 5:

Coastal wetlands increase the spawning ground available for fish due to the development of saltmarsh habitats.

Information 6:

Coastal wetlands create new saltmarshes and mudflats which provide food sources for a wide variety of wildlife.



The process of managed realignment (Source: Climatetechwiki, 2012)

Information 7:

Land needs to be made available to create a managed realignment site. This involves purchasing land at a fair market price, and it most cases this is agricultural land.

Flooded agricultural land at the Humber Estuary managed realignment scheme

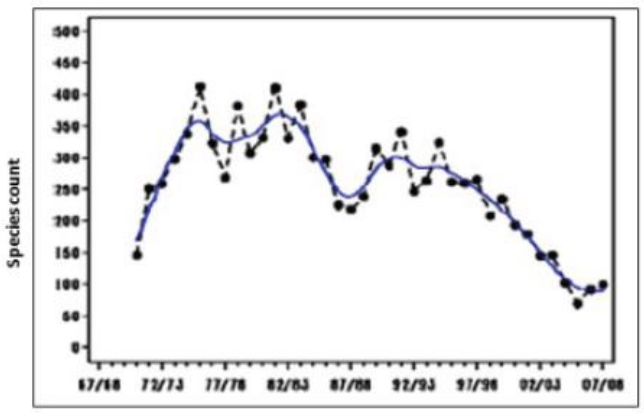
Information 8:

Under the European Habitats and Wild Birds Directive, the Scottish Executive has a legal duty to protect and enhance coastal wetlands in the Tay Estuary and Montrose Basin, as these wetlands are home to internationally important water bird populations.

European designated sites in the Tay Estuary (Source Scottish Natural Heritage 2012)

Information 9:

In the Tay and Eden estuaries, the shelduck population has declined in recent years due to the loss of its coastal habitat, as a result of coastal erosion.



Shelduck declines in the Tay and Eden estuaries. (Source Wetland Bird Survey WeBS, 2012)

PAGE 7: Future Flood Defences in the Tay Estuary

Newburgh Managed Realignment Scheme

Newburgh (a town on the south bank of the Tay Estuary) is at risk from coastal flooding due to predicted sea level rise:

- The local authority needs to look at future flood defence options.
- A managed realignment scheme is being proposed to protect homes and businesses in the town from flooding.
- It is predicted that the managed realignment scheme would increase flood protection for at least 100 homes in Newburgh (homes shown on the map below).
- Full flood defence benefits will be realised in 15-20 years and then last for at least 100 years.
- Your local authority is responsible for funding 20% of the scheme's cost. The extra income needed for the council to fund this would be raised by increasing your council tax.

Cost of the Managed Realignment Scheme

We would now like you to think about the value to you personally of developing this managed realignment scheme for Newburgh on the Tay Estuary:

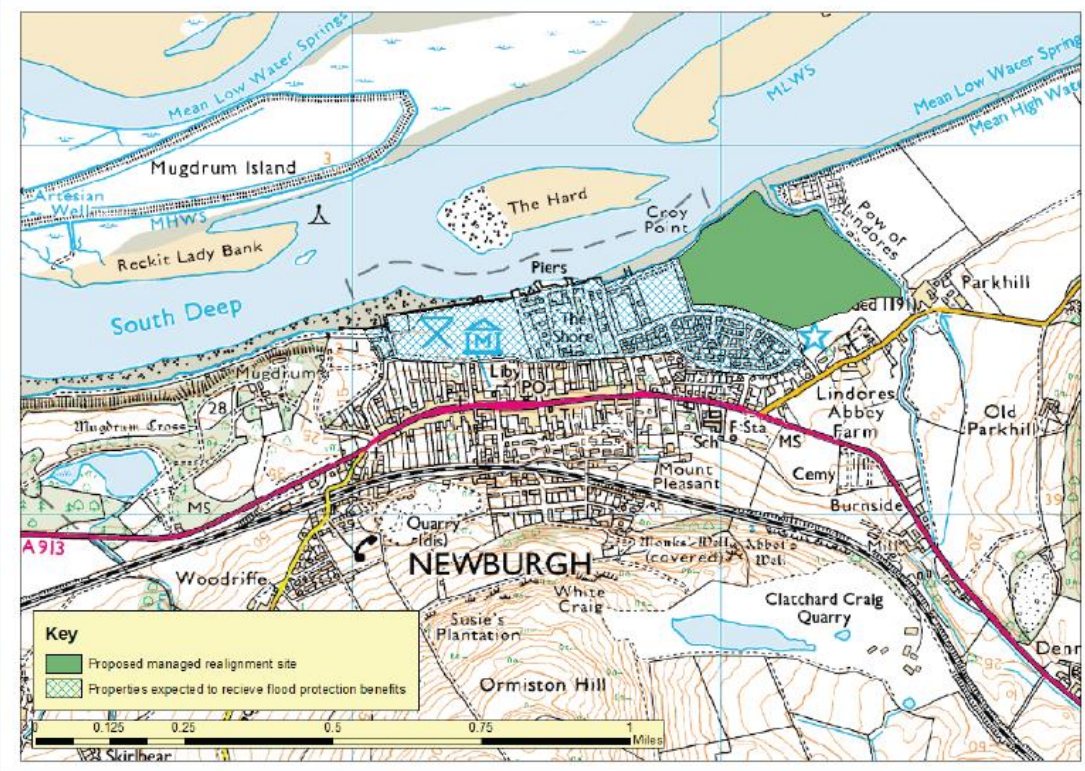
- On the next page you will be shown a table of prices that would be added to your council tax annually to cover the costs and maintenance of the scheme.
- You are asked to choose amongst a variety of price options as the precise costs of going ahead with the managed realignment scheme at present are unknown.
- The price you choose will be used to inform the local authorities and the Scottish Government when deciding future flood defence options in the Tay Estuary.
- Before you answer carefully consider the cost to you. Think about your household budget and what you would have to trade off to pay for the increase in council tax e.g. what you

like to buy or a reduction in your planned savings. The average household council tax bill in Scotland is £984 per year.

What happens if there is no Managed Realignment Scheme?

- If the managed realignment scheme does not take place the existing flood defences (sea walls) will continue to be maintained by the local authorities at no additional cost on your council tax bill.
- However there will be no additional flood protection and additional benefits of managed realignment will not be realised.

Remember that your preferences will be used in conjunction with costs of the scheme, when they are known, by local authorities and the Scottish Government to inform which flood defence policy is chosen.



Proposed managed realignment scheme at Newburgh in the Tay Estuary

PAGE 8: Willingness to Pay for Newburgh Managed Realignment Scheme

Newburgh Managed Realignment Scheme

Please select either yes or no to each of the prices presented in the table that your household would definitely be willing to pay in additional council tax each year to fund the development of a managed realignment scheme at Newburgh on the Tay Estuary. *

	Yes	No
£0 *	○	○
£5 *	○	○
£10 *	○	○
£15 *	○	○
£20 *	○	○
£30 *	○	○
£40 *	○	○
£50 *	○	○
£60 *	○	○
£70 *	○	○
£80 *	○	○
£90 *	○	○
£100 *	○	○
£110 *	○	○
£120 *	○	○
£130 *	○	○
£140 *	○	○
£150 *	○	○
I am prepared to be in excess of £150 *	○	○

PAGE 9: Reasons for not contributing towards the scheme (only shown to those note willing to pay)

You chose not to contribute towards the managed realignment scheme, what was the main reason for this?

- I would like to pay towards the scheme but I cannot afford to
- I do not believe that managed realignment is an effective flood defence
- I do not believe we need to invest in flood defences
- It is the sole responsibility of the Scottish Government to invest in flood defence
- I would prefer to spend my income on other things
- Other (please explain)

PAGE 10: A Short Questionnaire for You (Round 2)

(All respondents take second quiz)

We will now ask you another round of questions to make sure that policy makers and officials do a good job of informing the public about these issues in future and thereby make better policy decisions.

1. In the Tay Estuary what percentage of homes are at risk from flooding?
    a. Less than 3%
    b. Between 3% and 5%
    c. Between 6% and 8%
    d. More than 9%
    e. I don't know
2. How much money is invested annually in river and coastal defence in Scotland?
    a. Between £10 million and £30 million
    b. Between £30 million and £50 million
    c. Between £50 million and £70 million
    d. Between £70 million and £90 million

e. I don't know

3. Historically, the main type of coastal flood protection in Scotland has been:
    a. Beach replenishment and nourishment
    b. Planning regulations to limit development on flood plains
    c. Concrete sea walls and rock armouring
    d. Managed realignment
    e. I don't know
4. Managed realignment schemes have the potential to provide:
    a. A lower level of protection from flooding
    b. No protection from flooding
    c. A greater level of protection from flooding
    d. The same level of protection from flooding
    e. I don't know
5. Coastal wetlands are beneficial to fisherman because:
    a. Wetlands do not benefit fisherman
    b. Wetlands provide a food source for fish
    c. Wetlands provide spawning grounds for fish
    d. Wetlands act as a 'no take zone' thereby helping to preserve fish stocks
    e. I don't know
6. Coastal wetlands are beneficial to wildlife because:
    a. Wetlands do not benefit wildlife
    b. Wetlands are less polluted than other coastal habitats
    c. Wetlands provide a food source for wildlife
    d. Wetlands are less likely to be disturbed by humans
    e. I don't know

7. Managed realignment schemes involve the loss of land to the sea. The land most likely to be lost is:
    a. Agricultural land
    b. Residential land
    c. Disused brownfield land
    d. Seafront land
    e. I don't know
8. The Scottish Government has a legal duty to the European Union to protect coastal wetlands because:
    a. Wetlands are important recreational assets
    b. Wetlands are important fishing grounds
    c. Wetlands are important habitats for waterbirds
    d. Wetlands are important natural flood defences
    e. I don't know
9. Which of the following is one of the main causes of decline of shelduck (a waterbird) in the Tay Estuary?
    a. Commercial fishing
    b. Coastal erosion
    c. Port operations
    d. Oil spills
    e. I don't know

PAGE 11: Information statement questions

Thinking of your monetary contribution towards the proposed managed realignment scheme, do you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Neither agree not disagree	Agree	Strongly Agree
The information provided to me confirmed what I already know about flood defence.	☐	☐	☐	☐	☐
The information provided to me affected my monetary contribution in retrospect.	☐	☐	☐	☐	☐
It was too complicated for me to think about the information provided to me.	☐	☐	☐	☐	☐

PAGE 12: Recreational Activities at the Newburgh Managed realignment Scheme

The Newburgh managed realignment scheme will provide a wide variety of outdoor activities for local people and visitors. The wetland habitat created as part of the scheme will provide an ideal area for walking, dog walking, fishing and bird watching.

Recreational activities available at the Tay Estuary managed realignment site

How often do you think you would visit the Tay Estuary managed realignment site to carry out the following activities?

	More than once a week	Weekly	More than once a month	Monthly	Less often	Never
Walking	☐	☐	☐	☐	☐	☐
Dog walking	☐	☐	☐	☐	☐	☐
Recreational fishing	☐	☐	☐	☐	☐	☐
Bird watching	☐	☐	☐	☐	☐	☐

PAGE 13: Final Questions

Please indicate whether you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neither agree not disagree	Agree	Strongly Agree
My property is at risk from flooding	☐	☐	☐	☐	☐
Flood risk in the area is increasing	☐	☐	☐	☐	☐
I am worried that the current flood defences are not adequate enough to protect my home	☐	☐	☐	☐	☐
It is the councils responsibility to fund flood defence not mine	☐	☐	☐	☐	☐

Is your property insured for flood damage?

- Yes
- No

When was the last time your home was flooded?

- Within the last three months
- Within the last six months
- Within the last year
- Within the last five years
- Over five years ago
- Never

Do you know anyone who has been flooded in the last... (please tick all that apply)

- Within the last three months
- Within the last six months
- Within the last year
- Within the last five years
- Over five years ago
- Never

Are you a member of... (please tick all that apply)

- The Scottish Wildlife Trust
- The Royal Society for the Protection of Birds (RSPB)
- The National Trust for Scotland

PAGE 14: Socio - Demographic Questions

Why is this information necessary?

These questions serve two vital purposes:

- The answers are used to ensure that all the respondents, taken together, provide a representative sample of the Scottish population or allow any sample bias to be taken into account.
- A major part of the survey is the cost involved in funding a managed realignment scheme. Household income is likely to affect a respondent's willingness to pay for a managed realignment scheme.

Any information provided by respondents will be:

- Stored securely.
- Used solely for the purpose of this research into people's preferences for managed realignment schemes.
- Subject to strict confidentiality.

Are you?

- Male
- Female

How old are you?

- 18 or 19
- 20 - 24
- 25 - 29
- 30 - 39
- 40 - 49
- 50 - 59
- 60 - 64
- 65 - 69
- 70 or older

What is your highest level of education?

- Secondary school
- Sixth form or college
- University (undergraduate)
- University (postgraduate)

Are you currently?

- Working full time
- Working part time
- Studying
- Unemployed
- Retired

What is your postcode?

What is your status at this property?

- I own the property
- I rent the property privately or through a lettings agency
- I live in the property rent free
- I rent the property from a council authority

My household (all household residents) income in the past year, before taxes, is approximately: (this information will be used solely for the purposes of this research, will be stored securely and remain strictly confidential)

- Less than £15,000
- £15,000 - £19,999
- £20,000 - £29,999
- £30,000 - £39,999
- £40,000 - £49,999
- £50,000 - £69,999
- £70,000 - £99,999
- £100,000 - £149,999
- £150,000 or above

How confident are you that the results of this survey will be used by policy makers in deciding future flood risk management in the Tay Estuary?

- Very Unconfident
- Unconfident
- Neither unconfident or confident
- Confident
- Very confident

Thank You for Taking Part

Example letter:

UNIVERSITY OF STIRLING

The Scottish Coastal Survey

www.stir.ac.uk/coastalsurvey

Dear resident,

Local people living near the Tay Estuary are being encouraged to get involved in shaping the future of their coastline. An online survey has been launched by researchers at the University of Stirling to find out more about what people know about their local coastline and their preferences for future flood defences. We would like you to take part in this survey. As a thank you, the first 500 people who complete the survey will receive a £10 Amazon voucher. Everyone who completes the survey will also be entered into a prize draw to win £100 worth of Amazon vouchers.

What is the Scottish Coastal Defence Survey?

Researchers from the Economics Department at the University of Stirling are investigating the costs and benefits of a new type of flood defence which could be used to protect homes on the banks of the Tay Estuary from coastal flooding. As part of this project we are interested in the opinions of local residents regarding the new proposals. You may be aware that new flood defences involve a cost to households so it is vital that future flood defence options are accepted by the general public. We would like to know what you personally would like to happen in your local area and your thoughts will be shared with various Scottish Government departments. You may feel that you do not live close enough to the Tay Estuary to warrant taking part; however, we need responses from a wide ranging area so your views are very important to us.

This survey has been produced as part of a research project carried out and funded by the University of Stirling and the Marine Alliance for Science and Technology for Scotland (MASTS).

How do I complete the survey?

- The survey should be filled in online at www.stir.ac.uk/coastalsurvey and should take no more than 20 minutes to complete.
- We would appreciate your response by Saturday 16th November 2013.
- Your response will be kept confidential and used only for the purposes of this research project.

- To find out more about the survey and to complete it please visit the website www.stir.ac.uk/coastalsurvey

If you have any questions please feel free to contact Katherine Simpson:

Email: k.h.simpson@stir.ac.uk

Economics Division, University of Stirling, Stirling, FK9 4LA

Appendix 2: Survey Variables

This Appendix explains in more detail the definition and construction of the key variables from the CV survey as used in this dissertation.

Actual variables

Table A1: Description of actual survey variables

	RESPONSID	Unique respondent ID
	ROUND	Survey round (1-4)
	CONTROL	Whether the respondent was treated (1) or not (0)
Information variables	Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18 Q19	Quiz Round 1:Responses for questions 1-9: incorrect (0) correct (2) don't know (1)
	TIMERQUIZ1	Timer quiz one (seconds)
	Q21, Q22, Q23, Q24, Q25, Q26, Q27, Q28, Q29	Quiz Round 2:Responses for questions 1-9: incorrect (0) correct (2) don't know (1)
	TIMERQUIZ2	Timer quiz two (seconds)
	INFOTIMER	Information timer (seconds)
	Q1SCORE	Quiz one score
	Q2SCORE	Quiz two score
	TREATPAIR	Type-treatment pair: control (0) LL(1) LM (2) LH (3) MM (4) MH(5) HH (6)
	INFO	Number of information bullets received (3, 6 or 9)
	APRIORI	Prior knowledge type based on first quiz score: control (0) low (1) medium (2) high (3)
	EXGROUP	Final knowledge type based on second quiz score: control (0) low (1) medium (2) high (3)
	LEARNING	How much the respondent "learned" (Quiz score two - quiz score one)
	BU1	Whether the respondent saw bullet point one (1) or not (0)
	BU2	Whether the respondent saw bullet point two (1) or not (0)
	BU3	Whether the respondent saw bullet point three (1) or not (0)
	BU4	Whether the respondent saw bullet point four (1) or not (0)
	BU5	Whether the respondent saw bullet point five (1) or not (0)
	BU6	Whether the respondent saw bullet point six (1) or not (0)
	BU7	Whether the respondent saw bullet point seven (1) or not (0)
	BU8	Whether the respondent saw bullet point eight (1) or not (0)
	BU9	Whether the respondent saw bullet point nine (1) or not (0)
	CONFIRMED	The information confirmed what I already know: strongly disagree (1), disagree (2), neither agree not disagree (3), agree (4), strongly agree (5)
	AFFECTED	The affected my WTP in retrospect: strongly disagree (1), disagree (2), neither agree not disagree (3), agree (4), strongly agree (5)

	COMPLICATED	The information was too complicated for me to think about: strongly disagree (1), disagree (2), neither agree not disagree (3), agree (4), strongly agree (5)
WTP variables	MAXWTP	Maximum stated willingness to pay
	NOWTP	Reason for not willing to pay: do not believe in managed realignment (1), do not believe in investing in flood defences (2), cannot afford to contribute more (3), rather spend my income elsewhere (4), Scottish government's responsibility (5), other (6)
	WTPTIMER	Time spent on WTP page (seconds)
Recreational activities	WALKING DOG FISH BIRD	How often would you undertake recreational activities at the managed realignment site: more than once per week (1), weekly (2), more than once per month (3), monthly (4) , less often (5), never (6)
	PROPERTYFLOODRISK	My property is at risk from flooding: strongly disagree (1), disagree (2), neither agree not disagree (3), agree (4), strongly agree (5)
Flood risk attitudes	FLOODINC	The flood risk is increasing: strongly disagree (1), disagree (2), neither agree not disagree (3), agree (4), strongly agree (5)
	WORRIED	I am worried the current defences are not adequate enough to protect my home: strongly disagree (1), disagree (2), neither agree not disagree (3), agree (4), strongly agree (5)
	COUNCIL	It is the councils responsibility to fund flood defence not mine: strongly disagree (1), disagree (2), neither agree not disagree (3), agree (4), strongly agree (5)
	INSURANCE	Insurance: yes(1) or no (0)
	HOMEFLOOD	My home has flooded within the last: last six months (1), last 12 months (2), last 5 years (3), over 5 years ago (4), never (5)
	KNOWFLOOD	I know someone who has been flooded within the last: last six months (1), last 12 months (2), last 5 years (3), over 5 years ago (4), never (5)
Socio-demographic variables	ENVGROUP	Member of an environmental group: yes (1) or no (0)
	GENDER	Gender: make (1) or female (0)
	AGE	Age group: 29 (18-29), 39 (30-39), 49 (40-49), 59 (50 - 59), 64 (60-64), 70 (65 and over)
	EDUCATION	secondary school (1), college (2), undergraduate degree (3), postgraduate degree (4)
	WORK	Employment status: employed (full or part time) (1) not employed (0)
	PROPERTY	Property owner (1) or not (0)
	INCOME	Household income 15000 (less than 15000) 20,000 (15-19k) 39,000 (20-39k) 69,000 (40-69k) 85,000 (70-99k) 100,000 (over 100K)
	POSTOCDE	Respondents Postcode
	CONFIDENCE	How confident are you this survey will be used by policy makers? very unconfident (1), unconfident (2), neither confident or unconfident (3), confident (4), very confident (5)
	SURVEYTIMER	Time spent on survey (seconds)

Derived variables

Table A2: Description of derived survey variables

MINUTESGOOGLE	Minutes drive the respondent lives from the site. Derived using postcode and Google maps
DISTANCEDRIVEGOOGLEMAPS	Distance drive (miles) the respondent lives from the site. Derived using postcode and Google maps
LOCALAUTHORITY	Respondents local authority derived from their postcode
RESIDENCE	Respondents town derived from their postcode
NEWBURGH	Whether the respondent lives in Newburgh (1) or not (0). Derived from postcode.
DISTANCE_BANDS	Distance the respondent lives from the site derived from postcode: at site (0),less than 10 miles (1),10-20 miles (3), over 20 miles (4)
BINARYWTP	Whether the respondent is willing to pay (1) or not (0). 0 for respondents who stated their WTP as 0 and 1 for respondents with a maximum stated WTP or £5 or more
UBWTP	Upper bound WTP for interval regression analysis. The next highest bound above the respondents maximum stated WTP
FLOOD	Whether the respondent lives on a flood plain (1) or not (0). Derived by comparing respondents postcode with at risk postcodes identified in ArcGIS
BINARY_HOMEFLOOD	Whether a respondent knows someone who has been flooded (1) or not (0). Derived from response to "my home has been flooded within…"
BINARY_KNOWFLOOD	Whether a respondent has been flooded (1) or not (0). Derived from response to "I know someone who has been flooded within…"
BINARY_CONFIDENCE	Whether a respondent is confident (1) or unconfident (0) that the results of the survey will be used by policy makers. Derived from responses to "How confident are you this survey will be used by policy makers?" 0 = very unconfident, unconfident and neither confident nor unconfident 1= confident and very confident.
BINARY_CONFIRMED	Whether the information confirmed what the respondent knew: yes (1) or no (0). Derived from response to "The information confirmed what I already know": 0 = strongly disagree, disagree and neither agree not disagree. 1 = agree or strongly agree
BINARY_AFFECTED	Whether the information affected the respondents WTP in retrospect: yes (1) or no (0). Derived from response to "The information affected my WTP in retrospect": 0 = strongly disagree, disagree and neither agree not disagree. 1 = agree or strongly agree
BINARY_COMPLICATED	Whether the information was too complicated for the respondent to think about: yes (1) or no (0). Derived from response to "The information was too complicated for me to think about": 0 = strongly disagree, disagree and neither agree not disagree. 1 = agree or strongly agree.
BINARY_FLOODRISK	Whether the respondent believes they are at risk from flooding or not: yes (1) or no (0). Derived from question "my property is at risk from flooding":0 = strongly disagree, disagree and neither agree not disagree. 1 = agree or strongly agree.
BINARY_WORRIED	Whether the respondent is worried about the current flood defences: yes (1) or no (0). Derived from question "I am worried that the current defences are not adequate enough to protect my home":0 = strongly disagree, disagree and neither agree not disagree. 1 = agree or strongly agree.
BINARY_INCREASE_RISK	Whether the respondent believes the flood risk is increasing: yes (1) or no (0). Derived from question "The flood risk is increasing":0 =

	strongly disagree, disagree and neither agree not disagree. 1 = agree or strongly agree.
BINARY_COUNCIL	Whether the respondent believes the council is responsible for funding flood defence: yes (1) or no (0). Derived from question "It is the council's responsibility to fund flood defence not mine":0 = strongly disagree, disagree and neither agree not disagree. 1 = agree or strongly agree.
CONSEQUENTIALITY	Whether the respondent believes the survey is consequential: confident (2), unsure (1) unconfident (0). Derived from question "I am confident the results of this survey will be shared with policy makers":0 = very unconfident, unconfident. 1 = confident, very confident.

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