The Marine Environment, Human Well-being and Environmental Valuation: a case study from Plymouth, UK.

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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signature:

Abstract

There has been increasing acknowledgement that environmental change is inextricably linked to changes in well-being. Despite this there is no consensus on the definition of well-being or valuation method(s) upon which to base policy evaluations for well-being. The thesis examines this issue by comparing and contrasting two approaches to measuring well-being benefits from marine and coastal environments: (1) the preference-based approach and (2) the experiential approach, with reference to two exemplar methods for valuing non-market marine and coastal goods within each paradigm: the Contingent Valuation Method (CVM) and the Life Satisfaction Approach (LSA). The thesis begins with a comprehensive review of the two methods, identifying areas of criticism and contrasting their respective strengths and weaknesses. This is followed by an empirical comparison of the two methods. This comparison was made possible by a local coastal regeneration project that occurred during the course of the PhD project (Teat's Hill, Plymouth, UK) and enabled an evaluation before and after the environmental intervention. A repeat cross-sectional survey was used to place a monetary value on the provision of the coastal regeneration using the two methods. The CVM was used to value the intervention before implementation. The LSA examined well-being before and after the implementation to value the effect of the regeneration on life satisfaction. Results of the CVM suggest that respondents would be willing to pay a monetary value of £7.97 (as a one-off payment) for the regeneration project. Results of the LSA suggested that life satisfaction was on average 3.89% higher for people interviewed after the regeneration, compared to people interviewed before the regeneration, after adjusting for relevant visit and individual level controls. The analysis also explored the potential of estimating a

monetary value using the LSA, to enable a direct comparison with the estimate from the CVM. The analysis indicated that £1,925.45 is the amount of money that an average household would be willing to give up for the provision of the coastal regeneration given that utility stays constant. The research in this thesis presents a number of new findings which have important implications for the valuation of coastal interventions and the use of well-being research in environmental policy, planning and decision-making.

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Author's declaration

All chapters presented in this thesis were written by Rebecca J. Shellock, under the supervision of Caroline Hattam, Mathew P. White and Tobias Börger. In addition, there have been a number of collaborators which have contributed to the empirical research presented in this thesis. This information is detailed below.

Chapters 5-7:

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Data collection (including piloting and fieldwork) was funded by the BlueHealth project (Horizon 2020) and NERC GW4+ DTP. The survey approach and questionnaire was designed by RJS, TB, CH, LRE and MPW. LRE, MPW and RJS applied for ethical approval for the research and the data collection was undertaken by a market research company (Marketing Means). JKG undertook GIS spatial analysis for the proximity to Teat's Hill data. OCU provided guidance on multiple imputation. RJS conducted all of the statistical analysis and was lead author on this work. TB, CH and MPW provided guidance on data analysis and provided feedback on the chapters.

Glossary of terms and abbreviations

Term or abbreviation	Definition
BHPS	British Household Panel Survey
CBA	Cost Benefit Analysis
CES	Cultural Ecosystem Services
CM	Choice Modelling
$\boldsymbol{CV}$	Compensating Variation
CVM	Contingent Valuation Method
DC	Dichotomous Choice
DCE	Discrete Choice Experiments
Ecosystem Services (ES)	The benefits that people obtain from ecosystems.
$\boldsymbol{EV}$	Equivalent Variation
HPM	Hedonic Pricing Method
Hypothetical bias	The difference between what a respondent indicates they would pay in the survey and what the respondent would actually pay.
Incentive compatibility	CVM elicitation formats have incentive compatibility if they provide respondents with the incentive to truthfully reveal any private information asked for by the mechanism and provide conditions for truthful preference revelation to be the dominant strategy (Carson *et al.*, 2014; Carson and Groves, 2007).
Instant utility	The pleasure or distress of the moment (the hedonic and affective experience), which can be derived from immediate reports of current experience or from physiological indices (Kahneman *et al.*, 1997).
LS	Life Satisfaction
LSA	Life Satisfaction Approach
LSOA	Lower-layer super output area

Marginal change	A proportionally very small change (positive or negative) to the total quality of a variable (Sivagnanam and Srinivasan, 2010).
Marginal utility	The change in utility that an individual obtains from consuming an additional unit of a good or service (Hall and Lieberman, 2012).
MENE	Monitor of Engagement with the National Environment survey
MI	Multiple Imputation
MICE	Multiple Imputation by Chained Equations
MPA	Marine Protected Area
Natural Capital	Those elements of the natural environment which provide valuable goods and services to people (Natural Capital Committee, 2017).
Non-marginal change	A discrete change (positive or negative) to the total quality or quantity of a variable.
OE	Open Ended
PC	Payment Card
Protesting	The process of individuals providing responses to questions that are not reflective of their genuine WTP, WTA or refusing to answer the question at all. Respondents may protest as a result of the survey instrument, the payment vehicle or the funder or institution implementing the project or survey.
Remembered utility	A measure of past temporally extended outcomes (TEOs), which is inferred from a subject's retrospective reports of the total pleasure or displeasure associated with past outcomes or episodes (Kahneman *et al.*, 1997).
RP	Revealed Preference
SBDC	Single Bounded Dichotomous Choice
SP	Stated Preference
SWB	Subjective Well-being

TCM	Travel Cost Method
Utility	A term which is synonymous with well-being (Bateman *et al.*, 2002). It is viewed as something that indexes the preferences of individuals and explains how they make decisions and choices.
Welfare	A term from the economics discipline which is synonymous with well-being as applied to the collective utility (well-being) of society.
Welfare economics (welfare theory)	A branch of economics that relates supply and demand to an individual's rationality and his or her ability to maximise utility.
WTA	Willingness to Accept
WTP	Willingness to Pay

1. Introduction

1.1. Problem statement

Marine and coastal environments, the subject of this PhD project, are a type of 'blue space' (Grellier *et al.*, 2017; Völker and Kistemann, 2011). Over one third of the world's population live around the coast (Neumann *et al.*, 2015) and such environments provide multiple benefits to people through the provision of resources, the regulation of the planet and their contribution to cultural and aesthetic uses (UK National Ecosystem Assessment, 2014a; UNEP, 2006; Worm *et al.*, 2006). For example, the marine and coastal environment is an important recreational resource worldwide (Paracchini *et al.*, 2014). In England, it is estimated that 271 million recreational visits are made to coastal environments annually (Elliott *et al.*, 2018). However, these environments are facing significant anthropogenic pressure and their global status is of concern (Costanza *et al.*, 1997, 2014; European Environment Agency, 2015). The need to understand the benefits of marine and coastal environments has never been more pressing (Börger *et al.*, 2014).

1.1.1. Environmental valuation

Environmental valuation has become a recognised tool for assigning monetary values to environmental changes and is an umbrella term for a variety of techniques (Atkinson *et al.*, 2018). It is increasingly used to address the fact that much of the economic value of marine and coastal goods and services lies outside of markets (i.e. non-market goods; Pendleton *et al.,* 2007). This commonly means that these goods and services are all-too-often ignored or downplayed in policy appraisals, cost benefit analyses of environmental projects (CBA; Fujiwara and Campbell, 2011; Brown, 2015) or in planning processes

(e.g. marine planning; Börger *et al.*, 2014). Undervaluation of these benefits has a number of implications for the protection of marine and coastal environments. First, policies and interventions intended to protect and enhance the benefits of such environments may be based on untested assumptions and sparse information (Pendleton *et al.,* 2007; Carpenter *et al.*, 2009; Milner-Gulland *et al.*, 2014). Second, if these benefits are not being valued, or are being undervalued, this may distort resource allocation away from marine and coastal environments (e.g. for cultural and aesthetic values), towards areas or activities which return an observable market value (Ambrey and Fleming, 2012). Monetary estimates from non-market valuations may therefore help to aid policy and decision-making by highlighting the hidden benefits of marine and coastal environments.

Two main approaches to monetary valuation for non-market goods and services have been developed: revealed preference (RP) and stated preference (SP) methods (Atkinson and Mourato, 2008). These approaches are known as preference-based methods and used to place a monetary value on the utilities that human society derives from the direct or indirect use of goods and services (Spash, 2000; Turner, 1999). RP methods rely on actual market data and human behaviour to reveal peoples' environmental preferences (Bockstael and Freeman, 2005; Markandya, 2002). They include the Travel Cost Method (TCM) and the Hedonic Pricing Method (HPM). SP methods are survey-based methods that use constructed or hypothetical markets to elicit preferences for a specific environmental change (Mitchell and Carson, 1989; Haab and McConnell, 2002; Hanley *et al.*, 2007). Methods include the Contingent Valuation Method (CVM) and Choice Modelling (CM).

The practice of putting a value on environmental goods and services is not without criticism. There are acknowledged debates surrounding the monetisation of environments (Spangenberg and Settele, 2010) and the utilitarian (anthropocentric) perspective of environmental valuation (Spash, 2000). It has been argued that nature has non-anthropocentric intrinsic value and species possess moral interests or rights, therefore, environmental valuation is only a partial approach (Turner, 1999). Others argue that the incorporation of environmental valuation into CBA may encourage the adoption of a 'weak sustainability approach', which assumes that manufactured capital can replace natural capital (Ang and Van Passel, 2012). There are also concerns over the accuracy of valuations. Marine and coastal environments are complex and non-linear in nature and their valuation can be difficult to undertake (Pascual *et al.*, 2010). Hence, estimates from valuation studies may not always be able to satisfy the end-users demand for accuracy and precision in CBA (Hanley *et al.*, 2015).

Finally, there has been criticism of preference-based approaches to valuation, and in particular the Contingent Valuation Method (CVM; Carson, 2012; Hausman, 2012; Kling *et al.,* 2012; Haab *et al.*, 2013). It has been contended that environmental goods have relevance to human well-being far beyond the satisfaction of preferences (Wegner and Pascual, 2011) and that people cannot place meaningful value on a change until they have experienced it (Nicholson *et al.*, 2009). It has therefore been suggested that an experiential approach could provide an alternative to preference-based environmental valuation methods (Kahneman *et al.,* 1997; Kahneman and Sugden, 2005; Dolan and Peasgood, 2008; Frey *et al.*, 2010; Fujiwara *et al.*, 2014; Fujiwara and Dolan, 2016). An example of an experiential method is the Life Satisfaction Approach (LSA; also

named the ‘Experience Preference Method’ or ‘SWB valuation approach’; Fleming and Ambrey, 2017; Frey *et al*., 2010; Welsch and Ferreira, 2014). The LSA places a monetary value on the well-being gained from people’s consumption of a good (i.e. their experiences).

1.1.2. Well-being and environmental valuation

The emergence of the LSA and the field of happiness economics has led to growing interest into how these valuation techniques relate to or connect with the concept of ‘well-being’. This interest has also arisen from the recognition that well-being is a more suitable measure of social progress than narrow socio-economic indicators such as gross national product (GDP) and income (Billé *et al.,* 2012; Schleicher *et al.,* 2017; Woodhouse *et al.,* 2015) and that environmental change is inextricably linked to changes in well-being (Milner-Gulland *et al.*, 2014).

The importance of well-being has also been highlighted through different ecosystem service (ES) frameworks (Costanza *et al.*, 1997; Millennium Ecosystem Assessment, 2005; TEEB, 2010; UK National Ecosystem Assessment, 2011). The ES concept was developed to emphasise the instrumental value of natural environments in attempt to further their protection and integration into policies and plans (Kok *et al.*, 2010; Persson *et al.*, 2018). The linkages between the environment and human well-being is a core focus of the conceptualisation of ES (Abunge *et al.*, 2013). Despite this conceptualisation and years of research, the complex links between ES and well-being remain poorly understood (Butler and Oluoch-Kosura, 2006; Carpenter *et al.*, 2009) and there remains a lack of understanding of what well-

being is (Agarwala *et al.*, 2014; Daw *et al.*, 2011) and how it can be operationalised (McKinley *et al.,* 2019*)*.

1.1.3. Measuring well-being

Well-being is a widely used term with numerous interpretations and no universally accepted definition (Butler and Oluoch-Kosura, 2006; McGillivray, 2006; King *et al.,* 2014). Interpretations of well-being vary significantly among discipline (e.g. economics, psychology, philosophy and environmental science; Nicholson *et al.*, 2009), which can generate confusion (Naeem *et al.*, 2016). It also presents challenges for developing a cohesive framework for assessing well-being, which meets the demands of marine and coastal policy, management and science (Breslow *et al.*, 2016; Fish, 2011; Satterfield *et al.*, 2013).

There are three archetypal accounts of well-being (Parfit, 1984): mental-state accounts (experiential approach), desire-fulfilment accounts (preference-based approach) and objective-list accounts (Dolan and White, 2007). It has been suggested that the implications of environmental changes for well-being may be quite different, depending on the account selected (Fleming and Ambrey, 2017). There is, however, no consensus on the most appropriate paradigm for well-being when it comes to the assessment of benefits provided by the natural environment and therefore the type of method(s) upon which to base policy evaluations for well-being.

This thesis compares and contrasts two environmental valuation methods that can be used to assess the value resulting from a change in the provision of marine and coastal goods: (i) the Contingent Valuation Method (CVM) and (ii) the Life Satisfaction Approach (LSA). These methods correspond with different

paradigms of well-being, illustrated by the stage they represent in the Dynamic Well-being Model (DWB). The DWB framework integrates the various economic, psychological and social measures of well-being in a way that provides greater clarity to policy-makers about what exactly it is they may want to measure (Figure 1.1; Dolan and White, 2006).

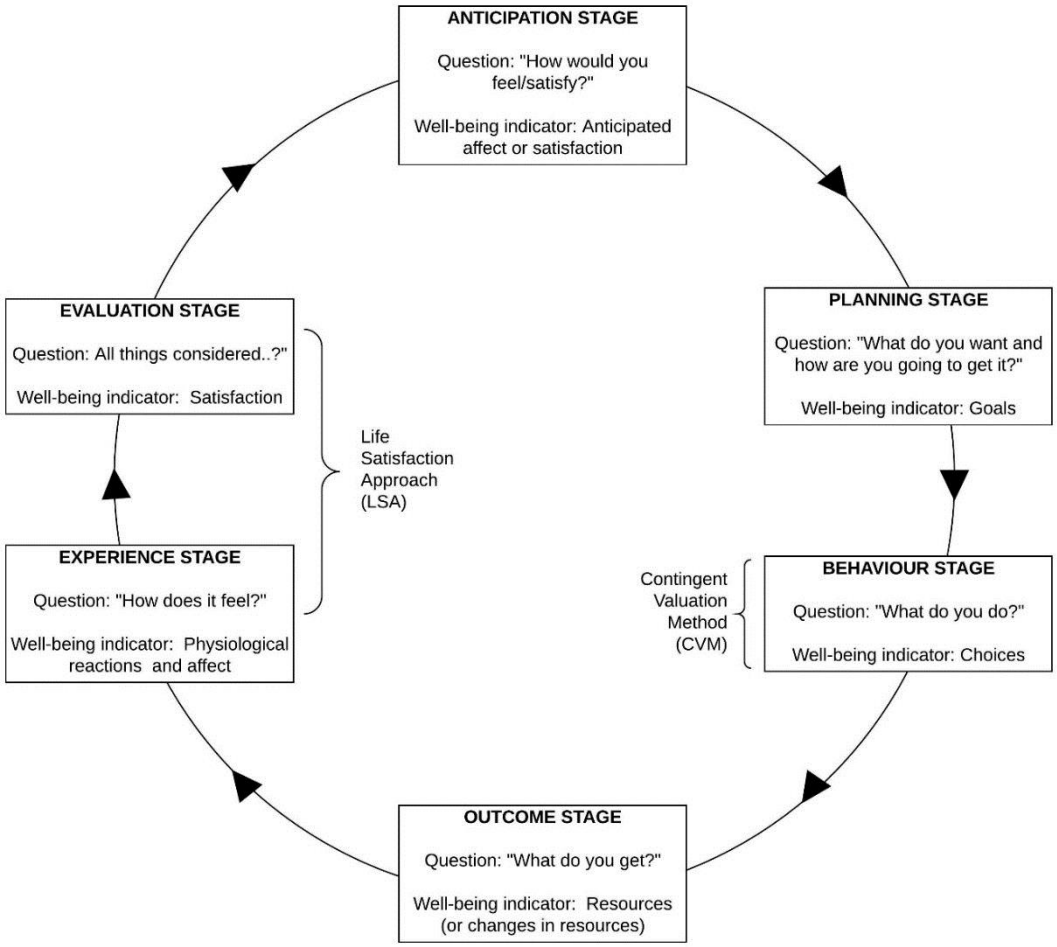

Figure 1.1. Stages in the Dynamic Well-being (DWB) model (adapted from Dolan and White 2006).

The Contingent Valuation Method (CVM) corresponds with the behaviour stage of the DWB model and aligns with the 'desire fulfilment' paradigm of well-being. The method originates from the economics discipline and is a preference-based method that assesses stated preferences for environmental goods and services (henceforth 'environmental goods') to estimate their values (Bateman *et al.*,

2002; Carson and Hanemann, 2005). The CVM originated as an environmental valuation method, capturing the utility changes resulting from the provision of non-market environmental goods. More recently, however, and going beyond the narrow economic definition of utility, it has also been connected to the wider concept of well-being. This occurred following the examination of different paradigms of well-being (Dolan and White, 2007) and the instigation of comparisons with experiential methods such as the Life Satisfaction Approach (LSA; Frey *et al*., 2010). The CVM conceives human well-being in terms of the satisfaction of personal preferences for environmental goods and assesses social welfare on the basis of individual utility (Wegner and Pascual, 2011).

The Life Satisfaction Approach (LSA), an experiential method, is consistent with the 'mental-state accounts' of well-being and the experience and evaluation stages of the DWB model. The LSA was originally developed by psychologists, but has more recently also been applied in happiness and environmental economics. It seeks to quantify the value of experiences (e.g. emotional states or cognitive effects) associated with the actual consumption of non-market goods (Clark and Oswald, 2002; Dolan and Kahneman, 2008; Welsch and Ferreira, 2014). This account conceives of human well-being in terms of the feelings of pleasure and displeasure, happiness and sadness and satisfaction and dissatisfaction that are gained from an individual's act of choice (e.g. consumption of an environmental good; Kahneman *et al.,* 1997; Kahneman and Thaler, 2006).

A small number of reviews have compared the two methods for their use in social (Fujiwara and Campbell, 2011; Fujiwara and Dolan, 2016) and environmental CBA (Fleming and Ambrey, 2017; Frey *et al.*, 2010; Fujiwara and

Campbell, 2011; OECD, 2018). Furthermore, the methods have been compared empirically in the valuation of urban regeneration (Dolan and Metcalfe, 2008), culture and sport (Bakhshi *et al.,* 2015; Humphreys *et al.,* 2017; Del Saz-Salazar *et al.*, 2017), education (Dolan and Fujiwara, 2012) and urban green spaces and parks (Fields in Trust, 2018). However, an in-depth, theoretical or empirical comparison of the two approaches in the context of marine and coastal environments has yet to be put forward.

1.2. Aims and research questions

This overall aim of this thesis is to compare and contrast two environmental valuation methods (the Contingent Valuation Method and the Life Satisfaction Approach) which can be used to capture the well-being changes resulting from the provision of marine and coastal goods. The thesis reports on a comparative empirical application of the methods in the valuation of a coastal intervention (Teat's Hill, England). This comparison is made possible by a local coastal regeneration project that occurred during the PhD project (2016-2018; Teat's Hill, England), which enabled an evaluation before and after the intervention. In practical terms, five research questions guide this thesis:

- **Research question 1:** How do the methods differ in terms of their theoretical perspective on well-being and their application to marine and coastal environments?

- **Research question 2:** How do the methods compare in terms of their strengths and weaknesses?

- **Research question 3:** To what extent was there an effect of the coastal intervention on well-being and why?

- **Research question 4:** How similar are the values estimated for the intervention elicited by the two methods?

- **Research question 5:** To what extent are the two methods commensurable or complimentary?

The thesis begins with a comprehensive review and critique of the two methods. Chapters 2 and 3, respectively, provide an overview of the two methods: the CVM (Chapter 2) and LSA (Chapter 3). Each chapter provides an introduction to the theory underpinning the approach, the respective exemplar methods and makes particular reference to how these methods have been applied in marine and coastal examples. Drawing on the preceding chapters, Chapter 4 compares and contrasts the valuation methods on a conceptual level, considering both theoretical perspectives and practical implications. This involves a synthesis of evidence from Chapters 2 and 3, highlighting the differences between the methods, considering their conceptualisation of well-being, aims, objectives, underpinning theory, valuation procedure and application to marine and coastal environmental goods, ES and policy. Areas of criticism are also identified, and their respective strengths and weaknesses are identified.

The theoretical evaluation is followed by an empirical comparison of the two methods. The CVM and LSA are compared in practice to value the implementation of the coastal regeneration (Teat's Hill, England). Chapter 5 provides an overview of the empirical context and stages involved in the design (e.g. study and questionnaire design) and implementation of the research. Chapter 6 presents the results of the CVM study, which valued the anticipated change in utility resulting from the provision of the coastal regeneration. Chapter 7 employs the LSA to assess the association between life satisfaction

and the regeneration, and explores the potential for placing a value on the well-being benefits gained from the experiences resulting from the coastal regeneration.

The theoretical and empirical findings are brought together in Chapter 8. First, the chapter draws together evidence from the LSA research to assess the effect of the intervention on well-being. Second, the estimates from the two methods are compared, to establish whether they produce similar estimates of the value of the change associated with the coastal intervention. The chapter culminates in a discussion of the commensurability and complementary of the two methods. Finally, Chapter 9 discusses the theoretical and policy contributions of the thesis. The chapter reviews the general limitations of the research and highlights research gaps and recommendations for the future application of the two methods in a marine and coastal context.

2. Literature review: Contingent Valuation method (CVM)

2.1. Chapter overview

This chapter provides a review of the Contingent Valuation Method (CVM), a stated preference method that can be used to value changes in non-market goods and services in areas such as the environment, health and culture. The chapter begins by providing an introduction to the preference-based approach and how it is connected to the wider concept of well-being (section 2.2). It then provides an overview of neo-classical welfare economics (welfare theory), the theory which underpins the preference-based approach (section 2.3). In keeping with economics texts (e.g. Varian, 2014), well-being will be referred to as 'utility' or 'welfare', acknowledging nomenclature from welfare economics. This contrasts with the experience approach to well-being (Chapter 3), which uses the term 'well-being' (Fujiwara and Campbell, 2011). The theory of welfare economics will be discussed in the context of valuing benefits from non-market environmental goods and services. This will be followed by an introduction to how utility (decision utility) is mathematically expressed and measured in practice, using the Total Economic Value (TEV) framework (section 2.4) and preference-based valuation methods (section 2.5). The chapter will then focus on the CVM, as one example of a stated preference (SP) valuation method (section 2.6). The valuation procedure, aims and objectives and the procedural aspects and considerations for the design of a CVM study are then discussed. The review culminates with a brief summary of the application of the CVM to the valuation of marine and coastal environments, ecosystem services, well-being and policy (section 2.7).

2.2. Introduction to the preference-based approach

The preference-based approach originates from research efforts in the discipline of economics (also known as 'desire fulfilment' or 'preference satisfaction'; Parfit, 1984). The approach emerged in the early 20th century, when economists retreated from the experiential approach. The step change was tied to debates about whether pleasures and pains could be measured (Fleurbaey and Hammond, 2004). Economists redefined utility to be a representation of preferences revealed through observed behaviour and started to develop an appropriate theoretical framework (Carter and McBride, 2013; Kahneman and Sugden, 2005). This branch of economics is known as welfare economics (or welfare theory; see section 2.3).

The approach is underpinned by the premise that individuals seek to maximise their utility. It aims to assess the level of utility that individuals anticipate they will experience from the consumption of any type of good, including non-market goods. It therefore uses an *ex-ante* assessment: Since it is not possible to measure utility directly, it is inferred from the preferences individuals state or reveal through actual behavioural choices (Dolan and White, 2007). According to this account, higher levels of utility are achieved from obtaining the most preferred selection of consumption goods (Hanley *et al*., 2007). If a good or service satisfies the individual's preference, then it contributes to utility and has economic value. An individual's utility is said to be higher in situation B than in situation A if the individual prefers B to A (Bateman *et al.*, 2002).

The preference-based approach has traditionally not been associated with the measurement of well-being, but has been discussed in the context of well-being following Kahneman and co-authors (Kahneman *et al.*, 1997; Kahneman, 1999).

They compared the two meanings of utility originating from economics (preference-based approach) and psychology (experiential approach) disciplines. This led to the coining of the term decision utility, which refers to the concept of well-being stemming from the preference-based approach. Decisions are assumed to provide an estimate of the expected future utility for a particular outcome (e.g. consumption of a good or service; Kahneman, 1999, 2003; Dolan and White, 2007; Berridge and O'Doherty, 2014). It was highlighted that decision utility "could be inferred from choices, either by direct comparisons of similar objects or by indirect methods, which elicited willingness to pay (WTP)" (Kahneman *et al*., 1997, p376). Based on this understanding, Dolan and White (2006) ascertained that the preference-based approach measures the behaviour stage of the dynamic well-being model (DWB; Chapter 1; Figure 1.1). This is the stage in which individuals consult their preferences for goods based on their predictions of relative states of utility that will be realised by consuming different goods.

2.3. Welfare economics as applied to environmental goods

The basic premise of welfare economics is that the purpose of economic activity is to increase utility. Welfare economics is based on rationality assumptions, the principle that individuals have well-defined pre-existing preferences for all goods and that they consistently choose the goods that maximise their individual utility, given the costs and benefits across the alternatives (Deaton and Muellbauer, 1980; Kahneman, 1994; Varian, 2014).

Originally, welfare economics was used to evaluate the welfare (i.e. well-being) effects of changes in the prices of goods purchased in markets. However, over the last fifty years, welfare economics has been extended to value non-market

goods and services, such as environmental goods, which are not traded in markets and therefore do not have market prices. It has become clear that the domain of preferences extends to environmental goods not available through markets and these preferences are well-defined (Bockstael and Freeman, 2005).

Preferences for environmental goods can be expressed using a direct and indirect utility function (Carson and Hanemann, 2005). The direct utility function, eq. (2.1), is a mathematical representation of preference ordering, whereby the highest level of utility is obtained from the most preferred consumption bundle (Hanley *et al.*, 2007). The direct utility function u defines utility as a function of the quantities of a bundle of market goods $x = (x_1, x_2, x_3, \dots, x_n)$ and q, an environmental good to be valued (Carson and Hanemann, 2005):

$$u = u(x, q) \tag{2.1}$$

Indirect utility, eq. (2.2) can be derived from direct utility, through the maximisation of u subject to the individual's budget constraint $y \geq px$, where y is income and $p = (p_1, p_2, p_3 \dots p_n)$ a price vector of all market goods in the bundle x. Inserting the optimal consumption bundle x back into the direct utility function $u = u(x, q)$ yields indirect utility:

$$v = v(p, q, y) \tag{2.2}$$

The indirect utility function is used to evaluate changes in utility resulting from a positive or negative change in the total quality of an environmental good (e.g. resulting from an environmental intervention, an oil spill or air pollution episodes; Welsch and Kühling, 2009). Therefore, it can contrast between two situations: (i) q^1, the level of the environmental good provided at time point 1

(T1) and (ii) q^2, the level of the environmental good provided at time point 2 (T2) (Carsonand Hanemann, 2005) [1]. Changes in utility can be measured for increases ($q^2 > q^1$) and decreases in the provision of environmental goods ($q^1 > q^2$).

2.3.1. Hicksian approach to welfare

Changes in utility due to changes in the provision of environmental goods can be assessed using the Hicksian welfare measures. The Hicksian approach evaluates welfare change as the money income adjustment necessary to maintain a constant level of utility before and after or before the change of provision of q (Bateman and Turner, 1992). There are two Hicksian welfare measures that can be used to evaluate welfare changes: Compensating Variation and Equivalent Variation. Compensating variation (CV) is the amount of income paid or received that keeps an individual at the initial level of utility (u^0) after the change in provision of the environmental good from q^1 to q^2 (Bateman and Turner, 1992; Carsonand Hanemann, 2005; Haab and McConnell, 2002). This measure takes an *ex-post* perspective on utility change, by making reference to situations after they have happened.

Equivalent variation (EV) is the amount of income paid or received that would move an individual to the level of utility (u^1) related to the new level of provision of the environmental good even if that provision did not happen (Bateman and Turner, 1992; Carson and Hanemann, 2005; Haab and McConnell, 2002). This amount of income is therefore *equivalent* in its effect on utility as the change in the provision in the non-market good from q^1 to q^2 would have been. This

[1] Note that q^1 can be zero in which case the environmental good or service is not provided at all.

measure assesses the change from an *ex-ante* perspective, i.e. it makes reference to the situation before it actually takes place. Following Carson and Hanemann (2005) and Bockstael and Freeman (2005), the compensating variation (CV) and equivalent variation (EV) of a change in an environmental good, q, can be expressed as:

$$v(p, q^1, y - CV) = v(p, q^2, y) \quad (2.3)$$

$$v(p, q^2, y) = v(p, q^1, y + EV) \quad (2.4)$$

2.3.2. WTP and WTA

The Hicksian welfare measures can be employed in practical welfare assessments, using two monetary measures: Willingness to Pay (WTP) and Willingness to Accept (WTA) (Ahlheim and Buchholz, 2000; Haab and McConnell, 2002; Markandya, 2002). WTP is the monetary measure of the value of gaining an improvement or avoiding a loss. Whereas WTA compensation is the monetary measure of the value of forgoing an improvement or allowing a loss (Bateman *et al.*, 2002). WTP and WTA examine the variations of individual income required to keep an individual unchanged in terms of utility, when there is a change in the provision of an environmental good (Haab and McConnell, 2002).

Theoretically, WTP and WTA can measure changes in utility following an increase ($q^2 > q^1$) or decrease ($q^1 > q^2$) in the provision of environmental goods and provide a monetary value of CV and EV according to eq. (2.3) and eq. (2.4).There are four possible change scenarios that can be captured by WTP and WTA (Table 2.1; Bateman and Turner, 1992; Haab and McConnell, 2002; Carson and Hanemann, 2005). Each of the four scenarios is discussed

below, with examples, to conceptualise these states within the topic of this thesis. The examples illustrate how these scenarios of welfare change relate to well-being and the marine environment, in the context of creating or removing access to the coast, via a coast path.

Table 2.1: Representation of the relationship between the Hicksian measures of CV and EV and concepts of WTP and WTA, in the context of environmental quality (adapted from Ahlheim and Buchholz, 2000).

	Compensating Variation (CV)	**Equivalent Variation** (EV)
Increase in the provision of an environmental good e.g. installing a coast path ($q^2 > q^1$)	Scenario 1 WTP (for the coast path)	Scenario 2 WTA (compensation of forgoing the coast path)
Decrease in the provision of an environmental good e.g. removing an existing coast path ($q^1 < q^2$).	Scenario 3 WTA (compensation for the removal of coast path)	Scenario 4 WTP (for preventing the removal of coast path)

The first two scenarios in Table 2.1 refer to a situation in which there has been an increase in the provision of an environmental good. If this change is regarded as an improvement, there is an increase in utility (utility gain) and therefore $CV > 0$ and $EV > 0$ (Carson and Hanemann, 2005). In scenario 1, WTP provides a monetary measure of CV and represents how much an individual is willing to give up to secure the (desirable) change. This is the loss of income which, after the increase in the provision of an environmental good, would hypothetically return the individual to his initial lower utility level. For example, how much income an individual is willing to give up at most (WTP) to have access to the coastline, through the creation of a coast path. In scenario 2,

WTA provides a monetary measure of EV, which represents how much extra income would have to be given to an individual (WTA) for them to attain the final improved utility level, in the absence of the increase in the provision of an environmental good. For example, how much extra money income (WTA) an individual would need to receive, if a coast path were not created, for the individual to receive the same level of utility that a coast path would have produced.

The final two scenarios refer to a situation in which there has been a decrease in the provision of an environmental good. If this change is regarded as being for the worse it constitutes a decrease in utility for the individual under study and therefore $CV < 0$, $EV < 0$ (Bateman and Turner, 1992; Carson and Hanemann, 2005). In scenario 3, WTA provides a monetary measure of CV and represents how much extra income would have to be given to an individual (WTA) for allowing the decrease in provision of an environmental good. This is the increase in income which returns the individual to the higher utility level after the decrease in the provision of an environmental good, given that the welfare loss does occur (Bateman and Turner, 1992). For example, the extra money income (WTA) that an individual would need to receive, if an existing coast path were closed. In scenario 4, WTP provides a monetary value of EV and represents how much an individual is willing to give up to prevent the loss of utility occurring. This is the maximum amount of income that an individual is prepared to give up to prevent the welfare loss occurring, leaving the individual at most as worse off as if it had occurred (at final lower utility level). For example, the maximum amount an individual would be willing to give up (WTP) to prevent the closure of the coast path.

2.4. Total Economic Value (TEV) and economic valuation

Economic valuation refers to the assignment of monetary values to non-market goods (Bateman *et al.*, 2002). The aim of economic valuation techniques is to uncover the Total Economic Value (TEV) of the good in question (Figure 2.1). TEV identifies all the changes in utility that accrue from a change in the provision of an environmental good and is based on the presumption that individuals hold multiple values for environments. The TEV considers that individuals can have both use and non-use values associated with environmental goods (Pearce and Turner, 1990).

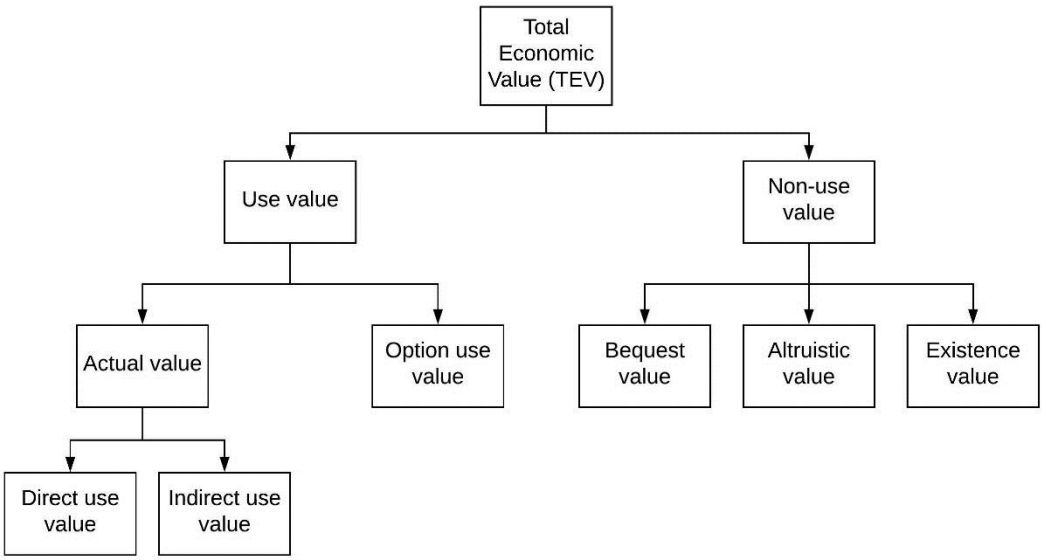

Figure 2.1. The Total Economic Value (TEV) framework, adapted from Pascual *et al.* (2010).

2.4.1. Use value

Use values are defined as those benefits that individuals derive from the actual use of the environment. There are two types of value associated with the actual use of the environment: direct use and indirect use value (Pearce and Turner, 1990).

- **Direct use values** involve individuals making actual or planned use of an environmental good. Direct use can be both consumptive, where the resources are extracted from the environment (e.g. fisheries and aquaculture), and non-consumptive, where the services are used without extracting any elements from the environment (e.g. the use of the sea for recreation, spiritual experiences, research and education).

- **Indirect use values** are those where individuals benefit from environmental goods supported by a resource rather than by directly using it (e.g. water regulation and nutrient cycling; Pascual *et al.*, 2010).

In addition to actual value, individuals may also place value on having the option to use a resource in the future, even if they are not current users (Krutilla and Fisher, 1985; Pearce and Turner, 1990). This is termed option use value. This future use is for personal benefit and may be direct or indirect (Pascual *et al.*, 2010; Pearce and Turner, 1990). It considers the unknown potential future use of the marine environment. For example the value placed on the potential for finding new medicinal products from deep sea organisms in the future (Jobstvogt *et al*., 2014).

2.4.2. Non-use value

Non-use values (also known as passive use values) are defined as the benefits that individuals gain from the environment, without a direct or indirect use of the environmental good in question. There are three types of non-use value:

- **Bequest value** is the value attached by individuals to the knowledge that future generations will also have access to benefits from environmental goods. For example, the value that current generations place on ensuring

the availability of biodiversity and environmental functioning for future generations (intergenerational equity concerns).

- **Altruistic value** is the value attached to knowing that other individuals in the present generation have access to the benefits provided by environmental goods (intragenerational equity concerns). For example, the value that individuals derive from the knowledge that marine biodiversity is available for present generations.

- **Existence value** is the value related to the satisfaction that individuals derive from the knowledge that environmental goods will continue to exist, even if the individual has no actual or planned use of it (Pascual *et al.*, 2010). For example, the value placed on simply knowing that marine biodiversity is there, even if it is never utilised or experienced (Krutilla, 1967).

2.5. Introduction to preference-based methods

Preference-based environmental valuation methods uncover the TEV of non-market goods, estimate WTP and WTA (Figure 2.2, Table 2.2) and have been linked to the conceptual framework of ecosystem services (see section 2.7). More recently, however, parallels have been drawn with the well-being literature, due to the coining of the terms decision utility and experienced utility (Dolan and Kahneman, 2008; Kahneman *et al.*, 1997). This has led to increasing discussions about the links between these methods and well-being, and the potential of these methods to measure well-being through an *ex-ante* approach. This section will discuss the two broad categories of preference-based methods.

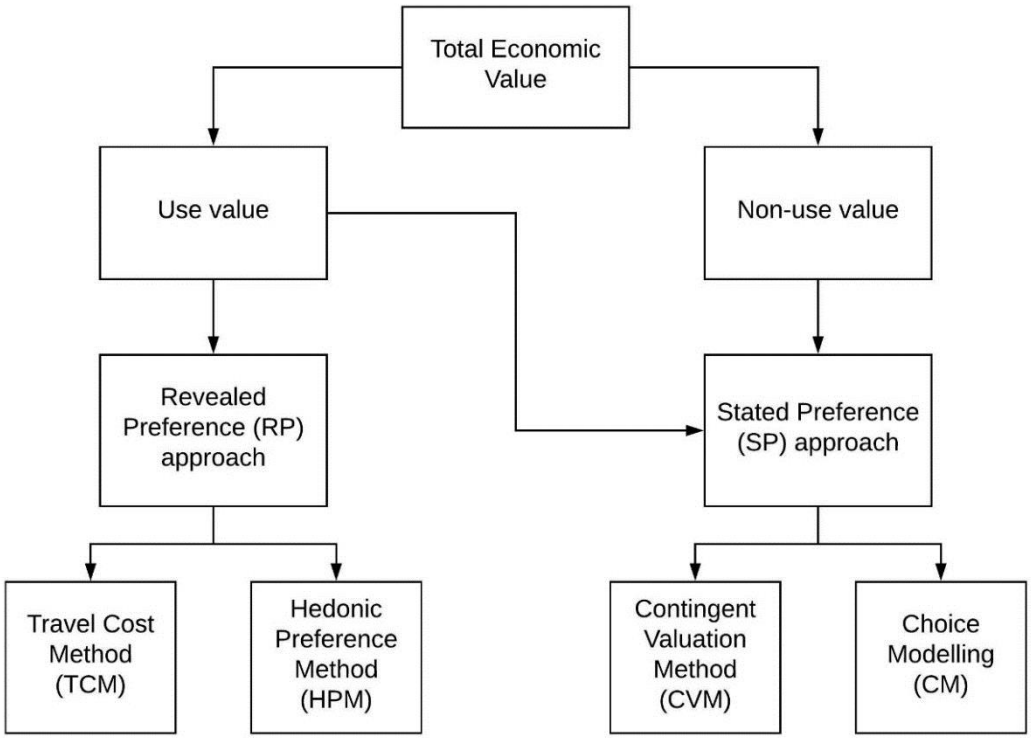

Figure 2.2. Preference-based methods that can be used to value TEV, adapted from Bateman *et al.* (2002).

2.5.1. Revealed Preference (RP) approach

The RP approach uses actual behaviour reflecting utility maximisation and assumes that preferences for non-market environmental goods or services are exhibited in the consumption of other marketed goods or services (Bockstael and Freeman, 2005; Markandya, 2002). The approach derives value from information about individual behaviour provided by, for instance, market transactions or recreational use of a site or area that are indirectly associated with the environmental good to be valued. The two main methods that fall into this category are the Travel Cost Method (TCM) and Hedonic Pricing Method (HPM). An overview of the two methods is presented in Table 2.2.

As shown in Figure 2.2, RP methods are used to estimate use values associated with non-market goods. For example, RP methods have been used

to value the benefits associated with recreational contact with the marine and coastal environment. However, RP methods cannot be applied in all cases of interest and are unable to assess non-use values (Frey *et al.*, 2010). In addition to this, the methods are based on a number of assumptions about consumer behaviour and the relationship between the environmental good and a surrogate market good (Pascual *et al.*, 2010). For example, the Hedonic Pricing Method (HPM) is based on the assumption that housing markets are in equilibrium (equilibrium assumption). However, the equilibrium assumption is only met if (i) there are a sufficiently wide variety of houses, (ii) if prices adjust rapidly, (iii) if households have full information and (iv) if transaction and moving costs are zero. The above assumptions can all be challenged (Frey *et al.*, 2010).

2.5.2. Stated Preference (SP) approach

The SP approach can be used to assess both use and non-use values generated by environmental goods and is the only approach by which non-use values can be quantified (Figure 2.2; Holland *et al.*, 2010). The approach circumvents the absence of markets for environmental goods by presenting individuals with a hypothetical market for a non-market commodity of interest (Mitchell and Carson, 1989; Haab and McConnell, 2002; Hanley *et al.*, 2007). Respondents are provided with a scenario describing a hypothetical change (e.g. change in policy) in which the level of provision of the environmental good that they desire will be affected (i.e. the move from q^1 to q^2). They are then asked how much they are willing to pay to obtain the proposed environmental good or which of different specifications of the environmental goods for different costs they prefer. This induces WTP or choice responses that trade off

improvements in goods and services for money. The SP approach is often used when direct and indirect price information on goods or services is absent (Pascual *et al.*, 2010).

From these responses, researchers can infer preferences for the changes in environmental goods which can be valued in monetary terms in the form of WTP or WTA (Haab and McConnell, 2002). Estimates are then aggregated across individuals or households to produce an aggregate WTP or WTA for the population of interest that can then be used in CBA or benefit transfer[2] (Bateman *et al.*, 2002). SP methods include Choice Modelling (CM) and the CVM (Louviere *et al*., 2000; Carson and Hanemann, 2005; Kanninen, 2006; Holland *et al.*, 2010). An overview of the two methods is presented in Table 2.2.

Table 2.2: Overview of two approaches (RP and SP) and their respective methods.

Type of approach	Method	Description	Key references
Revealed Preference (RP) approach	Travel Cost Method (TCM)	The TCM estimates the expenditures incurred by households or individuals (e.g. money and time) to reach a specific site. Originally the method was used to estimate the value of visits to recreational sites (i.e. recreational activity), but has been adapted to value changes in environmental quality by combining it with the contingent behaviour method.	Ward and Beal, (2000) Parsons (2003) Bockstael and Freeman (2005)
	Hedonic Pricing Method (HPM)	The HPM estimates the economic value of environmental goods that directly affect market prices, using information about the implicit demand for an environmental attribute of marketed commodities. It is most commonly applied to	Palmquist (1999)

[2] Benefit transfer can also be used for RP studies.

		variations in house pricing or tourist accommodation.	
Stated Preference (SP) method	Contingent Valuation Method (CVM)	The CVM estimates the economic value of environmental goods, by asking respondents directly for their preferences. Using a survey, respondents are asked for their WTP for the environmental goods or their minimum WTA compensation to forego such an increase.	Carson and Hanemann, (2005) Bateman *et al.* (2002), Johnston *et al.*, (2017)
	Choice Modelling (CM)	CM is a generic term for a variety of approaches including: contingent ranking, paired comparisons, contingent rating and choice experiments. CM derives value by rating and ranking the different characteristics of a good, for instance, which aspects of a marine and coastal environment are more or less important. CM is used to determine which attributes are significant determinants of value, their implied ranking, the value of changing them and the TEV of a resource or good. The most popular CM method in the environmental literature are Discrete Choice Experiments (DCE), which ask respondents to select their most preferred option (bundle of goods), considering their attributes, characteristics and the levels that they take.	Hess and Daly (2014) Kanninen (2006) Bateman *et al. (*2002) Louviere *et al.* (2000)

2.6. Selecting a preference-based method for comparison

Both the HPM (RP) and CVM (SP) have been adopted in theoretical (e.g. Frey *et al.*, 2010; Fleming and Ambrey, 2017; OECD, 2018; Welsch and Ferreira, 2014) and empirical comparisons with experiential methods (e.g. Dolan and Metcalfe, 2008; Luechinger, 2009.). However, the CVM was selected as the exemplar method for the comparison with the LSA in this thesis for a number of reasons.

First, estimates from the CVM and LSA have been compared for a range of non-market goods such as regeneration (Dolan and Metcalfe, 2008), adult learning (Dolan and Fujiwara, 2012), culture (Bakhshi *et al.*, 2015; Del Saz-Salazar *et al.*, 2017), sport (Humphreys *et al*., 2017) and urban parks and green spaces (Fields in Trust, 2018). Despite this, there is no such study in a marine and coastal context. This thesis aims to extend the current field of research by comparing the methods in the valuation of marine and coastal goods. Second, the method is well-established as a method to value marine and coastal goods (see section 2.7) and a number of best practice guidelines exist (e.g. Mitchell and Carson, 1989; Bateman *et al.*, 2002; Haab and McConnell, 2002; Johnston *et al.*, 2017). Third, the shortcomings of the method are well-known and are discussed in Chapter 4 (Venkatachalam, 2004; Carson, 2012; Haab *et al.*, 2013). Fourth, the CVM is relatively more straightforward to design and implement in comparison to CM.

Finally, in contrast with RP methods, the CVM is able to value both use and non-use benefits from environmental goods (section 2.4). It is important to understand the potential well-being benefits gained from blue and green spaces, regardless of use and this is central to the empirical focus of the thesis (Teat's Hill; discussed in Chapter 5). The CVM enables the study to establish, in economic terms, a value for the environmental intervention (Teat's Hill regeneration), which captures benefits from the direct use of the environment to the individual and the non-use benefits. This helps to provide an understanding of the benefits that can be gained from the existence, preservation of and future provision of such interventions and natural environments (e.g. blue and green spaces; Bateman *et al.*, 2002; Fields in Trust, 2018), regardless of use. Non-use values may include benefits in the form of enhanced community image,

social interaction or simply knowing that the intervention or natural environment exists, either now or in the future (Pearce and Özedemiroglu, 2002; Fields in Trust, 2018). In a wider marine context, an estimation of non-use values may also be significant as very few people have frequent first-hand experience of offshore and submarine environments (e.g. Börger *et al*., 2014; Jobstvogt *et al.*, 2014; Spash, 2002).

2.7 The Contingent Valuation Method (CVM) explained

The following sections provide an overview of the CVM, in terms of its aims, objectives, valuation procedure (subsection 2.7.1) and how a CVM study is designed, implemented and analysed (subsection 2.7.2).

The CVM is the oldest and most frequently employed SP approach (Carson *et al.*, 1992; Haab and McConnell, 2002) and a number of best practice guidelines have been developed (e.g. Mitchell and Carson, 1989; Arrow *et al.*, 1993; Bateman *et al.*, 2002; Johnston *et al.*, 2017). It originated as an environmental valuation method and was therefore conceived as a method to capture welfare changes resulting from the provision of public environmental goods. More recently, however, and going beyond the narrow economic definition of welfare, it has also been connected to the wider concept of well-being. The CVM conceives human well-being in terms of the satisfaction of personal preferences for environmental goods and assesses social welfare on the basis of individual utility (Wegner and Pascual, 2011). It is used to value changes in environmental goods that have not yet occurred (i.e. *ex-ante* valuation; Abdullah *et al.*, 2011) and the preferences elicited may act as an indirect indicator of anticipated affect and satisfaction (Dolan and White, 2006).

The method elicits individual preferences, in monetary terms, for hypothetical changes in the quantity or quality of a non-market good or service (OECD, 2018). This is achieved using a specially constructed questionnaire that has two main objectives. The first objective is to elicit people's WTP or WTA for an environmental good. If truthful, CVM responses are considered to be direct expressions of value and are interpreted as measures of compensating (CV) and equivalent variation (EV) (Bockstael and Freeman, 2005; discussed in section 2.3). Respondents are presented with a scenario describing a hypothetical change in the provision of the environmental good and are asked directly for their maximum WTP for the environmental good or their minimum WTA compensation to forego such an increase (Hanley *et al.*, 2007; Mitchell and Carson, 1989).

The second objective is to assess the determinants of WTP or WTA. It is best practice to use econometric analyses to examine the association between the monetary measure and explanatory variables, relating to socio-demographic characteristics (e.g. income, age, gender) and attitudes, opinions, behaviours and experiences of the non-market good in question (e.g. frequency of visit to a site or perception of the quality of the non-market good; Bateman *et al.*, 2002; Johnston *et al.*, 2017). This assessment is imperative for two reasons. First, it helps to ascertain the representativeness of the survey sample relative to the population of interest. This is important if the mean WTP or WTA is going to be extrapolated from the survey sample to the population of interest to obtain an estimate of the total value of the good. This is described as aggregate WTP or WTA (Bateman *et al.*, 2006; Bateman *et al.*, 2002). Second, it is used to assess the construct validity of the study. Regression models are used to express the relationships between WTP and other variables that normally affect demand

(bid curve or valuation function; Bateman *et al.*, 2002; Jones *et al.*, 2008). If key variables are found to be statistically insignificant or affect WTP or WTA in ways not in accordance with theory, this casts doubt on the construct validity of the results (Bakhshi *et al.*, 2015). The concept and assessment of construct validity will be discussed in more detail in Chapter 4 (section 4.4).

2.6.1. Design, implementation and analysis of a CVM study

To achieve the aims and objectives discussed above there is an extensive design, implementation and analysis process for CVM studies. This is due to the challenge of communicating potentially complex issues to respondents in relation to the environmental good in question. For example, information about an environmental problem or a specific habitat, which respondents might be unfamiliar with (e.g. offshore environments or the deep sea; Spash, 2002, 2008; Torres and Hanley, 2017). This is in addition to the challenge of capturing estimates of WTP and WTA, which are accurate measures of value (Cummings *et al*., 1986; discussed in Chapter 4). The process involved is outlined in Figure 2.3 (based on Bateman *et al.* 2002, Johnston *et al.* 2017) and illustrates that there are eight stages.

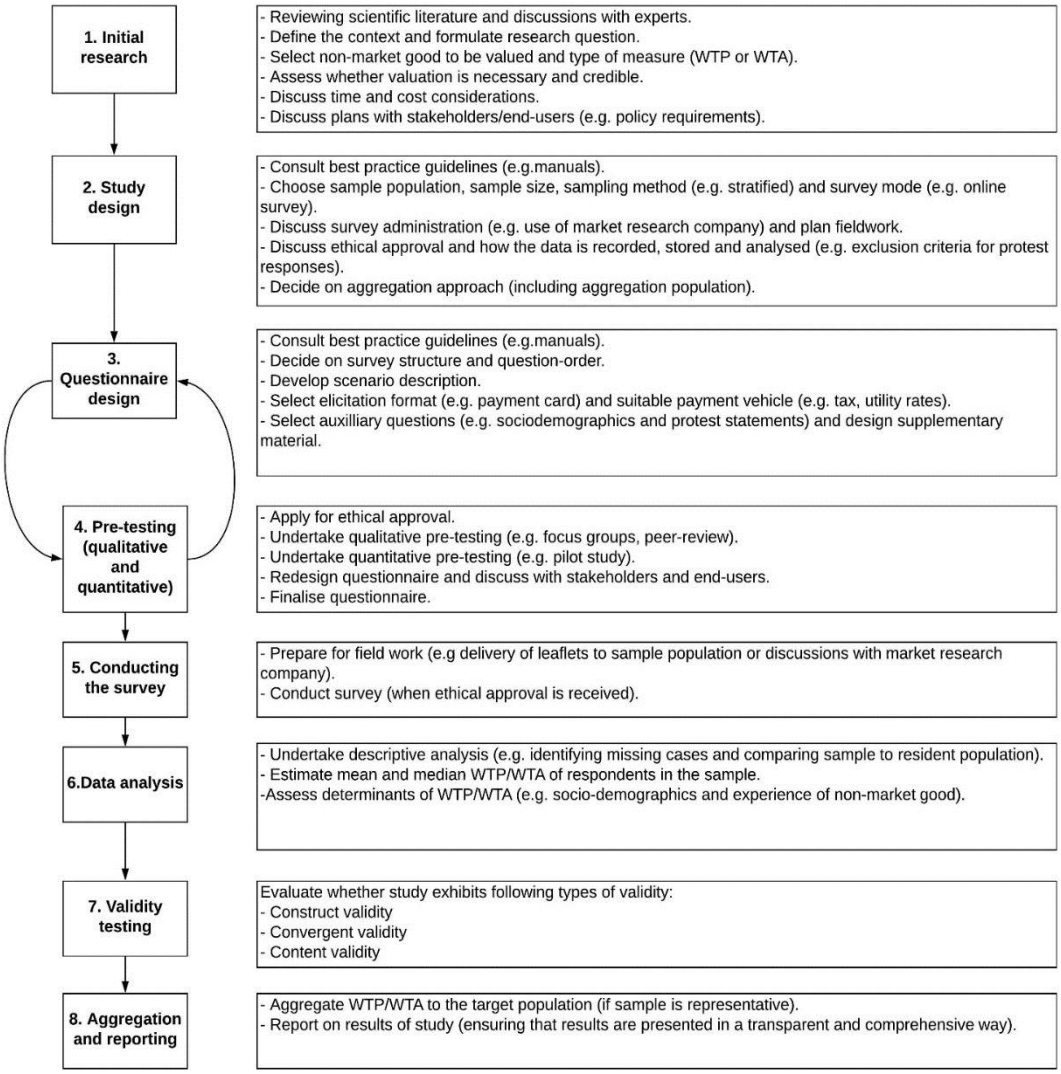

Figure 2.3. Process involved in the design, implementation and analysis of a CVM study (based on Bateman *et al.*, 2002; Börger *et al.*, 2018; Johnston *et al*., 2017).

2.6.1.1. Initial research and study design

The early stages of the study require extensive effort. Initial research (Stage 1) is required to determine the aims of the research project and the nature of the non-market good to be valued. This may involve engagement with the end-user of the research and interested stakeholder groups. Once the scope of study is decided, the study design is considered (Stage 2). Key decisions should be made with regards to the survey population, sample size, sampling method (e.g.

stratified or random sampling), the aggregation population and survey administration modes. The main survey administration modes are face-to-face interviews, telephone interviews, mail surveys and internet-based surveys. Each differs in terms of cost, time, the quality and quantity of data, sample control, response rate, the degree of complexity and versatility allowed (Loomis and King, 1994; Mannesto, 1991; Nielsen, 2011). Finally, further considerations, include the survey administration (e.g. use of a market research company) and recording and storage of data (Bateman *et al.*, 2002).

2.6.1.2. Questionnaire design and pre-testing

The next step (stage 3) involves the design of the questionnaire. The CVM uses a survey instrument which sets one or more questions to elicit the monetary value of a change in a non-market good. The design of the questionnaire is central to the success of the CVM study, in terms of the accuracy (validity and reliability) of estimates. CVM questionnaires are generally organised in a particular manner to reflect current best practice (Bateman, *et al.*, 2002; Carson, and Hanemann, 2005; Johnston *et al.*, 2017; Mitchell and Carson, 1989). This is highlighted in Table 2.3.

Table 2.3: CVM questionnaire design (drawing on Bateman *et al.*, 2002; Carson and Hanemann, 2005; Johnston *et al.*, 2017).

Section No	Description
1	Provides the respondent with a general introduction to the survey topic. The introduction sets the context for the decision to be made by identifying the sponsor and topic.
2	Consists of warm-up questions that ask the respondent about their prior knowledge of the good and their attitudes towards it.
3	Presents the CVM valuation scenario, which describes the (1) policy change and the resulting change in environmental quality or provision of the environmental good of interest, (2) the constructed market and (3) the method of payment (payment vehicle).
4	Involves questions(s) that request information about the respondent's WTP or WTA to make the presented environmental change occur. An elicitation question is used to gain information about the value of the proposed environmental change to the respondent.
5	Includes debriefing questions which help to ascertain how well the respondent has understood the scenario.
6	Involves a set of questions regarding respondent characteristics including attitudes and demographic information. These questions yield a pool of potential covariates for identifying determinants of WTP or WTA.

The valuation scenario (section 3) and elicitation question (section 4) have been described as core elements of CVM questionnaires (OECD, 2018). The valuation scenario must be designed to get respondents to think seriously about the topic of interest, provide the necessary information for them to be able to provide informed responses and encourage them to identify and reveal their monetary valuation by truthfully stating their WTP or WTA for the change in the quantity or quality of the environmental good in question (Bateman *et al.*, 2002). Mitchell and Carson (1989) comment that "the principal challenge facing the designer of a CV study is to make the scenario sufficiently understandable,

plausible and meaningful to respondents so that they can and will give valid and reliable values despite their lack of experience with one or more of the scenario dimensions" (p120). The scenario also presents the payment vehicle: how the provision of the good is to be financed and how respondents will be asked to contribute to or pay for it (OECD, 2018). Payment vehicles can involve voluntary payments, such as donations and gifts (e.g. a donation to an environmental management organisation; Jobstvogt *et al.*, 2014). Alternatively, they can be more coercive in nature, using taxes, rates, fees, charges or prices (e.g. an increase in council tax rates; Bateman *et al.*, 2006). The literature on consequentiality, since Carson and Groves (2007), has been clear that only coercive payment vehicles provide respondents with the incentive to truthfully reveal any private information asked for by the mechanism and provide conditions for truthful preference revelation to be the dominant strategy. This is termed incentive compatibility (Carson and Groves, 2007; Carson *et al*., 2014) and is discussed further in Chapter 4 (section 4.1).

The scenario is followed by the value elicitation question. Respondents are asked for their WTP or WTA for the change in the quantity or quality of the non-market good in question if they were presented with the opportunity to obtain it, under the specified terms and conditions of the valuation scenario (OECD, 2018). Given that WTP and WTA questions are inevitably hypothetical, a crucial methodological question is how to ascertain the truthfulness of the response (Ryan *et al.*, 2004). One of the key areas of design is the format of the elicitation question. The issue of elicitation format selection and their relative advantages and disadvantages has generated innumerable articles in academic journals (Carson, 2012; Hanley *et al.*, 2007). Common elicitation formats include bidding games, open-ended (OE) questions, payment card (PC), dichotomous choice

(DC) (single bounded, double bounded and triple bounded; Bateman *et al.*, 2002). An introduction to each of these commonly used elicitation methods are provided below, with an overview of the advantages and disadvantages presented in Table 2.4.

- **Bidding games format.** This method is the oldest elicitation technique (Davis 1963) and can be described as a multiple-bounded DC method. Respondents are provided with a randomly assigned bid from a range of predetermined bids (Venkatachalam, 2004). They asked whether they would be willing to pay or willing to accept the specific amount (the bid) to improve the quantity or quality of an environmental good and are able to answer yes or no (Bateman, and Turner, 1992). If they answer yes, they are provided with gradually increasing bids until they finally reject a bid (i.e. they are faced with multiple rounds of DC questions). If the respondent answers no to the first bid, the follow up bids are lowered until they accept the bid. The process is similar to an auction or a 'market-like' situation. One of the earliest studies using this format was by Randall *et al* (1974) who assessed the effectiveness of this format in the context of valuing aesthetic environmental improvements in the Four Corners Region, USA.

- **Open ended (OE) format**. OE questions ask respondents to state the largest sum that they would be WTP or WTA to improve environmental quality or to avoid (or repair) environmental damage (Arrow *et al.*, 1993; Bateman *et al.*, 2002). For example, Walsh *et al.*, (1984) used the OE format to estimate the value of wilderness protection in Colorado, USA.

- **Payment Card (PC) format.** The format was developed by Mitchell and Carson (1981) to overcome issues encountered by the OE and bidding

games format (see Table 2.4). The format presents respondents with a visual aid containing a list of monetary amounts. Payment cards can be designed to include (i) range payments (e.g. £1-2 and £2-5) or (ii) interval payments (e.g. £1, £2, £5). Respondents are asked to choose a number on the card (or any number in between) which best represents their maximum WTP or WTA for an environmental good (Bateman *et al.*, 2002; Carson and Hanemann, 2005).For example, Mitchell and Carson (1981) used the PC format to estimate the national benefits from freshwater water quality improvements in the USA.

- **Dichotomous choice (DC) format (or 'take it or leave it' and 'closed-ended').** The format emerged as an alternative to the OE format (Arrow *et al.*, 1993; Ryan *et al.*, 2004) and was first used by Bishop and Heberlein (1979). The first step is the same as the bidding game format, but is followed by a second step which asks respondents to answer a closed ended question, with two possible responses: yes or no (Bishop and Heberlein, 1979). The number of closed-ended questions asked is dependent on the type of DC format. Therefore, the method does not elicit the maximum WTP or WTA. The Single Bounded Dichotomous Choice (SBDC) format asks respondents to answer a single closed ended question. The Double Bounded Dichotomous Choice (DBDC) involves two questions, whereby the answer to the second question is conditional on the response to the first (Carson, 1985; Hanemann, 1985). If a respondent answers yes to the first question, the question is repeated with a higher value, if no, the question is repeated with a lower value (Carson and Hanemann, 2005). The Triple Bounded Dichotomous Choice (TBDC) includes a third binary discrete question (Bateman *et al.*, 2001). For example, Ahmad and Hanley (2009)

used a DBDC elicitation format to assess people's willingness to pay to reduce damages to three marine parks in Malaysia.

Table 2.4. Overview of the main advantages and disadvantages of elicitation formats.

Name of Elicitation format	Main Advantages	Main Disadvantages	Key references
Bidding games	• Facilitates respondents' thought processes and encourages them to consider their preferences carefully.	• Anchoring bias	Green and Tunstall (2001) Frew *et al.* (2004)
Open ended (OE) questions	• Straightforward way of uncovering values. • Avoids anchoring and yea saying bias.	• Does not provide assistance in selecting a WTP. • Does not reflect the way that individuals behave in a real market. • Respondents may find it harder to come up with a WTP (Non-response bias).	Arrow *et al.* (1993) Ryan *et al.* (2004) Bateman *et al.* (2002)
Payment card (PC)	• Provides guidance in selecting WTP. • Reduces respondent fatigue. • Reduces influence of starting point bias.	• Range bias • Mid-point bias	Whynes *et al.* (2004) Ryan *et al*. (2004)
Dichotomous Choice (DC)	• Incentive compatible • Reduced incentives for strategic responses.	• Anchoring bias. • Higher number of protest responses • Yea-saying bias. • Increased analytical demands. • Need for larger sample sizes.	Carson and Groves, (2007) Jorgensen *et al.* (1999) Ready *et al.* (1996) Hoehn and Randall, (1987) Bateman *et al.* (2001)

The quality of a survey instrument relies on pre-testing. Pre-testing is considered essential to ensure validity (stage 4; discussed in Chapter 4, section 4.4; Carson, 2012; Johnston *et al.*, 2017). Johnston *et al.* (2017), recommends the use of two types of pre-testing. The first is qualitative pre-testing (e.g. focus groups), which can aid the design of scenarios, elicitation questions and provide insights into potential subjects' comprehension of survey materials. The second is quantitative pre-testing, i.e. a pilot survey, which permits limited statistical analyses of a pilot sample of data to test initial hypotheses, facilitate design modifications, and evaluate reliability and validity (Johnston *et al.*, 2017). This will be discussed in more detail in Chapter 5. The stages of questionnaire design (stage 3) and pre-testing (stage 4) are an iterative process, in which the questionnaire is refined based on insights from the qualitative and quantitative pre-testing (Börger *et al.*, 2018).

2.6.1.3. Implementation and analysis

The remaining stages (5-8), encompass implementation and analysis. The choice of survey mode affects the implementation of fieldwork. For example, it may involve contracting a market research company to conduct the survey using face-to-face interviews or online questionnaires. The survey is then conducted and the resulting data are analysed. This involves undertaking analysis, which provides descriptive statistics, an estimate of mean WTP or WTA and an assessment of the determinants of WTP. This is followed by an assessment of the validity of the results, examining construct validity and convergent validity (discussed in Chapter 4). An assessment of the determinants of WTP and WTA is also central to the process of aggregation. A representative sample population is required for the aggregation of WTP or

WTA to the economic jurisdiction or population in question. After validity testing and exploring the potential for aggregation of WTP, the study results are reported.

2.7. Application of the CVM to marine and coastal environments, well-being and policy

The CVM has had thousands of applications to the environment (Carson, 2011). This section provides an overview of the early application of the CVM and how it has been applied to the valuation of the natural environment. Due the focus of this thesis, there is a particular focus on marine and coastal environments[3] There will also be a discussion of its application in terms of ES and policy.

2.7.1. Valuation of marine and coastal environments and ecosystem services

The CVM was devised as an economics valuation method which could be used to value non-market goods and services. The CVM was proposed by Ciriacy-Wantrup (1947) and applied in 1963 to the economic valuation of outdoor recreation in the USA (Davis, 1963). Following this, CVM studies were undertaken, but were considered to be exploratory in nature, with researchers establishing the method's credibility (Carson, 2011). However the book by Mitchell and Carson (1989), played a central role in defining the CVM (e.g. theoretical framework) and the method ceased to be experimental. Following this, the number of CVM studies increased rapidly.

[3] Estimates converted to GBP (£) based on conversion rates from year of data collection.

One of the most significant applications of the CVM was by Carson *et al.* (1992) which was applied to marine and coastal goods. Carson and colleagues used the CVM to assess the natural resource damages from the Exxon Valdez oil spill in Alaska. A survey was administered face-to-face to a national sample in the USA to estimate WTP to avoid a future Exxon Valdez oil spill, through the funding of a programme to prevent a future spill with comparable effects in the same location. The public's WTP to avoid a future oil spill similar to the Exxon Valdez case was estimated at £3.7 billion ($4.9 billion; Carson and Mitchell, 2003; Carson, 2012). The estimates were used by the State of Alaska to sue Exxon Mobile in court, which was settled through a U.S. District Court consent decree in 1991 (Kling *et al*., 2012).

The Exxon Valdez damage claim brought the CVM and its conceptual underpinnings to the attention of many economists, government agencies and the courts (Carson and Mitchell, 2003; Haab *et al.*, 2013). Prompted by the court case, Exxon convened a conference on the CVM which came up with a critical assessment of the method (Hausman, 1993). Consequently, the US National Oceanic and Atmospheric Administration (NOAA) convened the Blue Ribbon Panel in 1992 to assess the method and resulted in the NOAA report on the CVM (Arrow *et al.*, 1993). The panel provided best practice guidelines on the use of CVM, particularly for application in natural resource damage assessment (Carson and Hanemann, 2005). The guidelines in Johnston *et al.* (2017) can be seen as an update of the NOAA guidelines 20 years on.

Around this time, the method began to be applied more frequently to marine and coastal goods, particularly charismatic species, such as marine mammals and turtles (e.g. Hageman, 1985; Loomis and White, 1996; Langford *et al.*,

1998). For example, Hageman (1985) and Loomis and White (1996) were among the first studies to estimate WTP for the protection of marine and coastal species (including dolphins, whales, sea otters, turtles and seals) in the USA. They estimated that the average household's WTP to ensure their continued survival, varied between £8.35 ($13) and £18.60 ($29) annually, depending on the species. The method was also used to value coastal habitats. Early studies assessed the value of beaches (e.g. Silberman and Klock, 1988; Silberman *et al.*, 1992; King, 1995). For example, King (1995) estimated the value of beach use in Eastbourne (UK) to be in the order of £4.5 million per year.

Over the last 20 years, the CVM has been increasingly framed as a method for valuing ES (Chaudhary *et al.*, 2015). The CVM was acknowledged as a relevant method for estimating the use and non-use value of (multiple) ES (Millennium Ecosystem Assessment, 2005) and this was further acknowledged by The Economics of Ecosystems and Biodiversity (TEEB) initiative (Pascual *et al.*, 2010) and the the UK National Ecosystem Assessment (2011, 2014). Previous reviews (Fletcher *et al.*, 2014; Torres and Hanley, 2016, 2017) have shown that the CVM has been used to value non-market goods across the three ES categories (provisioning, regulating and cultural services). For example, Torres and Hanley (2016) identified 56 peer-reviewed studies which valued ES derived from marine (e.g. coastal water and coral reefs) and coastal habitats (e.g. beaches and coastal areas) between 2000 and 2016.

2.7.2. Use within policy

The CVM has been recognised by policy-makers for use in decision-making, benefit transfer and for CBA of interventions involving non-market goods (Fujiwara and Campbell, 2011; HM Treasury, 2018). It has been acknowledged

that economic valuation studies may be useful in providing information on the costs and benefits associated with marine and coastal policies (Börger *et al.*, 2014; Torres and Hanley, 2017). There are cases of uptake within marine and coastal policy in the USA, for example, the seminal work by Carson *et al.* *(*1992). However, there has been increasing acknowledgment that economic valuation research is not widely used in actual decision-making concerning marine and coastal environments (Pendleton *et al.*, 2007; Hanley *et al.*, 2015; Torres and Hanley, 2017). The limited percolation of valuation evidence into policy and planning has been attributed to a number of factors, including methodological issues associated with their application (Hanley *et al.*, 2015), the lack of relevant economic valuation studies (e.g. poor fit of studies to current regulatory frameworks and management needs) and a lack of confidence in results (Laurans *et al.*, 2013). This raises uncertainty in terms of the relevance and applicability of the CVM to marine and coastal policy and planning.

2.8. Summary

This chapter introduced the more traditionally and frequently used preference-based *ex-ante* approach for valuing changes in environmental goods. The approach is conceived as a method to capture welfare changes resulting from the provision of public environmental goods. However, it has also been connected to the wider concept of well-being, as it may provide an indicator of current and anticipated well-being. An overview of the theory that underpins the preference-based approach (welfare economics) was presented, including how utility is formally expressed and measured in practice, using the Total Economic Value (TEV) framework and associated preference-based valuation methods. The chapter then focused on the exemplar preference-based method for this

study, the CVM. The overview highlighted the aims, valuation and steps required in the design and implementation of a CVM study, in addition to the application of the method to marine and coastal goods. This discussion facilitates the comparison and critique with the experiential approach to measuring well-being. The experiential approach and a respective exemplar environmental valuation method (Life Satisfaction Approach; LSA) will be the focus of the next chapter (Chapter 3).

3. Literature review: Life Satisfaction Approach (LSA)

3.1. Chapter overview

This chapter provides a review of the Life Satisfaction Approach (LSA), a method which can be used to measure changes in well-being and place a monetary value on interventions that bring about that change. A more extensive review is provided for the LSA in comparison to the CVM (Chapter 2), to help the reader understand the background to this emerging valuation method. The chapter begins by providing an introduction to the concept of an experiential approach to measuring well-being (section 3.2). Secondly, there will be an introduction to subjective well-being (SWB) and its underlying theory (including the dimensions and measures of SWB; section 3.3). This will be followed by an overview of the two experiential methods that are underpinned by the theory of SWB. The first is the original SWB method itself, upon which the LSA is based. The SWB method is a non-monetary valuation method that produces a self-report of SWB on a Likert scale (section 3.4). This section will provide an overview of the methodological aspects of the SWB method (including the types of SWB assessment). Furthermore, the application of the method to natural environments will be discussed, with particular reference to marine and coastal environments. The second is the LSA, the subject of this thesis. The LSA is a monetary valuation method that uses SWB data to estimate the impact of changes in goods, particular outcomes or interventions on people's evaluation of well-being (section 3.5). The section will highlight the procedural aspects involved in the design, implementation and analysis of an LSA study. The review culminates with an overview of the application of the LSA in the health and environmental literature and policy (section 3.6).

3.2. Introduction to the experiential approach

The experiential approach is an *ex-post* assessment of well-being (also known as the 'mental-state account' of well-being; Parfit, 1984). It is derived from psychology and is generally grounded in utilitarian philosophies (Kahneman *et al*., 1997; Dolan and White, 2007; Frey *et al*., 2010). The approach views well-being as a psychological phenomenon, characterised by feelings of pleasure and displeasure, happiness and sadness and satisfaction and dissatisfaction. Experiential approaches measure the 'evaluation' and 'experience' stages of the DWB model (see Chapter 1, Figure 1.1, Dolan and White, 2006). This is in contrast to preference-based approaches which assess the 'behaviour stage' of the DWB. The experiential approach collates people's lived experiences (e.g. from visits to natural environments, White *et al.*, 2017) and assesses the well-being that results from the individual's act of choice (Kahneman *et al*., 1997; Kahneman, 2003; Kahneman and Sugden, 2005; Dolan and White, 2006; Kahneman and Krueger, 2006; Kahneman and Thaler, 2006). This interpretation of well-being has been described as equivalent to or synonymous to the concept of Subjective Well-Being (Diener, 1984).

3.3. Introduction to the concept of Subjective Well-being (SWB)

SWB is often used by psychologists as an umbrella term for how we think and feel about our lives. It assumes an individual's well-being to be a composite of the cumulative experiences of both positive and negative emotional states ('experienced well-being') alongside their overall assessment of life ('evaluative well-being'; Diener *et al.*, 1999). Utilitarians such as Bentham were the intellectual forerunners of SWB, focusing on the emotional, mental and physical pleasures and pains that individuals experience (Bentham, 1789). Well-being

(or utility) was described as the sum of experienced pleasures minus pains (Carter and McBride, 2013). Bentham's philosophy was based on three claims (Bentham, 1789) and has been reviewed by a number of authors (Kahneman *et al.*, 1997; Read, 2007; Diener *et al.*, 2009; Carter and McBride, 2013; Berridge and O'Doherty, 2014). Firstly, that the goodness or badness of experience is the pleasure or pain arising from the experience. Bentham proposed that people's choices are governed by "two sovereign masters" and that a good decision involves choosing the outcome that will produce the most pleasure and least pain. When choices are made between two different outcomes, each outcome has its own hedonic consequences. Secondly, that pleasure or pain is in principle quantifiable. Thirdly, that the quantity of pleasure and pain obtained can be added across people.

This concept was progressed by a number of neoclassical economists including Jevons and Edgeworth. They incorporated the Benthamite emphasis into their new marginal utility approach to economics. Like Bentham, Jevons (1888) and Edgeworth (1879) considered utility to be a real psychological (or physiological) entity. Bentham's approach was reformulated in mathematical terms, using energetics theory, to enable utility to be expressed as an explicit quantity. It was theorised that like a force, marginal utility drew people towards more appropriate consumption options (Lewin, 1996). For example, Edgeworth (1879) referred to absolute measures of pleasure and pain from which overall happiness measures should be calculated over some time period. He proposed that happiness could be measured by a 'hedonimeter', a machine that could measure the level of pleasure or pain that an individual was experiencing at any moment (Frey and Stutzer, 2002; Kahneman and Sugden, 2005; Ahuvia, 2012). During this time, the psychology of pleasure and pain (or sensation) was an

essential part of economics and the boundary between the disciplines was not sharply defined (Bruni and Montesano, 2009).

Empirical research on utility (which is now known as SWB in the field of psychology) began in the early 20th century (Diener *et al.*, 2009). Flugel (1925) studied moods by having people record their emotional events and then summing emotional reactions across moments. This was followed by the use of global surveys which assessed SWB after World War Two (Diener *et al*., 2009). However, during this time, the mental-state account (i.e. experiential approach) began to lose popularity among economists (Bruni *et al*., 2007; Lewin, 1996; Loewenstein and Ubel, 2008). Economists' instead redefined utility to be a representation of preferences (i.e. the desire-fulfilment account) revealed through observed behaviour (i.e. preference-based approaches) and commenced the reconstruction of economic theories (Kahneman *et al.*, 1997; Kahneman and Sugden, 2005; Carter and McBride, 2013). This shift was initiated in the 1930s and 1940s by a number of individuals including Vilfredo Pareto, Roy Allen and Paul Samuelson. This resulted in "the elimination of psychological concepts from economics by basing economic theory on principles of rational choice" (Bruni and Sugden, 2007, p146). This step change was tied to debates about whether pleasures and pains could be measured and the possibility of interpersonal comparisons of utility (Fleurbaey and Hammond, 2004).

Since the 1970s, however, developments in the economics and psychology literature have led to a revival of the experiential approach to measuring well-being (Ahuvia, 2012; Kahneman and Sugden, 2005; Stutzer and Frey, 2010). A review of the concept of SWB by Diener (1984) led to a growing awareness and

an increasing number of reviews and books dedicated to SWB. In 1997, Kahneman and colleagues presented experimental work which, in contradiction to earlier research, showed that experiences could be measured *(Kahneman et al.*, 1997). They identified that SWB can be measured in real time ('instant utility'; momentary assessments) or retrospectively, based on evaluations of past outcomes or episodes ('remembered utility'; see section 3.4.1). These developments led to the rapid growth of the scientific and applied discipline of SWB. Increasing numbers of researchers began to pioneer SWB assessments, polling individuals about their happiness and life satisfaction (Diener *et al.*, 2009; Diener *et al.*, 1999).

It is now contended that a return to the ideology of Bentham could solve a number of the problems associated with relying on preference-based approaches for environmental valuation, as experienced by the CVM and TCM (e.g. Kahneman and Sugden, 2005; Dolan, 2008; Loewenstein and Ubel, 2008). Researchers have argued that interventions (e.g. health or environmental interventions) should be valued "in terms of their impact upon how people think and feel about their lives" (i.e. using the concept of SWB) (Dolan, 2008, p93). Experiential approaches may provide a better measure of well-being as they allow the direct assessment of well-being and do not rely on behavioural and rationality assumptions (Frey and Stutzer, 2002b).

The experiential approach gathers data on well-being using SWB measures (or outcomes). Two stages of the DWB framework (Chapter 1; Figure 1.1) can be assessed using SWB measures, as part of the experiential approach: (i) the experience stage and (ii) evaluative stage. These measures are included in SWB assessments (Ferreira and Moro, 2013; White *et al.*, 2017; discussed in

section 3.4.1). The following sections provide an overview of the dimensions and measures of SWB (3.3.1) and an introduction to the types of SWB assessments (3.3.2.).

3.3.1 Dimensions and measures of SWB

SWB is widely assumed to be composed of four dimensions: positive affect, negative affect (jointly known as 'experienced well-being'), life evaluation and eudaimonia ('evaluative well-being') (National Research Council of the National Academies, 2013). Measures of SWB have been developed based on these three dimensions of well-being for use in assessments. SWB measures ask respondents to sum their experiences over a given reference period, for example emotions yesterday or satisfaction with life nowadays. The reference period (time frame) of the measures will also be discussed in this chapter, as they define what is being measured and can therefore influence comparability of responses and the risk of error (OECD, 2013).

3.3.1.1. Experienced well-being ('affect')

Experienced well-being represents the 'experience stage' of the DWB model (Chapter 1, Figure 1; Dolan and White, 2006). The experience stage is the state reached after attainment of a particular outcome and it pertains to the hedonic impact and experience of that outcome, for example, when an individual wins the lottery (a change in income), or consumes a good or service (e.g. an environmental good). Experienced well-being is concerned with people's feelings and emotional states. It may also include effects associated with sensations (e.g., pain, arousal) and other factors such as feelings of purpose or pointlessness that may be closely associated with emotional states and assessments of those states (National Research Council of the National

Academies, 2013). This type of well-being has been referred to as 'experienced utility' (Kahneman *et al.*, 1997; Dolan and White, 2007; Berridge and O'Doherty, 2014).

The seven most common measures used to assess experienced well-being (or affect) are displayed in Table 3.1. The measures differ in their respective reference periods. Existing measures range from asking respondents about their feelings over a short time period, for example at that particular moment (e.g. Zuckerman lnventory of Personal Reactions; ZIPERS) or yesterday (e.g. experienced SWB questions; Office for National Statistics, 2011, 2012) to longer reference periods of 1-2 weeks (e.g. European Social Survey well-being module, Profile of Mood States; POMS and the Warwick-Edinburgh Mental Well-being scale; WEMWBS). In addition to this, a number of the measures have also been used to measure SWB over multiple time frames, including The Positive and Negative Affect Schedule (PANAS; Watson, Clark and Tellegen, 1988) and the Scale of Positive and Negative Experience (SPANE; Diener *et al.*, 2010). The PANAS questionnaire can be used to measure affect at the present moment, today, during past few days, during past week, during past few weeks, during past year and in general (Watson *et al*., 1988). Of note, WEMWBS also includes measures of eudaimonic well-being (Table 3.3.). SPANE was developed to overcome some of the shortcomings of the PANAS measure, including the predomination of high activation and arousal adjectives (Li *et al.,* 2013; Jovanović, 2015). SPANE can be used to assess positive and negative feelings for the following reference periods: last month, yesterday, past week or in general.

Table 3.1. Examples of commonly used experienced well-being (or affect) measures.

Name of measure	Description	Reference
The Positive and Negative Affect Schedule (PANAS)	PANAS provides respondents with a range of different feelings and emotions, and they are asked the extent to which they feel that way using a 5 point scale (1= “very slightly or not at all” and 5= “extremely”).	Watson *et al.* (1988)
Scale of Positive and Negative Experience (SPANE)	SPANE is a 12-item questionnaire that can be used to assess positive and negative feelings for the following reference periods: last month, yesterday, past week or in general. For both the positive and negative items, three of the items are general (e.g., positive, negative) and three per subscale are more specific (e.g., joyful, sad). All items are rated on a five point scale from 1 (“very rarely or never”) to 5 (very often or always).	Diener *et al.* (2009)
Experienced subjective well-being questions	A two item questionnaire which assesses positive and negative affect. Respondents are asked about their happiness and anxiety yesterday and to respond on a scale from 0 (“not at all”) to 10 (“completely”).	Office of National Statistics (2012)
Extended experience subjective well-being questions	A seventeen item questionnaire which assesses positive and negative affect. Respondents are asked about their happiness and anxiety, in addition to feelings of enjoyment, relaxation, anger and loneliness. Respondents respond on a scale from 0 ("not at all") to 10 ("completely")	Office of National Statistics (2011)
European Social Survey well-being module	The European Social Survey well-being module has 15 questions on the respondent’s affective state over the past week, with responses on a 4-point scale (1= “None or almost none of the time”, 4= “All or almost all of the time”).	Huppert *et al.* (2009)

Zuckerman Inventory of Personal Reactions (ZIPERS)	ZIPERS measures positive and negative affect by asking respondents to indicate the extent to which they are experiencing the given reactions and feelings at that particular moment. Responses are given on a 5 point scale (1= “Not at all”, 5 =”very much”).	Zuckerman (1977)
Profile of Mood States (POMS)	POMS is a list of 65 adjectives that describe feelings or moods experienced over a seven day period. Adjectives include feelings of negative affect (e.g. tension-anxiety). Respondents are asked to self-report using a 5-point response scale from 0 (“not at all”) to 4 (“extremely”).	McNair *et al*. (1971)
Warwick-Edinburgh Mental Well-being scale (WEMWBS)	WEMWBS has 14 items and they are answered using a 5 point Likert scale (1=”none of the time”, 5= “All of the time”). The 14 items cover from both experienced well-being (hedonic aspects; e.g. feelings of optimism and cheerfulness) and eudaimonic well-being (e.g. satisfying interpersonal relationships and positive functioning). The scores are then added together to provide a single score ranging from 14-70. The scale also exists in a short form with 7 items (Short Warwick-Edinburgh Mental Well-being scale; SWEMWBS), which focuses on positive affect.	Tennant *et al.* (2007)

3.3.1.1. Evaluative well-being

Evaluative well-being corresponds to the second experiential stage, the 'evaluation stage' (Chapter 1; Figure 1.1.). This typically involves an evaluation of how pleasurable (based on affective experiences) and meaningful (based on eudaimonic considerations) their life is (Dolan and Metcalfe, 2012; National Research Council of the National Academies, 2013; OECD, 2013). During this stage, people are asked to provide more considered assessments of their well-being (Dolan and White, 2006). It is often applied to specific domains of life, such as relationships, community, health, environment and work (Diener et *al.*, 1999; Dolan and White, 2006; National Research Council of the National Academies, 2013).

This stage is associated with how a person thinks and feels about, for instance, consumption of an environmental good, on refection, in hindsight, and with other things considered and taken into account. For instance one may experience joy at seeing a turtle at the time (experienced well-being), but be saddened at their plight when back on land (evaluative well-being). Emotions are still likely to play a part and be experienced, but this stage also factors in more cognitive considerations and comparison processes. Few studies explore people's longer-term reactions to specific events and goods but tend instead to ask about life as a whole made up of all such instances and contexts.

This is assessed using two types of evaluation measure. The first is life evaluation. Rather than specifying a particular reference period, evaluative questions typically ask respondents how their life is overall nowadays or these days (OECD, 2013). Examples of measures of life evaluation are displayed in Table 3.2. They include: (i) The Cantril Ladder of life scale; (ii) The Andrews

and Withey 1976 Delighted-Terrible scale; (iii) Overall Life Satisfaction Question; (iv) The Evaluative well-being question; and (v) The General Health Questionnaire (GHQ-12). GHQ-12 was not developed for this purpose, instead it was designed to measure psychological distress (Guthrie *et al.*, 1998), but, it has previously been considered as a measure of well-being (e.g. Powdthavee and van den Berg, 2011; Tsurumi *et al.*, 2018). Comparable with WEMWBS, GHQ-12 also crosses the boundaries between the different dimensions of well-being. It can be described as a measure of affect (experienced well-being) and eudaimonia (evaluative well-being).

Questions of life satisfaction (henceforth simply 'LS' for short), including the Overall Life Satisfaction Question and the Evaluative Well-being question, are perhaps the most well-known and commonly used evaluative measure, particularly in the UK and Europe. This has been attributed to their usefulness to policy-makers (Tinkler and Hicks, 2011). In the UK, LS questions have been included in the UK Understanding Society Study (formerly the British Household Panel Survey; BHPS), the Annual Population Survey and the Opinions Survey. At a regional and international scale, the questions have been included in the World Values Survey, the European Social Survey, the German Socio-Economic Panel, the Canadian General Social Survey or the National Institute of Statistics and Economic Studies (INSEE, France) (OECD, 2013).

Measures of eudaimonia assess how an individual's experiences or choices tie in with non-hedonic goals such as those pertaining to psychological flourishing (also known as 'eudaimonic well-being'). Respondents are asked to evaluate how meaningful their life is, based on eudaimonic considerations. Eudaimonic considerations refer to people's perceptions of meaningfulness, sense of

purpose, how worthwhile they feel the activities they engage in are and the overall value of his or her life and the feeling that it has been well-lived (National Research Council of the National Academies, 2013). Eudaimonia goes beyond reflections of life as a whole and experienced emotions and focuses on psychological functioning and the realisation of a person's potential (Graham and Nikolova, 2015; OECD, 2013). This dimension of SWB reflects the Aristotelian notion of happiness. Aristotle in his Nicomachean Ethics (349BC) took as a starting point that humans want the best possible life, one that is lived to its fullest potential or in accord with some internal virtue (Ackrill, 1973; Waterman, 1990; Kashdan *et al.*, 2008; Ryff and Singer, 2008; Graham and Nikolova, 2015).

Most eudaimonic measures do not provide specific guidance to respondents about the reference period in question. It is presumed that individuals indicate their views at the present moment, but look back across their lives for an undefined period (OECD, 2013). Example measures include the Flourishing Index (Huppert and So, 2009), the Psychological Well-being scale (Diener *et al.*, 2009) or the Eudaimonic subjective well-being question (Office for National Statistics, 2012). An overview of the three measures is provided in Table 3.3.

Table 3.2: Examples of life evaluation measures.

Name of measure	Description	Reference(s)
Cantril ladder of life scale	The Cantril ladder of life measure asks respondents to imagine a ladder where the bottom (0) is the worst possible life and the top (10) is the best possible life and then asks them to evaluate their current life by indicating where they feel they are on this scale.	Cantril (1965)
The Delighted-Terrible scale	The question asks respondents "How do you feel about your life as a whole?" and instructs them to answer in terms of what has happened in the last year and what they expect in the near future (Diener *et al.,* 2009). The respondent is asked to respond on a seven point scale from "Delighted" to "Terrible".	Andrews and Withey (1976)
The Evaluative Well-being question	The Evaluative well-being question asks respondents "Overall how satisfied are you with your life nowadays?" Respondents are asked to provide an answer from 0 ("not at all") to 10 ("completely").	Office of National Statistics (2012) and Office of National Statistics (2011).
The Overall Life Satisfaction Question	The question asks: "All things considered, how satisfied are you with your life as a whole these days?" Respondents are asked to respond on a 10 point scale (1= completely dissatisfied, 10=completely satisfied).	Bjørnskov (2010)
General Health Questionnaire- 12 items (GHQ-12)	The questionnaire presents respondents with 12 items (positive and negative) about their health over the last few weeks. They are asked to respond using a scale from 0 (more than usual) to 3 (much less than usual). Examples of positive items include: "have you been able to concentrate on what you were doing?" and "have you been reasonably happy all things considered?" Negative items include: "have you been thinking of yourself as a worthless person?" and "have you felt that you could not overcome your difficulties?"	Goldberg (1978)
British Household Panel Survey (BHPS) question	The question asks: "How dissatisfied or satisfied are you with your life overall?" Respondents are asked to respond on a scale from 1 ("not satisfied at all") to "completely satisfied").	UK Data Service, (2019)

Table 3.3: Examples of eudaimonic measures.

Name of measure	Description	Reference(s)
Eudaimonic subjective well-being question	Question asked respondents "overall, to what extent do you feel the things you do in your life are worthwhile?" on a scale from 0 (“not at all worthwhile”) and 10 (“completely worthwhile”).	Office of National Statistics (2012)
Psychological Well-Being Scale (PWB)	The Psychological Well-being Scale presents respondents with eight statements and asks them to indicate their agreement with each item on a scale from 1 (“strongly disagree”) to 7 (“strongly agree”). The statements explore meaningfulness of life as a whole (e.g. “I lead a purposeful and meaningful life”) and in relation to specific domains of life, including social relationships and daily activities (e.g. “I am engaged and interested in my daily activities”).	Diener *et al.*(2009)
Flourishing Index	The Flourishing Index asks respondents questions themed around indicators of eudaimonia. These include: competence, engagement, meaning, optimism, positive relationships, resilience, self-esteem, emotional stability, vitality and positive emotion. The index uses 4 point, 5 point and 11 point scales.	Huppert and So (2009)

3.4. Experiential method: Subjective Well-being method (SWB)

Two experiential methods have emerged and are based on the concept of SWB: the SWB and the LSA. The SWB method produces a non-monetary estimate of well-being, in the context of environmental goods and services, examining their association with SWB measures. The LSA derives a monetary value for an environmental good, based on the association between SWB and (i) income and (ii) the environmental good in question (i.e. marginal rate of substitution). This section will discuss the SWB method (section 3.4) and the subsequent section will focus on the LSA (section 3.5).

An understanding of the influence of socio-demographic variables on SWB is vital for understanding the effects of environmental goods on SWB (i.e. how important the environment is in comparison to other variables). These include factors related to the individual (e.g. income and gender; Dolan *et al.*, 2008), visit-specific characteristics (e.g. frequency of visit to natural environments), area (area level variables; e.g. crime), and time (e.g. day of the week or season; MacKerron and Mourato, 2013). An overview of the aforementioned factors is shown in Table 3.4 and they are also discussed in Chapter 7, with specific reference to LS. The table augments the studies highlighted in the review by Dolan, Peasgood and White (2008).

Table 3.4: Overview of variables which have been shown to be associated with LS.

Variable type	Example variables	Example references
Individual-level	Income Age Gender Ethnicity Personality Education Health (e.g. physical and psychological health) Work (or labour-market status) Marital status Having children Owning a dog	Ferrer-i-Carbonell and Gowdy (2007) Brereton *et al.* (2008) Ferreira *et al.* (2013) MacKerron and Mourato (2009) Ambrey and Fleming (2014) Ambrey *et al.* (2017) Wang *et al.* (2017) Aoshima *et al.* (2018) Dolan and Metcalfe (2008) Blanchflower and Oswald (2004b) Diener *et al.* (1999) Helliwell (2003) Blanchflower and Oswald (2004) Kim and Jin (2018) White *et al.* (2017) Office for National Statistics (2018) Di Tella *et al*. (2001) Frey and Stutzer (2002) Maccagnan *et al.* (2019) Fields in Trust (2018) Office for National Statistics (2018) Oswald and Powdthavee (2008) Shields and Wheatley Price (2005) Haller and Hadler (2006) Bertram and Rehdanz (2015) Clark *et al*. (2008) Diener *et al.* (2002)
Environment	Visit frequency Neighbourhood exposure (e.g. proximity to green space or the coast)	Fields in Trust (2018) White *et al.* (2017) Brereton *et al. (*2008)
Time-related	Weather Day or year of interview	White *et al.* (2017) Elliott *et al.* (2019) MacKerron and Mourato (2013)
Area-level	Safety in the area Deprivation of the area	Ferrer-i-Carbonell and Gowdy (2007) Lelkes (2006) Shields and Wheatley Price (2005) Lelkes (2006) White *et al.* (2017)

Regression analysis is used to investigate the association between an environmental good and SWB (e.g. proximity to the coast or exposure to a marine and coastal good or service). A selection of the aforementioned variables, dependent on the study (Table 3.4) are also included in the model, to control for their effects (e.g. White *et al.*, 2013; White *et al.*, 2017). This is modelled empirically as an additive function in eq (3.1) (based on Dolan *et al.*, 2008):

$$LS = \alpha + \delta q + \beta x + \varepsilon \quad (3.1)$$

Where LS is the stated level of life satisfaction reported by a respondent, q is the environmental good and $x = (X_1, X_2, \dots, X_n)$ is a set of explanatory variables that contains some of the typical determinants of well-being (e.g. individual-level, area-level and time related factors; Table 3.4). Inter- and intra-individual differences in reporting are captured within the error term ε, which is normally distributed with mean zero.

The next section will provide an introduction to the methodological aspects of the SWB method. There will be an overview of how SWB is assessed in practice and the range of methods that can be used (section 3.4.1). This is followed by an overview of the application of the SWB method to natural environments (section 3.4.2). There will be particular reference to marine and coastal environments and the use of evaluative measures of well-being. This is because LS data from retrospective assessments has been used previously in the LSA, to derive a monetary value for environmental goods (discussed in 3.5; Clark and Oswald, 2002; Boyce, 2009; Stutzer and Frey, 2010; Welsch and Ferreira, 2014).

3.4.1. Types of SWB assessment and methods

Experienced and evaluative well-being can be measured in the moment, using momentary assessments. Momentary assessments ('moment-based approach') measure the quality of the hedonic experience that people are having, moment by moment, in the course of their lives (Kahneman, 2000; Kahneman and Sugden, 2005). This was the first approach used to measure SWB (Flugel, 1925) and assesses instant utility (Kahneman, 2000). In addition, they can be measured retrospectively. This assessment measures remembered utility, the pleasure or displeasure associated with past outcomes or episodes (Kahneman and Sugden, 2005; OECD, 2013). There are various methods that can be used to collect data on momentary and retrospective reports of SWB. These are highlighted in Table 3.5 and discussed in more detail below.

Table 3.5: An overview of the two categories of SWB assessment and their respective methods.

Type of assessment	Description	Assessment method
Momentary	Momentary assessments measure instant utility, the quality of the hedonic experience that people are having, moment by moment, in the course of their lives.	• Randomised control trials • Natural experiments • Experience Sampling Method (ESM) • Ecological Momentary Assessment (EMA)
Retrospective	Retrospective assessments measure remembered utility, the pleasure or displeasure associated with past outcomes or episodes.	• Randomised control trials • Natural experiments • Day Reconstruction Method (DRM) • Large-scale surveys

3.4.1.1. Randomised controlled trials

Randomised controlled trials randomly assign participants to experience different environments or control conditions (White *et al.*, 2017). Respondents are asked to provide a self-report assessment of the specific health outcome (e.g. SWB) following their exposure to the specified conditions. Experiments can involve exposure through simulations of nature (laboratory experiments) or through real nature. They have been used to investigate the links between health outcomes (e.g. SWB) and exposure to nature (e.g. coastal environments; (McMahan and Estes, 2015).

Laboratory simulations of natural environments, including coastal environments, have previously involved video recordings (Ulrich *et al.*, 1991; Karmanov and Hamel, 2008; White *et al.*, 2015), audio-visual presentations (Fredrickson and Levenson, 1998), photographs (Berman *et al.*, 2008; White *et al.*, 2010) and virtual reality (Tanja-Dijkstra *et al.*, 2014; Grellier *et al.*, 2017). For example, White *et al.* (2015) examined the benefits from exercising in simulated natural environments among a sample of post-menopausal women. The participants were asked to exercise under laboratory conditions for 15 minutes while watching projections of urban, green or blue landscapes on to a wall (or while facing the blank wall as a control condition). Affect, in addition to other outcomes (e.g. heart rate) were measured at 5, 10 and 15 minutes during exercise. The study revealed that natural environments were associated with increases in positive affect, but there was no significant difference between the green and blue landscapes.

Laboratory experiments provide an opportunity for controlled comparisons of reactions to different environmental settings. They randomly assign participants

to experience different environments or expose them to several environments and compare their reactions to each (White *et al.*, 2017). However, laboratory experiments often employ lower sample sizes than other assessment types, which may provide less stable estimates of effect size (McMahan and Estes 2015). There is also debate as to whether nature simulations can serve as effective substitutes for actual exposure to nature (Levi and Kocher, 1999; Mayer *et al.*, 2009). A recent meta-analysis (McMahan and Estes 2015) reviewed 36 studies and identified that exposure to real environments had a greater effect on positive affect than exposure to laboratory simulations of nature.

Studies have also exposed respondents to real nature, through a variety of mechanisms. These include exposure to indoor plants (Dijkstra *et al*., 2008; Beukeboom *et al.*, 2012; Drahota *et al.*, 2012) and engagement in specific activities (e.g. walks in the woods or on urban streets; Mayer *et al.*, 2009; Johansson *et al.*, 2011). For example, Mayer *et al.* (2009) examined positive and negative affect in a group of students who spent 15-minutes walking in nature *vs*. a group of students who spent 15-minutes walking in an urban area. They identified that exposure to nature increased positive emotions, in addition to other outcomes (e.g. connectedness to nature, attentional capacity, and ability to reflect on life problems). Randomised control trials have been described as “the most rigorous way of determining whether a cause-effect relation exists between treatment and outcome and for assessing the cost effectiveness of a treatment” (Sibbald and Roland, 1998, p1). However, they may also have limitations. The method can be limited by ethical and practical concerns and they are more costly and time consuming than other types of study (Kendall, 2003).

3.4.1.2. Natural experiments

Natural experiments ('quasi-experiments') are empirical studies in which individuals are exposed to experimental and control conditions determined by factors outside of the control of the investigators (CTI Review, 2016). Groups of respondents exposed to a particular intervention are matched with and compared to a similar group of respondents that have not been exposed to the intervention. Natural experiments are observational studies and are not controlled in the traditional sense of randomised control trials. Investigators tend to have little control over the level of variation in the determination of interest or in the allocation of treatment groups, which is rarely completely random (CTI Review, 2016; OECD, 2013). They have predominantly been used to examine the impact of environmental interventions (including those with blue space components) on outcomes such as physical activity (National Institute for Health and Care Excellence, 2018; World Health Organisation Europe, 2017). However, they can also be used to assess experienced and evaluative well-being.

Longitudinal or (repeat) cross-sectional surveys can be used to assess SWB, like large scale-surveys. For example, Ward Thompson *et al.* (2019) used a natural experiment to examine the impact of a green-space intervention (Woods In and Around Towns, WIAT, programme). Three intervention and three control woodland sites were used and longitudinal data (n= 609) were collected in three waves: pre (2013), post (2014) and delayed post (after the social interventions; 2015). A range of outcome measures were included, but well-being was assessed using the SWEMWBS measure.

There are a number of benefits of using natural experiments to assess SWB (OECD, 2013). Much of the evidence on SWB is non-experimental, cross-sectional data, so it can be difficult to establish causal relationships. Therefore, natural experiments may better address issues associated with reverse causality and omitted variable bias if the intervention group is not chosen on the basis of differences in SWB (Dolan and Metcalfe, 2012).The method also has the benefit of being able to use data sets of large and high quality samples (e.g. data from national agencies), which can enhance the representativeness and generalisability of the findings. Although natural experiments have been used to explore the impact of interventions on SWB (National Research Council of the National Academies, 2013), there are challenges associated with their use. For example, in natural experiments, the researcher does not have the ability to experimentally manipulate variables (OECD, 2013).

3.4.1.3. Large-scale surveys

Large scale surveys are the most frequently used method to assess SWB. SWB measures have been included in data collection gathering efforts in a number of countries, including the UK (Stiglitz *et al*., 2009; Dolan and Metcalfe, 2012; National Research Council of the National Academies, 2013). Large-scale surveys have used both longitudinal (e.g. German Socio-economic Panel and the UK Household Longitudinal survey) and cross-sectional designs (e.g. Gallup World Poll, the World Values Survey and the UK's Monitor of Engagement with the Natural Environment survey; MENE). Evaluative well-being measures (e.g. LS) are the most common measures in large scale surveys (Diener *et al.*, 2002). Large scale surveys have been delivered using face-to-face interviews, telephone interviews and online surveys.

There are a number of advantages and disadvantages associated with large-scale surveys such as the ability to provide significant sample sizes, which are important for detecting drivers of SWB and providing more stable estimates of effect size (OECD, 2013). Large scale surveys also carry less risk of experimental demand characteristics (e.g. the placebo effect) than randomised control trials and natural experiments, where a respondent's knowledge that they are part of a study may influence reports of SWB. They also provide opportunities to adopt a quantitative spatial approach, in which SWB data is merged with geographical information to explore the links between exposure to the natural environment (e.g. neighbourhood exposure) and SWB (de Vries *et al.*, 2003; Brereton *et al.,* 2008; White, *et al.*, 2017). At present, the majority of large-scale surveys tend to rely on cross-sectional survey design. Cross-sectional studies do not, however, enable causal inferences to be made directly, may be prone to non-response bias and may suffer from day-to-day variability (OECD, 2013; Sedgwick, 2014).

3.4.1.4. Behavioural diary methods

This type of method uses longitudinal study designs in which participants provide ongoing reports of their everyday experience (MacKerron and Mourato, 2013). Methods include the Ecological Momentary Assessment (EMA), the Experience Sampling Method (ESM) and the Day Reconstruction Method (DRM). It has been argued that these types of method provide some of the best evidence regarding influences on well-being in general (Kahneman *et al.*, 2004; Hektner *et al*., 2007; Shiffman *et al.*, 2008).

The ESM and EMA provide a momentary assessment of well-being by focusing on in-situ assessments of SWB obtained in response to random signals (e.g.

alerts via smartphone) each day over several days (Bolger and Laurenceau, 2013). The ESM asks participants to produce real time reports on their well-being and the activity they are undertaking at either random or fixed time points, usually several times a day, throughout the study period (Csikszentmihalyi and Larson, 2014). Electronic diaries are often used to remind respondents when entries are due and to record the timing (OECD, 2013). Two recent studies have used the ESM to explore the relationship between SWB and individuals' immediate natural environment (MacKerron and Mourato, 2013; Bakolis *et al.*, 2018). For example, MacKerron and Mourato (2013) developed a mobile phone app called Mappiness, which alerted people at quasi-randomly selected times over the course of the day to find out information about what they were doing, who they were with and how they felt (e.g. happiness and relaxation). They gained over 1 million responses from over 20,000 participants.

The EMA is similar to the ESM as it collects real-time data on subjects' current behaviour and experience in real time in their natural environments (Shiffman *et al.*, 2008). However, it also collects data on physiological measures including skin response, temperature and motion (Wilhelm *et al.*, 2003). The EMA use a variety of mechanisms to collect SWB data including traditional diaries and electronic devices (e.g. paging devices, wrist-watches and palmtop computers; Smyth and Stone, 2003). For example, Riis *et al.* (2005) used the EMA to compare moods (including experienced well-being, e.g. happiness and anxiety) of haemodialysis patients and healthy respondents. Ninety eight respondents were studied over a seven day period and were alerted every 2 hours.

These methods may have a number of advantages. First, they use a longitudinal approach. Therefore, they can be used to examine temporal

sequences of events or experiences (Shiffman *et al.*, 2008) and avoid a number of issues associated with cross-sectional studies (e.g. day-to-day variation and inability to differentiate between cause and effect; National Research Council of the National Academies, 2013). Second, they have the ability to capture daily life as it is directly perceived from one moment to the next, affording the opportunity to examine fluctuations in SWB and its relationship with external contexts (Bolger and Laurenceau, 2013; Hektner *et al.*, 2007). Third, they minimise the occurrence of memory burden and the risk of recall bias, which may be encountered by methods which provide retrospective assessments. However, they have been described as being cumbersome, expensive and in some cases have been limited to very small samples (Killingsworth and Gilbert, 2010).

The DRM provides a retrospective assessment of well-being and combines a time-use study with a technique for recovering affective experiences. The DRM asks respondents to recall memories of the previous day by constructing a time-use diary consisting of a sequence of episodes. They are then asked to describe each episode by answering questions about the situation and about the feelings that they experienced, as in the ESM (Kahneman *et al.*, 2004; Stutzer and Frey, 2010). Therefore, the DRM provides an estimate of the total amount of self-reported SWB experienced during an activity (White and Dolan, 2009). For example, Kahneman *et al.* (2004) asked a random sample of women (n=908) to think about their previous day and to decompose it into short episodes. For each episode, they were asked to state if they were interacting with anyone and to self-report on their positive or negative feelings (e.g. happiness, worry and anxiety). White and Dolan (2009) adapted the DRM and included six additional self-report items to assess thoughts and evaluations (life

evaluation and eudaimonia) as well as affect. The research investigated the relationship between daily activities and SWB.

Commonly cited advantages of the DRM are as follows (Kahneman *et al.*, 2004). Firstly, the DRM has a lower response burden and has a more complete coverage of the day than momentary assessments, such as the ESM. Secondly, the DRM is less distorted by limitations of memory and has lower susceptibility to retrospective reporting biases that are inherent in global reports of SWB, adopted in other retrospective assessments. However, further development of the method is required before the validity and reliability of the DRM is ascertained (Diener and Tay 2014).

3.4.2. Application of the SWB method with respect to natural environments

This section reviews the application of the SWB method to natural environments, particularly with reference to marine and coastal environments and LS. SWB measures have been used to explore the benefits of exposure to natural environments, producing non-monetary estimates of well-being. The most commonly used measures are LS and GHQ-12 (Gascon *et al.*, 2015, 2017; see section 3.3). However, other measures have also been used (e.g. WEMWBS, Table 3.1; Roe *et al.*, 2013). To date, the majority of studies have used large scale-surveys to examine the link between natural environments and SWB (Gascon *et al.*, 2015, 2017, 2018). These studies often use a quantitative-spatial approach, in which cross-sectional or longitudinal SWB data is merged with geographical information (GIS data) on neighbourhood (residential) exposure to natural environments (e.g. blue and green spaces).

As highlighted by systematic reviews on natural environments and health (e.g. Gascon *et al.*, 2015, 2017, 2018), there are fewer examples of longitudinal designs, compared to cross-sectional studies in the health and environment literature. Longitudinal (cohort) studies select groups from the wider population, which are followed over time to identify changes to SWB as a result of their access to natural environments. White *et al.* (2013) used BHPS data from over 10,000 individuals to explore the relation between urban green space and well-being. They found that on average, individuals had both lower mental distress and higher LS when living in urban areas with more green space.

Instead, the majority of studies have used a cross-sectional study design. Cross-sectional observational studies use local, regional, and national survey data to explore correlations between well-being and visits to, amount or proximity to green or blue space at a population level (Parliamentary Office of Science and Technology, 2016). In terms of neighbourhood exposure, studies have examined the links between SWB and proximity to blue spaces (e.g. coast and beaches; Brereton *et al.,* 2008; White, *et al.*, 2017) and green spaces (e.g. parks and woodlands; de Vries *et al.*, 2003). For example, Brereton *et al.* (2008) used LS data from the Urban Institute Ireland National Survey on Quality of Life (2001) to assess the relationship between LS and a range of environmental variables, including: proximity to the coast (within 2km and 2-5km) and beach (within 5km and 5-10km). Whilst proximity to the beach did not have a significant effect on SWB, the study identified that proximity to the coast is an important factor affecting LS. There was no significant association between LS and proximity to the beach. But, there was a significant association for coastal proximity. Individuals living within 2km of the coast reported higher LS, than those living further from the coastline.

In terms of SWB and visits to natural environments, research has suggested that people show improvements in evaluative and experiential well-being from visiting green and blue spaces (de Bell *et al.*, 2017; White *et al.*, 2017). For example, White *et al.* (2017) used data from the MENE survey to examine the association between visit frequency and visits to nature yesterday and the four components of SWB (discussed in section 3.3). There was no significant relationship between LS and visits to natural environments when controlling for a range of other determinants of well-being. But there were significant associations for the other components of SWB, for example, visit frequency was associated with eudaimonic wellbeing and a visit yesterday was associated with positive affect yesterday.

More recently, SWB research has been linked to two subfields of economics: happiness economics and environmental economics, where it may be used to value the effect of different events or conditions on human happiness and psychological health (Clark and Oswald, 2002; Stutzer and Frey, 2010; Welsch, 2002). The experiential approach to environmental valuation merges elements from psychological theory (sections 3.2-3.4) and welfare economics (discussed in Chapter 2; section 2.3). The approach makes use of an empirical proxy of the notion of utility (experienced utility) which was previously considered by economists to be unobservable (Frey and Stutzer, 2002) and combines them with economic concepts (e.g. indirect utility function, marginal rate of substitution, CV and EV). The method has therefore been referred to as the Life Satisfaction Approach (LSA; also named the 'Experience Preference Method' or 'SWB valuation approach'; Fleming and Ambrey, 2017; Frey *et al*., 2010; Welsch and Ferreira, 2014). This thesis focuses on the use of LS as a SWB measure in the LSA.

3.5. Experiential method: Life Satisfaction Approach (LSA)

The aim of the method is to place a monetary value on the well-being gained from people's experiences, i.e. the experienced or evaluative well-being they gain from the consumption of a good. The method uses measures of LS as a proxy of an individual's underlying utility to arrive at this estimate (Fujiwara and Campbell, 2011). Therefore, hypothetical judgements used in preference-based approaches (e.g. the CVM) are replaced with an *ex-post* calculation of impact based on the stated level of LS (Frey *et al*., 2010; OECD, 2013; Welsch and Ferreira, 2014).

The LSA models individuals' LS as a function of their income, the prevailing environmental conditions and a range of other determinants of LS.The method exploits spatial or temporal variation in an environmental good, to calculate the trade-off people would be willing to make between income and the good in question (Welsch and Kühling, 2009). Analogous to the CVM, the LSA provides estimates of the Hicksian welfare measures (CV and EV) by producing a WTP estimate. This is dependent on the scenario in question (e.g. whether there is an increase or decrease in the provision of the good in question; see section 2.2). There has been an inconsistent use of terminology for the LSA value estimate, which provides difficulties for interpretation. Alternatives include: the SWB value (Fujiwara and Dolan, 2016), implicit Marginal Rate of Substitution (MRS; Bertram and Rehdanz, 2015), implicit willingness-to-pay (Frey *et al.*, 2010; Fleming and Ambrey, 2017), income compensation or income equivalence value (Dolan and Metcalfe, 2008; Carroll *et al.*, 2009) and compensating surplus or equivalence surplus value (Ambrey and Fleming, 2012; OECD, 2018). In theory, the approach can measure use values from

goods, however, there is no consensus on whether it can also capture non-use values (see Chapter 4; section 4.3). It may also help to capture the effect of changes that people may either not be consciously aware of, or fail to attribute to particular causes or policies (OECD, 2018).

3.5.1. Objectives and underpinning theory

Application of the LSA is a two-step process and therefore has two objectives. The first objective is to assess the association between LS (LS), the non-market good and income. This represents the approach taken in the SWB method, discussed in section 3.4. A regression analysis is used to investigate this association, whilst controlling for a range of other determinants of LS (explanatory variables; including gender, health, relationship status and employment status). Eq (3.1) for the SWB method is adapted to produce eq (3.2).

$$LS = \alpha + \gamma y + \delta q + \beta x + \varepsilon \quad (3.2)$$

Where LS is the stated level of LS reported by a respondent. q is a variable indicating the provision of the non-market good to be valued. For example, in the current thesis, q is a binary variable representing the implementation of a coastal regeneration project. y is the household's total annual income after tax and compulsory deductions from all sources. $x = (X_1, X_2, \dots, X_n)$, is a set of explanatory variables which contain some of the typical determinants of well-being (e.g. individual-level and visit-related variables; section 7.4.2). α is a constant. Eq. (3.2) highlights the need to understand the association between LS and income for the LSA to work. Measurement error resulting from inter- and intra-individual differences in reporting are captured by the error term ε (Dolan

and Metcalfe, 2008; Fujiwara and Campbell, 2011). The coefficients δ and γ inform us respectively of the association between LS and the provision of a non-market good (e.g. the implementation of a coastal regeneration project) and income. Both coefficients are expected to be positive. The vector β describes the association between LS and the additional explanatory variables.

The second objective is to value benefits of a non-market good on LS. The estimate derived from the LSA is denoted $WTP_{\Delta q}$ to distinguish it from the WTP estimate derived from the CVM (see Chapter 2, section 2.3). The two values are estimated using different approaches and this is discussed in Chapter 4 (section 4.2). $WTP_{\Delta q}$ is the value uncovered from the marginal rate of substitution between the non-market good and income, using the ratio of the non-market good and the income coefficients from eq (3.2). This is described as taking the partial derivatives of LS with respect to q and y (Dolan and Metcalfe, 2008; Fujiwara and Campbell, 2011; OECD, 2018). The MRS can be used to estimate the value associated with an increase or decrease in provision of an environmental good (Welsch and Ferreira, 2014; Welsch and Kühling, 2009). However, this section focuses on the value associated with an increase in the provision of an environmental good.

Eq (3.3) illustrates how this is estimated for a marginal change in a non-market environmental good:

$$WTP_{\Delta q} = -\frac{\frac{\partial LS}{\partial q}}{\frac{\partial LS}{\partial y}} = -\frac{\delta}{\gamma} \tag{3.3}$$

If the change in q represents a discrete, i.e. non-marginal, change from q^1 to q^2 the WTP for this change can be expressed as:

$$WTP_{\Delta q} = -\frac{\delta \Delta q}{\gamma} \tag{3.4}$$

$WTP_{\Delta q}$ is estimated using the sub-sample that gains the environmental good ($\Delta q = q^2 - q^1$). This provides a monetary value of CV, corresponding with welfare scenario 1 (see Chapter 2; Table 2.1). It is interpreted as the amount of money that an individual would be willing to give up for the provision of an environmental good (i.e. increase in provision) given that utility stays constant (Fujiwara and Campbell, 2011; Welsch and Ferreira, 2014; Welsch and Kühling, 2009).

The income term is typically modelled in a log form $ln(y_0)$ to account for the diminishing marginal utility of income. This results in the specification of a semi-log model and is illustrated below:

$$WTP_{\Delta q} = y_0 - e^{\left[\ln(y_0) - \frac{\delta \Delta q}{\gamma}\right]} \tag{3.5}$$

Where, y_0 is the status quo level of income for the individual, usually assumed to be the sample average level of income (OECD, 2018).

3.5.2. Design, implementation and analysis of an LSA study

There are limited best practice guidelines for the LSA. However, the stages for the design, implementation of SWB surveys, and the analysis of SWB data are well-documented (OECD, 2013). This section provides an overview of this process to enable a comparison with the CVM (Chapter 2). The process is

outlined in Figure 3.1 and highlights the different stages involved when using primary and secondary datasets.

3.5.2.1. Initial research and study design

As shown, there is significant work in the early stages of the study. Initial research and planning (Stage 1) is required to (i) define key research questions, (ii) the analytical approach, (iii) ascertain data requirements for the desired analysis (e.g. primary or secondary datasets), (iv) to outline survey questions needed to elicit required data and (v) determine time and cost considerations (OECD, 2013). This may involve engagement with the end-user and stakeholder groups.

Once the scope of study is decided, the study design is considered (Stage 2). At this stage, the difference between the process for primary and secondary data studies becomes apparent. Both types of study require key decisions to be made on the study population and sample size. However, primary data studies have additional considerations, due to the development of a questionnaire. This includes consideration of the type of study design (cross-sectional *vs.* longitudinal), the study duration (enumeration period), the type of SWB assessment (e.g. natural experiment; discussed in section 3.4.1), sampling method (e.g. stratified or random sampling) and survey mode (e.g. face-to-face interviews; discussed in Chapter 2, section 2.6.2.1). Surveys can be carried out using a range of survey modes, as discussed in Chapter 2; Figure 2.3). The choice of survey mode can influence costs and respondent burden, therefore the choice of mode is an important decision when collecting data. In addition, there are further considerations, including the survey administration (e.g. use of a market research company) and recording and storage of data.

On the other hand, secondary data studies need to consider the types of survey vehicles and respective datasets. SWB questions are often included in a module which is included in existing surveys rather than requiring a whole survey questionnaire in itself (OECD, 2013). There are various types of survey vehicle and secondary datasets, which differ in terms of their survey population, survey mode, type of SWB assessment, study design (cross-sectional or longitudinal design) and study duration. Decisions on the choice of dataset(s) should be selected based on the key research questions, analytical approach and survey questions needed to elicit required data (e.g. SWB measures and explanatory variables). An understanding of the above and use of the data requires examination of technical reports and guidance documents for the datasets. They also provide information on data processing, storage and guidance on their use (including ethical issues).

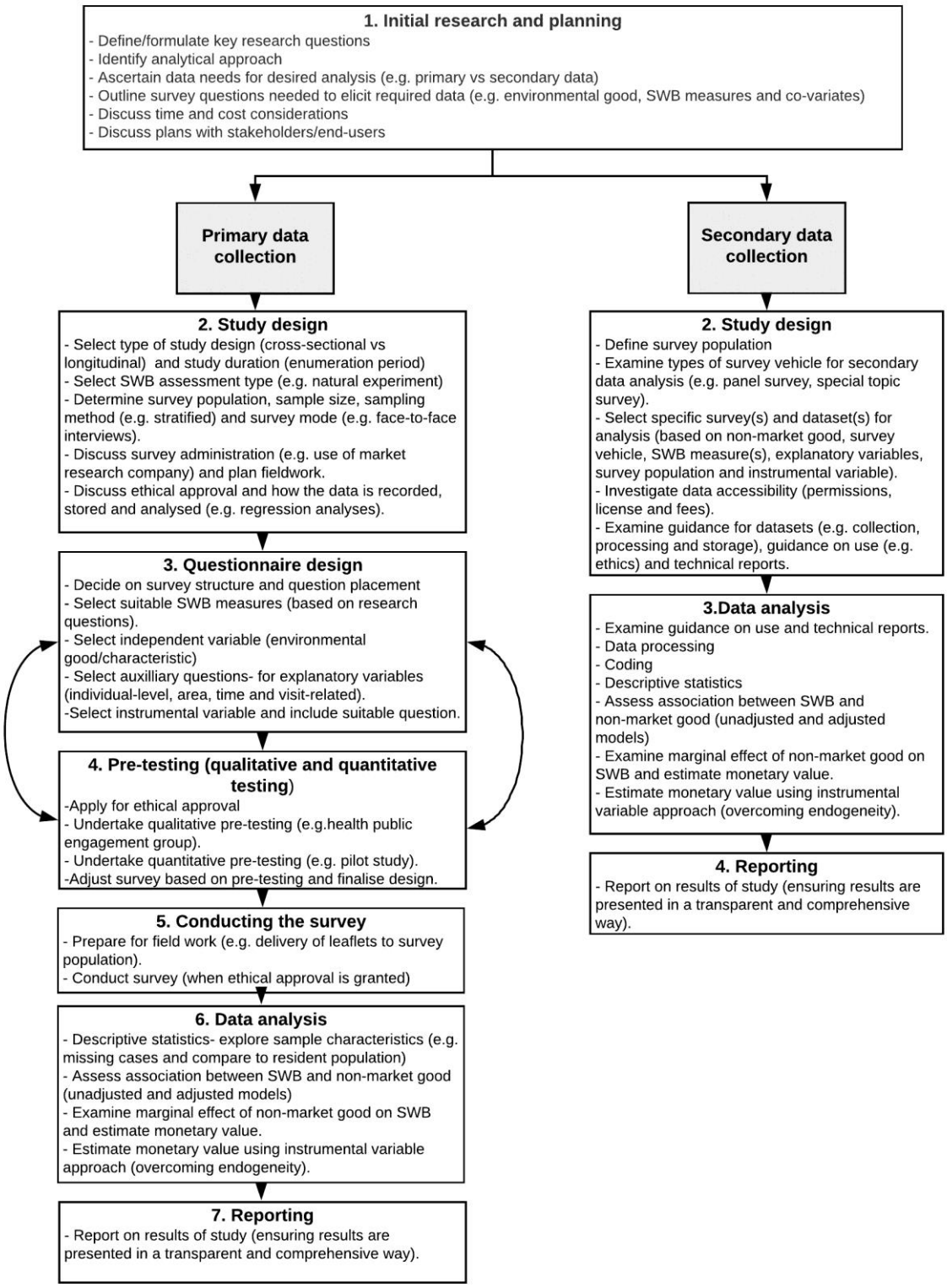

Figure 3.1. Process involved in the design, implementation and analysis of an LSA study.

3.5.2.2. Questionnaire design

The next stage for primary data studies is questionnaire design and pre-testing. Questionnaires need to include three components. The first is a SWB measure(s). As highlighted in section 3.3 there are three different dimensions of well-being and therefore various types of SWB measures and modules for inclusion in questionnaires (OECD, 2013) and it is not clear which measure should be used for which purpose (Dolan *et al.*, 2011; Powdthavee and van den Berg, 2011; OECD, 2018). A range of SWB measures can be used in the valuation of non-market goods, e.g. GHQ-12, happiness and anxiety (Kim and Jin, 2018; Tsurumi, *et al.* 2018). But LS measures represent the closest measure to an economist's notion of utility and have been used most frequently (Fujiwara and Campbell, 2011). The choice of SWB measure should be based on the research questions, study design and the specific policy in question (if applicable). It is also important at this stage to decide upon the time period for the LSA estimate, drawing on guidance from previous research (as discussed in 3.3.2). The second are the questions pertaining to the non-market environmental good in question. The third are the auxiliary questions. The choice of SWB items affects the selection of auxiliary questions (e.g. questions related to the determinants of SWB; Table 3.4), because the different dimensions of SWB have different determinants (Dolan *et al.*, 2011; OECD, 2018).

The quality of the survey relies on pre-testing and it is often an iterative process to design a questionnaire (as shown in Figure 3.1). Pre-testing can be undertaken more than once; depending on the degree of modification required. Although the SWB measures have undergone thorough testing (OECD, 2013),

self-reports may be affected by the additional content of the survey and question placement (i.e. question-order). Therefore, SWB questionnaires should generally be organised in a particular manner to avoid question-order bias (discussed in Chapter 4; section 4.6). Two categories of pre-testing are recommended. The first is qualitative pre-testing which can aid the design of the questionnaire, provide insights into respondents' comprehension of survey materials and help to consider how to manage the risks associated with questions that are distressing to respondents (OECD, 2013). The second is quantitative pre-testing, which permits limited statistical analyses of a pilot sample of data to test initial hypotheses and facilitate design modifications. The two-stage pre-testing approach is identical to best practice guidelines for SP studies (e.g. CVM; see section 2.6).

3.5.2.3. Implementation and analysis

The remaining stages pertain to implementation and analysis. For primary data studies, planning for fieldwork is required and the process depends on the choice of survey mode. For example, it may involve engaging with a market research company for studies using face-to-face interviews and online surveys. For primary and secondary studies, data analysis is undertaken to meet the aim and objectives of the LSA study, discussed in section 3.5.1. This involves the use of descriptive statistics to examine the sample characteristics and regression analysis.

Regression analyses are undertaken to assess the association between the non-market good, with and without controls for determinants of SWB (unadjusted and adjusted models; eq.2). The subsequent coefficients from the analysis are then used to estimate the marginal effect of the project delivering

the environmental good, such as a coastal regeneration, on LS (eq. 3-4) and a monetary value for the non-market good in question ($WTP_{\Delta q}$). An instrumental variable approach may also be used to overcome issues of endogeneity. Instrumental variables can be derived from the primary dataset or a related secondary dataset (Powdthavee, 2008; Fujiwara *et al*., 2014; see Chapter 4, section 4.5). Following this, the study results are reported.

3.6. Application of the LSA to natural environments

The LSA approach was first applied in 2002 to value health conditions (Clark and Oswald, 2002; Ferrer-i-Carbonell and van Praag, 2002) in addition to urban air pollution (Welsch, 2002). Since 2002, there has been growing application of the LSA to value non-market environmental goods (see Table 3.6). There is a paucity of research, however, that has valued actual changes in the environmental quality (i.e. provision of non-market goods) resulting from environmental interventions and policy. This has been described as an important challenge (Gascon *et al.*, 2018; OECD, 2018). Instead, previous applications of the LSA in the environmental context have used a quantitative-spatial approach (Kopmann and Rehdanz, 2013; MacKerron and Mourato, 2009; Tsurumi and Managi, 2015). This has commonly involved comparing environmental characteristics (e.g. amount of green space) across large areas (e.g. regions and countries) with heterogeneity for these goods. This section will discuss application of the method to environmental disamenities (section 3.6.1) and amenities (section 3.6.2).Estimates are converted into pounds where applicable[4].

3.6.1. Environmental disamenities

[4] Estimates converted to GBP (£) based on conversion rates from year of data collection.

The method has been commonly used to value environmental disamenities (Welsch and Ferreira, 2014), including air pollution (MacKerron and Mourato, 2009; Menz and Welsch, 2010), climatic characteristics (e.g. Rehdanz and Maddison, 2005) and flooding (e.g. Luechinger and Raschky, 2009).

LSA studies have used cross-sectional data to value changes in air quality. Research has found that higher levels of nitrogen dioxide (MacKerron and Mourato, 2009; Menz and Welsch, 2012; Welsch, 2002, 2007), lead (Welsch, 2002), sulphur dioxide (Luechinger, 2009; Menz and Welsch, 2012) and particulate matter (PM_{10}) (Menz and Welsch, 2010; Menz, 2011; Levinson, 2012; Cuñado and de Gracia, 2013; Ambrey et al., 2014) in an individual's neighbourhood are all associated with significantly lower LS. This translated into a considerable monetary value for improvements to air quality. Research has also valued the relationship between LS, noise pollution (Weinhold, 2013) and climate conditions (Frijters and Van Praag, 1998; Maddison and Rehdanz, 2011; Cuñado and de Gracia, 2013). For example, Cuñado and de Gracia (2013) estimated the MRS between incomeand air quality in Spain. The MRS was expressed in euros per "polluted" day, interpreted as a day in which the average daily PM_{10} exceeds 50 $\mu g/m^3$. They obtained an MRS equal to £242 (325 euros) for air pollution. This is the willingness to pay per year to reduce in one day the number of days with an excess of PM_{10}.

3.6.2. Environmental amenities

In recent years there has been rising interest in valuing the current provision of environmental goods using the LSA (environmental amenities; Table 3.6). For example, studies have valued the association between LS, land use and scenic amenity (e.g. Ferreira *et al*., 2006; Moro *et al.*, 2008; Ferreira and Moro, 2010;

Ambrey and Fleming, 2011; Kopmann and Rehdanz, 2013; Ambrey *et al.*, 2014; Welsch and Ferreira, 2014). For example, Kopmann and Rehdanz (2013) valued changes in natural land cover, using LS data from the European Quality of Life Survey (EQLS). They identified that WTP estimates tended to be higher for habitats that were scarcer (e.g. wetlands: £51.37, 69.96 euros), in comparison to those that were more common (e.g. Natural forests: £0.02, 0.03 euros) in Europe. The LSA has also been increasingly applied to the valuation of green spaces in urban areas (Tsurumi and Managi, 2015; Wang *et al*., 2017; Aoshima *et al.*, 2018) and urban parks (Fields in Trust, 2018; Kim and Jin, 2018). For instance, Fields in Trust (2018) valued visits to local parks and green spaces in the UK. Visiting parks and green space more than once a month was estimated to be worth £974 per person per year.

Although the approach has started to emerge in the environmental economics literature, the LSA has seen limited application to a marine and coastal context. The LSA has been used previously to value the monetary value of coastal proximity (e.g. Cuñado and de Gracia, 2013), water quality of blue spaces (e.g. lakes, rivers, harbours, oceans and coastlines; Ambrey *et al*., 2017), increases in the size of specific habitats (e.g. inland and marine wetlands; e.g. Kopmann and Rehdanz, 2013) and changes to the quality of coastal environments (e.g. Jarvis *et al*., 2017). In addition to assessing the value of climate and air pollution (3.5.2.1), Cuñado and de Gracia (2013) also valued the benefits of living in a region bordering the sea. The value of coastal proximity exceeded those for air pollution and climate and was estimated to be 16,000 to 26,000 Euros per year. Another example is Jarvis *et al.* (2017). The study valued changes in self-reported perceptions of quality of the cultural ES provided by the Great Barrier Reef (Australia), including features such as coral reefs, reef fish, beaches and

islands. Overall, the study investigated the additional income required to compensate residents should current levels of satisfaction with the cultural ES values drop to zero (equivalent to a situation where residents are neither satisfied nor dissatisfied). Mean WTP ranged between £11,056 ($16,655 AUD) and £19,447 ($29,296 AUD) depending on the region.

Table 3.6: Examples of LSA studies (categorised by the type of environmental amenity and environmental good).

	Type of environmental good	**Example studies**
Environmental disamenities	Air, water and noise pollution	Welsch (2002) Welsch (2006) Welsch (2007) Luechinger (2009) MacKerron and Mourato (2009) Luechinger (2010) Menz and Welsch (2010) Menz (2011) Gandelman *et al*. (2012) Levinson (2012) Menz and Welsch (2012) Cuñado and de Gracia (2013) Weinhold (2013) Ambrey *et al.* (2014) Barrington-Leigh and Behzadnejad (2017)
	Climate	Frijters and Van Praag (1998) Van de Vliert *et al.* (2004) Maddison and Rehdanz (2011) Cuñado and de Gracia (2013)
Environmental amenities	Environmental land use and scenic amenity	Ferreira *et al.* (2006) Moro *et al.* (2008) Ferreira and Moro (2010) Kopmann and Rehdanz (2013) Welsch and Ferreira (2014) Ambrey and Fleming (2011) Ambrey *et al.* (2014)

	Marine and coastal environments	Jarvis *et al*. (2017) Cuñado and de Gracia (2013)
	Water quality	Ambrey *et al.* (2017)
	Urban green spaces/landscape	Aoshima *et al.* (2018) Kim and Jin (2018) Fields in Trust (2018) Wang *et al.* (2017) Tsurumi *et al.* (2018) Tsurumi and Managi (2015) Bertram and Rehdanz (2015)

3.6.3. Policy and Ecosystem Services

SWB measures (e.g. LS) are increasingly applied by public policy-makers globally to monitor societal progress (i.e. the well-being of people and households), inform policy design and policy appraisal (Dolan *et al.*, 2011). Like the CVM, the LSA expresses benefits in monetary units, which facilitates its use as a valuation technique for CBA (Fujiwara and Dolan, 2016; HM Treasury, 2011). There is still uncertainty as to whether the LSA is robust enough for use in CBA. Previously, it was considered that the LSA was still an emerging method which might hinder its use in policy and CBA in a meaningful way (Fleming and Ambrey, 2017; Fujiwara, 2013; Fujiwara and Dolan, 2016). However, recently, the status of the LSA has been elevated (HM Treasury, 2018; OECD, 2018). The following statement was included in the recent HM Treasury (2018) Green Book: “it is recognised that the methodology continues to evolve and it may be particularly useful in certain policy areas, for example community cohesion, children and families” (p42). Therefore, the LSA might be robust enough to use in CBA in certain policy areas, but the environment is not considered one of these currently.

Despite the use of LS measures in policy in the UK and the application of the LSA to environmental goods, there has been limited acknowledgement of this approach in the ES literature. To date, the method has not been recognised as a monetary valuation method in the ES literature and has not been framed this way in the LSA literature. However, based on the review of studies above (3.6.1-3.6.2), prior research has predominantly valued regulating services (e.g. climate and air quality). Although limited, the LSA has also been used to value provisioning services (e.g. drinking water; Gandelman *et al.*, 2012) and cultural ecosystem services (e.g. aesthetics; Ambrey and Fleming, 2011; Jarvis *et al.*, 2017).

3.7. Summary

This chapter introduced the experiential approach to measuring well-being and valuing environmental non-market goods. The experiential approach uses an *ex-post* assessment of well-being and has its foundation in psychology. It views well-being as a psychological phenomenon, characterised by feelings of pleasure and displeasure, happiness and sadness and satisfaction and dissatisfaction. This interpretation of well-being has been described as equivalent to or synonymous with the concept of Subjective Well-being (SWB) and the mental state account of well-being. Therefore, the chapter began by introducing the concept of SWB and its underlying theory (including the dimensions and measures of SWB). This was followed by an overview of the two types of experiential method: (i) SWB method (non-monetary) and Life Satisfaction Approach (LSA; monetary). The chapter then focused on the LSA, highlighting the aims, valuation procedure and procedural aspects of the LSA (design, implementation and analysis), to facilitate the comparison and critique

with the CVM. Finally, the chapter culminated in a discussion of the application of the LSA in a health and environmental context.

4. Comparison and critique of the methods

4.1. Chapter summary

This chapter compares and critiques the CVM and LSA, drawing on the comprehensive reviews in the previous chapters, to address two research questions. First, it examines how the valuation methods differ in terms of their conceptualisation of well-being and their application to marine and coastal environments (section 4.2; research question 1). Second it investigates how the methods compare in terms of their respective strengths and weaknesses (research question 2). The strengths and weaknesses of the two methods are then discussed in terms of three main points: challenges to their underlying theory and assumptions (section 4.3), the accuracy of the respective valuation estimates (validity; section 4.4 and reliability; section 4.5) and the relative influence of context effects on the two methods (psychological factor issues and scale-response issues; section 4.6). This will culminate in a discussion of the findings in relation to each research question (section 4.7).

4.2. Comparison of the two methods

The two non-market valuation methods share four key similarities: (i) they measure changes in utility (or well-being), (ii) produce estimates of WTP (measure of CV or EV) for environmental goods, (iii) make use of or refer to welfare theory and (iv) utilise questionnaires to estimate the value of environmental goods (see Table 4.1). However, there are three key disparities, which are discussed below.

4.2.1. Conceptualisation of well-being

There is a clear difference between the methods, in terms of their conceptualisation or characterisation of well-being (Kahneman *et al.,* 1997; Dolan and White, 2006; Fujiwara and Dolan, 2016). The CVM conceives human well-being in terms of the satisfaction of personal preferences for environmental goods and assesses social welfare on the basis of individual utility (Wegner and Pascual, 2011). This account corresponds with the decision utility characterisation of well-being and measures the decision stage of the DWB model. Hence, the CVM-based WTP is the amount of money an individual is willing to give up *ex- ante* to obtain an environmental good. Therefore, WTP is described as an indicator of anticipated affect, anticipated satisfaction and goals (Dolan and White, 2006). The LSA assesses experiences and is based on the experienced utility characterisation. The method measures the experience and evaluation stages of the DWB model. Hence, estimates from the LSA refer to the "extra money which would in the long run secure for the average person an extra util of happiness" (Layard, 2006, p. C33).

4.2.2. Aims, objectives and valuation procedure

These conceptual differences result in disparities in the aims, objectives and valuation procedure, as outlined in Table 4.1. The CVM places a monetary value on the utility that individuals anticipate they will receive from the consumption of a good. A one-step process is used to estimate WTP or WTA as a survey is used to directly elicit respondents' willingness to pay for a specific environmental good, in response to a hypothetical scenario. Income is not involved in the estimation of the monetary measure. Instead, socio-demographic variables (including income) are included in a regression model to examine the determinants of WTP or WTA.

This contrasts with the LSA which aims to place a monetary value on the well-being gained from people's experiences (i.e. the experienced or evaluative well-being they gain from the consumption of a good). The LSA has a more indirect approach valuation than the CVM, requiring a two-step process. The LSA relies on the use of income in statistical analyses to translate measures of LS into monetary terms ($WTP_{\Delta q}$). In the first stage, respondents are asked to state their level of LS (van den Berg and Ferrer-i-Carbonell, 2007; Stutzer and Frey, 2010; OECD, 2018). Satisfaction with life as a whole can be described as a weighted average of satisfaction with several economic and non-economic aspects of life. Therefore, the measure is not linked specifically to the environmental good in question, in contrast to the CVM. The associations between LS and the environmental good are examined in a regression analysis, resulting in a non-monetary estimate, which explains how LS changes in response to changes in an environmental good. Second, the method uses the marginal rate of substitution (MRS) to derive a monetary estimate of the change in well-being resulting from the provision of the environmental good ($WTP_{\Delta q}$).

4.2.3. Application to marine and coastal environments

The methods also differ in terms of their relative application to marine and coastal environments. The CVM is a more widely established method than the LSA for the valuation of environmental goods (Carson, 2011; Ciriacy-Wantrup, 1947), including marine and coastal goods (Fletcher *et al.*, 2014; Torres and Hanley, 2016). It has also been acknowledged as a relevant method for estimating the value of ES (Pascual *et al.*, 2010; UK National Ecosystem Assessment, 2011, 2014).

On the other hand, the LSA is a more novel approach, with its first application in 2002 (Clark and Oswald, 2002; Welsch, 2002). It has not been recognised as an ES valuation method and has had much less application to marine and coastal goods (e.g. Cuñado and de Gracia, 2013; Jarvis *et al.*, 2017). Note, this disparity does not hold in terms of policy application, there has been limited percolation of evidence from both the CVM and LSA into marine and coastal decision-making and CBA (Hanley *et al.*, 2015). As a result of the differences described in subsections 4.2.1-4.2.3, there are dissimilarities in the strengths and weaknesses of the two methods. This will be discussed in more detail (sections 4.3 to 4.6).

Table 4.1: Summary table providing an overview of the two methods.

	CVM	**LSA**
Conceptualisation of well-being		
Type of approach	Preference-based	Experiential
Discipline and underpinning theory	Economics (Welfare economics)	Psychology (Subjective Well-being) and Economics (Happiness Economics and Environmental Economics).
Utility characterisation	Decision utility	Experienced utility
Nature of method	*Ex-ante*	*Ex-post*
Stage(s) of the Dynamic Well-being Model (DWB)	Behaviour stage	Experience stage[1] Evaluation stage
Aims and objectives		
Aim	To place a monetary value on the utility that individuals anticipate they will receive from the consumption of a good,	To place a monetary value on the well-being gained from people's experiences, i.e. the experienced or

	through their preferences and choices.	evaluative well-being they gain from the consumption of a good.
Objectives	(1) To estimate WTP/WTA for the non-market good in question (CV or EV). (2) To examine the determinants of WTP or WTA.	(1) To assess the association between SWB (e.g. LS) and the non-market good. (2) To value the impact of a non- market good on well-being ($WTP_{\Delta q}$).
Valuation Procedure		
Estimates derived	Willingness to pay (WTP) or Willingness to Accept (WTA).	(1) Non-monetary (%) change in LS resulting from environmental good. (2) Monetary ($WTP_{\Delta q}$).
Type of change(s) valued	Non-marginal	Marginal and non-marginal
In theory, types of values that can be measured by method	Use and non-use	Use and non-use
Type of data used	Primary data	Primary data Secondary data
Application		
Application to valuation of environmental goods	Used by thousands of studies to value environmental goods.	Over 50 studies have used the LSA to value environmental goods.
Application to marine and coastal policy	Limited percolation of evidence into marine and coastal policy and CBA.	Limited percolation of evidence into marine and coastal policy and CBA.

[1] Note: the stage of the DWB model assessed is dependent on the SWB measure selected for a study.

4.3. Challenges to underpinning theory

4.3.1. Rationality assumptions

As discussed in Chapter 2, the CVM is underpinned by welfare economics, a theory that has long been criticised (as reviewed by Carson, 2012; Haab *et al*., 2013). Individual preferences may not be well-behaved in the neoclassical sense (i.e. they may not be complete and transitive, violating the rationality assumption (Hanley *et al.,* 2007; Bateman *et al.*, 2008; Varian, 2014). For example, individuals may not have complete preference orderings for all goods and therefore preferences may be constructed on the spot using heuristics (Heukelom, 2014; Kahneman and Sugden, 2005; Kahneman and Tversky, 1979; Slovic, 2000). This may be particularly the case for environmental goods associated with less visible and well-known habitats (e.g. deep sea and offshore marine environments; Börger *et al*., 2014; Jobstvogt *et al*., 2014; Spash, 2002) and hard to detect features, such as biodiversity (Beaumont *et al.*, 2008). Assessment of use and non-use values may therefore be limited by what respondents know about environments and their components (Christie *et al.*, 2006; Hanley *et al.*, 2015).

4.3.2. Divergence between WTP and WTA

The divergence between WTP and WTA estimates is also argued to be too high to be consistent with economic theory, potentially invalidating CVM findings (Diamond and Hausman, 1994; Hausman, 2012). Experiments have been consistent in showing that individuals value losses (i.e. WTA) more than gains (i.e. WTP) (Cummings *et al.*, 1986; Coursey *et al.*, 1987; Kahneman *et al*., 1990). A meta-analysis on the WTP/WTA disparity revealed that this was particularly the case for environmental goods, in comparison to other types of good (Tunçel and Hammitt 2014). Psychologists attribute this divergence to the endowment effect, which predicts that people require more compensation to

part with something already in possession (i.e. WTA) than they would give up to acquire it (i.e. WTP) (Kahneman *et al.*, 1991; Knetsch, 1994; Shogren *et al.*, 1994; Morrison, 1998).

Others, however, argue that WTP and WTA need not correspond for environmental goods (Horowitz and Mcconnell, 2002; Tunçel and Hammitt, 2014). Ahlheim and Buchholz (2000) consider that large differences between WTP and WTA should be expected since "substitutes for these goods are not easily available and the WTP-WTA difference is negatively correlated with the substitution possibilities" (p15). That means that the more unique a non-market good the more the WTA to forgo it can be expected to exceed the WTP to obtain it. The selection of Hicksian welfare measure (CV and EV) and monetary measure (WTP or WTA) should be motivated by a combination of theory and empirical considerations (Johnston *et al.*, 2017). It has been suggested that the choice largely depends on the type of environmental change to be valued (environmental improvement or degradation) and the political and socio-economic circumstances. The WTP-WTA divergence debate remains unsettled (Haab *et al.*, 2013) and further research is required to understand the implications of the divergence for environmental policy and management (Kling *et al*., 2012; Kim *et al.,* 2015).

4.3.3. Lack of best practice guidelines for the LSA

As discussed in Chapter 3, the LSA merges elements from psychological theory, happiness and environmental economics (an area of application of welfare economics). It makes use of an empirical proxy of the notion of utility (experienced utility) and combines them with economic concepts (e.g. indirect utility function, marginal rate of substitution, CV and EV). Despite the economic

origin and underlying assumptions of the method, there has been less challenge to the theory underpinning the LSA. In contrast to the CVM, best practice has not yet been developed for the LSA. This can be seen as a weakness, as it can lead to inconsistencies in application and debates amongst researchers. Two key gaps in knowledge are addressed here: (i) the type of change that can be valued using the LSA (i.e. capacity of the method) and (ii) the time frame for LSA valuation estimates.

4.3.3.1. Capacity of the LSA to value specific types of change

In theory, the LSA can be used to measure both marginal and non-marginal changes (see Chapter 3; section 3.5). However, there is disagreement in the empirical literature, as to the type of change that the method can be used to value in practice (Fleming and Ambrey, 2017; Fujiwara and Dolan, 2016). Some researchers have presented the LSA as a method for measuring both marginal and non-marginal changes (Welsch and Ferreira, 2014; Welsch and Kühling, 2009).

Other researchers have argued that the LSA should only be used to measure one type of change and there are inconsistent views. The OECD (2018) consider that the LSA is better suited to measuring large (non-marginal) changes that more clearly impact on SWB than marginal changes, whose impact might be impossible to detect due to the bounded nature of the SWB scales (e.g. 0-10). In contrast, Fujiwara and Dolan (2016) argue that despite application to large (non-marginal) impacts, the LSA should only be used to value small (marginal) changes in q. This is because non-marginal changes in q can affect levels of disposable income, which may alter the marginal utility of income (γ) and potentially the marginal utility of q itself (Fujiwara and Dolan,

2016). However, this may not be a valid argument, as a non-linear specification of the LS equation may be used to overcome this problem. However, the use of non-linear forms is often ad-hoc. Disparities between the theoretical and empirical literature is partly responsible for the different advice on the LSA in the literature.

In addition, it is currently unknown whether the LSA can be used to measure non-use values (Bakhshi *et al.*, 2015), unlike the CVM which is promoted for this purpose (Carson and Hanemann, 2005; Holland *et al*., 2010; Fleming and Ambrey, 2017). Bakhshi *et al.* (2015) argue that the LSA cannot be used to measure non-use values in any obvious way, as the individual needs to have experienced the good for it to be reflected in their LS responses. This has led the researchers to propose an alternative method, a vignette study. Survey respondents are presented with a hypothetical scenario and are asked to report their levels of SWB as if they were provided with a non-market good, keeping all else in their life constant. However, the study concluded that the vignette did not provide theoretically consistent findings. For example, there may be issues with asking respondents to predict impacts of goods on their LS. The vignette study requires further research and application.

In contrast, recent studies have used the LSA and assessed the benefits of non-market goods associated with parks, green spaces (Fields in Trust, 2018) and coastal environments for users and non-users (Jarvis *et al.* 2017). For example, Fields in Trust (2018) used LSA to estimate the well-being value associated with the frequent use of local parks and green spaces. They contrasted between two states of life, use of green space and non-use. They considered that this captured the existence versus the removal of a specific

park or green space (e.g. a value attributed to the preservation of the green space for future generations). This provides an indication that researchers are considering the LSA as a method for the assessment of use and non-use values (i.e. comparable to the CVM).

Furthermore, there may be suggestions that the LSA could be used to monetise non-use values derived from people's vicarious experiences of natural environments (e.g. through reading books and watching TV programmes). Kellert (2002). Duerden and Witt (2010) and Soga *et al.* (2016), have previously highlighted the potential links between well-being and vicarious experience. Whether this represents use or non-use value, however, is open to debate and provides an avenue for future research.

4.3.3.2. Time frame for LSA valuation estimates

The time frame over which gains in SWB are expected to last have received little attention in the literature. Hence, there appears to be inconsistency in the use and reporting of time periods for well-being quoted in LSA studies. Some researchers have suggested that the estimate should be treated as a value weighted over a finite time horizon (Blanchflower and Oswald, 2004a; Dolan and Metcalfe, 2008; van Praag and Baarsma, 2005). The values derived have previously been described as an annual value by Dolan and Fujiwara (2012), Dolan and Metcalfe (2008) and Fields in Trust (2018). This is also mentioned in Fujiwara and Campbell (2011). Other studies, however, do not make reference to a time period at all (Del Saz-Salazar *et al.*, 2017; Humphreys *et al.,* 2017). Therefore, interpretation and reporting appears to be study-specific. This may limit the ability to compare across studies and have implications for the use of LSA estimates in CBA (Dolan and Metcalfe, 2008).

4.3.4. Hedonic adaptation

A larger focus of debate for the LSA is on the phenomenon of hedonic adaptation, due to the use of the LS measure (Diener *et al.,* 2006; Loewenstein and Ubel, 2008). Hedonic adaptation (Brickman and Campbell, 1971) refers to the full or partial return (e.g. of well-being) to baseline following positive and negative life events. Therefore, impacts on well-being may only be transient (Wilson and Gilbert, 2008; Luhmann *et al.*, 2012; Mackie and Smith, 2015; OECD, 2018). Evidence indicates that individuals, at least in part, can adapt to both desirable and undesirable experiences and states, such as increases in income (Brickman *et al.*, 1978), marriage (Lucas *et al.*, 2003), disability (Silver, 1983) and divorce (Lucas, 2005). The process of adaptation underpins Amartya Sen's 'happy slave' example, "if a starving wreck, ravished by famine, buffeted by disease, is made happy through some mental conditioning ... the person will be seen as doing well on this mental states perspective' (Sen, 1985, cited in Dolan and Metcalfe, 2012).

An example is provided to illustrate this concept for marine and coastal goods. There may be an initial peak in LS following the creation of a coast path before adaptation, followed by a decrease in LS as individuals adapt to the coast path (e.g. a return to LS pre-coast path levels). Under this hypothesis, the higher overall average in LS may be due to an increase in the first couple of years, as the coast path provides short-lived benefits.

The concept of hedonic adaptation and its impact on well-being from environmental goods has been discussed (e.g. Loewenstein and Frederick, 1997; Kahneman and Sugden, 2005). For example, it has been hypothesised previously that individuals are unlikely to adapt to environmental goods, such as

beautiful landscapes (Kahneman and Sugden, 2005). Adaptation effects can be estimated using longitudinal data and by including time-lagged explanatory variables for the good being valued (Fujiwara and Campbell, 2011). But there is still a paucity of empirical studies which have investigated the extent to which people adapt to environmental goods and over what time scales (Welsch and Ferreira, 2014). One exception is Alcock *et al.* (2014). They used longitudinal data from the BHPS to investigate how moving to greener areas affects well-being (GHQ-12; see Chapter 3, section 3.3) over time. Mental health improved within a year and stayed approximately the same for the following two years after the move. This suggested that there were lasting positive changes in SWB and that adaptation was a not a fact of life for green space in this context.

There is no consensus as to whether this phenomenon is an advantage or disadvantage to the LSA. It may be a strength of the LSA that the values are based on real experiences capturing issues such as adaptation in real life situations. However, it has also been considered as a disadvantage to the LSA (e.g. Loewenstein and Ubel, 2008; OECD, 2018). Loewenstein and Ubel (2008) described hedonic adaptation as of the most serious problems associated with experienced utility. Evidence that people adapt relatively quickly to both positive and negative change might indicate that policy interventions aimed at improving a population's SWB are doomed to fail because people adapt to changes in life circumstances (Luhmann, Maike and Intelisano, 2018). There has been greatest concern for negative changes. For example, the potential to habituate to bad circumstances and the moral hazard associated with the "happy slave" phenomenon, has been perceived as an obstacle to the use of SWB (e.g. in development work; OECD 2018). This is because it might lead to a lack of attribution of public resources towards preventive measures.

Furthermore, it might also mean that changes in policy may not be reflected in the level of SWB.

Besides theoretical concerns, criticism has also been directed to the practical application of the CVM and LSA. If the results are to be used in decision-making, the two methods need to produce accurate estimates, i.e. estimates that are both valid and reliable (Haab *et al.*, 2013; Humphreys *et al.*, 2017). Interpretation of validity and reliability differs however across the economic and psychological disciplines.

4.4. Validity

Validity refers to the extent to which the CVM and LSA measure the theoretical construct under investigation, i.e. WTP and WTA (Bateman *et al.*, 2002; Kling *et al.*, 2012; OECD, 2013; Humphreys *et al.*, 2017). Construct validity (also known as theoretical validity and internal validity) examines the extent to which the estimates perform in the way that theory predicts (i.e. how they change under the conditions they are evaluated). Convergent validity refers to how the estimates compare with other measures or methods based on the same concept.

4.4.1. Construct validity

For the CVM, construct validity is investigated by exploring whether WTP or WTA estimates relate to income and other variables in a way that economic theory predicts and whether they are sensitive to variations in the scope of the good. The literature focuses primarily on scope effects, whether individuals are willing to pay more (or at least not less) to have a higher quantity or better quality of a good (Kling *et al.*, 2012). Scope effects have been examined using

the adding up test (Diamond *et al.*, 1993), which tests whether the WTP for one good, plus the WTP for a second good is equal to the consumer's WTP for both goods combined. If a study fails the adding up test, the CVM is assumed not to elicit truthful answers or that elicited preferences are inconsistent with economic theory (i.e. construct invalidity).

Scope insensitivity, the observation that WTP responses do not vary with quantity or quality of the good as expected, has been attributed to a range of factors (Carson *et al.*, 2001), such as respondents not reporting real economic preferences but instead deriving moral satisfaction from the act of giving *per se* (Kahneman and Knetsch, 1992). A large number of studies have observed scope effects in CVM studies (as reviewed by Desvousges *et al*., 2012). Whilst, some studies have failed to find scope effects (Desvousges *et al.*, 1993; Diamond and Hausman, 1994; Diamond *et al.*, 1993; Kahneman and Knetsch, 1992). The effect of scope insensitivity on the CVM has remained an issue of debate for over two decades (Haab *et al*., 2013; Borzykowski *et al*., 2018; Johnston *et al.*, 2017). Researchers looking at the same evidence have come to opposite conclusions with respect to the effect of scope effects on validity (Hausman 2012; Kling *et al.*, 2012). Recent guidelines for SP studies suggest that researchers should allow for valid circumstances in which value estimates may or may not demonstrate responsiveness to scope (Johnston *et al.*, 2017). The debate on the existence of scope effects is not closed yet (Borzykowski *et al.,* 2018) and remains an avenue for further research.

Limited research has assessed the construct validity of WTP estimates derived from the LSA (with the exception of Humphreys *et al*., 2017). Instead research has primarily assessed the validity of LS measures input into the LSA valuation

procedure (e.g. Diener et al., 2013; OECD, 2013). Evidence suggests that LS measures exhibit expected relationships with determinants of well-being, for example variables relating to income, life circumstances and daily activities (Dolan *et al.*, 2008; OECD, 2013). However, there has been concern about the validity of estimates from studies using small LS datasets (Bakhshi *et al.*, 2015; Humphreys *et al.*, 2017; Johns and Ormerod, 2007). Bakhshi *et al.* (2015) and Humphreys *et al.* (2017) contend that large datasets with spatial variation are required to provide statistical significance for determinants of LS and therefore detect the impact of goods on LS. Although not explored for environmental goods, this may have implications for the design of future studies.

4.4.2. Convergent validity

For the CVM, tests of convergent validity involve comparing WTP or WTA estimates to values that would be generated if real payments were made and values generated from other studies (e.g. RP studies). Most criticism has resulted from the lack of convergence between real and hypothetical payments, known as hypothetical bias (Haab *et al.*, 2013; Hausman, 2012). Meta-analyses have found that on average WTP estimates exceed actual payment for the same goods by a factor of three (List and Gallet, 2001; Murphy *et al.*, 2005). The causes of hypothetical bias are poorly understood and remain a major question in SP analysis (Loomis, 2011). Three *ex-ante* survey design approaches have been developed to mitigate hypothetical bias: (i) the use of incentive compatible and consequential elicitation formats (Carson and Groves 2007, 2011; see Chapter 2, section 2.6); (ii) the use of cheap talk scripts that inform respondents about potential hypothetical bias and instructs them not to overstate their WTP (Cummings and Taylor, 1999); and (iii) experimental survey

protocols asking respondents to swear an oath to respond truthfully (Jacquemet *et al.,* 2011, 2017).

As for construct validity, most LSA research has focused on the convergent validity of LS measures, rather than of WTP estimates. There is increasing evidence that LS measures exhibit convergent validity. First, LS measures correlate with measures of well-being that are not based on respondent reports, for example reports from informants and interviewers (e.g. Lepper, 1998; Pavot and Diener, 1993). Second, measures predict future observable outcomes (Diener *et al.*, 2013), for example, illness, disease and mortality (Sales and House, 1971; Koivumaa-Honkanen *et al.*, 2000). Third, there is convergence between life evaluation measures (Eid and Diener, 2004; OECD, 2013). Finally, there is convergence between LS and objective measures of well-being, such as quality of life (objective-list account; Oswald and Wu, 2009).

4.5. Reliability

Reliability refers to whether methods yield consistent results when administered under the same conditions (Bateman *et al.*, 2002; Diener *et al.*, 2013). According to Haab *et al.* (2013), “the lower variability in estimates, the more consistent and the less influenced by researcher decisions the estimates” (p607). Discussions of reliability have focused on (i) temporal reliability and (ii) statistical issues.

4.5.1. Temporal Reliability

Temporal reliability (or test-retest reliability) refers to the level of consistency of WTP estimated at two different times (Humphreys *et al.* 2017). Test-retest studies administer the same question to the same respondent more than once,

separated by a fixed period of time (Haab *et al.*, 2013; OECD, 2013). The temporal reliability of WTP from LSA studies has been little studied, but the reliability of life evaluation measures has been tested extensively. Although not in an environmental context, correlations between LS reports for studies separated by one to two years have been demonstrated (Krueger and Schkade, 2008; Lucas and Donnellan, 2012; Michalos and Kahlke, 2010). Test-retest studies for the CVM suggest that WTP and WTA values also exhibit temporal stability and are therefore reliable (Brouwer, 2006; McConnell *et al.*, 1998; Whitehead and Hoban, 1999). For example, Loomis (1989) surveyed the same individuals at two points in time, asking for their WTP for improvements to water quality. The study identified that there was no statistical difference between the WTP values.

4.5.2. Statistical issues

The LSA relies heavily on statistical analysis to translate measures of LS into monetary terms ($WTP_{\Delta q}$). As discussed in Chapter 3 (section 3.5) the method uses regression analysis to estimate the associations between LS, the non-market good in question and income. Therefore, SWB models need to accurately estimate the income coefficent. This is in contrast with the CVM. It does not depend on income, as it estimates WTP directly and averages the WTP across the sample. Regression analysis is used to assess the construct validity of the CVM results (section 4.4).

Debate has centred on two statistical issues: (i) endogeneity and (ii) interpersonal comparability. The two issues are more commonly discussed in the context of the LSA (Frey *et al.*, 2010; Fujiwara and Dolan, 2016), although

they are also relevant to the CVM (e.g. Choi *et al*., 2017; Martínez-Espiñeira and Lyssenko, 2011).

4.5.2.1. Endogeneity

A number of LSA studies have reported implausibly high monetary estimates for a range of goods (Clark and Oswald, 2002; Powdthavee, 2008; Powdthavee and van den Berg, 2011; Fujiwara *et al*., 2015), such as the valuation of changes in climatic conditions (e.g. Ferreira and Moro, 2010) and pollution levels (e.g. Levinson, 2012; Luechinger, 2009). The overestimation of WTP may result from a range of factors, including an unrepresentative survey sample and the presence of outliers in datasets (OECD, 2018).

However, the majority of researchers have considered that the problem lies in the estimation of the coefficients in regression models (see Chapter 3; section 3.5; Fujiwara and Dolan, 2016; Fleming and Ambrey, 2017; OECD, 2018). The LSA relies on an association between income and the good on one hand and LS on the other (Fujiwara and Dolan, 2016). Estimates are assumed to represent the full effects of the non-market good and income on LS (Frey *et al.*, 2010; Fujiwara *et al.*, 2014). But studies have identified a downward bias of income coefficients (i.e. γ; the marginal utility of income) and upward bias in coefficients for non-market goods (δ; Fujiwara *et al.*, 2015). This may lead to an overestimation of well-being values, as the coefficients (δ and γ) represent the numerator and denominator in the valuation equation. Endogeneity concerns are often invoked to explain this effect, where explanatory variables, such as income are correlated with the error term, ε (Dolan and Fujiwara, 2012; Fujiwara and Dolan, 2016). Reverse causality, where happier people can be more productive and earn more (Powdthavee, 2010), selection effects (e.g.

people using a coast path more often might already be happier or more satisfied with their lives to begin with), omitted variable bias (Luechinger, 2009; Welsch, 2002) and measurement error can all lead to endogeneity.

One key approach has proposed for addressing concerns with endogeneity. This is the use of instrumental variable (IV) estimation. This involves the use of IVs which correlate with income (and hence function as its proxy), but are not correlated with the error term, ε (Fujiwara *et al.,* 2014), i.e. they are an exogenous income windfall. The use of an IV approach may help to provide a more accurate estimation of the effect of income on SWB, and in turn, lead to more realistic values estimated using the LSA (OECD, 2018).

IVs can be derived from within the original dataset, if the questions are asked within the survey. For example, Dolan and Metcalfe (2008) included questions concerning whether the respondent's partner was in employment and whether the respondent was in rented accommodation. Alternatively, IVs can be derived from large-scale datasets (e.g. the BHPS; UK Data Service, 2019). Examples of variables that have been used to instrument income include lottery wins amongst lottery players (Fujiwara *et al.*, 2014; Gardner and Oswald, 2007), industrial sector, spouse's income and education level (Pischke, 2011). For example, lottery wins can be used as an instrument for income as winnings are randomly allocated amongst lottery players after adjusting for the amount that players spend on lottery tickets. Lottery wins among lottery players have been shown to correlate with income, but are uncorrelated with other factors that might cause a change in the LS. It works under the assumption that frequent lottery players will tend to win more on average (Fujiwara *et al.*, 2018). This IV will be discussed in more detail in Chapter 7 (section 7.4). There is, however,

no consensus on best practice for the use of IV approaches in LSA analysis (Kopmann and Rehdanz, 2013).

4.5.2.2. Interpersonal comparability

The interpersonal comparability of LS measures is considered a requirement for their use in the valuation of goods using the LSA (Frey *et al.*, 2010; Kahneman, 2003), but their interpersonal comparability is debated (Clark, 2016; Fleurbaey and Hammond, 2004). Interpersonal comparability refers to the degree to which the responses of different individuals can be meaningfully compared (Dolan *et al.*, 2006), i.e. "individuals answering similarly to such satisfaction questions are enjoying a similar level of satisfaction" (van Praag et al., 2001, p7). The uniqueness of individuals' previous experiences, however, may mean that LS is interpersonally incomparable, which has implications for its inclusion in CBA (Gilbert, 2007; Robbins, 1938). Others argue that interpersonal comparability may not be a large issue for the LSA (Fujiwara and Dolan, 2016; Stutzer and Frey, 2010). The LSA compares the LS of groups of individuals under different exposure to a good or service, therefore individual differences and personal individualities may tend to counterbalance one another (Frey and Gallus, 2016; Stutzer and Frey, 2010).

4.6. Context effects

The experiential approach is often promoted due to concern over the influence of context effects on the CVM (e.g. Smith et al., 2008; Sugden, 2005). Answering a survey question involves cognitive (memory and aggregation) and communicative processes (Stutzer and Frey, 2010). First, respondents use cognitive processes to consider their response to the question before answering the interviewer and this involves memory and aggregation. Second, the

respondent communicates their answer to the interviewer (i.e. communicative process). Cues can occur during these two stages and impact how individuals answer questions (OECD, 2013; Schwarz and Strack, 1999) and this may affect the validity and reliability of estimates. These issues are common to most survey-based methods and are largely attributable to survey design and issues with implementation (OECD, 2018). Therefore, they can affect both the CVM and LSA (Diener *et al.*, 2013; Venkatachalam, 2004).

Context effects can be categorised into: (i) psychological factor issues and (ii) scale response issues (Diener *et al.*, 2013). Psychological factor issues relate to biases that occur when respondents are unduly influenced by the content of the survey (e.g. a question, scenario or introduction text) or the presence of an interviewer. These include framing effects, mood effects and social desirability bias. Scale response issues relate specifically to biases which may occur when respondents are asked to respond on a scale (e.g. LS response scale or CVM payment card). Both of these biases may lead to respondents making little mental effort and instead rely on easily accessible information or cues. This contrasts with chronically accessible information, which in the case of LS, relates to facets of people's lives that they think are important and relevant to evaluations of their life (Schwarz *et al.,* 1999).

4.6.1. Similarities

Figure 4.1 provides an illustration of the context effects which may affect the methods at the cognitive and communicative stages of the process. The review finds that the majority of context effects (eight in total) are relevant to both methods. A description of each of the effects with key references is shown in Table 4.2. During the private judgement stage, survey responses from both

methods may be influenced by the information that is most temporally accessible. This can result in framing effects, mood effects, scale response issues and social desirability bias.

4.6.1.1. Framing effects and social desirability bias

Respondents exposed to CVM and LSA surveys may be unduly influenced by information contained in the survey task and survey instrument and this may result in framing effects, a psychological factor issue. There are two types of framing effect: priming effects and focusing effects.

Focusing effects (or the focusing illusion) is the phenomenon in which the survey draws attention to the distinctive aspect of change and results in a corresponding increase in the perceived importance of the good. There is insufficient empirical evidence on the impacts of the focusing effects on the methods, particularly in the case of the CVM. But, it has been a major area of debate when comparing the two methods. Researchers have suggested that preference-based methods such as the CVM are highly vulnerable to focusing effects (Dolan and Kahneman, 2008; Kahneman and Sugden, 2005; Loewenstein and Schkade, 1999). Some researchers have suggested that the LSA eliminates focusing illusion issues (e.g. Schkade and Kahneman, 1998; OECD, 2018) because respondents are not typically asked about the value of a particular policy change, which may have dominated their thinking during the survey process. Instead the value is inferred *ex-post* from analysis.

Conversely, other researchers have suggested that methods of experienced utility such as LSA may confront similar focusing effects (Kahneman and Sugden, 2005). This may occur when a question about the good in question creates an unusual deployment of attention, which can bias responses of SWB.

For example, Smith *et al*. (2008) found that if survey introductions mentioned Parkinson's disease, respondents focused more on their health status, making it a much more important aspect of their LS judgement. Such effects may also apply to environmentally-orientated surveys, such as the MENE survey (Natural England, 2017), which ask respondents about recent visits to natural environments (e.g. the coast) and their perceptions of environmental quality before the LS question.

Priming effects may occur when the survey context (e.g. question order) influences how questions are understood and/or increases the accessibility of information to respondents. There is also limited empirical work which assesses the influence of priming effects on the CVM and LSA. The OECD (2018), however, argue that the LSA is probably less sensitive than the CVM to issues such as priming effects, because a direct estimate of WTP is not elicited. Overall, empirical research is required to investigate the claims for focusing effects and priming effects, which will aid future comparison of the two methods (discussed in Chapter 9; section 9.6).

Respondents in both CVM and LSA studies may also be influenced by social desirability bias prior to the reporting stage (communicative process). However, there is little evidence to suggest that the CVM and SWB measures are uniquely susceptible to social desirability mode effects. As highlighted in Table 4.2, social desirability is a tendency for an individual to present themselves in a favourable light and/or to give responses that conform to prevailing social norms (i.e. more socially desirable or respectable characteristics; OECD, 2013). The extent of this effect may depend on the choice of survey mode.

In the case of the CVM, respondents may give a WTP or WTA amount that differs from his or her true WTP or WTA amount in an attempt to please or gain status in the eyes of a particular interviewer (Bateman *et al.*, 2002). It has long been established that WTP statements may be confounded with social desirability bias and therefore the misreporting of preferences (Börger, 2013; Laughland *et al.*, 1994; Mitchell and Carson, 1989). Research has shown that the choice of survey mode may influence the extent of social desirability effects (Leggett *et al.*, 2003; Börger, 2013).

It has been highlighted that social desirability may be more likely to occur during a face-to-face interview, than with other modes of administration that allow for more anonymity (e.g. self administered surveys; Ahlheim *et al.*, 2010; Leggett *et al.*, 2003; Whittaker *et al.*, 1998). For example, Leggett *et al.* (2003) used the CVM to elicit respondent's WTP for a national monument in the USA. They identified that WTP was 23-29% higher when the survey was elicited through face-to-face interviews, compared to self-adminstered surveys. The magnitude of effects has been variable, but is generally considered to be relatively minor (Bateman *et al.*, 2002). On the other hand, others have found no significant difference between survey modes (e.g. Ethier *et al.*, 2000; Smith 2006). Ethier *et al.* (2000) found that two survey modes (face-to-face interviews and self administered surveys) yielded the same WTP estimates for green electricity.

In relation to the LSA, respondents may report a SWB score that differs from their true well-being. However, much of the evidence on social desirability is ambigious and findings vary from study to study (OECD, 2013). Several studies have suggested evidence of social desirability mode effects on SWB (Dolan and Kavetsos, 2016; Pudney, 2010). For example, Dolan and Kavetsos (2016) used

data from the Annual Population Survey in the UK and found that individuals consistently reported higher SWB (LS, worthwhile, happiness and anxiety) over the phone compared to face-to-face interviews. But, it has been emphasised that these findings can be difficult to disentangle and attribute to social desirability bias, rather than other types of context effects (OECD 2013).

In contrast, others (e.g. Jäckle *et al.*, 2006; Sarracino *et al.*, 2017; Scherpenzeel and Eichenberger, 2001) have failed to identify a significant mode effect on SWB measures. This research has compared face-to-face interviews with alternative modes including telephone interviews and self-completion methods and used a range of different measures of life evaluation. For example, Jäckle *et al.* (2006) compared how survey mode affected scores of LS from the European Social Survey module. They found that there was no significant effect of survey mode (face-to-face interviews *vs.* telephone interviews) on mean scores of LS. However, they did find that other socially sensitive questions were affected, for example, higher household incomes were reported during telephone interviews.

4.6.1.2. Mood effects

Second, both methods may be affected by mood effects or emotions during the survey process. There is substantial evidence from the behavioural science and psychology literature to suggest that emotions can affect people's decisions in a range of settings (e.g. Elster, 1998; Loewenstein, 2000). Rick and Loewenstein (2008) highlighted that incidental emotions, which include anger, fear, surprise and sadness, may pose a challenge for rationality assumptions that underpin welfare economics. It has been suggested that this type of emotion may affect

high level cognitive processes (e.g. decision-making and reasoning; Blanchette and Richards, 2010; Stanton *et al.*, 2014).

Although the literature focuses predominantly on actual behaviour, there have been concerns that incidental emotions may also affect stated choices and therefore CVM estimates (Ajzen *et al.*, 1996; Hanley *et al.*, 2017). Despite these concerns, there is currently mixed evidence on the influence of incidental emotions on reports of WTP and WTA (e.g. Capra *et al*., 2010; Hanley *et al.*, 2017). For example, Hanley *et al.* (2017) undertook a laboratory experiment which combined three different emotion treatments (sadness, happiness and neutral) and a Discrete Choice Experiment (DCE) concerned with changes in coastal water quality and fish populations in New Zealand. They found that there was no significant effect of changes in emotional state on the WTP decision. Instead, personality traits (e.g. agreeableness, openness, and conscientiousness) may have a larger role to play on shaping concerns about the environment and explaining differences in WTP for non-market environmental goods (Boyce *et al.*, 2019).

There has also been discussion of mood effects in the LS literature (Fujiwara and Campbell, 2011). It has been stated that reports of LS may be influenced by the respondent's current mood (Diener *et al.*, 2013; Kahneman and Riis, 2005; Schwarz and Strack, 1999). OECD (2013) recommends that researchers should avoid "placing the subjective well-being questions immediately after questions likely to elicit a strong emotional response or that respondents might use as a heuristic for determining their response to the subjective well-being question" (p160). Previous research has also shown that the weather (Schwarz,

et al., 1983) and watching a football team win (Schwarz *et al.*, 1987) may influence reports of LS.

It has been considered that current mood could impact reports of LS in two ways. First, if a respondent is in a good mood, it may "lead to the selective retrieval of positive information relating to their life, leading to a more positive evaluation" (Fujiwara and Campbell, 2011, p25). Second, people may use their current mood as an indicator or proxy for their LS, i.e. their well-being in general, described as a 'current-mood-heuristic' (Fujiwara and Campbell, 2011; Schwarz, Norbert and Strack, 1999). However, it may also be argued that these events are randomly distributed across individuals and/or can be controlled for in regression models (e.g. weather; Levinson, 2012).

4.6.1.3. Scale-response issues

Both methods may encounter the same scale response issues as respondents are asked to report their WTP and LS using a response scale (e.g. Likert scale or payment card). In both cases, they may be influenced by yea-saying, mid-point bias, anchoring bias and range bias.

Table 4.2: Overview of the context effects that may influence the validity and reliability of estimates from both methods.

Type of influence	Description	Key references
Psychological factor issues		
Priming effects (also known as question order bias and sequencing effects)	When the survey context (e.g. question order) influences how questions are understood and/or increases the accessibility of information to respondents.	Samples and Hollyer (1990) Strack *et al.* (1988) Deaton (2012) Bakhshi *et al.* (2015) OECD (2013)

Focusing effects (also known as the focusing illusion)	Phenomenon in which the survey draws attention to the distinctive aspect of change and results in a corresponding increase in the perceived importance of the good.	Smith *et al.* (2008) Schkade and Kahneman (1998) Kahneman and Thaler (2006) Wilson and Gilbert (2005)
Social desirability bias (or interviewer bias)	A phenomenon whereby the presence of an interviewer leads respondents to distort their answers in surveys to present themselves as having more socially desirable or respectable characteristics.	Ambrey *et al*. (2014) Leggett *et al.* (2003) Smith (1979) Strack *et al.* (1990)
Mood effects	Phenomenon in which the respondent's current mood or emotions influences reports of WTP/WTA or LS during the survey process.	Fujiwara and Campbell (2011) Capra *et al.* (2010) Hanley *et al.* (2017) Rick and Loewenstein (2008)
Scale response issues		
Yea-saying bias	The tendency of respondents to agree with or respond positively to survey items regardless of their content.	Bakhshi et al. (2015) OECD (2013) Ready *et al.* (1996)
Range Bias	Phenomenon in which respondents are influenced by the range of values on the scale represented in the survey (e.g. on a scale or payment card).	Brulé and Veenhoven (2017) Schwarz *et al.* (2008) Schwarz and Strack (1999) Whynes *et al.* (2004)
Anchoring bias (also known as starting point bias)	Where respondents are influenced by the starting values in the question.	OECD (2013) Wilson *et al*. (1996)
Mid-point bias	Phenomenon in which respondents tend to select the answer that is the middle option.	Chang and Krosnick (2009) Schwarz *et al.* (2008) Schwarz and Strack (1999)

4.6.2. Differences

There are only two differences between the CVM and LSA in terms of context effects. The CVM encounters two issues that the LSA does not, namely protesting behaviour and strategic bias.

The nature of the WTP question as part of the CVM means that responses may not be reflective of individuals' genuine WTP or WTA for the environmental good (van Praag and Baarsma, 2005; Welsch and Kühling, 2009). Individuals may protest against the survey or proposed change, described as protesting behaviour (Bateman *et al.*, 2002; Halstead *et al*., 1992; Spash and Hanley, 1995). Alternatively, they may adjust their response to achieve a more desirable outcome, known as strategic bias. Freeriding and overpledging are two examples of strategic behaviour (Mitchell and Carson, 1989; Samuelson, 1954; Venkatachalam, 2004). Freeriding occurs when an individual understates his or her true WTP for a good on the expectation that others would pay enough for that good and therefore they need not have to pay, i.e. they freeride on other people's payments. Kenter *et al.* (2013) found respondents were willing to pay less for protecting UK marine and coastal sites because they perceived others were already paying and they could potentially enjoy the benefits for free (i.e. freeriding).

Overpledging may occur when an individual assumes that his or her stated WTP value would influence the provision of the good under question or when the individual anticipates that they won't have to pay in reality, but they want to influence the decision for the provision of the environmental good. In contrast, the LSA avoids issues of strategic bias (Fujiwara and Campbell, 2011; Stutzer and Frey, 2010) and protesting as individuals are not asked to value the environment directly, but instead to evaluate their LS. This is less cognitively

demanding because specific knowledge of the environmental good is not required and they are not asked to perform the unfamiliar task of placing a monetary value on the environment (Fleming and Ambrey, 2017; Welsch and Kühling, 2009).

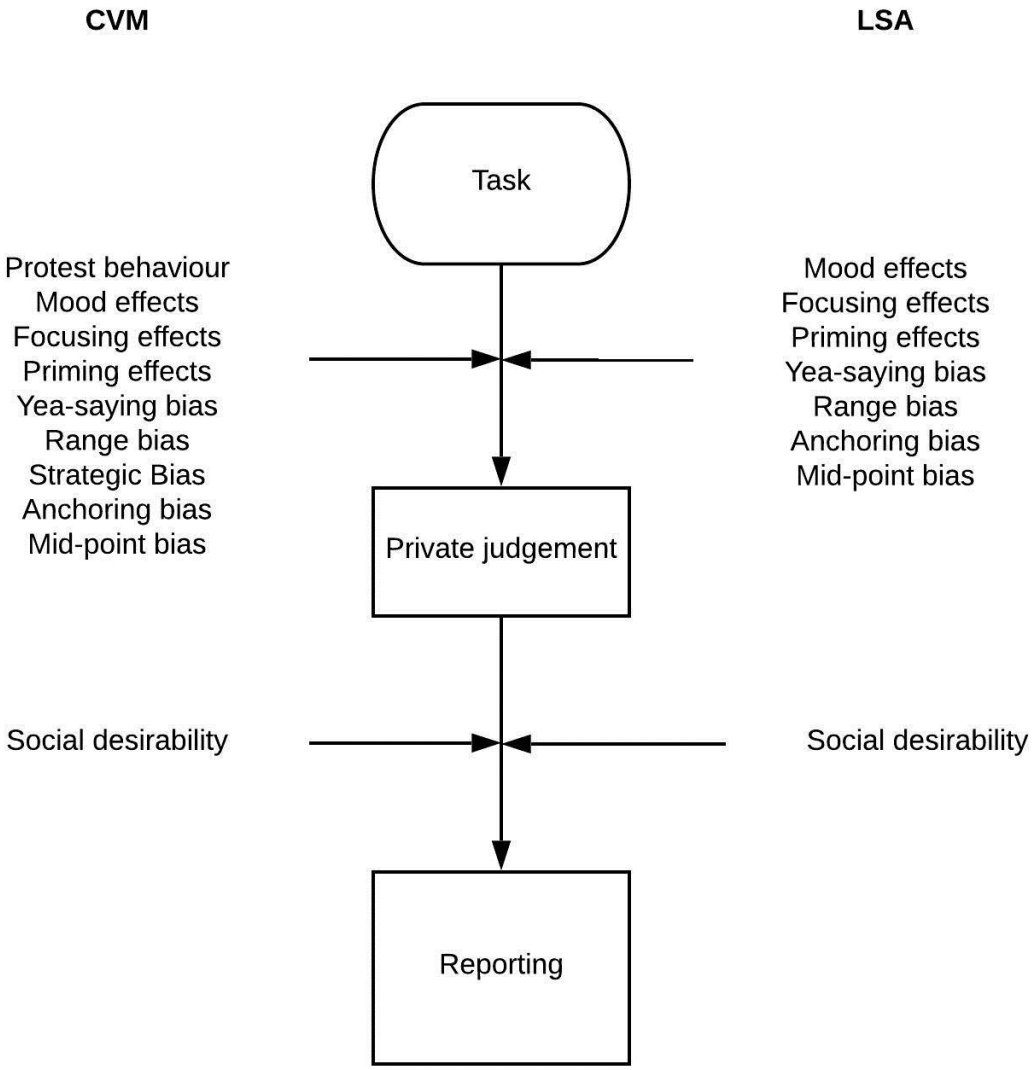

Figure 4.1: An illustration of the types of context effects that may affect the CVM and LSA during the survey process.

4.7. Summary of literature review

This chapter compared and critiqued the CVM and LSA, drawing on comprehensive reviews in the previous chapters (Chapters 2 and 3) to address research questions 1 and 2. The chapter contributes to the ongoing well-being debate in the context of the natural environment (with particular reference to a marine and coastal context), widening the scope of previous reviews in the field (e.g. Frey *et al.*, 2010; Fleming and Ambrey, 2017; OECD, 2018).

4.7.1. Research question 1: How do the methods differ in terms of their theoretical perspective on well-being and their application to marine and coastal environments?

The review examined whether the methods differed in terms of their theoretical perspective on well-being and their application to marine and coastal environments. First, the findings indicate that the methods differ in terms of their theoretical perspective on well-being. The two methods are based on different characterisations of utility (decision utility *vs*. experienced utility) and draw upon different perspectives (i.e. *ex-ante* vs *ex-post*). Therefore, the well-being estimates may have different meanings, supporting previous reviews in the field (Fleming and Ambrey, 2017; Welsch and Ferreira, 2014). This provides an initial indication that the two methods are incommensurable. This will be examined in more detail in Chapter 8 (section 8.4), drawing on both theoretical and empirical findings.

Second, the review indicated that there is a significant difference between the methods in terms of their application to marine and coastal environments. The CVM has been used for decades to value goods from marine and coastal environments (Fletcher *et al.*, 2014; Torres and Hanley, 2016). There has been

growing examination of the links between marine and coastal environments and SWB (Gascon *et al.*, 2017). The LSA, however, is a more novel approach. Only a small number of studies have been used to value marine and coastal goods (e.g. Cuñado and de Gracia, 2013; Jarvis *et al.*, 2017).

4.7.2. Research question 2: How do the methods compare in terms of their strengths and weaknesses?

The review also compared the respective strengths and weaknesses of the two methods. This was in terms of challenges to underpinning theory, the accuracy of estimates (validity and reliability) and the respective influence of context effects on the methods. Table 4.3 summarises the previous sections (sections 4.3 to 4.6), providing an overview of the strengths and weaknesses of the two non-market valuation methods: the CVM and LSA. Overall, this review postulates that the two methods have dissimilar strengths and weaknesses, as a result of their aforementioned differences (section 4.7.1). This is with exception of context effects (psychological factor issues and scale-response issues), which may influence the validity and reliability of both methods. This examination of the two methods provides theoretical grounding and identified areas of enquiry for the empirical study (Chapter 5-7). Furthermore, this insight will help to provide guidance and recommendations for the future application of the two methods for the valuation of well-being benefits from marine and coastal goods and ES (see Chapter 8; section 8.4).

Table 4.3: Summary table displaying the key strengths and weaknesses of the two methods.

	CVM	LSA
Strengths	• Frequently applied method with wide application to environmental goods. • Best practice defined for the method, outlined in CVM manuals.	• Less challenge to the theory underpinning the LSA. • Large body of evidence suggests that LS measures exhibit validity and test-retest reliability.
Weaknesses	• Challenges to theory underpinning the method and its assumptions (e.g. preference construction and divergence between WTP and WTA) • Debate as to the validity of CVM estimates due to scope insensitivity and hypothetical bias.	• Continuously developing method and is not as established in the environmental discipline. • Best practice has not yet been developed for the method. • Encounters statistical issues such as interpersonal comparability and endogeneity. • No consensus to whether the method can measure non-use values, non-marginal changes and EV.

5. Method: study design and implementation

5.1. Summary of literature review

The preceding chapters introduced, compared and critiqued the two methods to valuing environmental non-market goods, considering both theoretical perspectives and practical implications, with reference to the marine and coastal environments. This chapter builds on these foundations and describes the approach used in the empirical assessment, which compared the two methods in practice, using a coastal case study (Teat's Hill, Plymouth, UK). The empirical assessment was undertaken to answer two of the overall research questions, as stated in Chapter 1:

- **Research question 3:** To what extent was there an effect of the coastal intervention on well-being and why?
- **Research question 4:** How similar are the values estimated for the intervention elicited by the two methods?

An overview of the context of the empirical case study is outlined in section 5.2, in addition to details of the initial scoping research and reasons for selection of the case study provided in section 5.3. The design of the study and the development of the survey are discussed in Sections 5.4 and 5.5, respectively. Following pre-testing, the chosen design of the questionnaire is examined in section 5.6, providing an overview of the core sections for the CVM and LSA (drawing on Chapters 2 and 3) and the question order of the survey. The remaining sections 5.7 and 5.8 discuss the processes of ethical approval and survey implementation for the study.

5.2. Empirical context

An empirical comparison of the CVM and LSA was made possible by a local coastal regeneration project that occurred during the course of the PhD project (2016-2019) at Teat's Hill in Plymouth, UK. In 2016, discussions between the research team and Plymouth City Council highlighted the potential for collaboration and an assessment of the value of the coastal regeneration project. This section provides an overview of the study area and the regeneration undertaken.

5.2.1. Study area

Teat's Hill is an area in Coxside, Plymouth, in the southwest of England (Figure 5.1). Teat's Hill has blue and green space features. It has a pebble beach (Coxside Beach) with a public slipway providing access to the sea. The site also has an adjoining green space with an open grass area and infrastructure, including a playground, ball court and benches. Figure 5.2 shows an aerial overview of the site alongside photos which illustrate the spatial scale and features of the site.

Following discussions, proposals were made by Plymouth City Council for a project to improve the Teat's Hill site. The proposal was made for two main reasons. The first concerned the deterioration of the quality of the infrastructure (facilities and access) at Teat's Hill. On-site meetings at Teat's Hill with Plymouth City Council highlighted a number of issues, which included damage to the public slipway and steps to the beach and overgrown vegetation at the site. The second concerned the environmental condition of Teat's Hill. In recent years there has been increasing acknowledgement of the accumulation of litter at the case study site despite the conservation significance of the surrounding

area. Teat's Hill is located near the Plymouth Sound and Estuaries Special Area of Conservation (SAC), a protected area designated under the European Commission (EC) Habitats Directive for the presence of reef habitats (Annex 1 habitat).

Prioritisation of this area was further enhanced by the socio-demographic characteristics of neighbourhoods surrounding Teat's Hill. Teat's Hill is located in the Sutton and Mount Gould ward of Plymouth. The area surrounding Teat's Hill is relatively deprived and there are a large number of social rented flats (Acorn, 2019). Residents in the area are typically skilled and unskilled manual workers, unemployed or on state benefit (UK Census Data, 2011a). In combination, the characteristics of the site and area fit with the general finding that natural spaces in poorer areas tend to be of lower quality and are less well maintained, which may exacerbate health inequalities (Allen and Balfour, 2014). Evidence suggests, however, that the health and well-being benefits of greater access to natural environments are strongest in areas of relative deprivation (Wheeler *et al.*, 2012, 2015).

Figure 5.1: The geographical location of: (1) Plymouth (UK) and (2) Teat's Hill (© Google). The extent of the Teat's Hill site is highlighted by the box with the dashed line.

Figure 5.2: Overview of Teat's Hill (© Google Maps).

5.2.2. Teat's Hill regeneration project

The Teat's Hill regeneration project was undertaken between 2016 and 2019. The project aimed to improve the environmental quality, facilities and access to Teat's Hill, as well as contributing to targets outlined in the Plymouth Plan. The Plymouth Plan aims to ensure that Plymouth residents have access to high quality natural space and playable space within 400m of where they live (Plymouth City Council, 2015a). The Teat's Hill regeneration project was co-ordinated by Plymouth City Council and involved a range of stakeholders, including: the University of Exeter (via the EU H2020 BlueHealth project), Plymouth Marine Laboratory, the National Marine Aquarium, Plymouth University and Plymouth Community Homes.

The Teat's Hill regeneration project involved three main work streams: public and stakeholder engagement (e.g. steering group meetings and public consultation), site capital improvements and research. Funding for the coastal regeneration was provided by two main sources: Section 106 capital funding via Plymouth City Council and from the BlueHealth project (Grellier *et al.*, 2017). Section106 is a legal agreement that local authorities and developers make and requires developers to make payments for infrastructure or affordable housing. BlueHealth is a 4.5 year pan-European project (2016-2020), that aims to "understand the relationships between exposure to blue space and health and well-being, to map and quantify the public health impacts of changes to both natural blue spaces and associated urban infrastructure in Europe, and to provide evidence-based information to policymakers on how to maximise health benefits associated with interventions in and around aquatic environments" (Grellier *et al.*, 2017, p1).

The Teat's Hill regeneration was completed at the end of May 2018 and the official opening event took place on the 1st June 2018. However, the public weren't prevented from visiting during the regeneration, as the site was gradually improved (i.e. phased improvements). Therefore, they were able to use particular features of the site (e.g. open air theatre) ahead of the official opening. This is discussed further in Chapter 7 (section 7.7). The improvements made as part of the regeneration project ('site capital improvements') are categorised into facilities, access and environmental quality and are discussed below. The intervention included physical improvements ('site capital improvements'), which improved facilities, access and environmental quality. The intervention also involved a behavioural or social component (community involvement). This is discussed in more detail below:

- **Facilities (Figure 5.3).** The children's playground was improved with the addition of new play equipment, which was themed around the maritime history of the Plymouth area. An open air theatre was created on the public slipway, to improve access and provide a space for outdoor teaching and community events. Old signage was replaced with new signs that provided a map of the site and described the history and environmental characteristics of Teat's Hill.

- **Access (Figure 5.4).** Car parking on the pathway to the public slipway was restricted to improve access for pedestrians, buggies, wheelchairs and mobility scooters.

- **Environmental quality (Figure 5.5).** Conservation efforts and regular clean-ups were initiated to remove litter and debris from the green and blue space.

- **Behavioural or social intervention (community involvement).** A programme of events was also initiated, which included nature-based and recreational activities and workshops.

Facilities

Before regeneration (2017)	After regeneration (2018)
	
	

Facilities

Figure 5.3: Improvements to facilities. Photos of the Teat's Hill site: before (T1) and after (T2) the coastal regeneration.

Before regeneration (2017)	After regeneration (2018)
	 

Access

Figure 5.4: Improvements to access. Photos of the Teat's Hill site: before (T1) and after (T2) the coastal regeneration.

Before regeneration (2017)	After regeneration (2018)
	
	

Environmental Quality

Figure 5.5: Improvements to environmental quality. Photos of the Teat's Hill site: before (T1) and after (T2) the coastal regeneration.

Before regeneration (2017)	After regeneration(2018)
	
	

5.2.3. Teat's Hill research

Research at Teat's Hill was led by the BlueHealth project. The research (1) assessed the behaviour of visitors to the Teat's Hill (visit numbers and activities), (2) evaluated the physical, social and ecological characteristics of the site, (3) developed landscape designs for the site capital improvements, and (4) assessed the effect of the coastal regeneration on local residents using a 'community level survey' (health, well-being and physical activity). This PhD research involved collaboration with the BlueHealth project to deliver a shared survey vehicle. Questions and additional content required for the two methods was included in the survey to assess the value attributed to the implementation of the coastal regeneration.

5.3. Initial research and reasons for selection of empirical context

Various one-to-one meetings were also held with members of Plymouth City Council (i.e. the end-users). This was undertaken to ensure that research was meaningful to end-users and could aid future policy making with respect to providing support for coastal regeneration projects on well-being grounds. Meetings helped to ascertain that valuation was necessary and credible in this context. It was also concluded that the intervention provided ideal conditions to conduct a natural experiment, enabling an evaluation before and after the intervention. The intervention had a clear, short duration, which allowed the effects of the change to be measured during the timeframe of the PhD project. In addition, the case study characteristics were very similar to the Swansea case study used by Dolan and Metcalfe (2008), which the PhD study was based upon. Dolan and Metcalfe (2008) compared the two methods in the context of

valuing the benefits of urban regeneration. Like their case study in Swansea, the Teat's Hill site was contained within clear spatial boundaries (Figure 5.6) and enabled the assessment of non-marginal change in a bundle of goods (discussed in section 5.2). This presented the conditions needed to value the regeneration using the CVM and LSA and evaluate the effect of the intervention on well-being using the LSA.

Figure 5.6: Satellite image of Teat's Hill prior to the Teat's Hill regeneration project (© Google). Note: black line indicates the boundary of the Teat's Hill site.

5.4. Study design

This section provides an overview of the study design, including the type of study, sample population, sample size and survey mode and administration.

5.4.1. Type of study

A natural experiment with a repeat cross-sectional design was selected for this study. As discussed in Chapter 3 (section 3.4), natural experiments ('quasi-experiments') are empirical studies that involve groups of respondents exposed to a particular intervention being matched with and compared to a similar group of respondents that have not been exposed to the intervention. Repeat cross-sectional surveys have been used previously in large-scale surveys (e.g. Gallup World Poll and the World Values Survey, OECD, 2013) to compare LS across groups with different exposure to environmental conditions (e.g. Brereton *et al*., 2008; Dolan and Metcalfe, 2008) and to assess the effectiveness of interventions in urban green space (Hunter *et al.*, 2015).

Pre-post assessments were used in this study to compare across two different cohorts of respondents: a group that had not been exposed to the coastal regeneration (interviewed before the implementation of the regeneration at T1) and a group that had been exposed to the coastal regeneration (interviewed at T2). The disadvantages of this method are acknowledged in Chapter 3 (section 3.4; Mann, 2003; National Research Council of the National Academies, 2013; Sedgwick, 2014). The T1 survey asked respondents for (i) their willingness to pay for the regeneration at Teat's Hill (for the CVM) and (ii) a self-report of LS (for the LSA). Respondents to the T2 survey were asked for their (i) willingness to pay for the maintenance of the Teat's Hill site[5] and (ii) a self-report of LS (for the LSA).

This study design was selected for the following reasons:

[5] Note: the results of the CVM WTP for maintenance results are not presented in this thesis.

- **The nature of the methods *(ex-ante* and *ex-post*).** As described in Chapter 2 and 3, the CVM is an *ex-ante* approach, observing preferences for future changes in an environmental good (i.e. the coastal regeneration), therefore requiring a pre-assessment. On the other hand, the LSA is an *ex-post* approach, which observes how a specific change has affected LS, therefore requiring a pre- and post-assessment.

- **Time and cost considerations.** A repet cross-sectional design was selected over a longitudinal design due to a number of advantages outlined in Chapter 3 (section 3.4). However, the study does acknowledge the disadvantages associated with the selection of a repeat cross-sectional study design including: day-to-day variability in LS, non-response bias (National Research Council of the National Academies, 2013; Sedgwick, 2014) and difficulties in establishing causation and differentiating causal effects from pure time effects (Mann, 2003).

- **Geographical area.** The size of the area and sample population also affected the study design. The small size of the geographical area and sample population supported the decision to select a repeat cross-sectional design.

5.4.2. Study population and sample size

Teat's Hill is a small green and blue space, analogous to the concept of 'pocket parks' in the urban green space literature (e.g. Cohen *et al.*, 2012, 2013; Merom *et al.*, 2003; West and Shores, 2011). These types of spaces generally serve the immediate population living near the site. This is commonly the population living within 0.4km (0.25 miles) and 1.6km (1 mile) (Cohen *et al.*, 2014; Hunter

et al., 2015). Therefore, the study population was initially considered to be those households falling within a 1km radius of the Teat's Hill site. These are specifically the seven surrounding postcode districts, known as Lower-Layer-Super-Output-Areas (LSOAs). The addresses of all households in the seven LSOAs (n=1057; Table 5.1) were supplied by Plymouth City Council. However, following advice from market research companies, the sample population was also expanded to people visiting the Teat's Hill site (in-site interviews; discussed in 5.4.3). This was due to the small population size within this area. Previous research has shown that distance may not be a substantial factor when spaces are well-equipped and have attractive features (Cohen *et al.*, 2015).

Table 5.1: The number of households and residents in each of the Lower-Layer-Super-Output-Areas (LSOAs).

LSOA name	No of households	No of residents
Sutton and Mount Gould E00076672	194	379
Sutton and Mount Gould E00076688	109	257
Sutton and Mount Gould E00076707	128	288
Sutton and Mount Gould E00076698	232	564
Sutton and Mount Gould E00076711	107	256
Sutton and Mount Gould E00076710	134	335
St Peter and the Waterfront E00076583	153	330
Total	1,057	2,409

Power analyses are not traditionally used in CVM studies to compute required sample sizes. The WTP variable is different from other variables usually entered

into a power analysis. In power analysis, it is assumed that a variable has a "true" mean value in the sample and it is used to determine how many respondents need to be sampled to obtain this true mean with a particular level of certainty. In the CVM, it is expected that WTP is different across respondents. Therefore, the sample size selection was based on previous CVM and LSA studies, in addition to research that has compared the methods empirically (e.g. Bakhshi *et al.,* 2015; Dolan and Fujiwara, 2012; Dolan and Metcalfe, 2008). Previous studies have sampled between 300-1,100 respondents, using face-to-face interviews and postal surveys. Therefore, the aim was to interview 900 respondents (T1: n=450, T2: n=450).

5.4.3. Survey mode and administration

The survey was administered using face-to-face interviews, which are the earliest mode for CVM surveys and were recommended by the National Oceanic and Atmospheric Administration (NOAA) blue ribbon panel (Arrow *et al.*, 1993). This type of survey mode was selected due to its practical advantages over the alternatives: (i) it allows the survey completion process to be guided by a trained interviewer, (ii) it helps to maintain respondent motivation and (iii) it allows for the use of visual aids to help the respondent understand the CVM scenario, which may be complex and unfamiliar. Face-to-face interviews have also been applied in LSA studies (e.g. Jarvis *et al.*, 2017) and studies comparing the CVM and LSA (e.g. Bakhshi *et al.*, 2015; Del Saz-Salazar *et al.*, 2017).

Professional market research interviewers were supplied by Marketing Means Ltd, a market research company. A mixed method approach was used,

involving two types of interview (door-stepping and in-site interviews). Two versions of the questionnaire were developed for each of the two methods (section 5.5). Screening questions were included in both versions of the questionnaire to ensure that respondents had not been involved in public or community engagement events surrounding Teat's Hill in the last 6 months (e.g. focus groups; see section 5.5). Any member of a household was able to take part in the survey. The questionnaire did not include a screening question asking if respondents were the person making financial decisions in the household.

Door-stepping was required to sample the seven LSOAs within 1km of the site, containing 1,057 households. The addresses were divided into two groups with every alternate household selected to divide the addresses between T1 and T2. Up to one week before interviewing began, leaflets were distributed to each of the households (see Appendix A). The leaflets detailed what the interview involved and reminded potential participants that they did not have to participate in the study. Where there were blocks of flats, the appropriate number of leaflets were delivered through the communal door, and where possible, copies of the leaflet were pinned to communal noticeboards.

Once the address list for the door-stepping approach was exhausted, in-site interviews were undertaken. In-site interviews were used to supplement the sample size achieved through the door-stepping approach. Interviews were carried out with visitors that were stopping at, passing through or traversing paths on the Teat's Hill site (within the boundary shown in Figure 5.6). This was feasible because the South West Coast Path passes through the site as does a

main access route to the historic city centre to the West of the site (from several parking areas to the East). Interviewers positioned themselves at specific points on and near the Teat's Hill site. Positioning of interviewers on the Teat's Hill site was determined using behavioural observation data from the STUMPD project (led by Plymouth City Council) and the BlueHealth project (EU Horizon 2020; Grellier *et al.*, 2017). The behavioural observation data revealed that most activity and footfall were observed on the South West coast path. Screening questions were included in the in-site questionnaire to ensure that only Plymouth residents were sampled to participate in the study. If the individual lived outside of the Plymouth Unitary Authority, they were not interviewed.

5.5. Survey development (pre-testing)

As discussed, the questionnaire was designed in collaboration with the BlueHealth project (Grellier *et al.*, 2017). During 2016-2018, extensive pre-testing was carried out to develop a questionnaire that was understandable and credible to respondents (Johnston *et al.*, 2017; OECD, 2013). Pre-testing used both qualitative and quantitative approaches as described in Figure 5.7. Pre-testing of the survey also contributed to the BlueHealth project's stakeholder engagement work stream.

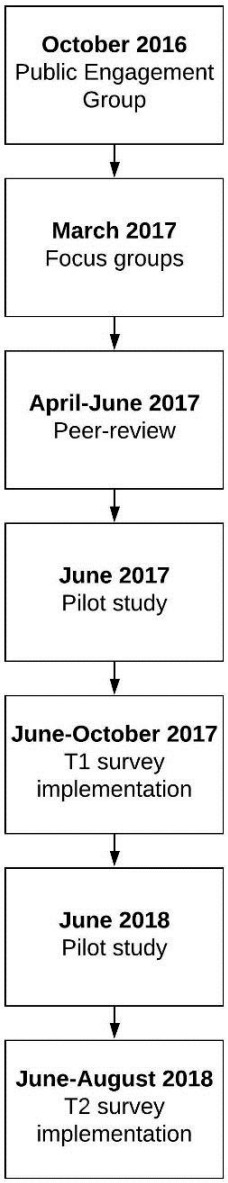

Figure 5.7: Timeline for pre-testing (qualitative and quantitative).

5.5.1. Public Engagement Group

The research team consulted with a Health and Environment Public Engagement (HEPE) group during study development. The HEPE group is comprised of members of the public from Cornwall that work with academics at the European Centre for Environment and Human Health (ECEHH). Through

consultation and collaboration the group aims to ensure that research considers the public perspective at all stages, from design and conduct to dissemination.

The HEPE group were engaged to help inform the design of the Teat's Hill questionnaire. The first draft of the questionnaire was sent to HEPE on the 31st October 2016, in advance of applying for ethical approval. Four members of the HEPE group provided written feedback on the draft questionnaire in November 2016. The respondents provided feedback on the structure, flow and content of the interview script as a whole. Respondents also provided detailed feedback on the CVM section of the survey (payment vehicle, scenario and elicitation format). The written feedback provided by the HEPE group (n=4) is provided in Appendix B.

5.5.2. Focus groups

A second draft of the CVM section of the questionnaire was designed based on feedback from the HEPE group, discussions with the research team and meetings with Plymouth City Council. The key modification from this discussion was the payment vehicle (discussed further in section 5.6). The CVM questionnaire was then trialled in three focus groups. The focus groups were held in March 2017 (14th, 16th and 20th March) at Plymouth Marine Laboratory. The specific aims of the focus groups were as follows: (1) to determine whether the valuation scenario was clear and easy for respondents to understand, (2) to determine whether the payment vehicle was suitable for use in the survey, (3) to establish whether the CVM question was clear for respondents to understand and ascertain how they feel about the nature of the task and (4) to ascertain

whether the payment card was acceptable for use in the survey, considering format and clarity.

A focus group recruitment company was used to sample participants that were representative of the populations in two local authority areas (wards), located near Teat's Hill (Sutton and Mount Gould and St Peter and the Waterfront). Participants were recruited from a database of individuals, held by the focus group recruitment company based on their socio-demographic characteristics (age, sex, social grade, employment status, marital status and ward). Twenty-four local residents attended the three focus groups (8 participants per focus group). The socio-demographic characteristics of the participants are shown in Appendix C.

The CVM scenario text and elicitation question were read out to the focus group participants (as they would be in the survey interview) and they were provided with the show cards. Participants were asked to state their maximum WTP for the improvements at Teat's Hill using the payment card (see subsection 5.6.2.4). The participants were then provided with a paper-based version of the interview script and asked to feedback on specific elements of the survey: (1) the valuation scenario, (2) payment vehicle and (3) elicitation question and format. The summary of results from the focus groups is provided in Appendix D. The focus groups resulted in the following modifications to the survey:

- The selection of the Plymouth Parks Foundation as the payment vehicle (see subsection 5.6.2.3).
- The time frame over which the payments are made (a one-off payment).
- The use of an interval payment card (see subsection 5.6).

- Reducing the length and adapting the content of the CVM valuation scenario (e.g. moving information about the history of the site from the questionnaire to the leaflet advertising the survey).
- Adding new photographs. This was to ensure that the scenario text and photographs concurred, in terms of providing an illustration of the quality of the Teat's Hill site (pre-intervention).

5.5.3. Peer review

Following the focus groups modifications were made to the CVM section of the survey questionnaire and added to the interview script,. The interview script was then peer-reviewed by scientists from the Sea and Society research group at Plymouth Marine Laboratory (n=6, 25th April 2017). Interviews of, or peer-reviews by, other scientists are recommended (Johnston *et al.*, 2017). This helped to provide insights into the ability of the survey to meet the intended goal(s) of the study, based on the research experience of experts. They provided feedback on the questionnaire, focusing on clarity, structure and flow and an indication of the average interview duration. This was followed by survey piloting with family and colleagues between 29th May and 5th June 2017 (n=10). In sum, 34 people were involved in the piloting of the survey over a seven-month period. This process highlighted wording issues ahead of the finalisation of the draft questionnaire on the 9th June 2017 and the start of data collection.

5.5.4. Pilot studies

Quantitative pre-testing was carried out using a field pilot. Piloting of the T1 survey was carried out by a professional market research company (Marketing Means) on the 5th and 6th June 2017. 17 interviews were administered in total,

12 through the door stepping approach and 5 through in-site interviews. Quantitative pre-testing is recommended for large or high-stake surveys and can provide insights that cannot be derived from qualitative pre-testing alone (Bateman *et al.*, 2002; Dillman *et al.,* 2014; Johnston *et al.*, 2017). Quantitative pre-testing helped to assess item non-response rate, average interview duration, the suitability of experimental design and to conduct preliminary investigations of hypotheses (Carlsson and Martinsson, 2003; Carson and Mitchell, 2003; Champ, 2003; Scarpa *et al.,* 2007). The average durations of the door-stepping interview and in-site interviews were 17 minutes and 15 minutes, respectively.

The piloting also helped to modify the plans for survey implementation in June 2017. Specifically it helped to identify issues associated with the closure of the Sutton Harbour pedestrian bridge. This bridge allows pedestrians to reach Teat's Hill from the historical Barbican Quarter and the City Centre, the areas with the largest footfall. The pedestrian footbridge was closed in May 2017 due to a mechanical fault (Plymouth Herald, 2017a, 2018a) and remained closed for the duration of the natural experiment. Its closure resulted in significantly reduced footfall at the Teat's Hill site because the bridge is the most direct and accessible route between Teat's Hill and the neighbouring areas. This led to the decision to position interviewers in alternative areas with higher footfall,

including outside the National Marine Aquarium and Lockyers Quay, which was close to the temporary ferry jetty (see Figure 5.8).

Figure 5.8. Map showing the two alternative locations for in-site interviews: (1) Lockyers Quay and (2) the National Marine Aquarium. They are shown in relation to Teat's Hill and the pedestrian footbridge.

Piloting also lead to a key amendment to the questionnaire, to include a screening question to ensure that only Plymouth residents were able to take part in the survey. Limited changes were also made to the content and items for the CVM and LSA. The T2 survey questionnaire conducted in July 2018 shared similar content and structure to the pre-assessment. However, there were differences in terms of the CVM section (Part 2) and additional questions were also added to the background information section (Part 3). The new version of the questionnaire was also tested by Marketing Means before going

ahead with the fieldwork. No substantial problems were identified during the interviews.

5.6. Questionnaire design

The questionnaire was finalised following the extensive and iterative process of pre-testing, discussed in section 5.5. The survey instrument was split into four main sections: (1) Use of and visits to green and blue spaces, (2) The Teat's Hill regeneration project, (3) Background information and (4) a section of questions to be completed by the interviewer.

Two versions of the questionnaire were designed, differentiating between the door-stepping and in-site approach. The questionnaires had the same core content (Part 1-4), and structure, but they differed in the 'introduction to interview and screening questions'. The door-stepping questionnaire included questions about whether people had received the postcard and read the relevant information (e.g. information on the postcard and associated web link). The in-site questionnaire included an additional screening question to determine whether people lived in the Plymouth Unitary Authority.

An overview of the survey instrument is displayed in Table 5.2. The final question order of the survey was selected based on best practice guidelines and the ethical approval process (discussed in section 5.7). The full questionnaire design for the T1 and T2 surveys are shown in the appendix (including door-stepping and in-site versions; Appendices E to J).

Table 5.2: Overview of the questionnaire (content and question-order).

Section	Description
Part 1: Green and blue spaces	Questions concerning visits to green and blue spaces, including Teat's Hill.
Part 2: The Teat's Hill regeneration project	Questions concerning the respondent's willingness-to- pay (WTP). The question content depended on the assessment stage: (i) T1 survey: the regeneration of Teat's Hill. (ii) T2 survey: the maintenance of Teat's Hill, following the regeneration.
Part 3: Background information	Questions concerning the respondent's health and well-being and socio-demographics.
Part 4: To be completed by the interviewer	Questions concerning the interviewer's perception of the respondent level of understanding, difficulty and annoyance.

5.6.1. Visits to green and blue spaces

Part 1 introduced the survey with broad questions relating to general visits to green and blue spaces, as well as specific visits to Teat's Hill. The questions were modified from those included in Natural England's MENE survey (Natural England, 2017). Exposure to Teat's Hill was operationalised using visit frequency to Teat's Hill (in last 4 weeks). Respondents were provided with show cards displaying maps of Teat's Hill and asked "And in the last 4 weeks, how many times have you visited Teat's Hill? This could include stopping there or just passing through. It can also be the beach or the park area". Response options included: (1) "Not at all in the last four weeks", (2) "Once or twice in the last four weeks", (3) "Once a week", or (4) "Several times a week". Respondents were then asked to describe the quality of Teat's Hill and provide further details about their visit, including the date, duration, the main activity undertaken and the number of adults and children on the visit. This section served multiple

purposes, meeting the requirements for both the CVM and LSA. Visit questions are a core component of SWB surveys in this context, and studies have shown associations between SWB and visit variables including visit frequency (e.g. White *et al.*, 2017; discussed in Chapter 3.4). The inclusion of this section was also key for the CVM. It is recommended that introductory sections are included to engage respondents in the topic, to establish a rapport, and to accustom the respondent to the interview process (Bateman *et al.*, 2002).

5.6.2. The Teat's Hill regeneration project (CVM)

Both the pre (T1) and post-assessments (T2) included a CVM questionnaire, as shown in Table 5.2. Given the interest in comparing the CVM and the LSA, only the CVM from the pre-assessment (WTP for the regeneration) is discussed in this section. The CVM questions were included in Part 2 of the survey (The Teat's Hill regeneration project). The questions were designed based on the review of literature (Chapter 2 and 4) and CVM guidance manuals (e.g. Arrow *et al.*, 1993; Bateman *et al.*, 2002; Johnston *et al.*, 2017). The subsequent subsections will discuss the key methodological choices and design elements relating to the CVM part of the questionnaire: (1) valuation scenario, (2) the type of welfare measure, (3) payment vehicle, (4) the framing of response options (the elicitation format) and (5) the use of auxiliary questions.

5.6.2.1. Valuation scenario

In the pre-assessment survey respondents were presented with a hypothetical scenario that described Teat's Hill and its current condition (baseline/status quo condition) and the proposed change to the site (in terms of alterations in environmental quality, access and facilities) through the Teat's Hill regeneration

project. The scenario is displayed in Figure 5.9. This was supported by the use of show cards, which displayed photos of the Teat's Hill site and details of proposed improvements to the site (see Appendices E and F).

We are now going to talk more about Teat's Hill, its current condition, and a potential renovation project in the area. [PROVIDE HANDOUT WITH SHOWCARDS B,C,D AND E ON IT].

- *As you can see from these photos, Teat's Hill has a beach, park, and children's area.* [POINT TO PHOTOS 1-3]
- *Teat's Hill is home to wildlife on land and in the sea. These include: birds, fish and seals.* [POINT TO PHOTO 4]
- *Over recent years, Teat's Hill has suffered damage, which has affected access, facilities and the environmental quality of the site.*
- *The current condition of Teat's Hill is shown in the following photos.*
- *There has been damage to the public slipway and access points.* [POINT TO PHOTO 5]
- *There has been a build-up of litter on the beach and in the water, including plastic and glass.* [POINT TO PHOTOS 6 AND 7]
- *As a result of the condition of Teat's Hill, Plymouth City Council and a research team are thinking about a project that would improve Teat's Hill. The project would be called the Teat's Hill renovation project.*
- *The project would focus on three main areas of improvement: environmental quality, access and facilities. The proposed plans for the project are shown here.*

SHOW CARD C, AND GIVE THE RESPONDENT TIME TO READ THROUGH – OR READ IT TO THEM IF REQUESTED.

- *The Teat's Hill renovation project would be organised by a number of institutions.*

SHOW CARD D

- *These institutions have all contributed towards the project, however more funding is required to put the plans into action.*
- *One possible way of financing this project is through the establishment of an independent charitable organisation, called the Plymouth Parks Foundation.*
- *The Plymouth Parks Foundation would raise funds for the improvement of outdoor spaces across Plymouth. Teat's Hill would be the first outdoor space to be improved.*
- *All Plymouth households would be asked to contribute a one off payment to the Plymouth Parks Foundation fund. This payment could be made by cash, cheque or direct debit.*
- *All contributions to the fund would go directly towards the practical renovation of Teat's Hill, not towards administration or maintenance. Maintenance costs will be covered by Plymouth City Council.*

Figure 5.9: CVM scenario for the T1 survey**.**

This was followed by an elicitation valuation question which was worded as follows: ***"****Considering the benefits of this project for you and your household, what is the maximum that you would be willing to contribute to this fund, as a one off payment, for these improvements? If the overall funds people state they are willing to contribute in this survey do not cover the costs of the project, the plans cannot be put into action. Before you decide on your contribution, please carefully consider whether the cost is acceptable to your household. When considering this, keep in mind your household budget and all the other demands you have on your budget".*

Respondents were then asked to respond using the payment card, displayed below:

	One-off contribution
○	0
○	£1
○	£2
○	£5
○	£10
○	£15
○	£20
○	£30
○	£40
○	£50
○	£75
○	£100
○	£150
○	£200
○	£300
○	£400
○	Over £400

The valuation question outlined above included the (i) welfare measure (WTP) and (ii) payment vehicle (one off payment to the Plymouth Parks Foundation).

5.6.2.2. Welfare measure

As discussed in Chapter 2, there are two monetary (welfare) measures that can be used in practical welfare assessments: WTP and WTA (Ahlheim and Buchholz, 2000; Haab and McConnell, 2002; Markandya, 2005). WTP was selected due to the nature of the change resulting from the Teat's Hill regeneration project (provision of a bundle of goods) and because the WTP may produce more conservative estimates of value, in comparison to WTA, due to the endowment effect (Arrow *et al.*, 1993). The provision of a bundle of goods represents welfare scenario 1, described in Table 2.1 (Chapter 2; section 2.2). In this case, it is how much income Plymouth residents are willing to give up for the coastal regeneration. The endowment effect is discussed in Chapter 4 (section 4.3).

5.6.2.3. Payment vehicle

The payment vehicle was a one off payment to a hypothetical fund, called the 'Plymouth Parks Foundation Fund'. The Plymouth Parks Foundation fund was described as an independent charitable organisation, which would raise funds for the improvement of outdoor spaces across Plymouth. It was stated that Teat's Hill was the first outdoor space to be improved through this fund.

The Plymouth Parks Foundation was selected as a payment vehicle for two main reasons. First, although hypothetical, the payment vehicle was felt to be realistic, credible and understandable to a broad range of respondents

(Johnston *et al.*, 2017). For instance, there had been previous discussions within Plymouth City Council, about setting up a charitable organisation ('Plymouth Parks Foundation') that would help to improve and enhance Plymouth's green and blue spaces. This was modelled on a similar scheme set up in the comparable English coastal town of Bournemouth, i.e. the Bournemouth Parks Foundation, which was founded in 2015 and aims to enhance the town's parks, gardens and green spaces. The Plymouth Parks Foundation was framed as a mandatory one-off payment for Plymouth residents, in order to avoid issues related to the use of charitable donations (e.g. strategic bias; discussed in Chapter 4, section 4.6).

Second, it was selected, due to feedback from pre-testing, specifically from engagement with HEPE and the focus groups. The initial draft to HEPE presented council tax as the payment vehicle; however, there were concerns about the use of this method. This led to testing of the Plymouth Parks Foundation in the focus groups and a discussion of alternatives (e.g. council tax and water rates). The Plymouth Parks Foundation was considered to be the most suitable payment vehicle for the Teat's Hill context. Similar concerns for the use of council tax were also observed during the focus groups, in support of findings from the HEPE group discussion and previous SP research in the South West. For example, Harvey et al (unpublished) carried out focus groups in 2012 and 2013 in Cornwall to investigate how the public perceived the coast in Cornwall (and the coast in general). The study highlighted that a number of payment vehicles were not fit for purpose in a community local to Plymouth, including an increase in water rates, council tax or parking charges. A one-off payment was selected as the time frame for the payment, based on feedback

from the focus groups and guidance from previous research (e.g. Dolan and Fujiwara, 2012).

5.6.2.4. Elicitation format

WTP was ascertained using the payment card (PC) format (shown above). The PC was selected as the most suitable elicitation format due to a number of strengths discussed in chapter 2 (Table 2.4; section 2.6). Respondents were presented with the WTP question and a budget reminder to prompt them to consider the demands on their budget. They were then presented with the PC and asked to select the amount on the card which most closely related to how much they would be willing to contribute to the fund. Followig feedback from focus group participants, the PC displayed 17 values, ranging from £0 to over £400 using an interval format. The PC was tested to ensure that the amounts were credible and salient to respondents, and covered all positive WTP amounts.

5.6.2.5. Auxiliary questions

Following the valuation question, respondents were presented with a series of auxiliary (or supporting) questions. “Auxiliary questions are often included in SP questionnaires to assist in understanding responses to value elicitation questions” (Johnston *et al.*, 2017, p47). Auxiliary questions were developed, pre-tested, and included in Part 2 of the survey for a number of purposes. The questions were included to (1) to understand respondents’ attitudes, opinions, behaviours and experiences, (2) to evaluate whether (and how) respondents understand and/ or accept information, (3) to identify protest responses or other motivations for value elicitation responses, (4) to help engage respondents as

they process information and (5) to partition the flow of text. The auxiliary questions used in the questionnaire and reasons for use are displayed in Table 5.3.

Table 5.3: Auxiliary questions included in Part 2 of the survey.

Question	Purpose of question
Were you aware of the condition of Teat's Hill before this interview?	• To partition the flow of text. • To help engage respondents as they process information
How difficult was it for you to come to a decision regarding the amount of money you would be willing to contribute to the Plymouth Parks Foundation fund?	• To evaluate whether (and how) respondents understand and/ or accept information
Which one of these areas of improvement is most important to you? Please select one area of improvement only.	• To understand respondents' attitudes, opinions, behaviours and experiences

Protesting was highlighted as a key practical issue of the CVM in Chapter 4 (section 4.6) and through pre-testing (e.g. focus groups). Following the WTP question, respondents were asked how strongly they agreed or disagreed with a range of statements about their contribution to the Teat's Hill regeneration project on a Likert-type scale ranging from 1 ("Strongly Disagree") to 7 ("Strongly Agree"). These statements are displayed in Table 5.4.

Table 5.4: Protest and True Zero WTP statements used in T1 survey.

Question/statement	Purpose of statement
"I have the right to enjoy the improvements to Teat's Hill, and should not have to pay extra for it".	To identify protest responses
"I approve of the Teat's Hill renovation project but I object to paying into the 'Plymouth Parks Foundation' fund for it".	
"I don't want to pay for the Teat's Hill renovation project, as I don't go there".	To identify 'True (valid) Zero WTP' responses
"Any improvements to Teat's Hill are not important to me"	

5.6.3. Background information

The background information section (Part 3) asked respondents about their well-being, health, and socio-demographic characteristics.

5.6.3.1. LSA

A global LS question was included in the survey. The evaluative SWB question was adopted from the Office of National Statistics (see Chapter 3; section 2.3). Respondents were asked "Firstly, all things considered, how satisfied are you with your life as a whole nowadays?" and to respond on a Likert-type scale from 0 to 10, where 0 means "not at all satisfied" and 10 means "completely satisfied". Responses to this item in connection to self-reported income are

used in Chapter 7 to place a monetary value on the well-being gained from people's experiences of the coastal regeneration.

5.6.3.2. Health and socio-demographic questions

Part 3 asked respondents about their health and socio-demographic characteristics. These background questions were included in Part 3 to ascertain the representativeness of the survey sample relative to the population of interest, but also to study the effect of a range of socio-demographic ('predictor') variables on WTP (CVM) and LS (LSA) (Bateman *et al.*, 2002; OECD, 2013), meeting the objectives outlined in Chapters 2 and 3. It is well documented that WTP and LS are affected by a range of different factors relating to demographics (e.g. age, gender and marital status), material conditions (e.g. income), and quality of life such as health status and employment status (Dolan *et al.,* 2008; López-Mosquera and Sánchez, 2011; OECD, 2013). The specific wording of the questions was derived from the European Social Survey and MENE survey. Background questions were included towards the end of the survey. For example, in the case of income it is best practice to include the question later in the survey, to minimise non-response (Johnston *et al.*, 2017).

5.6.4. Additional questions

Additional information was collected based on best practice (e.g. Bateman *et al.*, 2002) in the 'Introduction to interview' and 'Part 4: to be completed by the interviewer'. In the 'introduction to the interview', interviewers were asked to record the weather status ('sunny', 'rainy', 'cloudy', 'windy', 'hot' and 'cold'). In Part 4, the interviewer was asked to fill in the 'interviewer debriefing questions'.

They were asked to record whether the respondent was alone during the interview and their perception of the respondent's level of understanding. In the event that the respondent stopped the survey, they were also asked to record the perceived reasons for this (i.e. understanding or annoyance). Respondents were not able to comment at the end of the survey.

5.7. Ethical approval

Ethical approval for the study was sought from the University of Exeter Medical School Research Ethics Committee. A first application was submitted in November 2016 and then modified for a second application in January 2017. The amended application provided (1) clarification on points raised by the Ethics Committee, (2) details of adapted procedures (e.g. for safeguarding respondents) and (3) a modified version of the survey. Ethical Approval was granted formally on the 1st June 2017 (see Appendix K and L).

The main amendment to the application was associated with the question order of the questionnaire. In an original draft of the questionnaire, questions pertaining to psychological well-being (LS and domains of LS) were placed at the start of Part 1 because they are potentially vulnerable to question order effects (OECD, 2013; see Chapter 4; subsection 4.6.1). However, the proposed question order was raised as an ethical issue by the committee. There were concerns that placing questions about psychological well-being at the beginning of the survey may be stressful to participants.

As a result of this, the question order of the survey was amended. Questions relating to health and well-being (including the LS and domain questions) were moved to Part 3 of the survey (background information). The items were placed

after a series of socio-demographic questions, with the hope of neutralising responses after the CVM question. Although this may affect the answers given, there is a precedent for this strategy in the MENE survey (Natural England, 2017) which also places the well-being questions in the demographics section of the questionnaire. The survey left the opening sections to focus on the use of natural environments. The data from the MENE has since been used to assess the relationship between nature exposure and SWB (White *et al.*, 2017).

5.8. Survey implementation

Interviews were undertaken on weekdays and weekends, between 9am and 8pm by two trained interviewers from Marketing Means. Interviewer bias was not tested for within the study. The T1 survey was conducted between 5th June and 28th September 2017. The T2 survey was undertaken between 27th June and 6th August 2018. The fieldwork for the second survey was completed over a shorter time frame and this may have occurred for a number of reasons. Potential reasons include the interviewers increased familiarity with the area (e.g. for door-step interviews) and improved weather conditions. Snap survey software was used on a tablet to display the questionnaire and collect survey data. Show cards were presented to respondents using paper-based copies.

5.9. Summary

This chapter provides an introduction to the empirical case study analysed in this thesis. The study was made possible by a local coastal regeneration project that occurred during the course of the PhD project at Teat's Hill in Plymouth. This provided an opportunity to use a natural experiment with a repeat cross-sectional design to assess well-being and value the changes in well-being

anticipated or resulting from the regeneration at T1 and T2. This chapter provides an overview of the extensive process undertaken to develop the study and survey (including initial research and pre-testing). This was followed by an outline of the questionnaire design, which encompassed the requirements for both the CVM and LSA. The chapter culminated in an overview of the ethical approval process and the implementation of the survey. The objectives, descriptive statistics and analysis for the CVM and LSA are discussed in the respective data chapters (Chapters 6 and 7).

6. Empirical study: Contingent Valuation Method (CVM)

6.1. Chapter overview

This chapter presents the results of the CVM survey which valued the Teat's Hill regeneration project in Plymouth, UK. Alongside the LSA study (Chapter 7), this analysis was undertaken to address research question 4 (Chapter 1; section 1.2). The value of the regeneration was estimated through the completion of two main objectives for the CVM (referred to in Chapter 2; section 2.7): (1) to estimate willingness to pay for the coastal regeneration of Teat's Hill and (2) to ascertain the determinants of WTP, i.e. the variables that affect respondents' WTP statements. This provides an estimation of people's utility, *ex-ante* for the coastal regeneration at Teat's Hill. The chapter presents an overview of the sample characteristics (section 6.2). This is followed by the estimation of mean WTP for the coastal regeneration (section 6.3), analysis of the determinants of WTP and an assessment of the validity of the results (sections 6.4. and 6.5). The chapter closes with a discussion of the results in relation to the wider CVM literature and the limitations of the study (section 6.6).

6.2. Sample characteristics

As discussed in Chapter 5, the data for the analysis came from a natural experiment using a repeat cross-sectional survey. Data for the CVM was derived only from the T1 survey, which was undertaken between June-September 2017. Professional interviewers conducted face-to-face interviews in respondents' homes (doorstep interviews) and with visitors to and passers-by the Teat's Hill site and areas within close proximity of Teat's Hill (in-site interviews). A total of 314 respondents were interviewed. The survey response

rate for the door-step surveys was 26.76% with 141 out of 527 households being interviewed as part of the T1 survey. 73 respondents were interviewed using in-site surveys. The socio-demographic characteristics for the full sample is shown in Appendix M.

6.2.1. Spatial analysis

The CVM is used to estimate the value of the regeneration for individuals living within the Plymouth Unitary Authority. Therefore, spatial analyses were used to (i) exclude respondents that lived outside the sample area, the Plymouth Unitary Authority (highlighted in Figure 6.1) and (ii) to estimate the distance (km) between the respondent's household address and Teat's Hill. The distance between household addresses and the closest access point at Teat's Hill (East and West) was identified using Arc GIS (version 10.5.1; ESRI Inc). The analysis highlighted that four respondents lived outside the Plymouth Unitary Authority and there were missing observations for household address for another 11 respondents. Overall, 15 respondents were excluded, resulting in a sample of 299 respondents. The spatial analysis also highlighted that there were some areas within the Plymouth Unitary Authority with few respondents. This may be due to a number of reasons. Firstly, these gaps may correspond with non-residential areas, such as industrial estates, privately owned land (e.g. National Trust) and green spaces (e.g. nature reserves and parks). Second, respondents living outside the 1km radius may visit other green and blue spaces in their area, rather than visit Teat's Hill. Third, it may be due to the nature of the convenience sample, adopted for the in-site interviews.

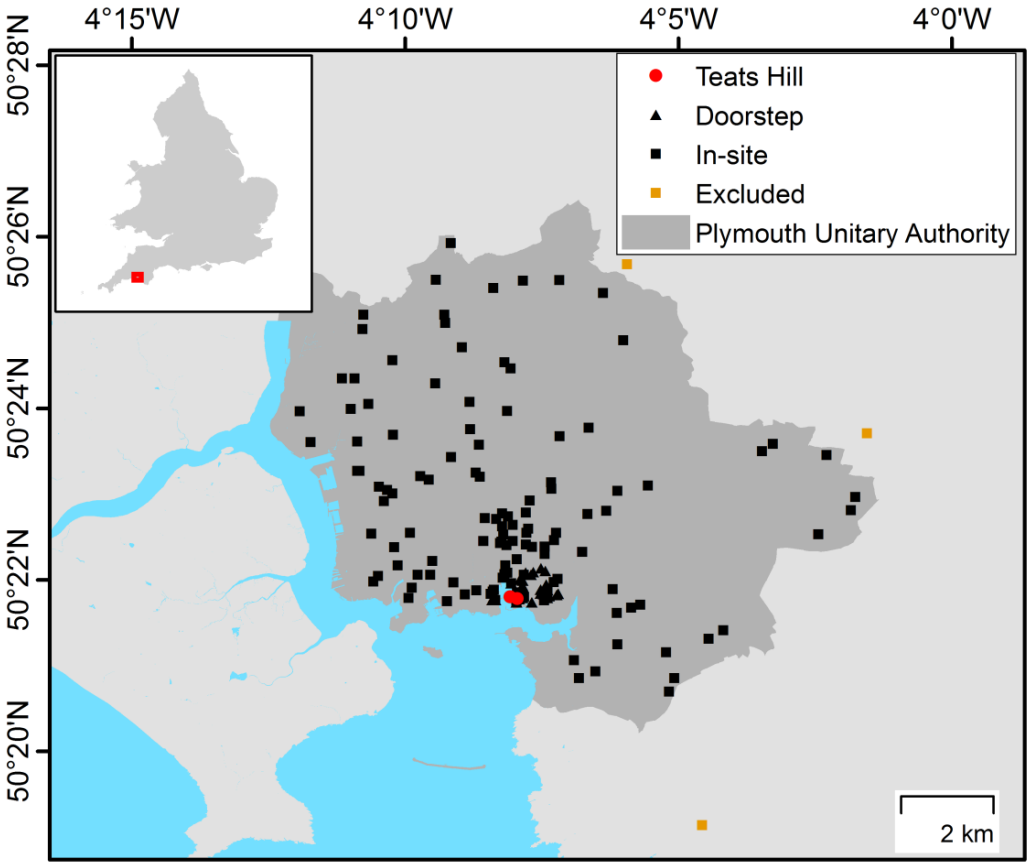

Figure 6.1: Map showing the distribution of respondents' household addresses (n=314; produced by Joanna Garrett). Respondents excluded from the sample are also highlighted.

6.2.2. Descriptive statistics

Following spatial analysis, descriptive analysis (n=299) was undertaken to assess the representativeness of the sample population for this study. The sample population was compared to the population within the 7 LSOAs and Plymouth Unitary Authority as a whole. They were both included due to the use of both door-stepping interviews and in-site interviews. Respondents to the door-stepping interviews were compared with the population of the 7 LSOAs, whereas respondents to the in site interviews were compared the population of the wider Plymouth Unitary Authority area. Data on the socio-demographics of

the seven LSOAs and the Plymouth Unitary was drawn from UK Census data. Data was averaged across the 7 LSOAs to produce mean values for the socio-demographics (UK Census Data, 2011a,b).

As shown in Table 6.1, there were apparent similarities between the study population and 7 LSOAs and Plymouth Unitary Authority populations for socio-demographic characteristics such as: gender (male), household size, relationship status (long term relationship). However, the comparison suggested that the study sampled a higher proportion of older respondents, which is supported by data for age and employment status (retired, employed and in education).

There were differences in the income question used in the survey and in the UK Census. This survey asks for annual household income after tax, whereas the UK Census asks for annual household income before tax. This makes it challenging to compare the mean annual income values: survey sample (£22,449.21) and Plymouth Unitary Authority (£20,162.00)[6]. However, it is estimated that the average annual household income for the Plymouth Unitary Authority sample after tax would have been approximately £16,989.74 in 2017 (T1). This would suggest that there may be a difference (£5,459.47) between the mean income of the sample (£22,449.21) and for the Unitary Authority as a whole (£16,989.74). Alternatively, the relative similarity between the average household income figures (survey sample: £22,449.21; Plymouth Unitary Authority: £20,162.00) may be as a result of respondents, in the current study, reporting their before tax income, due to difficulties with answering the after tax

[6] Note: there are no available data on income at an LSOA level.

question. As a whole, the survey was therefore not representative of the population within the seven LSOAs and Plymouth Unitary Authority, when compared to the Census Data. This limits the ability to aggregate WTP to the wider population and is discussed further in section 6.6.

Table 6.1: Means, proportion (%) and standard deviations of socio-demographic variables for the sample (n=299). This is compared to the mean statistics for 7 LSOAs and Plymouth Unitary Authority.

	Survey sample				Plymouth Unitary Authority
	N	Mean / %	Std.dev	7 LSOAs (mean)[a]	(mean)[a]
Age	295	46.62	19.17	35.56	38.96
Male (%)	299	48.16	-	52.79	49.41
Household size	298	2.53	1.41	2.21	2.29
Work status (%)					
Employed	294	49.66	-	61.68	57.72
Unemployed	294	5.78	-	5.96	4.24
Retired	294	24.83	-	8.68	14.09
In education	294	9.18	-	11.86	13.01
Otherwise not working	294	10.54	-	11.82	10.93
Long term relationship status (%)					
In long relationship	224	41.52	-	30.90	43.13
Other	224	58.48	-	69.10	56.87
Total household annual income	161	22449.21[b]	16,300.54	- [c]	20,162.00[d]

[a] Data derived from the UK Census (2011; retrieved UK Census Data 2011a,b).

[b] Household annual income after tax (mid-point in £).

[c] Data unavailable for income at the LSOA scale.

[d] Data unavailable for annual income after tax. Used total annual income before tax (2011; retrieved from UK Census Data, 2011a,b).

6.3. Results (Objective 1): Assessing WTP for the coastal regeneration

6.3.1. Identification and exclusion of protest responses

Descriptive analysis revealed that 147 out of 299 respondents (49.16%) stated £0 WTP. As discussed in Chapter 4 (section 4.6), protesting is an issue that can be encountered by CVM studies. Protest responses are a response to a valuation question in which a respondent provides a zero WTP rather than their genuine WTP to protest against the proposed project or the survey study (Bateman *et al.*, 2002). Two statements were included in the survey to help distinguish between respondents who were genuine zero bidders (i.e. those who expect their utility to be unaffected by the good being valued) and protestors. The first statement was: “I have the right to enjoy the improvements to Teat’s Hill, and should not have to pay extra for it". The second statement was: "I approve of the Teat’s Hill regeneration project but I object to paying into the ‘Plymouth Parks Foundation’ fund for it”. Responses to these protest statements were reported on a Likert scale from ‘Strongly Disagree’ to ‘Strongly Agree’ and are shown in Table 6.2 (n=147). For reference, Appendix N shows the responses for all respondents, not just those that stated zero WTP.

Table 6.2: Summary of responses for respondents stating £0 WTP on the payment card. Protest statement 1: “I have the right to enjoy the improvements to Teat’s Hill, and should not have to pay extra for it". Protest statement 2: "I approve of the Teat’s Hill regeneration project but I object to paying into the ‘Plymouth Parks Foundation’ fund for it”. Protest responses were reported on a Likert scale from ‘Strongly Disagree’ to ‘Strongly Agree’ (max n=147).

	Protest statement 1		Protest statement 2	
	Frequency	%	Frequency	%
Strongly disagree	1	0.68	2	1.37
Disagree	3	2.04	3	2.05
Slightly disagree	2	1.36	6	4.11
Neither agree nor disagree	14	9.52	11	7.53
Slightly agree	13	8.84	11	7.53
Agree	45	30.61	31	21.23
Strongly agree	69	46.94	82	56.16
Total	147	-	146	-

There are no clear-cut decision rules or criteria for the identification and exclusion of respondents, based on the analysis of protest statements. It is often based on subjective judgement (Jorgensen and Syme, 2000; Bateman *et al.*, 2002; Meyerhoff and Liebe, 2006; Rollins, *et al.*, 2010; Meyerhoff *et al.,* 2012; Johnston *et al.*, 2017). A number of identification rules were examined: (i) Agree to one or more protest statements, (ii) Agree to both protest statements, (iii) Strongly agree to one or more or more protest statements and (iv) Strongly agree to both protest statements. Descriptive analysis was undertaken, which calculated the number of respondents identified as protestors and the percentage of the sample excluded based on each rule. The rules excluded between 19.06% and 43.48% of respondents, as a result of the protestor criteria. The descriptive analysis is displayed in Appendix O.

Given this lack of agreement, the selected identification rule was based on studies which valued marine and coastal goods (e.g. Börger *et al.*, 2014; Börger and Piwowarczyk, 2016). Furthermore, it enabled a precautionary approach to be adopted to maintain sample size, discussed in Börger *et al.* (2014). The criteria selected for this study defined protestors as respondents who selected £0 on the payment card (zero WTP) and strongly agreed to both of the protest statements: Table 6.3 focuses specifically on the respondents which stated strongly agree to the statements (n=147).

Table 6.3: Descriptive statistics for respondents that stated zero WTP. Analysis of responses to the two protest statements (n=147).

	Strongly Agree (N)	**%**	**Mean[a]**	**Std.dev.**
"I have the right to enjoy the improvements to Teat's Hill, and should not have to pay extra for it".	69	46.94	6.03	1.25
"I approve of the Teat's Hill regeneration project but I object to paying into the 'Plymouth Parks Foundation' fund for it". [b]	82	56.16	6.06	1.41
Both statements	57	39.04	-	-

[a] Measured on a seven-point Likert-scale (1='strongly disagree', 7=strongly agree')
[b] n=146

69 respondents (46.94%) stated strongly agree to protest statement 1 and 82 respondents (56.16%) stated strongly agree to protest statement 2 (56.16%). Spearman's rank analyses (n=146) revealed that there was a significant

correlation between responses to the two protest statements ($r=0.504$, $p<0.01$). Altogether, 57 respondents from the overall sample of 299 (19.06%) stated strongly agree to both protest statements and were identified as protestors. A similar proportion of individuals has been identified and excluded from previous SP analyses (Börger and Piwowarczyk, 2016; Del Saz-Salazar *et al.*, 2017). It is recommended that analyses are undertaken to compare the samples before and after the exclusion of protest responses to ensure that the characteristics of the population have not been systematically biased (Bateman *et al.*, 2002). A comparison of the sample characteristics before and after the exclusion of protest responses is shown in Table 6.4. This shows that there are limited differences between the socio-demographic characteristics of the sample before and after the exclusion of protestors.

Table 6.4: Sample characteristics: before (n=299) and after (n=242) the exclusion of protest responses.

	Before exclusion			After exclusion		
	N	**Mean/%**	**Std.dev.**	**N**	**Mean/%**	**Std.dev.**
Age	295	46.62	19.17	239	44.92	19.59
Male (%)	299	48.16	-	242	49.59	-
Household size	298	2.53	1.41	241	2.60	1.47
Work status (%)						
Employed	294	49.66	-	237	50.63	-
Unemployed	294	5.78		237	5.49	-
Retired	294	24.83	-	237	23.63	-
In education	294	9.18	-	237	10.97	-
Otherwise not working	294	10.54	-	237	9.28	-
Long term relationship status (%)						
Long term relationship	224	41.52	-	177	40.11	-
Other	224	58.48	-	177	59.89	-
Total annual income after tax[a]	161	22,449.21	16,300.54	138	22,370.97	15,956.75

[a] income (mid-point in £).

6.3.2. Mean WTP

Estimations of mean WTP were based on analysis for 241 respondents, after excluding protest responses and removing an outlier (WTP=£200). The outlier was identified by investigating the WTP distribution for the sample, exploring their corresponding socio-demographic characteristics and examining the share of WTP of monthly income. There were limited responses at the higher end of the WTP distribution on the payment card and only one respondent selected £200. The respondent was in paid work and had a middle range income (£21,715 to under £25,994). It is recommended that outliers are omitted when WTP is perceived to be unrealistically large, for example when WTP exceeds an unrealistic proportion of income (Bateman *et al.*, 2002; Pearce and Özedemiroglu, 2002). The share of the WTP of monthly income for the respondent exceeded the average for the sample; therefore, the decision was made to exclude the observation.

The ease of making the WTP decision was examined amongst respondents (n=237). The majority of respondents (n=180; 75.95%) stated that it was “very easy” or “easy” to come to the decision regarding their contribution to the Plymouth Parks Foundation fund. This was in contrast to other respondents who stated “very difficult”, “difficult” and “neutral” (n=57, 24.05%). Of the 241 respondents, 90 respondents (37.34%) stated £0 WTP. 151 respondents (62.66%) stated a positive WTP, ranging from £1 to £100.

The summary WTP statistics for the sample is displayed in Table 6.5 and the WTP distribution is shown in Figure 6.2 The resulting mean WTP for the coastal regeneration for Teat’s Hill was estimated to be £7.97. Table 6.5 also provides a

comparison of the estimates derived from the two survey methods (door-stepping and in-site interviews).

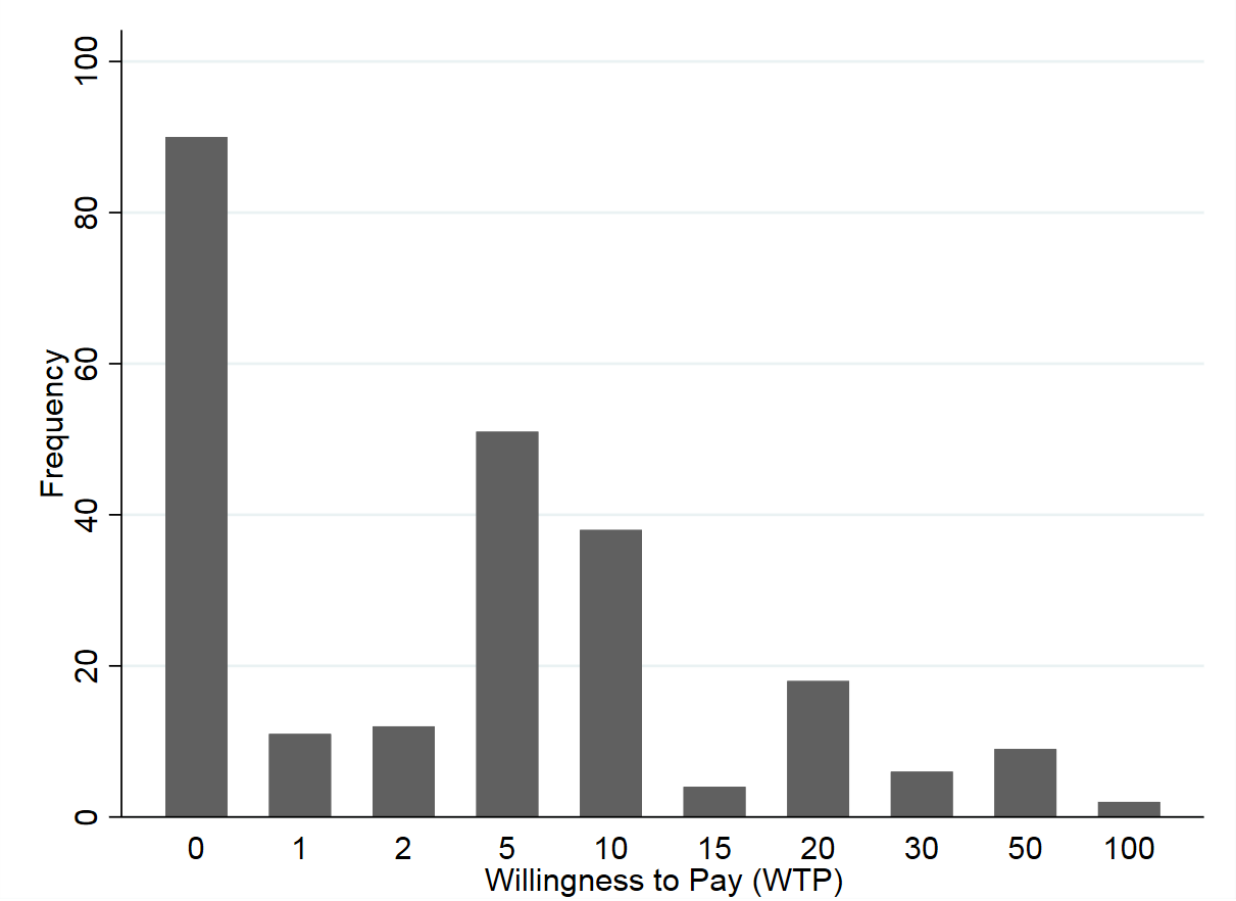

Figure 6.2: Distribution of stated WTP for the coastal regeneration at Teat's Hill (n=241).

Table 6.5: Summary statistics for WTP for the coastal regeneration at Teat's Hill: (i) the sample excluding protestors (n=241) and (ii) by interview method (doorstep and in-site).

	Sample	Interview method	
		Doorstep	In-site
Total number of respondents (n)	241	103	138
Missing WTP[a]	0	0	0
Mean Income (mid-point)[b,c]	22,360.14	22,491.25	22,279.94
Median Income (mid-point)[b,c]	19,923.49	19,923.49	19,923.49
Arithmetic Mean WTP[b]	7.97	9.59	6.75
standard error	0.89	1.66	0.93
95% confidence interval	(6.21;9.72)	(6.29;12.89)	(4.92;8.59)
Median WTP[b]	5	5	2
Minimum WTP[b]	0	0	0
Maximum WTP[b]	100	100	50.00

[a] Number of missing cases for the variable willingness to pay (WTP)

[b] All values in GBP (£)

[c] Number of cases for income after exclusion (sample size: n=137).

Table 6.6 compares WTP and income for the sample including protestors ('before exclusion'; n=299) and excluding protestors ('after exclusion'; n=241). This comparison indicates that the WTP and income of the sample before and after the exclusion of protestors is relatively similar. Therefore, there is confidence that the estimated mean WTP has not been biased by the removal of respondents.

Table 6.6: Summary statistics for the WTP for the coastal regeneration of Teat's Hill, comparing samples before and after the exclusion of protest responses and an outlier.

	Before Exclusion	After Exclusion
Total number of respondents (n)	299	241
Missing WTP[a]	0	0
Mean Income (mid- point)[b,c,d]	19,923.49	22,360.14
Median Income (mid- point)[b,c,d]	22,449.21	19,923.49
Arithmetic Mean WTP[b]	7.09	7.97
standard error	0.98	0.89
95% confidence interval	(5.16;9.02)	(6.21;9.72)
Median WTP[b]	1	5
Minimum WTP[b]	0	0
Maximum WTP[b]	200	100

[a] Number of missing cases for the variable willingness to pay (WTP)

[b] All values in GBP (£)

[c] Number of cases for income- before exclusion (sample size: n=160).

[d] Number of cases for income- after exclusion (sample size: n=137).

6.4. Empirical strategy

Regression analysis was undertaken to address objective 2, to ascertain the determinants of WTP, i.e. the variables that affect respondents' WTP statements. This was to evaluate the construct validity of the CVM study (discussed in Chapter 4; section 4.4). Models are used to express the functional relationships between WTP and other variables that normally affect demand (bid curve or valuation function; Bateman *et al.*, 2002; Jones, *et al.,* 2008). They estimate whether WTP estimates relate to income and other variables in a way that economic theory predicts (Kling *et al.,* 2012). As stated by Bakhshi *et al.* (2015) "if key variables are found to be either statistically insignificant or, most importantly, to affect WTP in unexpected and illogical ways, this casts doubt on

the theoretical validity of results" (p42). The assessment of construct validity is discussed further in section 6.6.

6.4.1. Dependent variables

Two dependent variables were examined in this study. The first variable concerned the WTP decision; whether an individual makes a positive WTP or zero WTP statement (0=zero WTP, 1= positive WTP). The second is the amount of WTP stated on the payment card (£0 to over £400). The variables are used to establish the extent to which household characteristics explain the WTP decision and the amount of WTP.

6.4.2. Explanatory variables

CVM best practice manuals (e.g. Bateman *et al.*, 2002) suggest that regression models should include explanatory variables related to: socio-demographic characteristics (e.g. age and income), knowledge of the good being offered and attitudes towards the programme being presented.

6.4.1. Reasons for choice of variables

A range of explanatory variables were investigated for inclusion in the regression models (shown in Appendix P). The final specification was selected based on theoretical expectations, in addition to a number of factors. First, it was based on the correlation between explanatory variables. Spearman's correlation was used to identify multicollinearity, ahead of post-estimation tests. Examination of a correlation matrix was used to see if any explanatory variables are highly correlated. Although it can miss subtle forms of multicollinearity, it is a

good ‘ball park’ method (Field *et al.,* 2012). The correlation matrices are displayed in Appendix Q and R.

Correlation testing identified that age was correlated with another potential control variable, the number of years the respondent had lived in Plymouth. As age had previously been identified as a determinant of WTP and there are more established theoretical expectations (e.g. Dolan and Metcalfe, 2008; Börger and Piwowarczyk, 2016), the number of years the respondent had lived in Plymouth was dropped. It also revealed that there was a correlation between distance and another potential variable for inclusion: interview method. Distance was selected instead of the interview method to enable the model to specify the value estimate as a function of distance from the affected area (e.g. Hanley et *al.,* 2003; Bateman *et al.,* 2006; Schaafsma *et al.,* 2012; Schaafsma *et al.*, 2013). Hanley *et al.* (2003) state that an understanding of distance-decay relationships may “prove very useful in applied valuation work, since they provide a natural way of conceptualising the question who benefits?” (p303). There was no statistically significant correlation between the explanatory variables included in the final model.

Second it was based on the minimum acceptable sample size. The analysis was interested in both the overall fit and the contribution of individual determinants within the model. As recommended by Field *et al.* (2012), the minimum acceptable sample size was estimated using a rule of thumb, based on Green (1991). The rule of thumb is $104 + k$, where k= number of predictors. Third, it was based on post-estimation testing of each of the models. It is important to ensure that the model has generalisability. If a model has

generalisability, it is assumed that predictions from the model can be applied not just to the sample on which it is based, but also to a wider population (Field *et al.*, 2012). Therefore, a number of post-estimation tests were undertaken following estimation of the regression model and the model was refined through this process. OLS models were tested for skewness, kurtosis, normality (Shapiro-Wilk Test), heteroscedasticity (Breusch-Pagan Test), multicollinearity (Variance inflation factors) and model specification error (specification link test and omitted variable test). Tobit and Probit models were also tested for multicollinearity.

6.4.2. Description of selected variables

Explanatory variables included socio-demographic variables including: gender (male=reference), age, employment status (employed=reference, unemployed, in education and retired), distance in km and log income (based on income of £/1000).

Income information was collected in categories ranging from 0 “less than £10,858” to 9 “£58,620 or more”. The median income value of the corresponding income class was used, in keeping with previous research (e.g. Whitehead, 1994; Lindberg *et al.,* 1997; Lyssenko and Martínez-Espiñeira, 2012; Desvousges *et al.,* 2015). Despite the application of best practice, 43.15% of respondents did not disclose their income. Therefore, a dummy variable, income disclosure, was also used to account for this non-disclosure (0= income not disclosed, 1= income disclosed). The inclusion of this variable retains sample size and reduces the influence of biases such as non-response bias and self-selection. For example, the removal of incomplete cases involves

discarding information on WTP and therefore may result in the intensification of selection bias. This is because respondents may select themselves out of the analysis by not disclosing their income (Whitehead, 1994). This is a common issue observed in CVM studies and is acknowledged in best practice manuals (Bateman *et al.*, 2002; Johnston *et al.*, 2017). Multiple Imputation (MI) has been described as the most common solution to this problem (Bateman *et al.*, 2002) and will be discussed in subsection 6.4.4.

Visit-related and attitudinal variables were also included. The first (recent visit) variable considered whether people had visited Teat's Hill in the last 4 weeks (Did not visit in the last 4 weeks=reference *vs*. visited in the last 4 weeks). A variable was also included to capture whether people were aware of the condition of Teat's Hill before the interview (unaware of condition=reference *vs.* aware of condition). An overview of the theoretical expectations for the association between the amount of WTP and the explanatory variables is shown in Table 6.7. Descriptive statistics for all variables are displayed in Table 6.8.

Table 6.7: Table highlighting the relationship between the amount of WTP and explanatory variables. Example studies are provided, drawing on marine and coastal research when available.

Variable name	Relationship with WTP	Example studies
Age	Negative relationship between age and WTP.	Dolan and Metcalfe (2008) Börger and Piwowarczyk (2016)
Male	Mixed evidence of relationship between WTP and gender.	Dolan and Metcalfe (2008) Ressurreição *et al.* (2012) Birol *et al.* (2006) Oh *et al.* (2008)
Employment status	Mixed evidence between WTP and employment status.	Dolan and Metcalfe (2008) Fields in Trust (2018) Ressurreição *et al.* (2012)
Log income	Positive association between income and WTP.	Dolan and Metcalfe (2008) Jobstvogt *et al.* (2014)[a]
Distance in km	Negative association between distance to a site and WTP.	Bateman and Langford (1997) Bateman *et al.* (2002) Bateman *et al.* (2006)
Recent visit to site	A positive relationship between the use of the good and WTP is to be expected.	Bateman *et al.* (2002)
Aware of condition of site	Associations between WTP and reported attitudes and concerns about the good are reasonably hypothesised.	Bateman *et al.* (2002)

Table 6.8: Descriptive statistics for the selected variables (max n=241).

Variable name	N	Mean	SD
Income (in £1,000)	137	22.36	16.01
Age	238	44.89	19.63
Distance in km	241	1.66	1.90
	N	**%**	
Income disclosure	241	56.85	
Male	241	49.38	
Employment status			
Employed	236	50.42	
Not in paid work	236	14.83	
In education	236	11.02	
Retired	236	23.73	
Recent visit	241	42.74	
Aware of condition	237	44.73	

6.4.3. Analysis strategy

All analyses were carried out using Stata SE (v15). A Probit model was used to assess the probability of an individual stating a positive WTP ($posWTP = 1$), rather than a zero ($posWTP = 0$). The model measures how this probability varies across individuals as a function of the explanatory variables (Cameron and Trivedi, 2010). Marginal effects were examined for the explanatory variables, as positive WTP is a binary variable. The marginal effect of an explanatory variable is the derivative (the slope) of a given function of the explanatory variables and coefficients of the preceding estimation. Marginal effects for discrete variables measure the predicted probabilities as the binary variable changes from 0 to 1. On the other hand, marginal effects for continuous variables measure the rate of change (Baum, 2006; StataCorp, 2019).

Two types of models were used to assess the factors that influence the amount of WTP stated by respondents. They are (i) the ordinary least squares (OLS)

regression and the (ii) Tobit regression. OLS regression assumes that there is a linear relationship between WTP and the explanatory variables which is a function of the coefficients, the constant α, and the error term, ε (based on Hutcheson and Sofroniou, 1999). An OLS regression model was run first, as it provides comprehensive diagnostic tests to explore the fit and applicability of the models. The second was the Tobit model. Respondents were not given the opportunity to express a negative WTP; therefore, the data are censored at 0 (left censoring). While the OLS assumes the dependent variable to have an unconstrained range, the Tobit model (or censored regression model; Tobin, 1958) is used to account for censoring and censors the data at the lower bound, WTP_L (Greene, 2002). The Tobit regression model uses point data, representing the exact WTP from the payment card.

6.4.4. Multiple Imputation (MI)

6.4.4.1. Introduction to MI

Multiple Imputation (MI; Rubin, 1987) was used to fill in missing data (see Table 6.9) and to enable robustness checks to be run with imputed data sets. Under this approach, each missing value in the dataset is replaced with an imputed value and this process is repeated a number of times (m) with an element of randomness (stochastically). The results from the m analyses are then pooled to give an overall MI estimate. Analysis methods (e.g. linear regression) can then be applied to the completed dataset (Garson, 2015). This gives final estimates of target parameters with standard errors that indicate the uncertainty of the missing data (Nguyen *et al.,* 2017). The use of MI not only affects the coefficient estimates for variables with missing data but also the estimates for

other variables with no missing data (Pedersen *et al.*, 2017). Imputation has been recommended in CVM best practice guidelines to account for non-response (Bateman *et al.*, 2002) and used in practice to reduce bias (Whitehead, 1994; Pennington *et al*., 2017).

Table 6.9: Examination of the number of missing cases for the dependent and explanatory variables.

Variable	Number of missing observations	Number of observations	Min	Max
Amount of willingness to pay	0	241	0	100
Age	3	238	18	92
Male	0	241	0	1
Distance in km	0	241	0.041	7.759
Employment status	5	236	0	3
Log income	104	137	1.692	4.071
Recent visit	0	241	0	1
Aware of condition	4	237	0	1

The use of MI involves making the assumption that the data are missing at random (MAR). The term MAR is counterintuitive, as MAR occurs when missingness is conditional on observed data. The probability of data being missed does not depend on unobserved data (Morris *et al.,* 2014; Pedersen *et al.*, 2017). For example, data in a WTP study could be described as MAR, if men are less likely to fill out the survey. Once gender is accounted for the missingness does not depend on their level of WTP. This assumption is impossible to validate based on observed data (Eddings and Marchenko, 2012; Russell *et al.*, 2018). Nevertheless, the use of MI enables the recovery of data for respondents that would have been lost from the models, due to missing data

for one or more variables. Overall, this helps to obtain accurate estimates in a broader range of circumstances than would be obtained simply by excluding incomplete cases (Enders, 2017). It has been suggested that if correctly and thoughtfully applied, MI should provide unbiased and valid estimates of associations based on information from the available data (Klebanoff and Cole, 2008; Pedersen *et al.*, 2017). The MI approach has been argued to be better than analysing only those respondents that provide complete data (i.e. complete-case analysis; Klebanoff and Cole, 2008; Russell *et al.*, 2018).

MI was run using Stata SE (v15) for a sample size of n=241 (see section 6.3). This sample excluded respondents that were identified as protestors and respondents that lived outside of the Plymouth Unitary Authority. MI by Chained Equations (or MICE) was used because it can impute for a range of different types of variable in the process (e.g. continuous, binary, unordered and ordered categorical variables; White *et al*., 2010; Nguyen *et al.,* 2017). Additionally, MICE has greater flexibility to account for uncertainty in the missing data mechanism compared to other approaches (Ward Thompson *et al.*, 2019). MICE imputation was undertaken following procedures set out by White *et al.* (2010), StataCorp (2013) and Enders (2017) . The implementation and reporting of MI in the thesis was based on Rezvan *et al*. (2015), who carried out a systematic review of articles published in two medical journals which used MI. They identified that there were issues in the documentation of key aspects involved the MI analysis, including the handling of non-normally distributed variables and the use of sensitivity analysis following MI, which involves comparing complete-case analysis to MI analysis (discussed in section 6.5).

6.4.4.2. Specification of the MICE model

Following best practice, imputation models contained the dependent variable, explanatory variables and auxiliary variables (those which predict the incomplete variable or are correlates of missingness for incomplete variables).

The choice of auxiliary variables was based on underlying theory and the use of a correlation matrix. It is useful to identify and include auxiliary variables that are (i) correlated with the value of the incomplete variable and/or (ii) correlated with the value of the likelihood of the data being missing, as they can help to improve the accuracy of the imputed values and make the missing at random (MAR) assumption more plausible (Rezvan *et al.*, 2015; Jakobsen *et al.*, 2017). Auxiliary variables that are strongly associated with both the value and missingness are more likely to have an impact on the results of MI and reduce bias (Pedersen *et al.*, 2017). It is important to select suitable variables to avoid misspecification and produce biased results. But it is still unclear as to whether it is beneficial to include a variable as an auxiliary if it does not pass the 0.4 correlation threshold with any of the variables to be imputed (Allison, 2012; Enders, 2010). Therefore, the approach taken is often study-dependent.

The correlation matrix revealed that the value of log income was correlated with employment status (r=-0.346, p<0.05) and WTP ($r = 0.263$, p<0.05). This was also the case for missingness of income: WTP ($r =$-0.156, p<0.05) and age ($r =$0.198, p<0.05). A number of potential auxiliary variables were examined. The number of years that the respondent had lived in Plymouth was selected as a suitable auxiliary variable. Although, it was below $r =$0.4, the variable was significantly correlated with the missingness of log income (r=0.225, p<0.05).

Following this, MICE requires the categorisation of all variables in the model into ‘regular’ and ‘imputed’ (see Table 6.10). Regular variables are those which have no missing values, including male and the amount of WTP. Imputed variables are those that have missing values and are therefore going to be filled in during the MICE process (including auxiliary variables with missing values). In line with previous research (Rezvan *et al.*, 2015; von Hippel, 2009), not normally distributed variables were transformed prior to imputation (e.g. log income).

Table 6.10: Specification of the MICE model (category and variable names).

Category	**Variable name**
Regular	Amount of WTP Male Recent visit Distance in km
Imputed	Log income Age Employment status Aware of condition Years in Plymouth

Variables to be imputed were then categorised, based on the type of data (continuous, categorical and binary) and hence the regression model required. As shown in Table 6.11, three types of regression were used: (i) Predictive Mean Matching (PMM), (ii) Multinomial Logistic Regression and (iii) Logistic regression. Employment status, a categorical variable, was analysed using multinomial logistic regression. Aware of condition, a binary variable was analysed using logistic regression. Missing values for continuous variables (e.g. log income and age) were filled in using PMM.

Table 6.11: Specification of the MICE model (type of variable, regression type and variable names).

Regression type	Variable name
Predictive Mean Matching	Log income Years in Plymouth Age
Multinomial Logistic Regression	Employment status
Logistic regression	Aware of condition

PMM was used because the distribution of the variables were skewed (StataCorp, 2013). PMM is a partially parametric method that matches the missing value to the observed value with the closest predicted mean (Morris *et al.*, 2014; StataCorp, 2013). PMM combines standard linear regression and the nearest-neighbour imputation approaches. First, PMM uses the normal linear regression to obtain linear predictions. Second it uses the linear prediction as a distance measure to form the set of nearest neighbours or donors with complete values. Finally, the method randomnly draws an imputed value from this set. The number of observations considered as matches for the missing data (i.e. the observations being imputed) or the donor pool,k, was set ahead of PMM. $k = 1$ is the default value for PMM in Stata, this means that one observed value is used to replace the missing observation. However, $k = 10$ was selected based on guidance from Morris *et al.* (2014). This means that an observed value is randomnly selected from the 10 nearest donors. It is recommend that larger values of k tend to be better in terms of coverage and efficiency. PMM uses only observed values, therefore, the distribution and range of the data are preserved and plausible imputed values are guaranteed (Rodwell *et al.*, 2014).

6.4.4.3. MICE process

MICE was used to impute the missing data. Missing data are stochastically imputed m times. Therefore, the number of imputations m must also be specified prior to analysis. It is recommended that the number of m should be at least equal to the percentage of incomplete cases (White *et al.,* 2011). The number of imputations was set at 50, as the proportion of incomplete for income was 43.15%. Table 6.12 displays the output from MICE, which outlines the number of cases imputed by the MICE process.

Table 6.12: Imputed data (n=241). Table displays the complete and incomplete observations, prior to MICE and the imputed and total observations following MICE.

	Observations			
Variable	Complete	Incomplete	Imputed	Total
Amount of willingness to pay	241	0	0	241
Age	238	3	3	241
Male	241	0	0	241
Distance in km	241	0	0	241
Employment status	236	5	5	241
Log income	137	104	104	241
Recent visit	241	0	0	241
Aware of condition	237	4	4	241
Years in Plymouth	237	4	4	241

6.4.4.2. Diagnostic checks

Model misspecification can lead to biased estimates and should be corrected before imputed data are analysed. There are still a scarcity of tools for checking the adequacy of models and a lack of best practice guidelines (Nguyen *et al.,* 2013). However, one common approach is to compare the imputations

generated by the models to the observed data. This can help to assess the accuracy of the model and is described as an internal check, as the data are being assessed with respect to available data (Abayomi *et al.,* 2008; White *et al.*, 2011; Rezvan *et al.*, 2015; Nguyen *et al.*, 2017). If there are large discrepancies between the distributions of observed and imputed values, this would suggest that there are errors in the imputation procedure. For example the presence of imputed values which are outside of the observed data range (Eddings and Marchenko, 2012; White *et al.*, 2010). This can be undertaken in Stata SE (v15) using diagnostic plots (Eddings and Marchenko, 2012). However, it is acknowledged that discrepancies between observed and imputed data may occur and are not necessarily problematic to the analysis, since under MAR it may be expected for such differences to arise (Nguyen *et al.*, 2017). The diagnostic plot for log income is shown in Appendix S.

It has also been suggested that both the results of complete-case analysis and MI are reported and compared (namely sensitivity analysis; Rezvan *et al.*, 2015), particularly when there are differences in results (Sterne *et al.*, 2009; Pedersen *et al.*, 2017). A sensitivity analysis was undertaken and the results are discussed in section 6.6.

6.5. Results (Objective 2): Assessing the determinants of WTP

6.5.1. Determinants of positive WTP

A Probit regression model was run to assess the determinants of positive WTP. This was run using two different model specifications, with different derivations for income, an explanatory variable. The first model included log income and the second included the variable income disclosure. This is a binary variable

representing whether the individual disclosed their income. 7 explanatory variables were included in the model, which was suitable based on the rule of thumb for the minimum acceptable sample size (104 + 7 = 111; see section 6.4). However, there was a lack of significance of the model as a whole when log income was included. Therefore, the model specification was altered to include income disclosure. The main regression (Model 1) is shown in Table 6.13, alongside the marginal effects of the model (Model 2)[7]. The marginal effects are discussed below.

There was a significant association between the dummy variable indicating that respondents stating their income had a positive WTP (dy/dx= 0.114). Thus, suggesting that respondents who stated their income were 11.4% more likely to state a positive WTP than those who did not state their income. There was also a significant association between positive WTP and distance in km (dy/dx= -0.046) suggesting that an increase in distance by one km decreases the probability of stating a positive WTP by 4.6%. There was also a significant association between positive WTP and awareness of the condition of Teat's Hill (dy/dx= 0.151). People who had an awareness of the condition of Teat's Hill before the interview were 15.1% more likely to state a positive WTP.

As shown in Table 6.13, there were no significant associations between the WTP decision (positive WTP) and the following variables: male, age, employment status and whether they visited in the last 4 weeks.

[7]Note that there were missing cases for explanatory variables.This reduced the sample size from n=241 to n=229.

Table 6.13: Main regression examining the determinants of the WTP decision (Model 1; n=229). Model specification includes the variable income disclosure. Model 2 (n=229) displays the marginal effects (dy/dx) for each of the explanatory variables.

	Model 1: Probit		**Model 2: Probit Marginal effects**	
Positive WTP	β	(SE)	dy/dx	(SE)
Income disclosure	0.304*	0.183	0.114*	0.068
Male	-0.102	0.178	-0.038	0.066
Age	0.001	0.007	0.000	0.003
Employment status				
Employed (ref.category)	-	-	-	-
Not in paid work	0.088	0.265	0.030	0.090
In education	-0.380	0.334	-0.143	0.123
Retired	-0.502	0.324	-0.192	0.127
Distance in km	-0.122***	0.046	-0.046***	0.017
Recent visit	-0.015	0.184	-0.005	0.068
Aware of condition	0.409**	0.179	0.150**	0.065
Constant	0.453	0.393	-	
N	229		-	
AIC	301		-	
Pseudo R^2	0.067		-	

Heteroscedasticity-robust standard errors used.
***, **, and * mean significant at the 1%-, 5%-, and 10%-level, respectively.

6.5.2. Determinants of the amount of WTP

OLS and Tobit models were used to explain how determinants affected the amount of WTP stated by respondents. The OLS models were run first, as they allow for comprehensive post-estimation tests to explore the fit and applicability of models. The results of the post-estimation tests are shown in Appendix T.

The OLS model (Model 3)[8] indicated that there was a positive association between the amount of WTP and (i) Log income (β= 4.546) and (ii) distance in km (β= -1.274; see Table 6.14). Therefore, it predicted that people who had a higher income and lived closer to Teat's Hill stated a higher WTP for the regeneration. There was no significant association between the amount of WTP and the remaining variables: male age, employment status, recent visit and aware of condition.

The Tobit model accounted for the left censoring of the WTP data at £0 WTP (see Table 6.14, Model 4). The model also identified that there was a significant association between the WTP amount and distance in km (β= -2.450). Dissimilar to the OLS, there was no signification association between the amount of WTP and log income in the model (β= 5.059). There were also no significant associations between amount of WTP and the remaining variables: male, age, employment status, recent visit and aware of condition.

An alternative model specification with income disclosure[9], rather than log income, was also used to enable a comparison with Model 1. The models are

[8] Note, there were missing cases for explanatory variables. This reduced the sample size from n=241 to n=133.
[9] Note, there were missing cases for explanatory variables. This reduced the sample size from n=241 to n=229.

shown in Table 6.15 (Model 5 and 6). There were similarities between the different regression models. Two variables were similar in all three models, indicating that they have an effect on both the WTP decision (positive or negative) and the amount of WTP. These included: income disclosure and distance in km. There were also differences between the models. Employment status, specifically being in education and retired both had a significant association on the amount of WTP, but not the WTP decision. This indicated that people who were in education or retired were predicted to state a lower WTP than people who were employed. As in Models (3) and (4), there were no significant associations between the amount of WTP and gender, age, not in paid work, recent visit and aware of condition.

Table 6.14: Main regressions for the amount of WTP (n=133): (i) OLS (Model 3) and (ii) Tobit (Model 4). Model specifications include log income.

	Model 3: OLS		**Model 4: Tobit**	
WTP amount	β	(SE)	β	(SE)
Log income	4.546*	2.579	5.059	3.287
Male	-2.481	2.752	-5.340	3.764
Age	0.123	0.139	0.102	0.177
Employment status				
Employed (ref.category)	-	-	-	-
Not in paid work	-1.448	4.411	-1.808	5.472
In education	-3.650	3.995	-7.375	6.430
Retired	-8.294	7.905	-13.766	9.447
Distance in km	-1.274**	0.637	-2.450**	1.061
Recent visit	-1.839	3.584	-2.047	4.661
Aware of condition	1.667	3.514	3.351	4.433
Constant	-2.074	10.599	-3.524	13.402
N	133		133	
AIC	1133		886	
R^2	0.112		0.020	
Adj R^2	0.047		-	

Heteroscedasticity-robust standard errors used.

R^2 for the Tobit model (Model 2) represents a Pseudo $R^{2.}$

***, **, and * mean significant at the 1%-, 5%-, and 10%-level, respectively.

Table 6.15: Main regressions for the amount of WTP (n=229): (i) OLS (Model 5) (ii) Tobit (Model 6). Model specification includes income disclosure (binary variable for income disclosure).

	Model 4: OLS		**Model 5: Tobit**	
WTP amount	β	(SE)	β	(SE)
Income disclosure	4.942***	1.779	7.381**	2.844
Male	-0.166	1.846	-0.662	2.664
Age	0.095	0.085	0.096	0.123
Employment status				
Employed (ref.category)	-	-	-	-
Not in paid work	-2.569	2.369	-2.815	3.335
In education	-5.634**	2.254	-8.349**	4.216
Retired	-6.622*	3.780	-10.590**	5.252
Distance in km	-0.998**	0.447	-2.036**	0.810
Recent visit	-0.920	1.843	-1.244	2.732
Aware of condition	1.150	1.871	3.401	2.678
Constant	5.283	4.143	0.724	5.917
N	229		229	
AIC	1864		1401	
R^2	0.071		0.015	
Adj R^2	0.033		-	

Heteroscedasticity-robust standard errors used.
R^2 for the Tobit model (Model 2) represents a Pseudo $R^{2.}$
***, **, and * mean significant at the 1%-, 5%-, and 10%-level, respectively.

6.5.3. Robustness check

As discussed, MICE analysis (n=241) was completed as a robustness check to ensure that the missing cases in the model, particularly for log income, were not biasing the regression estimates. This was run specifically for the OLS model, as there is limited functionality and diagnostics for running MICE for Tobit models. MICE analysis (Model 7; n=241) for the amount of WTP is shown in Table 6.16, alongside complete-case analysis (Model 3; n=133).

Complete-case analysis and the MICE analysis revealed the same findings. The significant associations between the amount of WTP and (i) log income (β = 3.033) and (ii) distance in km were upheld in the MICE analysis (β = -0.804). This suggested that the missing cases in the model were not biasing the estimates and provided an indication that the models were robust.

Table 6.16: Comparing main regressions for the amount of WTP (OLS) from: (i) complete-case analysis (Model 3: n= 133) and (ii) Multiple Imputation analysis (MICE, Model 7; n=241).

	Model 3: Complete-case analysis		**Model 7: Multiple Imputation (MICE) analysis**	
WTP amount	β	(SE)	β	(SE)
Log income	4.546*	2.579	3.033*	1.645
Male	-2.481	2.752	-0.604	1.863
Age	0.123	0.139	0.045	0.084
Employment status				
Employed (ref.category)	-	-	-	-
Not in paid work	-1.448	4.411	-0.387	2.584
In education	-3.650	3.995	-2.432	2.486
Retired	-8.294	7.905	-3.706	4.023
Distance in km	-1.274**	0.637	-0.804*	0.435
Recent visit	-1.839	3.584	-0.497	1.867
Aware of condition	1.667	3.514	1.063	1.826
Constant	-2.074	10.599	0.107	6.459
N	133		241	
AIC	1133		-	
R^2	0.112		0.062	
Adj R^2	0.047		0.030	

OLS regression model. Heteroscedasticity-robust standard errors used.
***, **, and * mean significant at the 1%-, 5%-, and 10%-level, respectively.

6.6. Discussion

The study was designed to value the utility changes resulting from the coastal regeneration at Teat's Hill. The research helped to address research question 4 (see Chapter 1; section 1.2) and the specific objectives of the CVM study, which are discussed here.

6.6.1. WTP for the coastal regeneration

As part of the CVM, individuals were asked to consult their preferences for the Teat's Hill regeneration and to make an *ex-ante* choice based on their predictions of relative states of utility in the future. The majority of respondents interviewed (62.66%) were willing to pay towards the coastal regeneration. The mean WTP for the regeneration was estimated to be £7.97 per household as a one-off payment. The results suggest that the majority of respondents attached a positive value to the coastal regeneration at Teat's Hill, and therefore have preferences for this non-market good. As WTP is an indicator of anticipated affect, anticipated satisfaction and goals (Dolan and White, 2006), this indicates that over half of respondents perceive that their utility would be affected by the proposed change (Strazzera *et al.*, 2003). The value derived may correspond with use and/or non-use values, for example the belief that others may benefit from the regeneration (e.g. bequest and altruistic value), discussed in Chapter 2 (section 2.4).

This is consistent with previous research that acknowledges that the provision of environmental goods and services has an effect on utility (Bateman and Turner, 1992; Bockstael and Freeman, 2005). It also supports previous studies that find that individuals place monetary value on improvements to green

spaces (Saz-Salazar and Rausell-Köster, 2008; White and Lovett, 1999) and coastal environments (Torres and Hanley, 2016), such as beaches (Silberman and Klock, 1988; Silberman *et al.,* 1992; King, 1995). This is in addition to research that has shown that people have WTP for improvements to public access through increased beach access points and parking (e.g. Oh *et al.*, 2008; Whitehead *et al.*, 2008), coastal trail improvements (e.g. McGonagle and Swallow, 2005; Barry *et al.,* 2011), and reductions in litter (e.g. plastic on beaches; Brouwer *et al.*, 2017).

However, this is the first study to have identified the WTP associated with a coastal regeneration project. Hence, there is a paucity of research to draw upon for a comparison. However, a few prior studies have used the CVM to value a bundle of goods (including environmental goods) provided by regeneration projects (Department for Communities and Local Government, 2010; Bottero *et al.*, 2017). These studies have also identified that people have preferences for regeneration projects with environmental components. The Department for Communities and Local Government, (2010) study valued preferences for a regeneration project in a coastal town (Seaham, Durham, UK). The study identified that people had preferences for a bundle of local environmental amenities, such as outdoor community facilities, cleanliness and improvements to open spaces. Mean WTP was estimated to be £42.42 per year. However, there is limited information as to whether the regeneration site itself was located on or away from the coast. Bottero *et al.* (2017) asked respondents for their WTP for the construction of a new urban park, which formed part of the urban regeneration programme in Collegno (Italy). They identified that people were WTP 31 € (approximately £24) as a one off payment for the urban park. Similar

to this study, both studies identified that people had preferences for regeneration projects which included environmental goods and aim to improve the quality of urban environments.

The current study also identified that 37.34% of respondents stated zero WTP for the Teat's Hill regeneration and were therefore not willing to contribute towards the project. Zero WTP is the value held by individuals if they are indifferent to the non-market good presented and indicates that they anticipate that their utility will be unaffected by the proposed change (Strazzera *et al.*, 2003). These individuals are distinct from those that exhibit a positive WTP or respondents excluded as protestors during analysis. High numbers of zero responses have been observed previously in the valuation of environmental goods (Ninan, 2012; Saz-Salazar and Rausell-Köster, 2008) and have been described as a characteristic of natural resource valuation surveys (Mitchell and Carson, 1989; Yoo *et al.,* 2000). Protest responses have also observed in the valuation of regeneration projects. For example, 18.87% of respondents were excluded from the aforementioned analysis in Seaham, UK (Department for Communities and Local Government, 2010).

6.6.2. Determinants of WTP

The second objective of the CVM was to identify the determinants of WTP. The study found that the WTP decision (zero WTP or positive WTP) and the amount of WTP for the Teat's Hill regeneration was influenced by theoretically relevant factors, related to the socio-demographic characteristics of the household and awareness of the condition of Teat's Hill. These findings were observed over a range of specifications and robustness checks (i.e. multiple imputation).

6.6.2.1. Income

First, log income was a significant predictor of the amount of WTP in both the complete-case analysis and MICE analysis for the OLS. Respondents with a higher income stated a higher WTP amount, as found in previous research (Horowitz and McConnell, 2003; Schläpfer, 2006). It has been suggested that the same amount of WTP payment impacts relatively less on the wealth of a higher income respondent, in contrast to respondents with a lower income (Lee, J., 2016). Income disclosure also predicts the WTP decision and the amount of WTP. Overall, the income effect is important for policy design, as it helps to better understand the distribution of benefits for the non-market good in question (Schläpfer, 2006).

6.6.2.2. Distance between household address and Teat's Hill

Second, the distance between a respondent's address and Teat's Hill had an influence on both the WTP decision and the amount of WTP. Respondents that lived closer to the site were more likely to have a positive WTP and state a higher WTP. This confirmed the presence of a distance decay effect, an effect that is characteristic of compensating variation (CV) studies (Bateman *et al.*, 2006). Previous CV studies have demonstrated distance decay effects in the valuation of wetlands and bird species (Pate and Loomis, 1997), rivers (e.g. flooding, river flows and water quality; e.g. Bateman *et al.*, 2000; Hanley *et al.*, 2003; Bateman *et al.*, 2006) and national parks (Bateman and Langford, 1997). It is suggested that as distance increases, WTP decreases as the travel cost and time increases (Lee, 2016), which reduces the potential frequency of visiting a site, such as Teat's Hill. The distance decay effect suggests that

individuals living closer to Teat's Hill may benefit more from the bundle of goods, and that they perceive that their utility will be affected by the proposed change.

6.6.2.3. Other variables

There was no significant influence of other socio-demographic characteristics on the WTP decision or the amount. Mixed evidence has been observed previously for the effects of individual-level socio-demographics such as work status (e.g. Dolan and Metcalfe, 2008; Ressurreição *et al.*, 2012) and gender (e.g. Oh *et al.*, 2008; Börger, 2013) on WTP. Despite expectations, there was no significant influence of the respondents' experience and knowledge of Teat's Hill on the amount of stated WTP. Visiting in the last 4 weeks and having an awareness of the condition of the site did not affect the amount of WTP that respondents were willing to contribute to the coastal regeneration. A lack of relationship between variables relating to knowledge, experience and familiarity has been observed previously, for example, in the valuation of national parks (Bateman and Langford, 1997), marine parks (Ahmad and Hanley, 2009) and cultural institutions (Bakhshi *et al.*, 2015). There was, however, a significant positive association between the WTP decision and the awareness of the condition of the site. Individuals that were aware of the condition of Teat's Hill before the interview were more likely to have a positive WTP. This is line with expectations, as associations between WTP variables and concerns about the good are reasonably hypothesised (Bateman *et al.*, 2002).

6.6.3. Assessing the validity of the study

As discussed in Chapter 4 (section 4.4), it is important to assess the validity of the results from the LSA. Convergent validity cannot be assessed, due to the lack of previous valuation in this area and lack of consensus as to whether estimates from the CVM and LSA should converge (discussed in Chapter 8, section 8.4). However, an assessment of construct validity can be undertaken, through the examination of the determinants of WTP. The regression models discussed in section 6.6 express the functional relationships between WTP and other variables that normally affect demand (bid curve or valuation function; Bateman *et al.*, 2002; Jones *et al.*, 2008) and can be used to assess construct validity.

As a whole, the inspection of variables revealed that the parameter estimates for these variables are consistent with welfare theory, prior expectations and previous empirical studies (Bateman *et al.*, 2002; Carson, 2012). Therefore, it is suggested that WTP can be interpreted as reflecting the utility changes associated with the coastal regeneration at Teat's Hill (i.e. meeting the criterion of construct validity).

6.6.4. Limitations of the study

This section focuses on the limitations specific to the CVM study. Issues such as sample size, missing observations and multiple imputation will be discussed in Chapter 9 (section 9.5), as they influence both methods.

6.6.4.1. Sample representativeness

As observed in section 6.2, the sample was not representative of the study population within the seven LSOAs, based on the 2011 Census data. This may be due to differences in the population between 2011 and 2017/2018 or

alternatively it may have resulted from the use of in-site surveys. The resulting mean WTP estimate therefore has unknown generalisability (Messonnier *et al.*, 2000; Johnston *et al.*, 2017) and this may lead to potential errors (underestimation or overestimation) if WTP values are extrapolated to the wider population (Messonnier *et al.*, 2000; Johnston *et al.*, 2017). The extrapolated value is called an aggregated WTP estimate.

An aggregated WTP has not currently been estimated, but, this is an avenue for future analysis. An aggregated value could be estimated by weighting the data to better represent the population. This has been discussed previously in CVM best practice manuals (Bateman *et al.*, 2002; Johnston *et al.*, 2017) and has been carried out in practice for SP studies (e.g. Hong Yeo, 2002; Brouwer *et al*., 2010). It could be done by scaling the sample average WTP to the study population and adjusting for sample selection using weights (e.g. for socio-demographic factors such as age). Alternatively, aggregation could be undertaken using a similar approach to Bateman *et al.* (2006), which they used to value water quality. This involves the use of GIS data to develop a spatially sensitive valuation function, which addresses self-selection and incorporates distance-decay relationships.

6.6.4.2. Use of in-site surveys

The total population in the seven selected LSOAs was relatively small; therefore, in-site interviews were also used to supplement the sample size. Unfortunately, the closure of the Sutton Harbour Bridge in spring 2017 reduced accessibility to the Teat's Hill site and visitation by Plymouth residents. Subsequently, a number of the in-site interviews were carried out near the site

(e.g. Lockyers Quay) and on the replacement ferry (from the Barbican to Queen Anne's Battery), rather than at Teat's Hill. This may have contributed to the difference between the mean WTP for the two interview methods (doorstep: £9.59, in-site: £6.80).

6.6.4.3. Education

As discussed in Chapter 5 (section 5.2), the PhD research involved collaboration with the BlueHealth project to deliver a shared survey vehicle. There was limited space in the survey and the content needed to meet the objectives of the different research projects. Therefore, level of education was omitted as a variable from the survey in T1 and was not controlled for in the survey analysis. Education level has been shown to affect WTP for environmental non-market goods (Halstead *et al.,* 1992; Le Goffe, 1995; Ressurreição *et al.*, 2012). This insight would have been useful for the assessment of construct validity and may have enhanced the precision of the MICE process and accuracy of the estimates from the resulting analysis.

6.6. Summary

This chapter presented the results of the CVM empirical research, which estimated people's utility, *ex-ante* for the coastal regeneration at Teat's Hill. The findings suggested that the majority of respondents had a preference for and placed a positive value on the coastal regeneration explored here. The mean WTP was £7.97 per household as a one-off payment. In the context of well-being, it could be inferred that Plymouth residents anticipate that they will receive utility benefits from the coastal regeneration. Factors such as income and proximity to the site (distance in km) were significantly associated with

WTP. This was in line with theoretical expectations, providing an indication of the construct validity of the results. As far as the author is aware, it is the first CVM study to value the benefits of a coastal regeneration project. Further, it enabled an insight into the utility provided by the regeneration prior to implementation. The *ex-ante* valuation estimates from the CVM will be compared with *ex-post* estimates from the LSA (Chapter 7) to compare and contrast the two environmental valuation methods.

7. Empirical study: Life Satisfaction Approach (LSA)

7.1. Chapter overview

This chapter presents the results of the LSA empirical research, which was undertaken to address research questions 3 and 4 (Chapter 1; section 1.2). A natural experiment was undertaken using a repeat cross-sectional design, which compared well-being across two groups: (i) a group without the regeneration (pre-assessment; T1) and (ii) a group with the regeneration (post-assessment; T2). The LSA requires a two-step process; therefore there are two main objectives of this research. The first is to investigate whether there is a significant relationship between the regeneration at Teat's Hill and LS. The second is to explore the potential to estimate a monetary value for the regeneration using the LSA, thereby enabling a direct comparison with the WTP estimate from the CVM. The chapter presents an overview of the data (section 7.2.) and descriptive characteristics (section 7.3). The empirical strategy is presented in section 7.4, followed by the estimation results in section 7.5. The study also used multiple imputation as a robustness check due to the high number of missing values in the dataset (e.g. for income). Therefore, the subsequent estimation results are also outlined and discussed. This is followed by an estimation of the monetary value of the regeneration using the LSA for comparison with the estimate from the CVM. The chapter culminates in a discussion of the results in relation to the wider LSA literature and the limitations of the study (section 7.7).

7.2. Data

Face-to-face interviews were administered at two time points in Plymouth, UK: (i) June- September 2017 (pre-assessment; T1) and (ii) June-August 2018 (post-assessment; T2). A total of 653 people were interviewed as part of the study: T1 survey (2017; n=314) and T2 survey (2018; n=339). 307 interviews were completed through the doorstep approach and 346 through in-site interviews. The survey response rate for the door-step surveys was 29.04%, with 307 out of 1057 households within the seven LSOAs being interviewed as part of the study. A response rate for the in-site interviews cannot be calculated, however, qualitative data was obtained from the market research company for the T2 survey. This provided an indication that the majority of people approached were interviewed (approximately 90%). Of those that refused (10%), the main reason for non-participation was having their family with them or visiting the aquarium, which is adjacent to the site.

As for the CVM study (Chapter 6), the LSA aimed to estimate the value of the regeneration for individuals living within the Plymouth Unitary Authority. Therefore, spatial analysis was used to (i) exclude respondents that lived outside this sampling area (highlighted in Figure 7.1) and (ii) to estimate the distance (km) between the respondent's household address and Teat's Hill using Arc GIS (version 10.5.1; ESRI Inc). The spatial analysis resulted in the exclusion of 10 respondents (pre: n=4, post: n=6).

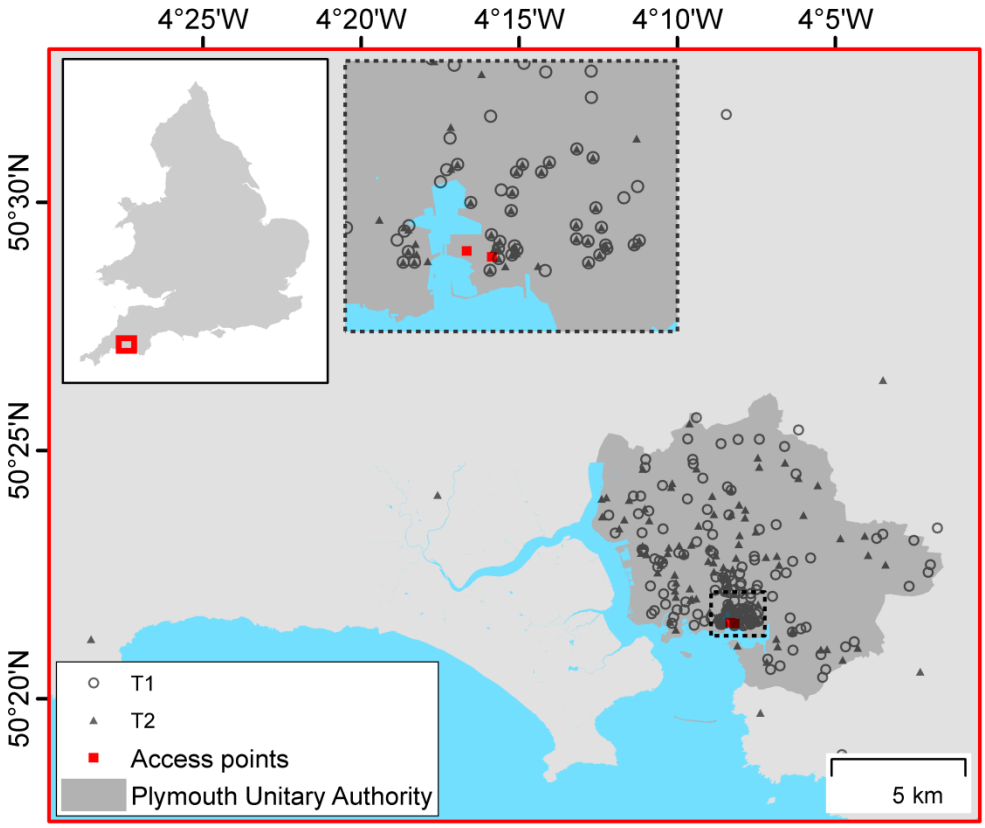

Figure 7.1: Map showing the distribution of respondents' household addresses, categorised by assessment stage: pre-assessment (T1) and post-assessment (T2). Map produced by Joanna Garrett.

Table 7.1 displays the descriptive statistics for a selection of socio-demographic variables for the individual assessment stages (T1 & T2) and resident population (7 LSOAs and Plymouth Unitary Authority). The sample means for the socio-demographics were similar for household size. However, there were apparent differences for the other variables: age, gender (male), work status, marital status and income. The survey was therefore not representative of the

resident population when compared to the 2011 Census data[10]. This was particularly the case for age and employment status. The mean ages of the T1 and T2 samples were over 11 years higher than the resident population in 2011. Further, the T1 and T2 samples oversampled retired individuals.

The average total household income for T1 exceeded the average for the Plymouth Unitary Authority. On the other hand, the T2 sample average was lower than that for the Plymouth Unitary Authority. However, when combined (see Appendix U), there were relative similarities between the average total household income for the sample and the Plymouth Unitary Authority (UK Census Data, 2011c). But, as discussed in Chapter 6 (section 6.3), there were differences in the income question used in the survey and in the UK Census. There may be two explanations for these descriptive findings for income.

Respondents may have reported their average annual household income after tax. Based on crude calculations, it is estimated that the average annual household income for the Plymouth Unitary Authority sample after tax would have been approximately £16,989.74 in 2017. This would suggest that there is a difference (£3,925.34) between the mean income of the sample (£20,915.08) and for the Unitary Authority as a whole (£16,989.74). Alternatively, the similarity between the average household income figures (Sample: £20,915.08; Plymouth Unitary Authority: £20,162.00) may suggest that respondents reported their before tax income, due to difficulties with answering the after tax question.

[10] Annual income before tax, data from 2011 (retrieved from http://www.ukcensusdata.com)

Table 7.1: Means, proportion (%) and standard deviations of socio-demographic variables for the T1 (n=310) and T2 (n=333) samples. The samples from the T1 and T2 assessments are compared to the mean statistics for 7 LSOAs and Plymouth Unitary Authority.

	T1 sample			T2 sample			7 LSOAs (mean)[a]	Plymouth Unitary Authority (mean)[a]
	N	Mean/ %	SD	N	Mean/ %	SD		
Age	305	46.82	19.23	332	47.03	18.28	35.56	38.96
Male (%)	310	48.06	-	333	44.14	-	52.79	49.41
Household size	308	2.51	1.40	332	2.45	1.32	2.21	2.29
Work status (%)								
Employed	302	49.01	-	332	50.60	-	61.68	57.72
Unemployed	302	8.94	-	332	4.82	-	5.96	4.24
In education	302	5.63	-	332	7.53	-	11.86	13.01
Other inactive	302	36.42	-	332	37.05	-	20.50	25.02
Long term relationship status (%)								
In term long relationship	231	41.13	-	327	51.38	-	30.90	43.13
Other	231	58.87	-	327	48.62	-	69.10	56.87
Total household annual income	166	22,438.54[b]	16,127.25	132	18,999.22	11,985.81	20,162.00[c]	20,162.00[d]

[a] Data derived from the UK Census (2011; retrieved from UK Census Data 2011a,b)

[b] Household annual income after tax (mid-point in £)

[c] Data unavailable for income at the LSOA scale. Used total annual income before tax (2011; retrieved from UK Census Data 2011c)

[d] Data unavailable for annual income after tax. Used total annual income before tax (2011; retrieved from UK Census Data, 2011c).

7.2.1. Life satisfaction

As discussed in Chapter 5, LS was measured using the ONS evaluative SWB question. Respondents were asked “Firstly, all things considered, how satisfied are you with your life as a whole nowadays?” and to respond on a Likert-type scale from 0 to 10, where 0 indicates “Not at all satisfied” and 10 indicates “Completely satisfied”.

7.2.2. Regeneration

As part of the natural experiment, respondents interviewed after the regeneration (T2 survey) were compared with a similar group of respondents that were interviewed before the regeneration (T1 survey). Respondents in the 2018 survey data set (T2) were denoted “1” and those in the 2017 data set (T1) were given a “0” (reference category).

7.2.3. Equivalised disposable household income

The survey collected information on household income after tax in categories ranging from 0 “less than £10,858” to 9 “£58,620 or more”. As for the CVM study (Chapter 6), the midpoint of the corresponding income class was used, to generate the absolute income variable. For the purpose of this analysis, equivalised disposable household income was computed in absolute terms and in logarithmic form.

The use of an equivalence scale accounts for “the fact that the needs of a household grow with additional household members, albeit not proportionally to the number of household members (due to economies of scale in consumption)” (Kopmann and Rehdanz, 2013, p23). There are various types of equivalence

scales and they adjust income to reflect the different resource needs of single adults, any additional adults in the household, and children in various age groups (Office for National Statistics, 2015). A number of studies have applied an equivalence scale to household income (Kopmann and Rehdanz, 2013; Ambrey *et al.,* 2017; Del Saz-Salazar *et al.*, 2017).

The first stage was to generate disposable income. This was based on guidance from the Office for National Statistics (2018a)[11], which provides a conversion between gross income and disposable income. The midpoint of income categories in the survey was used to generate disposable income (see Table 7.2). The conversion figure was applied to all households with the same midpoint of the corresponding income class.

Table 7.2: Conversion between mid-point of income and disposable income.

Midpoint of income category (£)	Conversion figure	Disposable income (£)
5,429.00	0.833	4,522.36
12,703.00	0.898	11,403.48
16,340.00	0.898	14,668.42
19,923.49	0.887	17,672.14
23,854.49	0.875	20,873.92
28,373.99	0.842	23,897.77
33,722.50	0.832	28,043.02
40,702.50	0.812	33,031.95
51,667.00	0.799	41,260.75
58,620.00	0.785	46,027.08

[11] Calculations outlined in 'The Effects of Taxes and Benefits on Household Income, 2016/2017 (Table 2a).

The second stage was to apply the 'OECD-modified equivalence scale' (OECD, 2011), to compute the equivalised household size. This has been used in previously in LSA research (e.g. Kopmann and Rehdanz, 2013) and by several government departments in the UK (Office for National Statistics, 2015). The scale assigns a value of 1 to the household head, 0.5 to each additional household adult member and 0.3 to each child under the age of 14. Net household income is then divided by the sum of these assigned weights, resulting in needs-adjusted net household income (Kopmann and Rehdanz, 2013). Due to a lack of relevant data, the age of 16 was used to distinguish between adults and children, following the same approach as Maccagnan *et al.* (2019). The final stage was to calculate the equivalised disposable household income. This was calculated using eq (7.1):

$$Equivalised\ disposable\ household\ income = \frac{Disposable\ income}{Equivalised\ household\ size} \quad (7.1)$$

A logarithmic form of equivalised disposable household income was then derived and selected for the analyses for two reasons. First, to account for the decreasing marginal utility of income (Ambrey *et al.*, 2017). Second, log equivalised disposable household income is used as part of an instrumental variable (IV) approach (Fujiwara *et al.,* 2014) to address the issue of endogeneity (discussed in Chapter 4; section 4.5). The use of an IV approach is discussed in section 7.4.

7.2.4. Explanatory variables

As aforementioned (Chapter 3; section 3.5), a regression model is used to examine the association between LS and the non-market good, whilst controlling for other explanatory variables. Therefore, relevant explanatory variables were

included in the models, based on previous SWB and LSA research. Expected relationships between the explanatory variables and LS are outlined in Table 7.3.

Individual-level variables included: gender (male=reference, female), age and age^2, employment status (employed= reference, in education, unemployed and other inactive), long-term relationship (in long-term relationship *vs.* not in long-term relationship=reference), number of children in the household, self-reported general health (Very Bad= reference, Bad, Fair, Good, Very Good), distance between respondent's household address and Teat's Hill (in km), dog owner (owner *vs.* not owner=reference), physical activity levels (0 days per week=reference, 1-4 days and 5+ days) and access to private outdoor space (no access= reference *vs.* access). Private outdoor spaces included private gardens, private communal gardens, balconies, yards and patio areas.

Little research has explored the relationship between LS and access to private outdoor space. Fields in Trust (2018) found limited association between LS and access to private outdoor space (e.g. gardens). However, there are a number of reasons for its inclusion. First, the proportion of private outdoor space (e.g. gardens) has been described as: "an indicator of living in a more prosperous area, which itself is expected to be strongly associated with wellbeing" (Fields in Trust, 2018, p62). Second, research has shown that visits to green space may be related to access to private outdoor space, although there is mixed evidence on the direction of this relationship. Ambrey and Fleming (2014) found that respondents without private outdoor space made more use of public green space, providing some supporting evidence for the compensating hypothesis. This contrasts with Maat and de Vries (2006) who found that respondents with a

garden or private outdoor space tended to use green space and parks more frequently than those without a garden (e.g. people living in a flat).

A visit related control was also included, this considered whether people had visited Teat's Hill in the last 4 weeks (not at all in the last 4 weeks=reference, visit in the last week). As shown above, a number of the variables were entered as dummy variables, due to their categorical nature (as in White *et al.*, 2017). Although it is acknowledged that weather may be associated with LS (Chapter 3, section 3.4), it was not included as an explanatory variable. There was a lack of weather data available for the specific interview locations for the door-step (7 LSOAs) and in-site interviews (Teat's Hill and neighbouring area). This will be discussed in section 7.7.

Table 7.3: Table highlighting the relationship between LS, income and explanatory variables. Example studies are provided.

Name of variable	Relationship with LS	Example studies
Male	Negative association between LS and gender. Females have higher LS.	Ferrer-i-Carbonell and Gowdy (2007), Brereton *et al.* (2008), Ferreira *et al.* (2013).
Age	Two forms of association between LS and age: (i) positive or (ii) U shaped.	MacKerron and Mourato (2009), Ambrey *et al.* (2017), Wang *et al.* (2017), Aoshima *et al.* (2018), Dolan and Metcalfe (2008), Blanchflower and Oswald (2004b).
Long term relationship	Positive association between LS and being in a long term relationship. For example, marriage increases LS.	Diener *et al.* (1999), Aoshima *et al. (*2018), Helliwell (2003); Blanchflower and Oswald, (2004), Kim and Jin (2018), White *et al.* (2017), Office for National Statistics (2018).
Employment status	Positive association between LS and being employed.	Di Tella, Macculloch and Oswald (2001), Frey and Stutzer (2002), Office for National Statistics (2018), Maccagnan *et al.* (2019).
General health	Positive association between LS and general health.	Fields in Trust (2018), Office for National Statistics (2018), Oswald and Powdthavee (2008), Shields and Wheatley Price (2005).
Children in household	Mixed evidence of association between LS and having children.	Haller and Hadler (2006), Bertram and Rehdanz (2015), Fields in Trust (2018), White *et al.* (2017).
Household income	Mixed evidence between income (absolute and equivalised disposable household income) and LS.	Clark *et al.* (2008), Bertram and Rehdanz, (2015), Fields in Trust (2018). Note: also reviewed by: Dolan *et al.* (2008)

Name of variable	Relationship with LS	Example studies
Physical activity	Mixed evidence of association between LS and physical activity. Relationship may be influenced by age.	Zayed *et al.* (2018), Busing and West (2016), Maher *et al.* (2015).
Recent visit to Teat's Hill	Positive association between LS and frequency of visit to local parks and natural environments.	Fields in Trust (2018), White *et al.* (2017).
Dog owner	Positive association between LS and dog ownership.	White *et al.* (2017).
Access to outdoor space	Limited association between LS and owning private garden/outdoor space.	Fields in Trust (2018).

7.3. Descriptive statistics

The summary statistics for dependent and explanatory variables are presented for the full sample (Tables 7.4) and by assessment stage (Table 7.5). LS (n=627; Figure 7.2) was 8.03 on average (on a 0-10 scale), which is only slightly higher that the Office for National Statistics (2018a) national mean of 7.7 for the UK as a whole. However, LS is higher than has previously been estimated for Plymouth. A survey in 2015 reported a mean LS of 6.6, which ranged from 6.3 to 7.0 across the different Plymouth wards (Plymouth City Council, 2015b). They also identified that 18.8% of residents scored their LS with a 9 or 10 and 16.4% score their LS with a 4 or less. These results contrast with our study which found that 44.02% of the sample provided a LS report of 9 or 10 and 4.16% score their LS with a 4 or less.

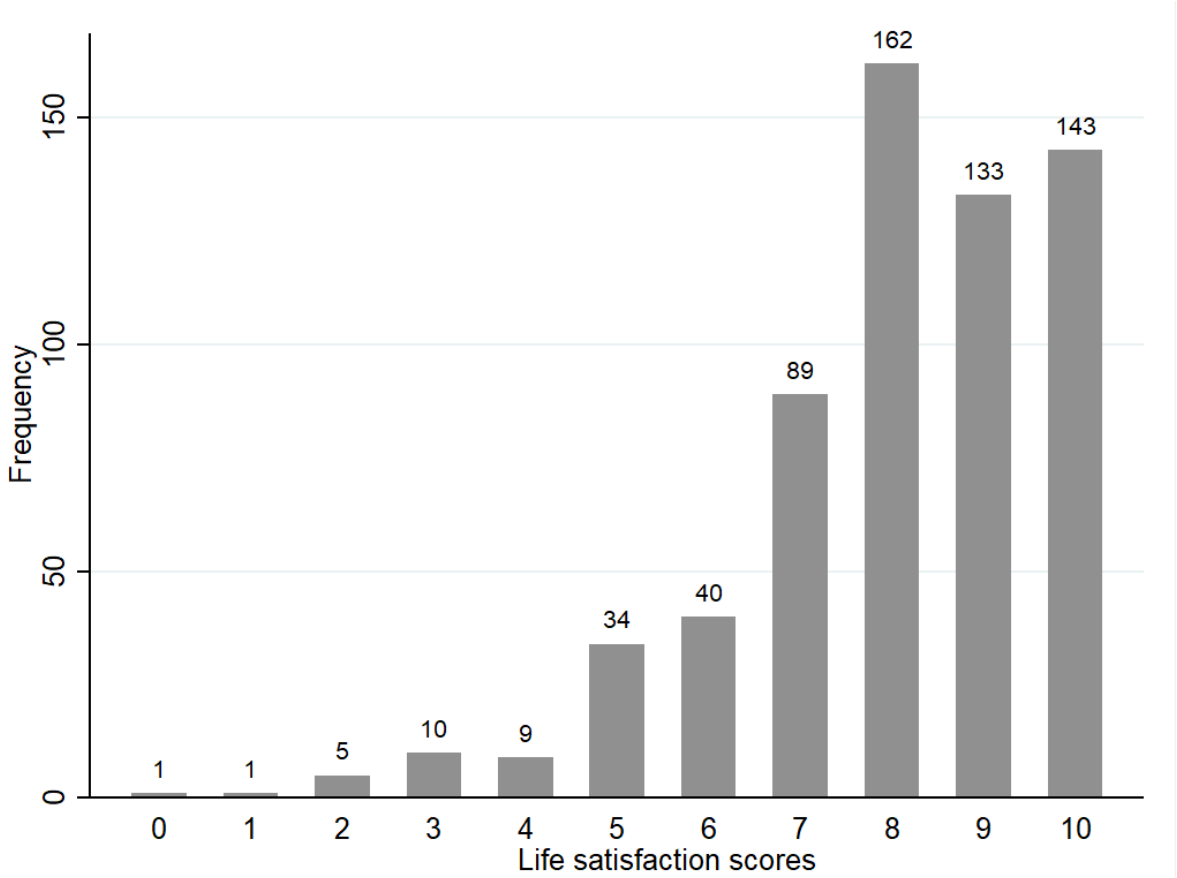

Figure 7.2: Frequency distribution of LS scores (n=627).

The distribution of LS scores from the T1 (n=300) and T2 (n=327) assessments are shown in Figure 7.3 for comparison. The average LS score for the T2 assessment (8.12) was slightly higher than the T1 assessment (7.92), before controlling for a range of determinants of LS (see section 7.4).

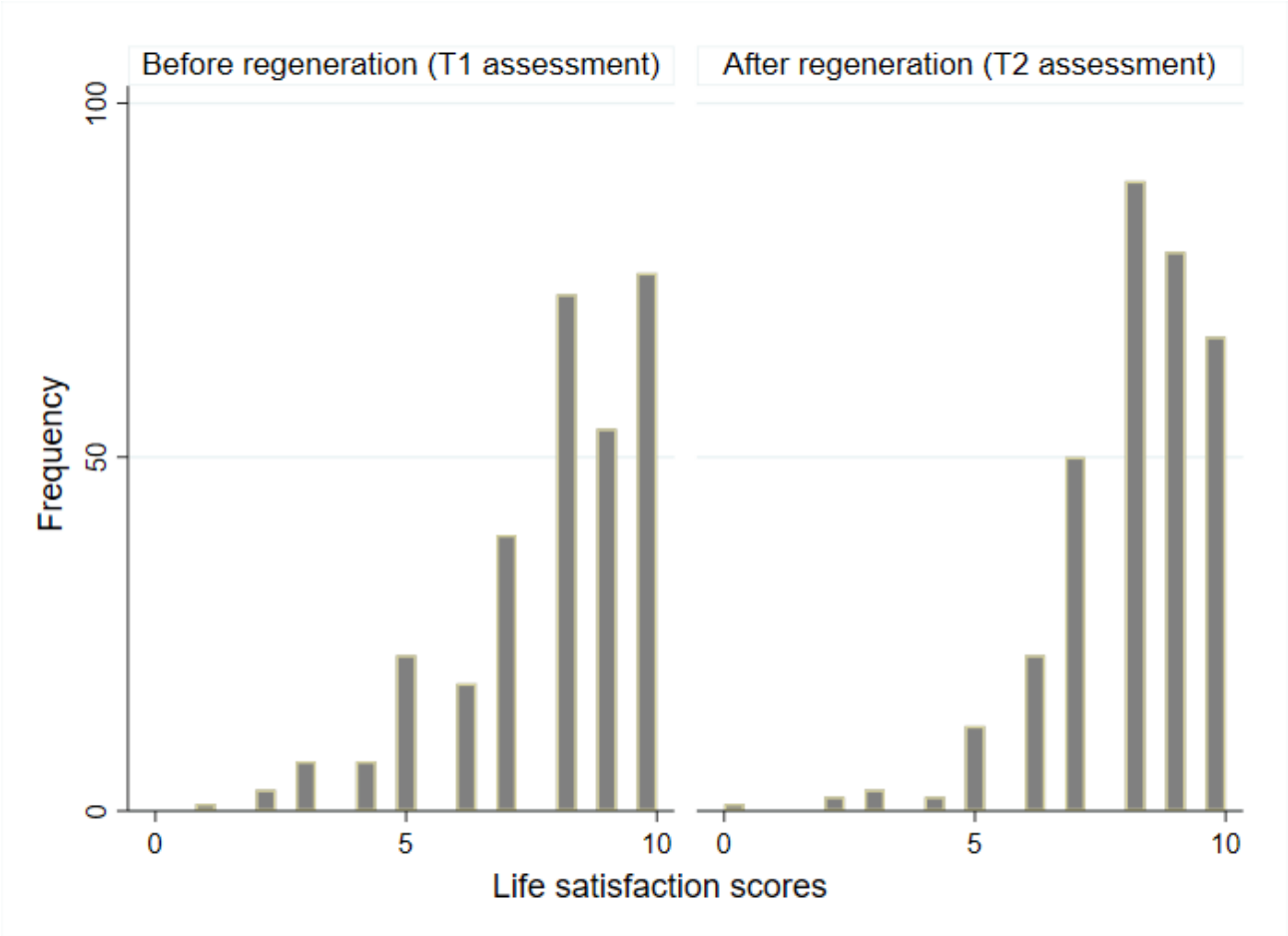

Figure 7.3: Frequency distribution of LS scores by assessment stage: T1 (n=300) and T2 (n=327).

Table 7.4: Descriptive statistics for sample (max n=643).

Variable name	N	Mean	SD
Life satisfaction (LS)	627	8.03	1.76
Number of children in household	639	0.62	0.93
Distance to Teat's Hill (km)	588	1.64	1.89
Equivalised disposable household income	290	11,563.49	7,789.63
Age	637	46.93	18.73
	N	**%**	
Regeneration			
Pre-regeneration (T1)	643	48.21	
Post regeneration (T2)	643	51.79	
Male	643	46.03	
In long term relationship	558	47.13	
Employment status			
Employed	634	49.84	
Unemployed	634	6.78	
In education	634	6.62	
Other inactive	634	36.75	
Recent visit to Teat's Hill	642	41.43	
Physical Activity			
None	629	25.76	
1-4 days	629	34.50	
5+ days	629	39.75	
General health			
Very Bad	627	2.23	
Bad	627	4.15	
Fair	627	21.69	
Good	627	41.31	
Very Good	627	30.62	
Access to private outdoor space	640	77.19	
Dog owner	639	32.55	

Table 7.5: Descriptive statistics for each assessment: T1 (n=300) and T2 (N=327).

Variable name	N	Mean	SD	N	Mean	SD
Life satisfaction	300	7.92	1.93	327	8.12	1.60
Number of children in household	298	0.81	0.93	326	0.48	0.92
Distance to Teat's Hill (km)	292	1.60	1.90	284	1.71	1.88
Equivalised disposable household income	155	12,292.98	8,787.80	132	10,640.66	6,266.72
Age	297	46.55	19.23	326	47.03	18.28
	N	**%**		**N**	**%**	
Male	300	48.00		327	44.04	
In long term relationship	225	41.33		324	50.93	
Employment status						
Employed	295	49.83		327	50.76	
Unemployed	295	5.08		327	7.65	
In education	295	9.15		327	4.89	
Other inactive	295	35.93		327	36.70	
Recent visit to Teat's Hill	300	44.00		326	38.86	
Physical Activity						
None	295	23.05		326	28.53	
1-4 days	295	32.88		326	35.58	
5+ days	295	44.07		326	35.89	
General health						
Very Bad	294	2.72		325	1.85	
Bad	294	4.42		325	3.69	
Fair	294	19.39		325	24.00	
Good	294	43.20		325	39.38	
Very Good	294	30.27		325	31.08	
Access to private outdoor space	299	68.90		326	83.74	
Dog owner	298	47.32		326	19.63	

3.65% (n=345) of respondents did not disclose their income. This was also observed in the T1 data and is discussed in Chapter 6 (section 6.5.1). The average equivalised disposable household income was £11,563.49 (Figure 7.3).

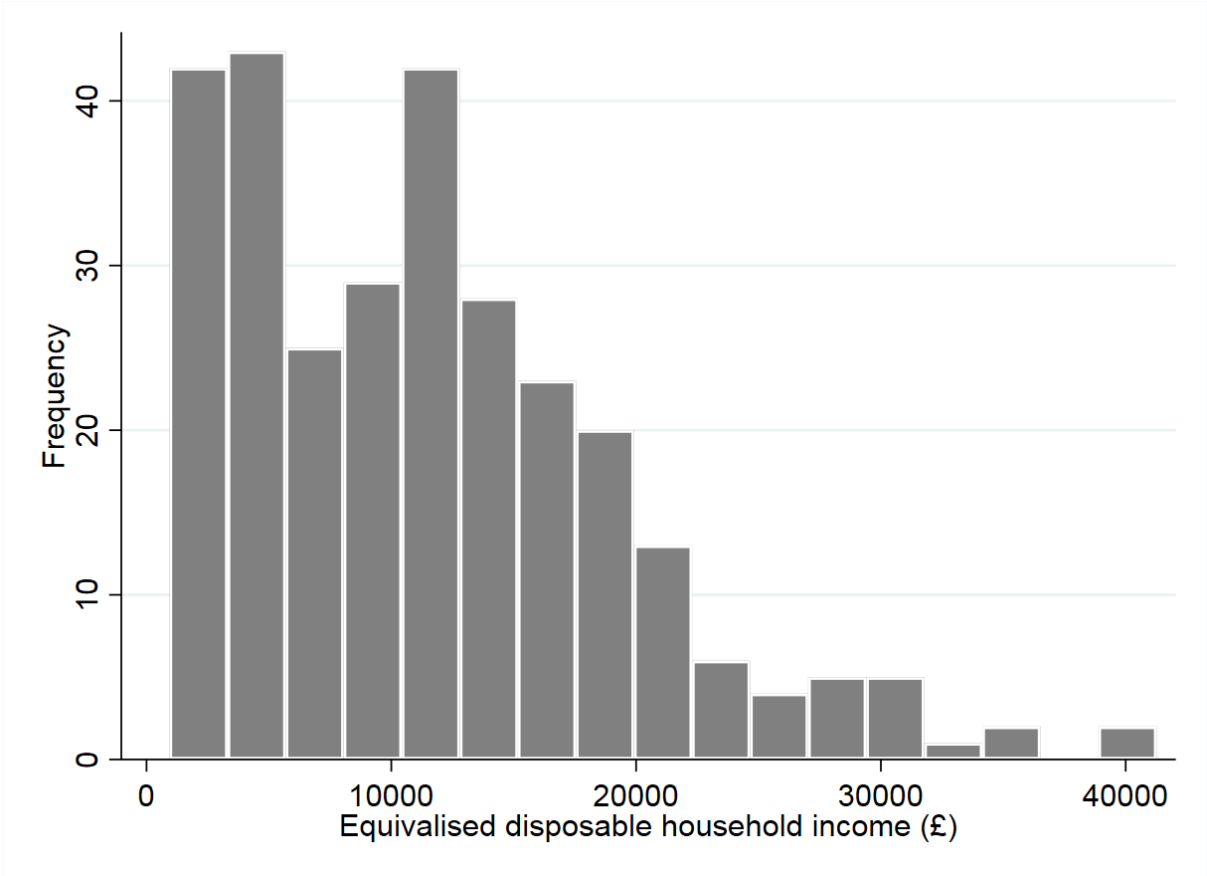

Figure 7.4: Distribution of equivalised disposable household income (£; n=290).

7.4. Empirical strategy

7.4.1. The Empirical Model

The Teat's Hill regeneration represents an increase in the provision of an environmental good. This change is regarded as an improvement and therefore may be considered an increase in utility (utility gain). Thus, this study corresponds with welfare scenario 1 displayed in Chapter 2 (Table 2.1; Carson and Hanemann, 2005). This study will estimate $WTP_{\Delta q}$, which provides a monetary measure of CV. Therefore, based on previous research (e.g. Fields in Trust, 2018; Maccagnan *et al.,* 2019; Welsch and Kühling, 2009; Fujiwara and

Campbell, 2011; Welsch and Ferreira, 2014), the time period ascribed to the estimate was "per annum". Overall, $WTP_{\Delta q}$ can be interpreted as the amount of money that a household would be willing to give up per year for the provision of the coastal regeneration (i.e. increase in provision; $\Delta q = q^1 - q^0$), given that utility stays constant.

$WTP_{\Delta q}$ is estimated using a two-step process, corresponding with the two objectives of the LSA (discussed in Chapter 3; section 3.5). This section will highlight how the objectives were achieved using the empirical strategy. The first objective is to assess the association between LS, the non-market good and income. A regression analysis will be used to investigate this association, whilst controlling for a range of other determinants of LS (explanatory variables; including gender, health, relationship status and employment status). This is represented by eq (3.2), displayed in Chapter 3 (section 3.5). The second objective is to value $(WTP_{\Delta q})$ the benefits of the regeneration on LS. The models derived in step 1 (Objective 1) are used to examine the association between the coastal regeneration and income on LS (LS). The estimated relationships are then used to derive the marginal rate of substitution (MRS) between the coastal regeneration and income. The equations for the linear (eq 3.4) and semi-log models (eq 3.5) are presented in Chapter 3 (section 3.5). The semi-log model specification was selected for the analysis. As discussed in Chapter 3 (section 3.5), the income term is typically modelled in a log form $ln(y_0)$ to account for the diminishing marginal utility of income. Equivalised disposable household income was log transformed, but the dependent variable (LS) was not. This resulted in the specification of a semi-log model.

7.4.2. Analysis strategy

All analyses were carried out using Stata SE (v15.0). LS is reported on an ordinal scale, from 0 to 10, where 0 “Not at all satisfied” and 10 “Completely satisfied”. Two types of statistical techniques have been used previously in LSA analyses: (i) ordered probit and (ii) Ordinary Least Squares (OLS). The ordered probit treats LS as an ordered categorical variable and assumes that the reporting scale is ordinal. The OLS treats LS as a continuous variable and assumes the reporting scale is cardinal. In many applications, research has shown that similar results are obtained when LS is interpreted in ordinal terms and cardinal terms (Ferrer-i-Carbonell and Frijters, 2004). However, this study uses an OLS, similar to previous studies (e.g. Kopmann and Rehdanz, 2013; Fields in Trust, 2018).

Unadjusted and adjusted models were run using the variables outlined in section 7.2 and in Table 7.6. The unadjusted model explores the simple relationships between LS and the coastal regeneration. The fully adjusted model controls for socio-demographic factors (individual-level variables) and the frequency of visit to Teat’s Hill (visit-related variables). The final models are presented here, but alternative model specifications were also examined with a range of different explanatory variables. The variables were identified based on previous practice in LSA studies (Bertram and Rehdanz, 2015; Dolan and Metcalfe, 2008; Ferreira and Moro, 2010; Kopmann and Rehdanz, 2013; Maccagnan *et al.*, 2019; MacKerron and Mourato, 2009). They were subsequently tested and they are shown in Appendix V.

The final model specification was selected following a series of estimations. First, variables were examined using a Spearman’s correlation analysis ahead of regression, to examine any potential multicollinearity issues. As shown in

Appendix W, there were no statistically significant correlations between explanatory variables. Second, using OLS estimations, models were examined for model fit, based on the Akaike Information Criterion (AIC). Third, a series of post-estimation tools were run. Models were tested for skewness, kurtosis, normality (Shapiro-Wilk Test), heteroscedasticity (Breusch-Pagan Test), multicollinearity (Variance inflation factors) and model specification error (specification link test and omitted variable test). Finally, the rule of thumb for the minimum sample size was estimated, as discussed in Chapter 6 (section 6.5). The rule of thumb is $104 + k$, where k= number of predictors. The final model included 14 explanatory variables, therefore, the model had sufficient sample size (n=220) to assess the association between LS and individual predictors in the model ($104 + 14 = 118$).

Table 7.6: Final model specification for the LSA (Models 1-3).

Model/block	Description	Variable(s)
1	Unadjusted model	Regeneration
2	Fully adjusted model	Log equivalised disposable household income [a] Distance (km) Male Age Age^2 Long term relationship Employment status Recent visit to Teat's Hill Physical activity General health Access to private outdoor space Dog owner Number of children in household
3	Fully adjusted model with interaction term	Regeneration x recent visit

[a] Alternative specification: absolute equivalised disposable household income.

Model 3 examined an interaction term, as the impact of Δq on LS may not be homogenous (Fujiwara and Dolan, 2016). The interaction between the regeneration and recent visits was included to investigate whether the recent visit variable moderates the relationship between LS and the regeneration. In other words, to determine whether the strength or direction of the relationship between LS and regeneration is brought about by visits to Teat's Hill, enabling a comparison between visitors and non-visitors to Teat's Hill. It was predicted that people who visited after the regeneration (T2) would have a higher LS than those who visited before (T1). But, there were no expectations for differences in respondents who did not visit in either time period (T1 or T2). An F-test was used to compare the performance of the model before and after the inclusion of the interaction term.

7.4.3. Multiple Imputation (MI)

Robustness of the estimates was checked ahead of estimation of $WTP_{\Delta q}$ using MI, according to the procedure discussed in Chapter 6 (section 6.5). This involves comparing estimates from complete-case analysis with estimates from MI regression. A similar approach has been undertaken by Russell *et al.* (2018) and Ward Thompson *et al.* (2019). However, the specification of the imputation models was different to the CVM, due to the difference in the dependent variables, explanatory variables and auxiliary factors. But, similar to the CVM, robustness was assessed due to concern of potential selection bias, resulting from missing values for a number of variables in the sample (see Table 7.7). For example, there were 353 missing observations for equivalised disposable household income (54.89%). In addition to this, there were missing

observations for the dependent variable, LS (n=16; 2.49%). MI by Chained Equations (or MICE) was run for the sample using Stata SE (v15).

Table 7.7: Examination of the number of missing cases for dependent and explanatory variables.

Variable	Number of missing observations	Number of observations	Min	Max
Life satisfaction	16	627	0	10
Regeneration	0	643	0	1
Equivalised disposable household income	353	290	6.85	10.63
Distance to Teat's Hill (km)	55	588	0.04	7.76
Male	0	643	0	1
Age	6	637	18	92
Age^2	6	637	324.00	8464.00
Long term relationship	85	558	0	1
Employment status	9	634	0	3
Recent visit	1	642	0	1
Physical activity	14	629	0	2
General health	16	627	1	5
Access to private outdoor space	3	640	0	1
Dog owner	4	639	0	1
Number of children in the household	4	639	0	6

7.4.3.1. Specification of the MICE model

The model specification process outlined in Chapter 6 for the CVM (T1 data; section 6.4) was undertaken for the LSA dataset (T1 and T2). The specification of the model involved an iterative process and the final specification is shown in Table 7.8. The table displays the variables which had complete cases (regular variables) and those with missing cases to be imputed (imputed variables).

Table 7.8: Specification of the MICE model (category and variable names).

Category	Variable name
Regular	Regeneration
	Male
Imputed	Life satisfaction
	Age
	Age^2
	Long term relationship
	Employment status
	Children in household
	Log equivalised disposable household income
	Distance (in km)
	Recent visit to Teat's Hill
	Dog owner
	Access to private outdoor space
	Physical activity
	General Health
	Education

MICE uses maximum likelihood functions and convergence is reached when the maximum of the likelihood function is found (Long and Freese, 2001). However, complex models may fail to converge if: (i) a large number of categorical variables have been included and (ii) some levels of the variables are sparsely populated (Plumpton *et al.*, 2016). There were some difficulties with gaining convergence for models including: employment status and general health, two categorical variables. This is a recognised problem when running complex MICE models with categorical variables, particularly unordered categorical

variables (e.g. employment status) which require Multinomial Logistic Regression (White *et al.*, 2010, 2011). Therefore the number and combination of variables was adjusted to create a workable model and achieve convergence (SSCC, 2012).

The model was also constructed with careful attention to avoid misspecification of the imputation model and biased results (Rezvan *et al.,* 2015). Log equivalised disposable household income was included in its transformed form, based on previous best practice (e.g. von Hippel, 2009). A combination of auxiliary variables were tested and their influence was examined using diagnostic testing. As discussed in Chapter 6, this involves looking at the suitability of variables using correlation matrices and diagnostic plots. The plots are shown in Appendix X.

The final MICE model included the dependent variable, explanatory variables and one auxiliary variable (education). As discussed in Chapter 6 (section 6.6), level of education was only included in the T2 survey and therefore was not added as a predictor variable in the main regression model. However, it was appropriate for use as an auxiliary variable and there are theoretical expectations for the relationship. For example, Bateman *et al.* (2002) recommended the use of education to impute for income, as "household income will be determined by a range of factors including profession, education, age and sex" (p181). Education was not correlated with missingness of the variable ($r= 0.022$, $p>0.05$). But, it was significantly correlated with equivalised disposable household income ($r= 0.279$, $p<0.05$). Although the correlation coefficient was below 0.4, inclusion of the variable resulted in the best fit model

when comparing observed and imputed values, assessed following the imputation using diagnostic plots (see Appendix X).

There are some disparities between the observed and imputed values for variables. However, it is acknowledged that discrepancies between observed and imputed data may occur and are not necessarily problematic to the analysis, since under Missing at Random (MAR) we may expect such differences to arise (Nguyen *et al.*, 2017).

The inclusion of interactions and non-linear terms such as age^2 can present further difficulties in MI. There is no consensus as to whether they should be included as a variable in MI ("just another variable"; JAV approach) or whether it should be generated following the imputation (passive imputation strategy). This has been an area of significant discussion (e.g. von Hippel, 2007; White *et al.*, 2011; Seaman *et al*., 2012; Tilling *et al.*, 2016) and there is still no agreed approach to handling non-linear terms and interactions in imputation models. Based on previous guidance (Seaman *et al.*, 2012; von Hippel 2009; White *et al.*, 2011), the decision was made to generate age^2 in the incomplete data and then impute age^2 like any other variable. This ensures that the model is compatible with the complete-case analysis model. Research has found that JAV performs well for linear regression analysis with interaction effects (Seaman *et al.*, 2012; Tilling *et al.*, 2016). von Hippel (2009) stated "it is tempting to try and "fix" the inconsistencies in the imputed values, but methods that do so lead to biased regression estimates" (p265). He refers to passive imputation strategies in Stata as biased.

Variables to be imputed were then categorised, based on the type of data and hence the regression model required. As shown in Table 7.9, four types of

regression model were used. Categorical variables were analysed using multinomial logistic regression and ordered logistic regression and binary variables were analysed using logistic regression. Missing values for specific continuous variables (e.g. log equivalised disposable household income and distance in km) were filled in using PMM (see Chapter 6; section 6.4). PMM was used because the distribution of the variables were skewed (StataCorp, 2013).

Table 7.9: Specification of the MICE model (regression model type and variable name).

Regression type	Variable name
Predictive Mean Matching	Life satisfaction Number of children in the household Distance in km Log equivalised disposable household income Age Age^2
Multinomial Logistic Regression	Employment status
Ordered Logistic Regression	Education Physical activity General health
Logistic regression	Long term relationship Recent visit Dog owner Access to private outdoor space Regeneration x recent visit

7.4.3.2. MI process

As in Chapter 6 (section 6.5), the *mi impute* command was used to impute data. As discussed above, missing data are stochastically imputed m times. Therefore, the number of imputations m must be also be specified prior to analysis. It is recommended that the number of m should be at least equal to the percentage of incomplete cases (White *et al.*, 2011). The number of imputations was set at 50, as the proportion of incomplete for income was 54.90%. The selection of m was the same as Bertram and Rehdanz (2015).

Table 7.10 displays the output from MICE, which outlines the number of cases imputed by the MICE process.

Table 7.10: Imputed data (n=643). Table displays the (i) complete and incomplete observations, prior to MICE and (ii) the imputed and total observations following MICE.

	Observations			
Variable	Complete	Incomplete	Imputed	Total
Life satisfaction	627	16	16	643
Number of children in the household	639	4	4	643
Distance to Teat's Hill (km)	588	55	55	643
Log equivalised disposable household income	290	353	353	643
Age	637	6	6	643
Age^2	637	6	6	643
Employment status	634	9	9	643
Education	329	314	314	643
Physical activity	629	14	14	643
General health	627	16	16	643
Long term relationship	558	85	85	643
Recent visit	642	1	1	643
Dog owner	639	4	4	643
Access to private outdoor space	640	3	3	643

7.4.4. Instrumental variable approach

As discussed in Chapter 4 (section 4.5), an endogeneity problem exists for income and this can result in biased and inconsistent $WTP_{\Delta q}$ estimates from the LSA. An IV approach was selected to account for potential income endogeneity

in the analysis, as proposed by Fujiwara *et al.* (2014). Previous research has compared standard to IV estimates and shown that when the endogeneity issue is taken into account, the value of the good is sharply reduced (e.g. Dolan and Metcalfe, 2008; Maccagnan *et al.*, 2019). The IV approach involves finding a source of exogenous variation in the explanatory variables. Another variable or set of variables are instead used which change the likelihood of receiving treatment but does not depend on the omitted factors that might cause a change in the outcome. This is known as the exclusion restriction (Fujiwara *et al.*, 2018). In other words, an IV will be correlated with the exploratory variable but will be uncorrelated with anything else that might cause a change in the dependent variable.

No suitable IV is available in the dataset. This challenge has been acknowledged previously, in that it is difficult to find a valid instrument for income. Moreover, there is no agreement on how to instrument income, particularly in (repeat) cross-sectional studies (Bertram and Rehdanz, 2015). As discussed in Chapter 4 (section 4.5) a number of IVs for income have been proposed and employed in the SWB literature to resolve issues such as endogeneity. These include: lottery wins amongst lottery wins (Fujiwara *et al.*, 2014), sight of payslips (Powdthavee, 2010) and wage differentials by industry (Pischke, 2011). This sub section provides an overview of the IV approach selected (7.4.4.1) and how it may be used to provide an unbiased estimate of $WTP_{\Delta q}$ (7.4.4.2).

7.4.4.1. Choice and description of Instrumental Variable (IV)

For this study, lottery wins was selected as the most appropriate IV, as the IV has been used frequently in research to value a range of goods (Maccagnan *et*

al., 2019). This IV is derived from Fujiwara *et al.* (2014) which used lottery wins as an IV and derived the data from the BHPS. Lottery wins can be used as an instrument for income as winnings are randomly allocated amongst lottery players after adjusting for the amount that players spend on lottery tickets. An IV is used under the assumption that frequent lottery players will tend to win more on average (Fujiwara *et al.*, 2018). Fundamentally, lottery wins among lottery players can be used because it will be correlated with income but is uncorrelated with other factors that might cause a change in the dependent variable (LS). Fujiwara *et al.* (2014) generated an unbiased coefficient (γ^*) for log equivalised disposable household income by using a two-stage least squares (2SLS) model. The 2SLS used a sample of lottery winners and compared people with small sized annual winnings (under £200) to those of with medium sized annual lottery winnings (£200 - £10,000). The unbiased coefficient for log equivalised disposable household income was estimated to be γ^*= 1.158. The reader is referred to Fujiwara *et al.* (2014) for further details and explanation concerning the estimation of the unbiased coefficient for income.

7.4.4.2. Transformation of IV coefficient

The γ^* from Fujiwara *et al.* (2014) is based on a LS reported on a scale from 1-7. However, LS in this study was reported on a scale from 0 to 10 as used in other LSA studies (Maccagnan *et al.*, 2019). Maccagnan *et al.* (2019) adjusted the γ^* from Fujiwara *et al.* (2014) by multiplying the coefficients by 10/6 to account for this difference. Therefore, the γ^* estimate calculated by Maccagnan *et al.* (2019) was used in this study, see Table 7.11.

Table 7.11: Unbiased income coefficients: original and transformed (derived from Maccagnan *et al.*, 2019).

	Unbiased income coefficient for income (γ^*). Derived from regression with LS on original scale (1-7)	**Unbiased income coefficient for income (γ^*). Transformed (LS on 0-10 scale).**
Fujiwara et al (2014)	1.158	1.930

7.4.4.3. Estimation of $WTP_{\Delta q}$ using IV approach

The unbiased income coefficient γ^* (see Table 7.11; Fujiwara *et al.,* 2014) can then be used alongside estimates from the current study to generate an unbiased WTP value. Eq (3.4) and Eq (3.5) are adapted to account for the use of γ^* and is rewritten to produce eq (7.2) and (7.3).

$$WTP_{\Delta q} = -\frac{\delta \Delta q}{\gamma^*} \tag{7.2}$$

$$WTP_{\Delta q} = y_0 - e^{\left[\ln(y_0) - \frac{\delta \Delta q}{\gamma^*}\right]} \tag{7.3}$$

Where, $\delta \Delta q$ is the coefficient for the coastal regeneration and y_0 is the mean equivalised disposable household income of the sample, from the current study.

7.5. Results (Objective 1): association between LS and the regeneration

7.5.1. Unadjusted and adjusted models

Table 7.12 displays the results of the unadjusted and adjusted models for LS. The unadjusted model (n=627) revealed that there was no significant association between the regeneration and LS ($\delta \Delta q$= 0.199). There was no statistically significant difference in LS between the T2 survey (8.122±0.088)

and T1 survey (7.923±0.111), before controlling for determinants of LS. After controlling for individual-level and visit-related variables, the adjusted model (Model 2; n=220)[12] revealed that there was a significant positive association between the regeneration and LS ($\delta\Delta q$= 0.389). In comparison to T1, LS was on average 0.389 scale points (3.89%) higher for people in T2. This indicates that LS increased by 3.89% from T1 to T2. There was no significant association between LS and log equivalised disposable household income. The interaction effect between regeneration and recent visit (Model 3) was not significant (see Table 7.13). The F-test revealed that the inclusion of interaction term did not improve the performance of the model ($F_{(1,200)}$=1.69, p=0.195). Therefore, Model 2 was selected as the most appropriate model for the LSA analysis.

[12] Note, there were missing cases for explanatory variables. This reduced the sample size from n=627 to n=220.

Table 7.12: Results of main regressions for life satisfaction (OLS), using Log equivalised disposable household income (complete-case analysis).

	Model 1: Unadjusted		**Model 2: Adjusted**	
Life Satisfaction (LS)	β	(SE)	β	(SE)
Regeneration	0.199	0.142	0.389*	0.229
Log Equivalised disposable income			-0.204	0.156
Distance (km)			-0.069	0.047
Male			-0.031	0.210
Age			-0.087**	0.036
Age^2			0.001***	0.000
Long term relationship			0.397*	0.215
Employment status				
Employed (ref.category)	-	-	-	-
In education			1.137***	0.395
Unemployed			-0.366	0.481
Other inactive			0.947***	0.283
Recent visit to Teat's Hill			0.357*	0.209
Physical activity				
None (ref.category)	-	-	-	-
1-4 days			0.595**	0.296
5+ days			0.727**	0.314
General health				
Very Bad (ref.category)	-	-	-	-
Bad			1.710*	1.011
Fair			1.166	0.909
Good			2.021**	0.887
Very Good			2.667***	0.906
Access to private outdoor space			0.307	0.280
Dog owner			0.435*	0.241
No of children in household			0.185	0.147
Constant	7.923***	0.111	8.112***	1.649
N	627		220	
AIC	2492		818	
R^2	0.003		0.301	
Adj R^2	0.002		0.230	

OLS regression model. Heteroscedasticity-robust standard errors used.
***, **, and * mean significant at the 1%-, 5%-, and 10%-level, respectively.

Table 7.13: Results of main regression for Model 3 for life satisfaction (OLS), using Log equivalised disposable household income (complete-case analysis). Model 3 includes the interaction term for regeneration x recent visit to Teat's Hill.

	Model 3: Inclusion of interaction term	
Life Satisfaction (LS)	*B*	(SE)
Regeneration	0.123	0.306
Log Equivalised disposable income	-0.220	0.153
Distance (km)	-0.066	0.047
Male	0.002	0.208
Age	-0.085**	0.036
Age^2	0.001***	0.000
Long term relationship	0.382*	0.218
Employment status		
Employed (ref.category)	-	-
In education	-1.126***	0.402
Unemployed	-0.334	0.472
Other inactive	-0.973***	0.282
Recent visit to Teat's Hill	0.056	0.332
Physical activity		
None (ref.category)	-	-
1-4 days	0.588**	0.294
5+ days	0.694**	0.320
General health		
Very Bad (ref.category)	-	-
Bad	1.692*	0.992
Fair	1.117	0.877
Good	1.987**	0.855
Very Good	2.675***	0.871
Access to private outdoor space	0.330	0.279
Dog owner	0.446*	0.242
No of children in household	0.186	0.152
Regeneration x recent visit to Teat's Hill	0.576	0.412
Constant	8.362***	1.621
N	220	
AIC	818	
R^2	0.307	
Adj R^2	0.234	

OLS regression model. Heteroscedasticity-robust standard errors used.
***, **, and * mean significant at the 1%-, 5%-, and 10%-level.

7.5.2. Association between LS and explanatory variables

7.5.2.1. Findings

The findings for explanatory variables were largely consistent with previous research (discussed in Table 7.3). There was a significant negative association between LS and age (β= -0.087) and a significant positive association between LS and age^2 (β=0.001). This indicated that the relationship between age and LS is non-linear. Further examination suggested that there is a decreasing function of LS with age until a turning point is reached, from which point the function starts to increase. This was investigated further by plotting predicted LS (pLS) against age (Figure 7.5). The turning point was calculated and estimated to be 39.44 years.

There was also a significant positive association between LS and (i) relationship status (β= 0.397), recent visit (β= 0.357) (physical activity (1-4 days: β=0.595, 5+ days: β= 0.727), general health (Bad: β= 1.710, Good: β=2.021, Very good: β=2.667) and dog ownership (β= 0.435). This indicated that being in a long term relationship (married, in a civil union, or cohabiting), visiting Teat's Hill more recently (within last month), engaging in physical activity, "good health" and dog ownership was associated with higher LS.

Significant negative associations were also observed between LS and employment status: in education β= -1.137) and other inactive (β= -0.947). This suggested that being in education or inactive (e.g. permanently sick or disabled, retired, doing housework, looking after children, or other persons or other reason) was associated with lower LS than being in employment. As shown in Table 7.12, there were no significant relationships observed between LS and

the following variables: distance in km, male, unemployed, “fair health”, access to private outdoor space and the number of children in the household.

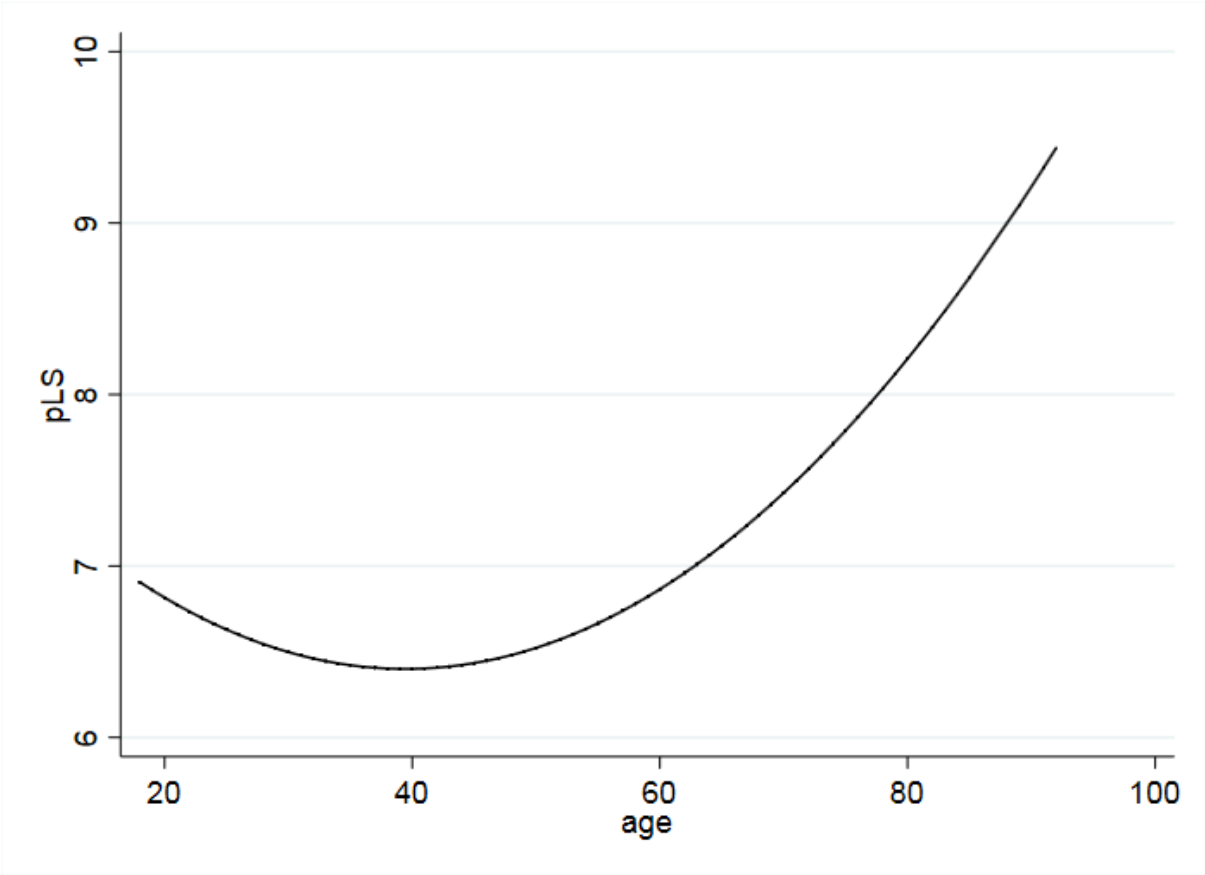

Figure 7.5: Test for non-linearity: predicted LS (pLS) plotted against age.

7.5.2.2. Comparison of associations with LS

As aforementioned, the magnitude of the relationship between LS and the regeneration was compared alongside other correlates, which were significantly related to LS in the fully adjusted model. This exercise has been undertaken in previous research (Maccagnan *et al.*, 2019; White *et al.*, 2017). This is displayed in Table 7.14. The size of the association between the regeneration and LS ($\delta\Delta q$= 0.389) was similar to being in a long term relationship *vs.* being single, divorced, separated and widowed (β = 0.397). This suggested that regeneration was at least as important as this life circumstance in terms of the association with LS.

Table 7.14: Comparison of the coefficients for the regeneration ($\delta\Delta q$) and explanatory variables with significant associations with LS (β). This analysis is based on the complete-case analysis (n=220).

Variable	**Coefficient** (β)	**Significance level**
Regeneration[a]	0.389	*
Age	-0.086	**
Age^2	0.001	***
Long term relationship	0.397	*
In education	-1.137	***
Other inactive	-0.947	***
Recent visit to Teat's Hill	0.357	*
Physical activity (1-4 days)	0.595	**
Physical activity (5+ days)	0.727	**
Bad Health	1.710	*
Good	2.021	**
Very good	2.667	***
Dog owner	0.435	*

[a] Notation for the regeneration coefficient ($\delta\Delta q$)
OLS regression model. Heteroscedasticity-robust standard errors used.
***, **, and * mean significant at the 1%-, 5%-, and 10%-level
R^2= 0.307 and Adj R^2= 0.234.

7.5.3. Robustness check

MICE analyses were completed as a robustness check to ensure that the missing cases in the models were not biasing the estimates. Two types of model were run using the data: (i) MICE analysis (n=643), which included imputed dependent variable cases and (ii) MID analysis (n=627), which excluded imputed dependent variable cases. There were similarities between the regression models for MICE and Multiple Imputation then Deletion (MID), therefore, the larger sample size (i.e. MICE) is presented here (n=643; Table 7.15). The MID analysis (n=627) is presented in Appendix Y.

There were a number of similarities between the analyses run with complete data (complete-case analysis; n=220) and the imputed dataset (MICE; n=643). The significant association between LS and the regeneration was upheld in the

MICE analysis (δq= 0.279). The MICE analysis resulted in a reduced effect size of regeneration, however, the significance level was higher and there was a lower standard error for the variable. The insignificant association between LS and log equivalised disposable household income was maintained in the MICE model, despite filling in the gaps for the missing cases. The majority of associations between LS and explanatory variables were also upheld in the MICE analysis. This was with exception of recent visit, dog owner and “bad health”, which lost significance in the MICE analysis. Overall, the analysis indicated that the model was robust.

The model including the interaction term (regeneration x recent visit) was also checked for robustness and the results are shown in Appendix Z and AA. There was no significant effect of the interaction between the regeneration and recent visit in the MI and MID models.

Table 7.15. Comparing main regressions for life satisfaction (OLS) from: (i) complete-case analysis (Model 1: n= 627; Model 2: n=220) and (ii) Multiple Imputation analysis (MICE, Models 4 and 5; n=643).

	Complete-case analysis				Multiple Imputation (MICE) analysis			
	Model 1: Unadjusted		Model 2: Adjusted		Model 4: Unadjusted		Model 5: Adjusted	
Life Satisfaction (LS)	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Regeneration	0.199	0.142	0.389*	0.229	0.190	0.141	0.295**	0.132
Log Equivalised disposable household income			-0.204	0.156			-0.150	0.134
Distance (km)			-0.069	0.047			-0.011	0.033
Male			-0.031	0.210			-0.017	0.127
Age			-0.087**	0.036			-0.066***	0.022
Age^2			0.001***	0.000			0.001***	0.000
Long term relationship			0.397*	0.215			0.462***	0.134
Employment status								
Employed (ref.category)	-	-	-	-	-	-	-	-
In education			-1.137***	0.395			-0.470*	0.261
Unemployed			-0.366	0.481			-0.551	0.343
Other inactive			-0.947***	0.283			-0.533***	0.188
Recent visit to Teat's Hill			0.357*	0.209			0.069	0.125
Physical activity								
None (ref.category)	-	-	-	-	-	-	-	-
1-4 days			0.595**	0.296			0.508***	0.176
5+ days			0.727**	0.314			0.757***	0.178

General health								
Very Bad (ref.category)	-	-	-	-	-	-	-	-
Bad			1.710*	1.011			1.149	0.822
Fair			1.166	0.909			1.671**	0.743
Good			2.021**	0.887			2.421***	0.735
Very Good			2.667***	0.906			3.144***	0.739
Access to private outdoor space			0.307	0.280			0.092	0.171
Dog owner			0.435*	0.241			0.097	0.146
No of children in household			0.185	0.147			0.159**	0.075
Constant	7.923***	0.111	8.112***	1.649	7.927***	0.110	6.999***	1.403
N	627		220		643		643	
AIC	2492		818		-		-	-
R^2	0.003		0.301		0.003		0.299	
Adj R^2	0.002		0.230		0.001		0.276	

OLS regression model. Heteroscedasticity-robust standard errors used.

R^2 and Adj R^2 for MI analysis is based on the average across 50 imputations.

***, **, and * mean significant at the 1%-, 5%-, and 10%-level.

7.6. Results (Objective 2): value of the regeneration

There was no significant relationship between income and LS in either the original and MI models. Due to the indeterminate effect of income on LS, an unbiased income coefficient γ^* was borrowed from Fujiwara *et al.* (2014). This unbiased coefficient was originally considered for adjusting for endogeneity (see section 7.4), but the current study was unable to assess this due to the lack of effect of income. Instead, the unbiased coefficient was used to enable a valuation of the coastal regeneration.

The $WTP_{\Delta q}$ for the regeneration was estimated for the full sample (n=220), using eq (3.5). See Chapter 3 (section 3.5). The mean equivalised disposable household income (y_0) was £10,548.04. The unbiased equivalised disposable household income coefficient γ^* (Fujiwara *et al.*, 2014) was 1.930 and the coefficient for the coastal regeneration $\delta\Delta q$ was 0.389 (see Table 7.16). It can be interpreted that £1,925.45 is the amount of money that an average household would be willing to give up per year for the provision of the coastal regeneration given that utility stays constant.

Table 7.16: LSA estimation of $WTP_{\Delta q}$ (£) for the coastal regeneration (n=220).

	LS value
Coefficient for the regeneration	0.389
Value of the regeneration (£)	1,925.45

$WTP_{\Delta q}$ estimate provides a value for the coastal regeneration (£)

7.7. Discussion

7.7.1. Summary of findings

This study set out to place a monetary value on the Teat's Hill coastal regeneration (Plymouth, UK). This study helps to address the broad research questions 3, 4 and 5 (see Chapter 1; section 1.2) and the specific objectives of the LSA study, which are discussed here.

7.7.1.1. Objective 1: the association between LS and the regeneration

The first objective of this research was to investigate whether there was a significant relationship between the regeneration at Teat's Hill and LS. Analysis of the repeat cross-sectional data found that once potential individual and visit-level confounds were controlled for, individuals who were interviewed following the regeneration (T2) had a higher LS than those who were interviewed before the regeneration (T2). LS was 3.89% higher (+0.389 on a 0-10 scale), in respondents interviewed at T2, respective to those interviewed as part of T1. Therefore, respondents interviewed after the intervention (T2) were more satisfied with their life when asked to provide an evaluation of their well-being than those interviewed before (T1). The association was observed in both the complete-case analysis (n=220) and the MICE analysis (n=643).

The significance of the regeneration in the model was highlighted when comparing the magnitude of the relationships between LS and the regeneration alongside other correlates. This comparison has been undertaken in previous in SWB (e.g. White *et al.*, 2017) and LSA research (e.g. Maccagnan *et al.*, 2019). This was highly informative and showed that relationship status had similar associations with LS, thus supporting previous claims that environmental characteristics may be at least as important as some life circumstances (Lyubomirsky *et al.,* 2005; White *et al.*, 2017).

To the author's knowledge, this is the first study to have looked at the association between LS and a coastal intervention. The majority of studies examining the impact of environmental interventions (including those with blue space components) have focused on environmental benefits (e.g. conservation of biodiversity) or outcomes such as physical activity (National Institute for Health and Care Excellence, 2018; World Health Organisation Europe, 2017). Although, using different outcomes, previous research in the health literature has shown that (non-coastal) interventions similar to Teat's Hill can have positive influences on visitation to environments (National Institute for Health and Care Excellence, 2018; Roberts *et al.*, 2016) and physical activity (Benton *et al.*, 2016; National Institute for Health and Care Excellence, 2018). In terms of well-being, however, there is limited research to draw upon; very few studies have assessed the well-being benefits of blue or green space interventions (e.g. Anderson *et al.*, 2017; Ward Thompson *et al.*, 2019) and they use alternative measures of well-being.

Anderson *et al.* (2017) also identified a positive association between well-being and an intervention. The study used a cross-sectional design to assess the effect of a low cost improvement to an urban green space site in Manchester on local residents. The intervention included the introduction of an ecologically-orientated outdoor exhibition space and mural, vegetation management and new seating. They found that after one year, there was an increase in well-being proxy measures related to well-being behaviour (e.g. connecting with other people, engaging in physical activity and taking notice or being aware of one's external environment).

However, the findings contrast with Ward Thompson *et al.* (2019). Ward Thompson *et al.* (2019) evaluated the impact of a green space intervention (Woods In and Around Towns, WIAT, programme), which included physical interventions (e.g. clearing shrubs, creating boardwalks and paths and adding signage) and social interventions (e.g. organised walks, family fun days and sport activities) in woodland sites. Well-being was assessed using the SWEMWBS measure (Chapter 3, section 3.3). Three intervention and three control woodland sites were used and longitudinal data (n= 609) were collected in three waves: pre (2013), post (2014) and delayed post (after the social interventions; 2015). The research found that there was a negative effect of the green space intervention on well-being and therefore it did not produce a community-level benefit in well-being. The authors offered no definitive explanation for the pattern of lower well-being associated with the intervention sites. However, qualitative findings suggested that other factors may have contributed to these negative changes over time (e.g. increases in aircraft noise and difficulties associated with urban renewal in the area).

The analysis does indicate that there is an association between LS and the regeneration, after controlling for a range of explanatory variables. There may be a number of reasons for a positive association between LS and the regeneration, which will be discussed in Chapter 8 (section 8.2). However, as the data in the current study are repeat cross-sectional, the findings should be taken with some caveats and caution. Analogous to previous research (e.g. Fujiwara *et al.*, 2014; White *et al.*, 2017), the study uses observational data and is based on a selection-on-observables assumption (whereby differences in characteristics between groups are assumed to be observable in the data and hence can be controlled for). Therefore, the study cannot be used to infer

causality, i.e. the findings should not be used to suggest that the regeneration caused the increase in LS of local residents in Plymouth between T1 and T2. Furthermore, there is complexity associated with identifying the mechanism(s) for the apparent increase in LS. Although, there was a significant relationship between LS and the regeneration, there is uncertainty as to whether the regeneration is capturing other aspects or changes between T1 and T2. One particular reason for the uncertainty is the lack of significant effect of the interaction between regeneration and whether people visited Teat's Hill recently. The increase in LS between T1 and T2 may not have resulted from visits to the site (i.e. changes in behaviour induced by the regeneration). The limitations of the study design are discussed in 7.7.3.

7.7.1.2. Objective 2: estimate of the monetary value of the regeneration

The second objective was to explore the potential to estimate a monetary value using the LSA, thereby enabling a direct comparison with the estimate from the CVM. The LSA was used to estimate a monetary value $WTP_{\Delta q}$ of the change in the observed differences in LS from T1 to T2. The research suggested that the 3.89% increase in LS (+0.389 on a 0-10 scale), corresponded to a value of £1,925.45 per average household per annum, using an unbiased co-efficient for income from Fujiwara *et al.* (2014). Based on theory, $WTP_{\Delta q}$ can be interpreted as a valuation of the provision of the bundle of goods (i.e. T1 *vs.* T2). This represents a value of people's actual experiences and attaches values to these conditions (Fields in Trust, 2018). This would indicate that the intervention may be worth £1,925.45 per average household per annum and represents the amount of money that an average household would be willing to give up for the provision of the coastal regeneration given that utility stays constant. But, as

discussed above, there is complexity associated with identifying the mechanism(s) for the apparent increase in LS and the findings should be taken with some caveats and caution. $WTP_{\Delta q}$ may instead represent the value of a broader range of changes between T1 and T2. This will be discussed in more detail in section 7.7.3.

The current research is the first study to explore the potential to estimate a monetary value for a coastal intervention using the LSA. Therefore as in subsection 7.7.1, there is limited literature with which to compare this finding. But, as highlighted in Chapter 3 (section 3.6), a small number of studies have used the LSA to value coastal environments (blue spaces; e.g. Cuñado and de Gracia, 2013; Kopmann and Rehdanz, 2013; Jarvis *et al.*, 2017) and parks and green spaces (e.g. Tsurumi and Managi, 2015; Wang *et al.*, 2017; Aoshima *et al.*, 2018; Fields in Trust, 2018). The current study differs from previous research. The majority of the aforementioned studies use a quantitative-spatial approach to value specific environmental goods. They also vary in terms of the non-market good being valued and the choice of LS measure. Nonetheless, this research does augment the current evidence base which attempts to value blue and green spaces, in terms of the well-being gained from people's experiences.

7.7.2. Assessing the validity of the study

Analogous to the CVM (Chapter 6, section 6.7), it is important to assess the validity of the results from the LSA. Convergent validity cannot be assessed, due to the lack of previous research in this area (see subsection 7.7.1) and the use of various different types of LS measures across the literature. Additionally,

there is uncertainty as to whether estimates from the CVM and LSA should converge (discussed in Chapter 8, section 8.4).

There is currently limited guidance on how to assess the construct validity of WTP estimates derived from the LSA. Instead the study can evaluate the construct validity of self-reports of LS, which has been undertaken more frequently. Construct validity is assessed by examining whether LS exhibits expected relationships with determinants of well-being (discussed in Chapter 4; section 4.4). The findings for explanatory variables were largely consistent with previous literature (discussed in Table 7.3). This research suggests that LS measures exhibit expected relationships with individual-level variables (e.g. age, health, employment status, marital status) and visit-specific variables (e.g. recent visits to Teat's Hill). In general, the evidence provides an indication that the study had construct validity.

7.7.3. Limitations and future work

This section will focus on the limitations which are specific to the LSA study discussed in this chapter. The general limitations related to the study as a whole (e.g. missing cases, multiple imputation and sample size) will be discussed in Chapter 9 (section 9.5).

7.7.3.1. Regeneration variable

In line with previous studies (Bakhshi *et al.*, 2015; Dolan and Metcalfe, 2008), the change in question, in this case the 'regeneration', was included as a binary variable in the regression analysis. The analysis controlled for a range of determinants of LS, as outlined in section 7.4. However, as aforementioned (see 7.7.1), the study is based on a selection-on-observables assumption,

whereby differences in characteristics between groups are assumed to be observable in the data and hence can be controlled for. Therefore, the regeneration variable may have captured and valued a broader range of changes between the T1 and T2 assessment stages. There may also have been unobserved factors that the study has not controlled for. Therefore, the reasons or factors driving these differences should be the basis of future study. Additional research is also required to establish whether such variables can be used to value well-being changes resulting from interventions and examine alternative specifications for studying the effects of regeneration projects.

7.7.3.2. Study design

A natural experiment was used, which can address some of problems associated with reverse causality and omitted variable bias. The study used a repeat-cross sectional study, over a longitudinal design due to costs, concerns about attrition and the ethics of data storage (discussed in Chapter 3, section 3.4.). However, the study does have similarities with a longitudinal design with data being collected at two time points (T1 and T2). The main difference is that the same respondents weren't sampled at T1 and T2. The repeat-cross sectional approach has benefits over cross-sectional studies commonly used in the natural environment and well-being field (Gascon *et al.*, 2015, 2018). But, it still limits the ability to make causal attributions or inferences. There was complexity associated with identifying the mediator(s) for the apparent increase in LS. For example, there was no significant effect of the interaction between regeneration and whether people visited Teat's Hill recently.

As discussed, the number of variables were controlled for in the adjusted models. But it cannot be ruled out the study excluded variables important to the

LS of the ‘pre’ (T1) group but not for ‘post’ (T2) group. Transient events such as the weather, political circumstances, holidays, or news stories (Mackie and Smith, 2015; White *et al.*, 2017) may also have been associated with the difference between LS in T1 and T2. The survey collected data on the weather status using categories (e.g. sunny, rainy, cloudy, cold; see Chapter 5, section 5.6). But fine scale data were not available for the 7 LSOAs and the Teat’s Hill site. Therefore, weather was not controlled for in the models. This has been discussed previously by Dolan and Metcalfe (2008).

Previous research investigating the impact of interventions (e.g. parks) have also used a natural experiment, without a control or comparator site (King *et al.*, 2015; Cranney *et al.*, 2016; Roberts *et al.*, 2016). However, Fitzhugh *et al.* (2010) recommend that accurately identified controls are required to make a definitive statement on causality, i.e. to establish whether the regeneration resulted in the increase in LS. However, this was not possible for this study, due to the inability to find a site with similar physical characteristics (size, features and amenities) and served a population with similar socio-demographic characteristics (at baseline) to the intervention. It is therefore recommended that future studies include a control group (or control site), where possible. Previous natural experiments exploring the influence of regeneration (e.g. Dolan and Metcalfe, 2008) and improvements to parks and urban environments (e.g. Tester and Baker, 2009; Fitzhugh *et al.,* 2010; Cohen *et al.*, 2012; Veitch *et al.*, 2012) on various health outcomes have used control sites.

The T2 survey was implemented in 2018 at the same time of year as the T1 survey in 2017. However, this may have implications in terms of exposure to the regeneration. The Teat’s Hill site was gradually improved between autumn 2017

and spring 2018. The specific exposure period is difficult to determine, as the site wasn't completely closed during this period and the regeneration work was phased. Hence, the public were still able to use the site and specific parts of the regeneration (e.g. open air theatre) ahead of the official opening on the 1st June 2018. It is also unclear as to whether it was sufficient time for people to experience the regeneration and observe an effect at T2 (27th June-6th August 2018). This may have had implications for the LSA analysis. Elsewhere, the choice of exposure period has varied significantly between studies. For example, Veitch *et al.* (2012) exposed respondents for only 2 months. In contrast, West and Shores (2011) and Fitzhugh *et al*. (2010) exposed respondents for 11 and 14 months respectively. Although dependent on the intervention in question and the time scale, it may be preferable to adopt the use of a longer exposure period (e.g. 11-14 months) in future studies.

This current study also originally planned to implement a pre, post and delayed post study design. Delayed post studies may help to test both the immediate effects and the longer-term effects of interventions. They may also capture any time lag between implementation of an intervention to a change in well-being (Valuing Nature Network, 2012). This may be informative to policy and planning, in prioritising projects that have long-term effects and provide value for money. See, for example, Cohen *et al.*, (2012) who used a delayed post assessments to assess the impact of parks on physical activity. The delayed-post was proposed for 6-9 months following the regeneration (i.e. December 2018 or March 2019). Following discussions with the project team and market research company, it was decided that sampling effort would be focused across two assessments rather than three. This was due to the small population size from which to sample, in addition to the timing of the site capital improvements. The

delayed-post survey work would have taken place in winter and spring when there is likely to be reduced visitation and therefore footfall at Teat' Hill. Despite these challenges, future research should consider the use of a delayed-post assessment.

7.7.3.3. Use of an unbiased coefficient for income

The relationship between LS and equivalised disposable household income is central to the estimation of $WTP_{\Delta q}$. A significant effect of income is required for the estimation. However, no such an effect was found in this study. The lack of association may have resulted from the large standard error and the positive skewed distribution of income (i.e. clustering of responses in lower income categories; shown in Figure 7.3). This may have had a knock-on effect on the calculation of log equivalised disposable income. Further, the presence of an insignificant coefficient for income is not unique to this study. There is mixed evidence of the relationship between income and LS, as shown in Table 7.3. For example, this lack of significance has been observed in another LSA study which uses primary data and values changes in a coastal good (Jarvis *et al.*, 2017).

As a result of this, an unbiased coefficient for income from Fujiwara *et al.* (2014) was used in the estimation of $WTP_{\Delta q}$. Fujiwara *et al.* (2014) generated this coefficient from BHPS data, which had a nationally representative sample, suitable for UK-wide research. However, our study is focused on respondents living either within one of the 7 LSOAs or within the Plymouth Unitary Authority boundary. There are difficulties with drawing parallels between the socio-demographic characteristics from the BHPS and this study, due to the differences in survey questions. Therefore a future extension of this study could

look to extract any available local (Plymouth) or regional data (South West) from the BHPS, to derive an income coefficient estimate for this specific area. Furthermore, it is recommended that forthcoming studies include a suitable IV question within their survey.

7.7.3.4. Survey design

There is the possibility that reports of LS may have been affected by priming effects (or question order effects). Priming effects were discussed in Chapter 4 (section 4.6) and have been highlighted as a contextual issue and a source of non-random error in survey research (e.g. Bakhshi *et al.* 2015; Gandelman *et al.,* 2012). The LS question was included towards the end of the survey (Part 3), due to ethical considerations (discussed in section 5.7). The positioning of questions was similar to the Monitoring Engagement with the Environment (MENE) survey (Natural England, 2017), which asks respondents about recent visits to natural environments (e.g. the coast) or their perceptions of environmental quality before the LS question. However, the MENE survey did not use preference-based methods such as the CVM, which were included in Part 2 of this survey. Based on this, people who like or care for Teat's Hill may have been reminded of its importance in the survey, which may have artificially inflated their LS at the time of the survey. There has been limited discussion into how to assess the influence of this effect in practice and is outside the scope of the thesis. But, research is necessary to investigate the potential influence of this contextual issue on LS estimates.

In addition to this, the current study used a single SWB measure. It has been argued previously that single LS measures do not allow the researcher to investigate how the various dimensions of life were accounted for and

aggregated by respondents (OECD, 2018). While the survey used in this study also included questions relating to domains of LS, including community, safety and health, analysis of these items was out of the scope of the thesis. Therefore, future analysis could be extended to examine the association between the regeneration and domains of LS, in addition to exploring their potential for using in the LSA, to value the impact of the regeneration. Both of these avenues of research are explored in more detail in Chapter 9 (see section 9.6.).

7.8. Summary

This chapter presented the results of the LSA empirical research, which investigated the links between the regeneration at Teat's Hill and the LS of local residents. The findings suggested that there was a significant association between life satisfaction and the regeneration, after adjusting for relevant individual-level and visit-specific controls. The positive association was observed over a range of specifications and robustness checks (i.e. multiple imputation). The results suggested that life satisfaction was on average 0.389 scale points (3.89%) higher for people interviewed at T2, compared to people in T1. The magnitude of the association between life satisfaction and the regeneration was similar to that between life satisfaction and life circumstances such as being in a long- term relationship. The chapter also explored the potential to estimate a monetary value for the regeneration using the LSA, to enable a direct comparison with the estimate from the CVM. There was no significant association between life satisfaction and log equivalised disposable household income. Therefore an unbiased income coefficient was drawn from a previous study that used an instrumental variable approach, to study the

association between income and life satisfaction. The monetary value of the regeneration on life satisfaction was estimated to be £1,925.45 per average household per annum. This represents the amount of money that an average household would be willing, in theory, to give up for the provision of the coastal regeneration given that utility stays constant. Although there are limitations, this study is the first to use the LSA to value the well-being benefits of a coastal intervention and provides an initial indication of the potential benefits of such interventions within areas of relative socio-economic deprivation.

8. Discussion of the empirical results

8.1. Chapter overview

The use of a natural experiment permitted the rare opportunity to value the implementation of a coastal intervention, within a deprived neighbourhood of Plymouth (UK). Two environmental valuation methods were used: the CVM and LSA. The empirical results from the methods are drawn together to answer three inter-related research questions:

- **Research question 3:** To what extent was there an effect of the coastal intervention on well-being and why?
- **Research question 4:** How similar are the values estimated for the intervention elicited by the two methods?
- **Research question 5:** To what extent are the two methods commensurable or complimentary?

8.2. Research question 3: To what extent was there an effect of the coastal intervention on well-being and why?

As discussed in Chapter 5 (section 5.2), the Teat's Hill intervention included a bundle of goods, related to the blue and green space features of the site. The bundle of goods involved physical improvements to the site such as improvements to facilities (e.g. children's play equipment, an open air theatre and new signage), increased access and improvements to environmental quality (e.g. efforts to reduce litter). It also included a social or behavioural component, related to nature-based and recreational activities and workshops.

Both the CVM and LSA are both environmental valuation that were used to provide an estimate of value for the coastal intervention.

The CVM provide an *ex-ante* valuation of the intervention. Respondents were asked to state their WTP for a hypothetical change that would improve facilities, access and environmental quality at Teat's Hill. They were asked to make a decision about their willingness to pay as an indicator of the change in utility they expect from the implementation of the coastal intervention. The results (Chapter 6) showed that respondents had preferences for the regeneration at Teat's Hill and were willing to pay £7.97 per household as a one-off payment for the regeneration. The CVM measured the behaviour stage of the DWB model, where individuals made a decision about their preferences for the coastal intervention. The findings suggested that some people perceived that they were going to gain well-being benefits from the intervention, i.e. they anticipated satisfaction if it were put into place (Dolan and White, 2006). The method can be used to explore the characteristics of individuals that predict stated WTP. However, it cannot be determined if the anticipated effect has been realised in practice. Therefore, it cannot for the basis for an evaluation of the effect of the intervention on well-being.

In contrast to the CVM, the LSA can be used to value the effect of actual changes on well-being. The LSA measured the evaluation stage of the DWB model, where people were asked to provide an assessment of their LS before (T1) and after (T2) the implementation of the intervention. The results suggested that there was a significant positive association between the regeneration and LS. LS was 3.89% higher in the T2 assessment, compared to the T1 assessment, after controlling for the determinants of LS. This suggested

that residents interviewed after the intervention (T2 survey) were more satisfied with their life than those interviewed before (T1 survey). The study also explored the potential to estimate a monetary value using the LSA, thereby enabling a direct comparison with the estimate from the CVM. Using an unbiased co-efficient for income from Fujiwara *et al.* (2014), the intervention was estimated to be worth £1,925.45 per average household per year.

As aforementioned (Chapter 7; section 7.7), the data are repeat cross-sectional, therefore they cannot be used to infer causality. It cannot be stated that the regeneration caused the increase in LS of local residents in Plymouth between T1 and T2. The interaction between regeneration and visits to the site were used to capture the differential effect of the regeneration on LS as a function of visits to Teat's Hill. The results indicated that there was no significant interaction between the regeneration and visits to Teat's Hill, which suggested that the increase in LS did not vary with visits to the Teat's Hill site. There remains uncertainty as to the mechanisms behind the association between LS and the regeneration. Therefore, the findings should be taken with some caveats and caution. On the one hand, the 'regeneration' variable may be capturing all changes between T1 and T2, not just the intervention at Teat's Hill. Alternatively, the variable may be capturing the effect of the intervention. Although this cannot be tested within this research, a number of suggestions are provided in terms of why the association between LS and the regeneration may have arisen.

8.2.1. Potential reasons for a beneficial effect of the intervention on LS

8.2.1.1. Design of the site

Environmental spaces have been described as the geographical contexts of interaction between people and nature (e.g. beaches, seascapes, gardens and parks), localities, landscapes and seascapes in which people interact with each other and the natural environment. The Teat's Hill intervention, composed of a bundle of goods, was delivered to improve the environmental space and afford a range of behaviours.

Teat's Hill was designed by the BlueHealth project (Grellier *et al.*, 2017). This design was based on discussions with stakeholders and local residents. Collaboration and consultation with stakeholders and local residents between 2017 and 2018 allowed their needs to be discussed and their feedback to be incorporated into the designs. Consultation was central to the design as it has been suggested that community co-design of interventions may produce more beneficial outcomes (Roberts *et al.* 2016).

The final design was also based on the application of affordance theory, which helped to create a design for the intervention that would encourage use of the site. Previous research has argued that benefits may not occur simply as a result of simply providing a space. Instead, benefits are more likely to be brought about by the space's functionality and affordance of activities (Lee *et al.*, 2015; Roberts *et al.*, 2016). Affordances are the properties of the environment that have functional significance for an individual (Gibson, 2014). An affordance of an environment offers possibilities for different kinds of activities, experiences and actions and may play a role in promoting well-being (Grahn *et al.*, 2010; Heras-Escribano and de Pinedo-García, 2018). For example, in the case of blue space, wider views of waterbodies with spacious and natural characteristics, the presence of bank vegetation, moist atmosphere,

rich and diverse wildlife and non-visual sensory stimulation may afford positive perceptions and create fascination (Völker and Kistemann, 2011, 2015). This notion has also been considered in the ES literature (e.g. Chan *et al.*, 2011; Fish *et al.*, 2016). The non-market good and their related functional and cognitive affordances are detailed in Table 8.1.

Table 8.1: Overview of the goods provided by the coastal regeneration and examples of behaviours they afford (functional and cognitive).

Goods provided as part of the bundle	**Example of functional and cognitive affordances**
Open air theatre (circular floor/stage, wall, hard stepped seating, grass area on slope for seating)	The circular floor/stage (or "orchestra" in ancient Greek theatre terms) allows people to gather, stand, sit, view, engage in social interactions, play with dogs, relax and observe. The flat surface allows wheelchair users to sit and observe and stay close to the water. The wall around the stage allows people to lean-on to and sit on it. Seating areas (i.e. hard and soft) allow people to sit and lounge freely, sunbathe, view, exercise, read and sit to eat and drink.
Slipway resurfacing improvement	To improve perceived physical safety and allow people to go closer to the water.
Vegetation clearance (along the edge and face of the cliff)	To open up views, increase visibility and improve perceived safety and place attractiveness.
Children's play area improvement (new play surface, sand pit, new play units)	To increase place attractiveness, safety and encourage play activity.
Installation of information boards	To enhance knowledge about the biodiversity, environmental quality of the site and history of the area, in addition to activities and project related information.

Installation of gates	To improve pedestrian accessibility, prevent parking (negative affordance), facilitate easy access to children's play area and prevent dogs accessing the area (negative affordance).

Visiting Teat's Hill was itself not a significant mediator of the relationship between LS and regeneration. But it could be hypothesised that both visitors and non-visitors may have benefited from the design of the site implemented through the regeneration. Visitors may have benefited from the intervention as it optimised the space to encourage use. For example, the design may have enabled or increased local resident's ability to engage in specific activities, actions or cultural practice. In addition to this, the design involved upgrading existing infrastructure and also adding new equipment at Teat's Hill. Findings from the systematic review by Roberts *et al.* (2016) suggest that upgrading existing infrastructure as well as providing new equipment may provide more benefits than adding new equipment alone.

Non-visitors may have also received benefits from the improvements to the site. For example, respondents may not have visited Teat's Hill over the 4 week period, but instead walked past the site or observed the site from their window. Therefore, people may have felt an increase in their LS as a result of being able to see the improvements to the site. Non-visitors may also have improved well-being, through non-use value, discussed in Chapter 4 (section 4.3). The capacity of LS to capture non-use values is still open to debate, but it could be theorised that knowing the site had been regenerated may have improved their LS. They could have found about the improvements to the site through discussions with friends and family (i.e. social interaction) or exposure to local newspaper articles about Teat's Hill (e.g. Plymouth Herald, 2018). This has

been described as vicarious experience. They may therefore gain well-being from the knowledge that Teat's Hill has been improved (existence value) or that other individuals now and in the future can visit a higher quality environment (altruistic and bequest value).

8.2.1.2. Provision of specific goods

The increase in well-being may be the result of a specific good or bundle of goods provided as part of the intervention. Few studies have examined the component parts of interventions and linked them to well-being outcomes. But an applicable example is Panter and Ogilvie (2015) who used a natural experiment and factor analysis to observe the mechanisms for changes in walking and cycling behaviour in local communities, following an intervention which improved routes. They found that improvements in access to walking and cycling routes caused the changes to people's walking and cycling behaviour. Pathways related to public perceptions explained only a small proportion of the effects observed.

By combining data from T1 and T2 (n=618), an initial assessment suggests that the most important area of improvement to respondents was environmental quality (n=358, 57.93%), in comparison to access (n=136, 22.01%) and facilities (n=124, 20.06%). It is beyond the scope of this thesis, however, to explore this further. But, it may indicate that environmental quality may have had a part to play for a number of respondents. As discussed in Chapter 6, previous research has shown that such changes to environmental quality can influence people's *ex-ante* well-being. For example, people are willing to pay for reductions in litter on beaches (Brouwer *et al.*, 2017). In addition (as discussed in Chapter 7), previous experiential research using different well-being measures has

indicated that litter can affect people's experienced well-being (Pretty *et al.*, 2005; Wyles *et al.*, 2016; White *et al.*, 2017). For example, the presence of public litter on beaches in the UK is associated with increased negative affect, including feelings of sadness and anger (Wyles *et al.*, 2016).

Alternatively for other respondents, it may be as a result of improvements to facilities or access. The intervention increased access to the coast for recreation (e.g. through improvements to pathways) and made improvements to facilities (e.g. seating, play area and information boards). As discussed in Chapter 6, substantial CVM research has indicated that people have preferences for improvements to public access through increased beach access points and parking (e.g. Oh *et al.*, 2008; Whitehead *et al.*, 2008) and coastal trail improvements (e.g. McGonagle and Swallow, 2005; Barry *et al*., 2011). There is limited research exploring LS and improvements to green or blue space infrastructure. However, previous research in Hong Kong (China) has shown that people's perception of facilities predicted how often people used them (Garrett *et al.*, 2018).

8.2.1.3. Coastal nature of the site

Previous research has not observed improvements in LS following green space interventions (e.g. Ward Thompson *et al.*, 2019; discussed in Chapter 7). However, this study involves an intervention at a coastal site, with blue and green space features. The observed increase in LS may have occurred or been augmented because the intervention was undertaken at a coastal site with access to a beach.

A decade of research suggests that people like to be near blue landscapes (White *et al.*, 2013, 2014, 2017) and they are willing to pay for access to high

quality marine and coastal spaces (Fletcher *et al.*, 2014; Torres and Hanley, 2016). Furthermore, coastal environments have been shown to have a number of benefits, relative to other natural environments (e.g. urban green spaces and woodlands). First, coastal visits are made by all sections of society in England. For example, Elliott *et al.* (2018) found that coastal visits, particularly to beaches, were more uniformly distributed across socio-economic classifications in comparison to other blue spaces (e.g. canals and lakes) and green spaces (e.g. woodlands and forests). They suggested that equitable use of coastal environments may assist in relieving some of the socioeconomic-related health inequalities which have previously been associated with natural environment access.

Second, visits to coastal environments tend to involve higher energy expenditure in comparison to visits to countryside and urban green space environments, due to their relatively long duration (Elliott *et al.* 2015). Third, visits to coastal environments are associated with better mental health (e.g. (MacKerron and Mourato, 2013; White *et al.*, 2013). For example, MacKerron and Mourato (2013) showed that people are happiest when they visit marine and coastal margins, in comparison to other types of blue (e.g. wetlands and freshwater) and green spaces (e.g. woodlands, grasslands and moors). Finally, more social and family activities are observed in coastal environments, respective to other environments (Elliott *et al.* 2018).

8.2.1.4. Public engagement

The engagement with local residents may also be another reason specifically for the potential improvement in LS. Between 2017 and 2018, there were a series of public engagement events. The intervention as a whole was designed

in collaboration with the local residents and they were engaged frequently in summer 2017. Designs and ideas for the site were discussed during these on-site engagement events (see Appendix BB). There were also additional nature based and recreational events and workshops at Teat's Hill for families, co-ordinated by various stakeholders including Plymouth City Council and the National Marine Aquarium. Examples of events and volunteering activities undertaken at Teat's Hill in 2018 are shown in Appendix CC. Public engagement was not included as an explanatory variable within the regression analyses, as no such variable was included in the survey. But, public engagement may be a causal mechanism, acting as a behavioural or social intervention.

It is difficult to disentangle the effects of the community engagement and the physical regeneration components (Slater *et al.*, 2016). It can be an issue to attribute outcomes to an environmental intervention when community involvement interventions run alongside (National Institute for Health and Care Excellence, 2018). The positive association between the regeneration and LS at Teat's Hill may therefore be a result of the combined effect of the physical improvements and community involvement during the project. This has been discussed previously in the case of parks and physical activity. It has been acknowledged that simply changing the build environment in disadvantaged neighbourhoods may be insufficient to bring about the beneficial effects of the natural environment and may require complementary community involvement (Broyles *et al.*, 2011; Derose *et al.*, 2014; Franzini *et al.*, 2010; Slater *et al.*, 2016).

An alternative explanation is that the behavioural intervention was the main reason for the association between LS and the regeneration, rather than the physical improvements itself. Teat's Hill had been described as "the forgotten corner of Plymouth" by local residents (Plymouth Herald, 2017b). It could be proposed that increased engagement with the community about Teat's Hill (e.g. through behavioural interventions) and recognition of the importance of the site may have resulted in an effect, rather than the intervention itself. Previous research has suggested that community engagement may have a number of benefits. For example, Attree *et al.* (2011) identified that individuals may gain perceived benefits from community engagement, including benefits for their physical and psychological health, self-confidence, self-esteem, sense of personal empowerment and social relationships.

8.2.2. External influences

In addition to the factors discussed above, there may be a number of external factors which the effects may instead be attributed to. First, as discussed, a number of variables were controlled for in the adjusted models. But, there may have been unobserved factors that the study has not controlled for, due to the selection-on-observables assumption. Therefore, it cannot be ruled out that the study excluded variables important to the LS of the 'pre' (T1) group but not for 'post' (T2) group.

Second, the results may have been influenced by the 'Hawthorne effect'. The Hawthorne effect (Parsons, 1974; Wickstrom and Bendix, 2000) is a widely acknowledge research phenomenon which concerns research participation, the consequent awareness of being studied, and the tendency for respondents to modify their behaviour (McCambridge *et al.*, 2014; Payne and Payne, 2004).

The Hawthorne effect has been discussed previously for experiential methods. For example, it has been suggested that respondents may report increased well-being because they are aware of their involvement in a study, regardless of any effect (Clark *et al.*, 2014). In the case of Teat's Hill individuals may have over reported their LS in the T2 survey, because they know the study was looking at the effect of the regeneration. The LS measure is meant to involve an independent assessment of their life. However, the process of being interviewed (e.g. interaction with interviewer or survey content) may have brought about a higher reported LS value. The potential influence of question order (as a limitation) was discussed in Chapter 7 (section 7.7).

The Hawthorne effect has been discussed in the context of preference-based methods (Mitchell and Carson, 1986; Shogren, 2005). This may be relevant because the CVM was included before the LSA in the survey. Mitchell and Carson (1986) developed a CVM survey to value drinking water risk reductions and undertook qualitative pre-testing (focus groups and interviews). Pre-testing suggested that respondents perceived that interviewers wanted high values for the good in question and they attributed this finding to the Hawthorne effect or a variant of this effect. The nature of the CVM valuation process could lead respondents to assume that the good in question is important because "such an elaborate effort is being made to measure their views about it" (Mitchell and Carson, 1986, p17).

8.3. Research question 4: How similar are the values estimated for the intervention elicited by the two methods?

It is important to ascertain whether a valuation based on decision utility and experienced utility converge for the same environmental good. The CVM study

estimated that WTP for the regeneration was on average £7.97 per household as a one off payment (Chapter 6). The LSA study identified that there was an increase in LS of 3.89% (+0.389 units) and this corresponded to a WTP ($WTP_{\Delta q}$) of £1,925.45 per average household per year. Therefore, in the context of the regeneration, the study finds that there is a large difference between the value estimates provided by the two methods. WTP estimates from the LSA are significantly higher than estimates from the CVM.

The findings present a challenge for interpretation and the use of the evidence in policy-making and planning. The two methods produce vastly different estimates for the regeneration and the values cannot be used as a range value (from i.e. £7.97 to £1,925.45). Furthermore from this research, it cannot be inferred as to which method if any best elicits a person's value or well-being for an environmental good. As discussed in Chapter 4, each method has its own unique strengths, weaknesses and applications. Therefore, it can be questioned as to which figure should be used in CBA and by policy-makers (e.g. local authorities) and planners. This issue has been acknowledged previously by Fields in Trust (2018) in the context of urban parks and green spaces. This challenge and issue of interpretation and application cannot be resolved using this empirical research. However, it presents an area for debate and future research.

8.3.1. Potential reasons for the differences in the estimates

There may be a number of theoretical reasons for the differences in the values from the two methods. Previous researchers have presented CVM values as an underestimate and those from the LSA as an overestimate (e.g. Fields in Trust,

2018). Although testing these hypotheses is outside of the scope of the thesis, the most common hypotheses are discussed below.

8.3.1.1. Affective forecasting

First, it has been previously argued that the deviation between valuation estimates from the CVM and LSA may arise because of failures in affective forecasting. This involves estimating the utility consequences of one's choices (Welsch and Ferreira, 2014). Failures in affective forecasting occur when individuals mispredict their future feelings and are mistaken in their desires about what makes them happy (Loewenstein and Frederick, 1997, Dolan, 2014, Kahneman and Thaler, 2006; Stutzer and Frey, 2008). It has been argued that this occurs particularly for complex policy areas such as the environment (Loewenstein and Adler, 1995; OECD, 2018; Wilson and Gilbert, 2003).

During the CVM process, respondents were asked to state their preferences in the form of WTP for the hypothetical provision of the bundle of goods provided by the Teat's Hill regeneration. This involves forecasting the utility that they will receive in the future (Loewenstein *et al.*, 2003) and is facilitated by rationality assumptions (discussed in Chapter 2, section 2.3). However, it may be contended that if people are unable to make accurate predictions of the hedonic consequences of their (hypothetical) choice (i.e. knowing what is good for them), it cannot be assumed that their choices maximise their utility (Loewenstein and Frederick 1997). This may lead to suboptimal preferences (Dolan and Kahneman, 2008) and responses that are systematically biased forecasts of experienced utility (inaccurate affecting forecasting; Kahneman and Sugden, 2005; Luechinger and Raschky, 2009).

This may have led to an undervaluation of the new site, whereby respondents were willing to pay too little for the coastal regeneration (*ex-ante*), which eventually provided greater improvements to well-being than they anticipated (Fujiwara and Dolan, 2016). Previous studies have suggested that individuals may underestimate the hedonic impact of future events (e.g. Andrade and Van Boven, 2010; Buechel *et al*., 2016) and it has been argued that this has serious implications for the CVM (Dolan and Kahneman, 2008; Kahneman and Sugden, 2005).

From this study it is difficult to infer the causal mechanisms behind affective forecasting findings; however, suggestions have been put forward elsewhere. Underestimation of well-being may occur if people mispredict the intensity or duration of the effect of goods (Wilson and Gilbert 2005). Although in a different context and using different methods, affective forecasting has been discussed for natural environments. Nisbet and Zelenski (2011) asked participants to forecast their anticipated affect (positive affect) of walking in a natural environment and then rate the positive affect that they experienced after this walk. The results suggested that people underestimated the hedonic benefits of being outdoors walking, i.e. they did not fully anticipate the well-being benefits derived from this experience.

It is not possible, however, to accurately assess whether affective forecasting may have occurred in the current research. Previous studies assessing affective forecasting have generally asked respondents to predict how happy they would be after a specific event has happened (e.g. winning a prize) and they are then asked to state their happiness once that event has occurred. They are comparing forecasted and experienced well-being (or emotional impact) using

one method, which involves the same specific question. In the case of this study, the methods do represent an *ex-ante vs. ex-post* comparison, however, it is argued here that estimates from the CVM and LSA cannot be compared in the same vein, as they measure different concepts, using dissimilar questions (see section 8.4).

8.3.1.2. Loss aversion

Previous studies have attributed differences to loss aversion during *ex-ante* assessments. Loss aversion is a phenomenon in which individuals consider the disutility of giving up an object to be greater than the utility associated with acquiring it (Kahneman *et al.*, 1991; Kahneman and Tversky, 1979). Using the framework of prospect theory, it is suggested that a utility function is steeper for losses than it is for gains (Kahneman and Tversky, 1979; Zank and Schmidt, 2005). WTP is the loss of income which, after the increase in the provision of an environmental good, would hypothetically return the individual to his initial lower utility level. Therefore during the CVM elicitation process, respondents may state a WTP value that is below the actual value they place on the good and may not correspond with an individual's psychological responses to the project itself, due to thoughts related to loss aversion (Bateman *et al.*, 1997, 2005).

Based on the above, it could be theorised that respondents may recognise the benefits that they may derive from an intervention at Teat's Hill, but they may not be willing to sacrifice a large proportion of their disposable income for it, as it might be higher than their unanticipated consumption budget. Individuals may not have anticipated this expenditure when organising, evaluating and keeping track of their financial activities, known as mental accounting (Thaler, 1999). Therefore, individuals may be more motivated to avoid losing their income (i.e.

by not contributing to the Teat's Hill regeneration project), than they are to gain a benefit (gain) from the resulting intervention. This may have resulted in lower WTP statements for this good. Dolan and Metcalfe (2008) attributed differences between the CVM and LSA estimates to loss aversion in the context of urban regeneration. But, it is argued that this cannot be concluded from this research. The study is unable to infer whether the WTP estimates derived from the CVM are underestimates. It can only be confirmed that the CVM value estimates are lower than the value estimates from the LSA.

8.3.1.3. Time frame for the estimates (payment period)

Differences between the CVM and LSA estimates may also be due to the effects of the time period over which value is assessed for the two methods. As part of the CVM, there is a stated time period for WTP; in this case in the form of a one-off payment to the Plymouth Park's Foundation. As an indirect valuation method, the time frame for the LSA is more complex to estimate. As discussed in Chapter 4 (section 4.3), there appears to be inconsistency in the use of time period for well-being quoted in LSA studies.

The evaluative SWB question selected for this study asks "Firstly, all things considered, how satisfied are you with your life as a whole nowadays?" Based on Fujiwara and Campbell (2011) and previous studies using similar measures (e.g. Fields in Trust, 2018; Maccagnan *et al.*, 2019), the time period ascribed to the LSA WTP measure was "per annum" due to the choice of income question. Therefore, there is a difference in the time period for the two methods and the effect of this difference is unknown. This lack of understanding and inconsistency in the time period for LSA estimates highlights an area for further investigation, as time frame is crucial if estimates from the two methods are to

be used together in CBA and welfare appraisal. This will be important for their continued use as methods for valuing non-market goods and associated changes in well-being (HM Treasury, 2018).

8.3.1.4. Context effects

A further reason for the dissimilarity between the estimates from the two methods may be due to issues of validity and reliability, for example resulting from context effects. As discussed in Chapter 4 (section 4.6), the methods are affected by various context effects related to psychological factor issues and scale-response issues, some of which are shared by both methods. These effects may affect the validity and reliability of estimates from the respective methods. Here, I discuss two particular context effects which may have resulted in this disparity, drawing on insights from Chapter 4.

First, the LSA estimates may have been influenced by priming effects (section 4.6). High LS reports and subsequent WTP estimates from the LSA have previously been attributed to priming effects (e.g. OECD, 2013; Bakhshi *et al.*, 2015). Priming effects occur when the survey context influences how questions are understood and/or increases the accessibility of information to respondents. In the case of this study, questions about Teat's Hill and the CVM scenario were presented in sections ahead of the LS question (see Chapter 5; section 5.6). This may have raised the accessibility of information and reminded individuals about Teat's Hill, which may have boosted the resulting report of LS. This effect may be particularly the case for the post-assessment (T2), which talked about the improvements made to Teat's Hill in 2018 and asked them to answer a series of question before asking for a report of LS. This may have resulted in a higher average estimate of LS in the T2 survey respective to the T1 survey.

Thinking about the improvements made to Teat's Hill in 2019 have resulted in higher LS, leading to a higher coefficient for the regeneration and an increased valuation of the regeneration from the LSA.

This is in line with conclusions made by Bakhshi *et al.* (2015). They valued the Natural History Museum and Tate Liverpool using both the CVM and LSA. They identified that there was a significant positive association between LS and visits to the Natural History Museum after controlling for a range of variables. They hypothesised that the high coefficient may resulted from reminding respondents about the Natural History Museum during the survey, which may have enlarged their LS disproportionately. However, these conclusions contrast to those from other researchers, who perceive that there is lower (OECD, 2018) or no possibility (Fujiwara and Dolan, 2016) of priming effects as WTP is not elicited directly. This empirical research cannot confirm or refute the influence of priming effects, which indicates the need for future research.

Another context effect that may have contributed to the disparity is strategic bias (Mitchell and Carson, 1989; Samuelson, 1954; Venkatachalam, 2004). As discussed in Chapter 4 (section 4.6), this bias may affect the CVM, but not the LSA (Fujiwara and Dolan, 2016; OECD, 2018). Although, it cannot be confirmed that the value is an underestimate, a lower mean WTP for the CVM may have been derived if respondents thought that they could freeride on other people's payments ('freeriding behaviour'). In other words, respondents may have stated a lower WTP than the good was worth to them in the expectation that others will pay enough to provide it nevertheless (Mitchell and Carson, 1989). Freeriding behaviour may have been heightened by the CVM scenario, which stated that "the Teat's Hill renovation project would be organised by a

number of institutions. These institutions have all contributed towards the project, however more funding is required to put the plans into action". Respondents may have felt confident that the good would be provided regardless of the amount that they offered and therefore stated that they would contribute less or nothing at all. As highlighted in Chapter 4 (section 4.6), this has been observed previously in a study that also valued coastal goods in the UK and used a similar payment vehicle (i.e. a contribution to a charitable fund; Kenter *et al.*, 2013).

8.3.1.5. Goods presented and experienced

A difference between the goods presented as part of the CVM hypothetical scenario and the bundle of non-market goods (Teat's Hill regeneration) actually experienced by respondents (i.e. the realisation of the project) may also contribute to the disparity between estimates. The CVM survey was designed, pre-tested and implemented ahead of the finalisation of the improvements for the regeneration of Teat's Hill. Therefore, the specific details of the changes or the specific bundle of goods provided by the regeneration project may not have been adequately included in the WTP question (e.g. the creation of the open air theatre was not included in the survey). Consequently respondents may have underestimated the amount that they would have been willing to pay. The WTP may have been higher if detailed information about the regeneration had been available at the time. This was discussed in Dolan and Metcalfe (2008), but has received little attention in research as a reason for the disparity of CVM and LSA value estimates.

In addition to this, the LSA captured both the physical improvements made to the site, in addition the effect of social interactions and engagement activities

associated with the implementation of the intervention. As discussed in section 8.2, there were a series of public engagement events held at Teat's Hill between 2017 and 2018. The engagement with local residents was perceived to be one of the reasons for the observed increase in well-being and the respective monetary value. This contrasts with the CVM, which valued the structural elements of the intervention, i.e. the physical improvements to environmental quality, facilities and access. The CVM scenario did not present social interaction and public engagement as one of the goods within the bundle for the Teat's Hill regeneration project.

8.3.1.6. Conceptual differences

As there are a number of conceptual differences between the methods, it could be argued that the values should not coincide for the same non-market good (Ayton *et al.*, 2007; Welsch and Ferreira, 2014; Fujiwara and Dolan, 2016; Fleming and Ambrey, 2017). There are hypotheses that decision and experienced utility should coincide (Blanchflower and Oswald, 2004a; Diener *et al.,* 2009; Frey *et al.,* 2010). It has been hypothesised that a SWB survey might evidence the degree to which an individual's preferences are satisfied and this has been termed 'preference realization' (Adler, 2013). Therefore, LSA values could be interpreted as WTP figures (Fujiwara and Dolan, 2016). However, the review of literature (Chapter 4) and empirical research (Chapters 6 and 7) cast doubt on the equivalence of decision utility and experienced utility and therefore the need for CVM and LSA value estimates to converge.

As discussed in Chapter 4, the two methods draw upon different perspectives (i.e. *ex-ante vs ex-post*), assess different stages of the DWB model (Dolan and White, 2006) and are based on different characteristics of well-being. The CVM

measures decision utility, the *ex-ante* expectation of experienced utility (i.e. a prospective assessment of well-being). WTP is assessed directly through a survey, in which people are asked to state their preferences for the non-market good in question. The CVM focuses purely on Teat's Hill. In contrast, the LSA measures experienced utility, which is the *ex-post* quality associated with an outcome (i.e. a retrospective assessment). All that is required is that respondents accurately state their level of well-being (OECD, 2018; Stutzer and Frey, 2010; van den Berg and Ferrer-i-Carbonell, 2007). The LSA uses LS as a measure of well-being, which contains information pertaining to the respondent's global evaluation of her or his life (Luechinger 2009). The LS question is not focused on Teat's Hill; instead it considers all aspects of life. A regression model is then used to examine the relationship between the regeneration and LS. Furthermore, the LSA value is not estimated directly, instead using a two-step process, as discussed in Chapter 3 (section 3.5).

This explanation for the divergence in estimates is favoured in this thesis. As stated by Ayton *et al.* (2007) "why should we automatically assume that the utilities one could infer from the choices people make tally with the utility associated with the quality of actual experience of the decision outcomes?" (p63). Therefore, people's utility expected to be obtained from the coastal regeneration may not necessarily need to equate with their experiences of it.

8.3.2. Comparison with previous studies

This study is the first to compare the methods to value a bundle of non-market goods associated with a coastal environment. Consequently, there are no directly comparable studies. Furthermore, it is important to note that the current study used an unbiased coefficient for income from Fujiwara *et al.* (2014) to

enable a valuation of the coastal regeneration. However, it is important to see how the results compare with previous studies in the field. Table 8.2 presents the results from this research and contrasts it with five previous studies comparing the methods in the valuation of education (Dolan and Fujiwara, 2012), art (Del Saz-Salazar *et al.*, 2017), sport (e.g. Humphreys *et al.*, 2017), urban regeneration (Dolan and Metcalfe, 2008) and urban parks and green spaces (Fields in Trust, 2018). Note: Appendix DD displays the LS coefficients for the non-market good in comparator studies.

The current study contrasts with two studies in particular, Del Saz-Salazar *et al.*, (2017), who value an art institution and Dolan and Fujiwara (2012) who value adult learning courses. As shown in Table 8.2, the LSA values were very closely aligned with the CVM values in these two studies. For example, Del Saz-Salazar *et al.* (2017) found that the CVM WTP was between €39.70-48.85 as a one-off payment and this was similar to the LSA value of €18.10-43.41. The respective studies suggest that estimates from a decision utility and experienced utility perspective are reasonably close to one another. They lend support to the 'preference realization' theory discussed earlier (section 8.3; 8.3.1; Blanchflower and Oswald, 2004; Diener *et al.*, 2009; Frey *et al*., 2010).

However, the results from this study are more similar to valuations for non-market goods in a similar policy area and in the UK. These include Dolan and Metcalfe (2008), who valued a site-level non-market good (urban regeneration) using a natural experiment, and Fields in Trust (2018), who valued urban parks and green spaces at a national scale. Analogous results were also observed for a different non-market good associated with Olympic sport medal wins at a national scale (Humphreys *et al.*, 2017).

To further understand why these differences between studies exist, they were each examined (Table 8.3) in terms of their study design (e.g. data collection, sample size, survey mode and whether they derived an estimate of WTP using an IV approach) and survey design (i.e. the selection of LS question). This exercise identified that the studies differ significantly in terms of their characteristics, making comparison between them difficult. Differences were found in terms of the LS measures used, indicating that different well-being constructs were measured that are not necessarily comparable. This study and Fields in Trust (2018) are the only studies which use the same LS measure (The Evaluative Well-being question; Office of National Statistics, 2012; Office of National Statistics, 2011). This highlights the need for best practice guidelines for the LSA if studies are to be compared.

Table 8.2: Comparison of the current study with previous empirical studies which have compared well-being estimates from the CVM and LSA.

Study	Non-market good	Geographical scope	CVM	LSA	
				Non-IV estimate	IV approach estimate
Current study	Coastal regeneration	Site-level (Teat's Hill, UK)	£7.97 (one-off payment)	-	£1,925.45 per household per year[1]
Fields in Trust (2018)	Urban parks and green spaces	National (UK)	£30.24 per year	£974 a year	N/A
Del Saz-Salazar *et al.* (2017)	Contemporary art archives and Collection	Site-level (Faculty of Fine Arts of the city of Cuenca, Spain)	€39.70-48.85 (one-off payment)[2]	€18.10-43.41[3,4]	N/A
Humphreys *et al.* (2017)	Winter Olympic medal success	National (Canada)	$17-26 per year	$14,094[4]	N/A
Dolan and Fujiwara (2012)	Adult learning courses	National (UK)	£1,070 per year	N/A	£1,584 per year
Dolan and Metcalfe (2008)	Urban regeneration	Site-level (Hafod, UK)	£228-£245 per year	£19,000 per year	£6,400 per year

[1] Note: the current study borrowed an unbiased income coefficient from an IV study (Fujiwara *et al.*, 2014).
[2] Dependant on type of statistical model (non-parametric, logit or spike).
[3] Dependent on respondent's answers to specific questions about the non-market good.
[4] No time period (e.g. per year) provided for estimate.

Table 8.3: Evaluation of the characteristics of previous LSA studies, relating to study and survey design.

Finding	Study	Type of data	Survey mode	Sample size (n)	LS question	Use of IV approach
CVM and LSA estimates similar	Del Saz-Salazar *et al.* (2017)	Primary	Face-to-face interviews	400	The Overall Life Satisfaction Question (Bjørnskov, 2010)	No
	Dolan and Fujiwara (2012)	Primary (CVM) Secondary (LSA)	Telephone interviews	CVM (1,001) LSA (21,225)	BHPS question (UK Data Service, 2019)	Yes
CVM and LSA estimates disparate	Current study	Primary	Face-to-face interviews	CVM (314) LSA (667)	The Evaluative Well-being question (Office of National Statistics, 2012; Office of National Statistics, 2011).	No[1]
	Fields in Trust (2018)	Primary	Online survey	4,033	The Evaluative Well-being question (Office of National Statistics, 2012; Office of National Statistics, 2011).	No
	Humphreys *et al.* (2017)	Primary	Not stated	2,090	"All things considered, on a scale of 1 to 10, with 1 being not satisfied at all and 10 being very satisfied, how satisfied are you with your life as a whole these days?	No
	Dolan and Metcalfe (2008)	Primary	Postal surveys	364	"Thinking about your own life and personal circumstances, how satisfied are you with your life as a whole?" (International Wellbeing Group, 2006).	Yes

[1] Note: the current study borrowed an unbiased income coefficient from an IV study (Fujiwara *et al.*, 2014).

8.4. Research question 5: To what extent are the two methods commensurable or complimentary?

This research question is addressed by drawing on the theoretical evidence (reviewed in Chapter 4) and empirical evidence (Chapters 5-7), from the valuation case study in Plymouth, UK. The first subsection focuses on commensurability (section 8.4.1) and the second focuses on complementarity (section 8.4.2.)

8.4.1. Commensurability

Commensurability refers to a situation in which there is a common measure through which the value of two entities can be compared. Taken together, the findings suggest that the conceptual differences between the two methods meant that they are incommensurable. As discussed, the methods both produce estimates of WTP for an environmental good. However, they draw upon different conceptualisations of utility (decision *vs*. experienced utility) and perspectives (i.e. *ex-ante* vs *ex-post*). Estimates from the LSA refer to the "extra money which would in the long run secure for the average person an extra util of happiness" (Layard, 2006, p. C33), whereas the CVM-based WTP is the maximum amount of money an individual is willing to give up *ex-ante* to obtain an environmental good. This suggests that the two methods should not be expected to produce similar value estimates. As discussed in section 8.3, the conceptual differences between the methods are thought to be the largest contributing factor to the disparity between the estimates for the valuation of Teat's Hill. To formally verify this, however, more research is required (see Chapter 9, section 9.6).

This thesis contributes to the literature that casts doubt on the commensurability of the methods (Ayton *et al.*, 2007; Bakhshi *et al.*, 2015; Fleming, C. and Ambrey, 2017; Fujiwara and Dolan, 2016; Welsch and Ferreira, 2014). The methods use substantively different approaches to valuing marine and coastal goods, hence the value estimates have different meanings. Consequently, values based on preferences from the CVM should not be equated with estimates based on experiences from the LSA and it should not be expected that they give the same valuation results for the same good. This stance is contrast with other researchers (e.g. Blanchflower and Oswald, 2004a; Diener *et al.*, 2009; Frey *et al.*, 2010), who support the preference realization hypothesis (see section 8.3).

8.4.2. Complementarity

While the CVM and LSA may not be commensurable as operationalised here, it is perceived that the methods may have complementarity. Complementarity refers to the situation in which results may differ but together they generate insights (Brannen, 2005). The benefits of complementarity between methods have been acknowledged previously in general (Greene *et al.*, 1989), but also for the valuation of ES from marine and coastal environments (Hattam *et al.*, 2015). Greene *et al.* (1989) highlighted that assessments of complementarity involve “elaboration, enhancement, illustration and clarification of the results from one method with the results from another” and this can “increase the interpretability, meaningfulness and validity of the constructs” (p259).

The LSA has been put forward as a complement to the CVM previously (Humphreys *et al.*, 2017; OECD, 2018). The methods draw on different perspectives, but may reveal information that would not have been uncovered if

using only one method. However, there is acknowledgement that the LSA may only act as a complementary method when it is more established (Del Saz-Salazar *et al.*, 2017; HM Treasury, 2018). There are no best practice guidelines and there are a number of challenges to its future use (e.g. evidence gaps; discussed in Chapter 4). Therefore future complementarity may be based on the premise that research gaps are addressed and best practice guidelines are developed for the LSA.

8.4.2.1. Valuation of interventions

As highlighted in section 8.3, the two methods produce vastly different value estimates for the regeneration at Teat's Hill. Although, the results differ, together they may help to provide an enhanced, elaborated understanding of the values of non-market environmental goods in general and more specifically those derived from a specific site-based intervention. In this empirical study, the interviews enabled local residents to comment on their preferences for and experiences of Teat's Hill. This can help to provide a more rounded picture of the importance and relevance of the changes made as part of the project (Grellier *et al.*, 2017). Further, a values-based appreciation focusing on people's relationship with the natural environment may build public support, help gather local knowledge (Walker-Springett *et al.*, 2016) and increase social equity (Palmer Fry *et al.*, 2017; Torres *et al.*, 2017). Overall, this helped to ensure that the research was more accurate, drawing upon local knowledge, and that the intervention fitted with local values (as discussed in Walker-Springett *et al.*, 2016).

These findings have implications for future research. Analogous to this study, forthcoming research could integrate the methods into a natural experiment with

a repeat cross-sectional or longitudinal study, providing an *ex-ante* and *ex-post* value of an intervention. In this scenario, the CVM could be used to provide information intended to contribute to discussions and demonstrate interest in an intervention or different policy options prior to implementation. The CVM can be useful for assessing ex-*ante* value and in a scoping capacity, providing an understanding of public perceptions and support for a future intervention or policy decision. Therefore, it can help to take account of local perspectives prior to implementation, enhancing local relevance and social equity (Palmer Fry *et al.*, 2017; Torres *et al.*, 2017).

The LSA expresses benefits in monetary units and therefore provides an *ex-post* assessment. This can help to deliver valuable information about how the intervention affected the experience of people's lives (Fujiwara and Dolan, 2016). It could be used within the pre-post design or used for monitoring the long-term well-being effect of an intervention. For example, the LSA may be useful for monitoring and valuing the long-term well-being effect of physical improvements to a site (e.g. those which improve access to nature; coast paths and parks) or the influence of conservation or policy interventions (e.g. the designation of coastal Marine Protected Areas). This may be particularly applicable when it is hard to image changes in state in advance.

8.4.2.2. Convergent validity

The potential for the methods to be used for convergent validity was considered as part of the thesis. The importance of assessing convergent validity was highlighted in Chapter 4 (subsection 4.4.2). Best practice guidelines (Bateman *et al.*, 2002; Johnston *et al.*, 2017) suggest that estimates from the CVM should be compared with results obtained from other methods. Multiple studies have

investigated the convergence of value estimates for environmental goods from the CVM and (i) Discrete Choice Experiments (DCE; e.g. Hanley *et al*., 1998; Cameron *et al.*, 2002; Adamowicz *et al.*, 2006), (ii) Travel Cost Method (TCM; e.g. Carson *et al.*, 1996; Rolfe and Dyack, 2010) and Hedonic Pricing Method (HPM; e.g. Brookshire *et al.*, 1982; Mayor *et al*., 2007).

Previous researchers (Humphreys *et al.*, 2017; van den Berg and Ferrer-i-Carbonell, 2007) have suggested that the LSA could be offered as an alternative method for testing and validating CVM results, i.e. assessing the convergent validity of estimates. For example, Humphreys *et al* (2017) tested for convergent validity by comparing the magnitudes and correlation between WTP estimates and LS reports for individual respondents. However, the empirical comparison in the present study and review of literature (Chapters 2-4) offer an alternative perspective. The two methods have conceptual differences and it is not expected that they produce the same value estimates. As discussed in section 8.3, the value estimates for the coastal regeneration are different by three orders of magnitude. Therefore, it is perceived that this function and act of complementarity cannot be fulfilled.

8.4.2.3. Individual applications

The methods may also be applied independently, due to their conceptual differences. One key area is in the valuation of ES. As discussed in Chapter 1, the ES approach to decision-making highlights the importance of ES to human well-being (Millennium Ecosystem Assessment 2005; TEEB, 2010; UK National Ecosystem Assessment, 2011, 2014). However, the verification, valuation and significance of the link remains a problem and this has led to a paucity of research in this area (Busch *et al.*, 2011). The potential applications of the

individual methods are discussed below. However, it is noted that future researchers should be cognizant of the strengths and weaknesses of the two methods, prior to application (see Chapter 4; Table 4.3).

There has been growing application of the LSA to value non-market environmental goods, but there has been little acknowledgement of this approach in the ES literature (see Chapter 3; section 3.6). If research gaps are addressed and best practice guidelines are developed, the LSA may also be used as a valuation method in ES assessments, offering an alternative to existing methods acknowledged by ES initiatives (Millennium Ecosystem Assessment, 2005; TEEB, 2010; UK National Ecosystem Assessment, 2011, 2014).

The LSA could also be used to value ES across large areas (e.g. regions and countries) with heterogeneity for these goods, described as a quantitative-spatial approach. Multiple ES could be valued over large geographic scales (regional, national or international scale). Various examples of this valuation approach are shown in Chapter 3 (section 3.6). This may help to understand the costs and benefits of environmental policies (e.g. land use, biodiversity and pollution) affecting ES (e.g. Kopmann and Rehdanz, 2013) or provide evidence on the effect of ES loss on well-being. The method has predominantly been applied to regulating and provisioning services, but there may also be opportunity to apply the method more extensively to value changes in cultural ES (e.g. recreation, scenic amenity and ecotourism; Jarvis *et al*., 2017).

The CVM has been widely applied to value changes to ES, using hypothetical or prospective scenarios, corresponding with policy and conservation interventions. In particular, it has been used to provide site-specific valuations,

considering values for single ES and can be undertaken as a snapshot. In line with prior application, it is perceived that the CVM, may be useful as an 'informative' and 'decisive' ES valuation tool for decision-making (Billé *et al.*, 2012). Estimates from the CVM have not been linked to the concept of well-being in the ES field. As discussed, the CVM can be used to value changes in environmental goods that have not yet occurred (i.e. ex-ante valuation; Abdullah et al., 2011) and the preferences elicited may act as an indirect indicator of anticipated affect and satisfaction. Therefore, evidence from the CVM could be used (or re-framed) in alternative way; in terms of providing a valuation of well-being.

As an informative ES valuation tool, the CVM could be used to provide valuation evidence intended to contribute to discussions and demonstrate interest in different policy options ahead of decision-making. This is similar to its role discussed in subsection 8.4.2.1. Besides, it can also be used as a decisive ES valuation tool. The method could contribute to a process in which a given choice is to be made, *ex-ante,* by a decision-maker facing alternatives. As such, value estimates from CVM studies serve as inputs into environmental CBA of specific interventions (Hanley and Barbier, 2009). This would provide an insight into how to best allocate costs for the maximisation of potential well-being benefits (Carson, 2011; Fujiwara and Campbell, 2011).

8.5. Summary

This chapter provided an overall discussion of the empirical results from the CVM (Chapter 6) and LSA (Chapter 7) to address three interrelated research questions (research questions 3, 4 and 5). First, the study assessed the extent to which there was an effect of the coastal intervention on well-being (research

question 3). The findings were indicative of an effect of the coastal intervention and a number of potential mechanisms for this effect were presented (e.g. the design of the intervention, provision of specific goods, the coastal nature of the site and the use of public engagement). However, it was also acknowledged there may be a number of external factors or drivers which the effects may instead be attributed to. Second, the valuation estimates from the methods were compared to establish how similar they were for the coastal intervention (research question 4). There was a large disparity between the value estimates, indicating that preferences and experiences did not coincide for the coastal regeneration. A range of hypotheses were presented, but it was theorised that this may be due to the conceptual differences between the methods. The estimates from the two methods may have different meanings and therefore it was questioned as to whether the values should equate for the coastal intervention. Finally, based on the above-mentioned evidence and the literature review, it was postulated that the methods were incommensurable (research question 5). However, the two methods may be complimentary in specific cases, for example in the valuation of environmental interventions.

9. General discussion

9.1. Chapter overview

This chapter begins by revisiting and summarising the findings of the main chapters in the thesis (section 9.2), in relation to the key research questions. The findings are then drawn together to provide an overall understanding of the insights gained from the thesis. This is discussed in terms of the theoretical implications (contributions to literature; section 9.3) and the wider policy and planning implications of the thesis (section 9.4). This is followed by a discussion of the limitations of the thesis (section 9.5) and a presentation of future priorities for research (section 9.6). The overall conclusions of the thesis are presented in section 9.7.

9.2. Summary of main findings

9.2.1. Research questions 1 and 2

The review of literature (Chapters 2-4) compared and contrasted two exemplar methods for valuing non-market environmental goods within each paradigm: the CVM and the LSA. This was to address:

- **Research questions 1**: How do the methods differ in terms of their theoretical perspective on well-being and their application to marine and coastal environments?
- **Research question 2:** How do the methods compare in terms of their strengths and weaknesses?

Chapter 2 introduced the Contingent Valuation Method (CVM), a frequently used *ex-ante* valuation method. The CVM conceives human well-being in terms

of the satisfaction of personal preferences for environmental goods and assesses social welfare on the basis of individual utility (Wegner and Pascual, 2011). The chapter first outlined the theoretical foundations of preference-based approaches and the range of methods applied. This provided the underlying theory for a discussion of the CVM, in terms of the method's aims, valuation procedure and design features. This was followed by an overview of the previous applications of the method to marine and coastal goods, ES and policy.

Chapter 3 introduced the Life Satisfaction Approach (LSA), an *ex-post* valuation method. The LSA conceives human well-being in terms of the feelings of pleasure and displeasure, happiness and sadness and satisfaction and dissatisfaction that are gained from an individual's act of choice. The chapter first provided an overview of Subjective Well-being (SWB) and its underlying theory (including the dimensions and measures of SWB). This was followed by an overview of the two types of experiential method: (i) SWB method (non-monetary) and (ii) LSA (monetary). The chapter then focused on the LSA, as an exemplar valuation method, providing an overview of how the method works, the degree to which it has been applied in the environmental literature (including marine and coastal examples), in the valuation of ES and the uptake of evidence within policy.

Chapter 4, drawing on this understanding of the two methods, synthesised the evidence and compared and critiqued the CVM and LSA. In relation to research question 1, the findings indicate that the two valuation methods differ in terms of their conception of well-being. The two methods draw upon different perspectives (i.e. *ex-ante* vs *ex-post*) and are based on different

characterisations of utility (decision utility *vs*. experienced utility). Therefore, the values may have different meanings (Fleming and Ambrey, 2017; Welsch and Ferreira, 2014). This highlighted uncertainty as to whether the two methods are commensurable and emphasised this as an area for examination within the thesis (Chapter 8; section 8.4). Furthermore, they differ in the extent of their application to marine and coastal environments. The CVM has been more extensively applied to the valuation of goods from marine and coastal environments than the LSA.

The research also highlighted the relative strengths and weaknesses of the methods in response to research question 2. Strengths and weaknesses were identified in terms of challenges to the underpinning theory, the accuracy of estimates (constructed of validity and reliability) and the influence of context effects. Strengths for the CVM include its frequent application to marine and coastal goods and the established best practice for the method. The weaknesses concern challenges to its underpinning theory, assumptions and the validity of estimates from the method.

The LSA, on the other hand, has less challenge to its underpinning theory and there is a consistent evidence base suggesting that the LS measure exhibits validity and reliability. However, the LSA is a continuously developing method and is not as established in the environmental field, particularly for marine and coastal environments. Best practice has yet to be put forward for the method, leading to differences in how the method is applied in the field (e.g. the type of value that can be captured using the LSA). Additionally, the LSA may encounter statistical issues such as interpersonal comparability and endogeneity. The methods however did share a mutual weakness, namely

context effects (psychological factor issues and scale-response issues). Therefore, researchers should be cognizant of the respective strengths and weaknesses of the methods and provided an insight prior to empirical analysis.

9.2.2. Research questions 3 and 4.

An empirical comparison (Chapters 5-7) of the two methods was undertaken and the evidence was drawn together in Chapter 8, to address the following research questions:

- **Research question 3:** To what extent was there an effect of the coastal intervention on well-being and why?
- **Research question 4:** How similar are the values estimated for the intervention elicited by the two methods?

In 2016, an opportunity to conduct a natural experiment presented itself and served the basis of the current study. The study was made possible by a local coastal regeneration project that occurred during the course of the PhD (Teat's Hill, Plymouth, UK). This enabled an evaluation before (T1) and after (T2) the environmental intervention. A repeat cross-sectional survey approach was adopted to value the implementation of the coastal intervention. This was undertaken using the two different methods: the CVM at T1 and the LSA across T1 and T2. The survey approach gathered the following information, to fulfil requirements for both the valuation methods: (i) people's willingness to pay for the coastal regeneration project, (ii) reported LS and (iii) background information (e.g. age, gender, work status, income). A total of 653 people were interviewed: 314 respondents during the pre-survey (T1) and 339 for the post-survey (T2).

The CVM study (Chapter 6) investigated people's stated preferences for the coastal regeneration. There were two research objectives for the study: (i) to estimate the mean willingness to pay for the coastal regeneration of Teat's Hill and (ii) to ascertain the determinants of WTP, i.e. the variables that affect respondents' WTP statements. The main finding was that the mean WTP for the regeneration was £7.97 per household as a one off payment, based on a sample size of 241 respondents. The findings suggested that the majority of respondents had a preference for and placed a positive value on the coastal regeneration. In the context of well-being, it could be inferred that Plymouth residents anticipate that they will receive utility benefits from the coastal regeneration. An assessment of the determinants of WTP was conducted to explore how WTP varied by different socio-demographic groups, usage, and attitudes towards Teat's Hill and the regeneration. WTP was positively associated with theoretically consistent drivers of WTP. The robustness of these associations was confirmed using multiple imputation and provided additional confidence in the construct validity of the CVM results.

The LSA study (Chapter 7) investigated the links between the regeneration at Teat's Hill and the LS of local residents. This assessment was undertaken using the full sample from the T1 and T2 surveys (n=653). There were also two research specific objectives for this study: (i) to investigate whether there is a significant relationship between the regeneration at Teat's Hill and LS and (ii) to explore the potential to estimate a monetary value using the LSA, thereby enabling a direct comparison with the estimate from the CVM. Analysis of the repeat cross-sectional data found that once potential individual-level and visit-specific confounds (explanatory variables) were controlled for, individuals who were interviewed following the regeneration (T2) had a higher LS than those

who were interviewed before the regeneration (T1). LS was 3.89% higher (+0.389 on a 0-10 scale), in respondents interviewed at T2, respective to those interviewed as part of T1. As for the CVM, the associations identified were checked and identified as being robust through analysis with imputed data.

The chapter also explored the potential for estimating a monetary value using the LSA. This was undertaken by using an unbiased income coefficient from a previous study which used an IV approach (Fujiwara *et al.,* 2014). The analysis suggested that the 3.89% increase in LS (+0.389 on a 0-10 scale), corresponded to a value of £1,925.45 per average household per annum. This indicated that on average, the intervention may be worth £1,925.45 to each household per annum. This represents the amount of money that an average household would be willing, in theory, to give up for the provision of the coastal regeneration (including public engagement) given that utility stays constant. The caveats and caution associated with the findings were also highlighted, due to nature of the intervention and study design.

9.2.2.1. Research question 3: To what extent was there an effect of the coastal intervention on well-being and why?

The empirical findings from the LSA were discussed to provide an assessment of the effect of the coastal regeneration on well-being. LS was 3.89% higher in respondents interviewed at T2, respective to those interviewed as part of T1. The results provided an indication that the bundle of goods provided by the coastal regeneration had an effect on the well-being of local residents. A number of reasons for this findings were suggested, including: the design of the site, the provision of specific goods, the coastal nature of the site and the use of public engagement. However, it was also acknowledged that there may be

external influences, which the findings may be attributed to. The study may have captured and valued a broader range of changes between the T1 and T2 assessment stages, in addition to the intervention. Therefore, it was highlighted that the reasons or factors driving these differences should be the basis of future study, to increase confidence in the findings. Additional research would be required to establish whether such variables can be used to value well-being changes resulting from interventions and to examine alternative specifications for studying the effects of regeneration projects.

9.2.2.2. Research question 4: How similar are the values estimated for the intervention elicited by the two methods?

The findings from the two methods were compared to determine whether they produce similar value estimates for the coastal regeneration. The value estimates from the LSA were significantly higher than estimates from the CVM, indicating that the measures for preferences and experiences did not coincide for this bundle of goods. This corresponds with the findings from a selection of previous studies (e.g. Dolan and Metcalfe, 2008; Humphreys *et al.,* 2017; Fields in Trust, 2018). A range of hypotheses were presented for the differences, which included: (i) affective forecasting, (ii) loss aversion, (iii) the time frame for the estimates, (iv) context effects, (v) differences between the goods presented and experienced and (vi) the conceptual differences between the methods. Out of these hypotheses, it was theorised that the most likely reason is the conceptual differences between the methods. This adds further weight to the findings in response to research question 1. The estimates from the two methods may have different meanings and questioned the commensurability of

the methods (i.e. whether the values should equate for the coastal regeneration; see 9.2.3).

9.2.3. Research question 5: To what extent are the two methods commensurable or complimentary?

Evidence from Chapters 2-8 was combined to assess the extent to which the two methods are commensurable or complimentary (research question 5). It is concluded that the methods were incommensurable, due to their conceptual differences. However, the two methods may be considered complimentary in specific cases, for example, in the valuation of interventions. In the case of Teat's Hill, the methods helped to provide an enhanced, elaborated understanding of the values of derived from a specific site-based intervention. The research also identifies that there are cases where they should be used independently, for example, in the valuation of changes to marine and coastal ES.

9.3. Contributions to the literature

9.3.1. Comparison of the two methods

This thesis offers novel contributions to the evidence base, as the methods are compared theoretically and empirically in the context of marine and coastal goods. The review brought together research from the generic and environmental literature base on well-being and used standard nomenclature to compare the two methods. The review presented an alternative insight into the validity and reliability issues faced by the two methods. The experiential approach to well-being is often promoted due to concern over the instability of preferences and the influence of context effects on the CVM (e.g. Smith et al.,

2008; Sugden, 2005). However, in contrast with previous reviews (Fujiwara and Campbell, 2011; Fujiwara and Dolan, 2016; Fleming and Ambrey, 2017; OECD, 2018), the outcome of this synthesis suggests that the two methods potentially experience similar context effects during the survey process. Consequently, they may face comparable validity and reliability issues.

The research also highlighted that the two methods have conceptual differences and have differing levels of application to the marine and coastal environments. From this, the key strengths and weaknesses of the two methods for the valuation of marine and coastal goods were ascertained. There is an extensive theoretical evidence base, which has discussed the two paradigms of well-being, i.e. decision utility and experienced utility (e.g. Kahneman *et al.,* 1997; Kahneman and Sugden, 2005; Loewenstein and Ubel, 2008; Robson and Samuelson, 2011; Berridge and O'Doherty, 2014; Oliver, 2016). In addition, reviews have compared and contrasted the exemplar methods: the CVM and LSA in the valuation of non-market goods (e.g. Fujiwara and Campbell, 2011), including environmental goods (Frey *et al.,* 2010; MacKerron, 2012; Fleming and Ambrey, 2017; OECD, 2018). But, to the best of the authors knowledge, an in-depth, comparison of the two methods in a marine and coastal context has yet to be put forward.

Further, the empirical comparison of the methods was applied to the valuation of the coastal regeneration. This research contributes to the empirical evidence base that compares the two methods. These findings appeared to coincide with analogous comparison studies valuing similar non-market goods (Dolan and Metcalfe, 2008; Fields in Trust, 2018), which also find that value estimates from the LSA significantly exceeded valuations derived from the CVM.

9.3.2. Evaluating the effect of environmental interventions

There is a growing body of evidence regarding the effectiveness of specific natural environment related interventions (National Institute for Health and Care Excellence, 2018; World Health Organisation Europe, 2017). But, there are still a number of evidence gaps. The majority of studies evaluating interventions (including those with blue space components) have focused on environmental benefits (e.g. conservation of biodiversity) or outcomes such as physical activity (e.g. Tester and Baker, 2009; Veitch *et al.*, 2012; Cohen *et al.*, 2015; Slater *et al.*, 2016).

The research used a repeat-cross sectional study design to evaluate the effect of the intervention on LS. This research contributes to the evidence base which investigates the effectiveness of interventions on well-being grounds. There has been limited implementation and/or reporting of research which examines well-being as an outcome for environmental interventions (Maxwell and Lovell, 2017; World Health Organisation Europe, 2017). Two peer-reviewed examples exist and they examine the influence of interventions in woodlands (Ward Thompson *et al.*, 2019) and urban green spaces (Anderson *et al.*, 2017). It therefore builds on a novel area of research and compliments the evidence base using other health outcomes. Overall, this information might be useful for many disciplines that have an interest in modifying open space to improve health, including public health professionals and urban planners (Roberts *et al.*, 2016).

Due to the study design, it is not possible to make clear causal inferences. Nonetheless, the results may provide an initial indication of the beneficial effects of the coastal intervention on some local residents. This contributes to growing acknowledgement that coastal environments may have important, specific

properties in terms of the benefits they might convey for well-being and therefore public health (Gascon *et al.*, 2017; White *et al.*, 2017). A deeper understanding of well-being benefits from interventions is important, as interventions may have beneficial effects even in the face of environmental change on the coast. For example, it has been considered that interventions may help to "capitalise on numerous opportunities to gain health benefits from coastal environments, thereby promoting wellbeing and community resilience" (Depledge *et al.*, 2017, p18). Overall, this study is pertinent to research efforts in the interdisciplinary literature (e.g. psychology, health, planning and landscape architecture), because marine and coastal environments are still understudied, in comparison to green spaces (Völker and Kistemann, 2011). Evidence gaps are acknowledged for marine and coastal environments globally (Fleming *et al.* 2014) and in the UK (Depledge *et al.*, 2017; Government Office for Science, 2018).

9.3.3. Valuing environmental interventions and Ecosystem Services

The valuation of interventions is an important area for future research and application (OECD, 2018). This is the first study to use the LSA to attempt to value an environmental intervention. This is surprising as HM Treasury guidance (e.g. Fujiwara and Campbell, 2011; HM Treasury, 2018), presents the LSA as a method for evaluating the benefits and costs resulting from interventions. The majority of previous applications of the LSA in the environmental context have instead looked at the value for the current provision of environmental goods. This research has been carried out predominantly using a quantitative-spatial approach, comparing environmental characteristics across large areas (e.g. regions and countries) with heterogeneity for these

goods (Fields in Trust, 2018; Kopmann and Rehdanz, 2013; MacKerron and Mourato, 2009; Tsurumi and Managi, 2015). But, there is a growing need to value not only the distance to natural environments, but other aspects including real accessibility, quality, and the actual use of these spaces (Gascon *et al.*, 2018; Grellier *et al.*, 2017).

The study also offers novel insights on the *ex-ante* and *ex-post* value of a coastal intervention, which has been acknowledged previously as an area for further investigation (Gascon *et al.*, 2017). This research supports and extends the established evidence base for the CVM which has shown that people are WTP for increases in the environmental quality of beaches and coastal areas (reviewed by Torres and Hanley 2017). It also augments the current evidence base, which has applied the LSA in the valuation of blue spaces (Cuñado and de Gracia, 2013; Kopmann and Rehdanz, 2013; Jarvis *et al.*, 2017). This is the first attempt to value a blue space intervention using the LSA and may therefore help to guide best practice for the design and application of future studies.

The research may also provide insights for the ES literature. Well-being is central to the ES framework, whereby it is postulated as the ultimate good to which the benefits of ES contribute (Russell *et al.*, 2013; Turnpenny and Russel, 2017). There is recognition that ES can have substantial effects on well-being, both indirectly and directly (OECD 2018). Despite this, knowledge of the specifics of how different attributes of environments effect human well-being remains limited (Raudsepp-Hearne *et al.*, 2010; Bennett *et al.*, 2015).

The literature review (Chapters 2-4) and discussion in Chapter 8 provided an overview of the methods and offered new insights for their use in the valuation of ES. The OECD (2018) recognised the potential for the LSA to contribute to

environmental CBA. However, there has been limited examination of the wider applications of the two methods in the valuation of ES and the relative benefits of this for an ES approach to decision-making. Therefore, this thesis may be a useful resource for researchers in that it provides an overview of theory and practice relating to the LSA and places it in the context of a well-known ES valuation method (the CVM).

9.4. Policy and planning implications

Marine and coastal policy and marine plans are increasingly scrutinised in terms of their potential to contribute to greater well-being (McKinley *et al.*, 2019). Therefore, in this section the policy and planning implications from the main chapters will be presented and interpreted together.

9.4.1. Policy implications

This section discusses the relevance of the thesis to policy at a local-level and national scale.

9.4.1.1. Local-level policy

The empirical research may have the most significant implications at a Plymouth level, providing evidence in terms of future planning, protection and funding of blue and green spaces.

The research provided an *ex-ante* and *ex-post* valuation of the coastal regeneration. The LSA findings should be taken with some caveats and caution. But, following further examination of the mechanisms behind the effect, this evidence could be used to contribute to a business case to ensure ongoing investment for interventions to improve the quality and accessibility of green and blue spaces in Plymouth and the wider area. This could be used to

prioritise neighbourhoods with the greatest social and health inequalities. The use of this valuation may have particular significance in the current policy landscape for green and blue spaces. A recent special issue of People, Place and Policy (Bennett *et al.,* 2018) highlighted that parks and green spaces were facing challenges in their management and funding due to shrinking public sector budgets and development pressures. According to Mell (2018), "as a discretionary service, green space provision has been identified as a service that can be cut to balance the accounts of many Local Planning Authorities" (p137).

In combination with outputs from the BlueHealth project (Grellier *et al.*, 2017), the LSA research makes steps towards delivering an evaluation of the effects of the Teat's Hill intervention, composed of a bundle of environmental goods (and public involvement and engagement activities). With further investigation, this research may help to provide an indication of the beneficial effects of improving access, facilities and environmental quality of a coastal green space on human well-being. This may be beneficial for Plymouth City Council, the end user of this research. Plymouth City Council have funded and implemented a host of improvements to green and blue spaces across Plymouth, but this is the only study site for which they have evidence that they can use to justify future work. The evidence could be used to aid future planning and decision-making with respect to providing support for environmental improvements and regeneration projects on well-being grounds. This evidence may be useful because the Teat's Hill intervention contributed towards two specific targets outlined in the Plymouth and South West Devon Joint Local Plan (West Devon Borough Council *et al.*, 2017). The plan aims to provide: (i) access to high quality natural and (ii) playable space within 400m of where people live across the region.

The current and future uses of the evidence are highlighted by Jemma Sharman and Zoe Sydenham, Natural Infrastructure Officers at Plymouth City Council (2019):

"We have already used the indicative results for funding bids as the Future Parks Accelerator (HLF/National Trust) and an EU funded stream for Urban Innovation Actions – both looking at different approaches to green/blue space management. The research process was just as important as the outcome and showed how research can inform evidence-based community level improvements. In the long term, we will be looking at how the research can be used and applied to other spaces, not just designing interventions but also how we can predict/assess the social and economic value of any changes. The research enables us to monitor and evaluate the Teat's Hill intervention, not just in terms of financial value, but also the wider health and well-being implications – and this will also inform future interventions and upcoming projects on other green and blue spaces. For example, it may be particularly useful for the Future Parks accelerator project, which is looking at transforming blue and green space estate management in the light of severe budget cuts and there being no statutory obligation for Local Authorities such as Plymouth City Council to do this. Therefore it is useful to explore different funding models for blue and green spaces, which could include income generation, social investment models and asset transfers; and open up spaces for community stewardship".

9.4.1.2. National-level policy

The literature review may be useful to national-level policy-makers as it provides a comparison of two valuation methods recognised by the HM Treasury Green Book guidance (HM Treasury, 2003, 2011, 2018) in the context

of environmental goods. The CVM and LSA are both presented as suitable methods for the appraisal and evaluation of policies, projects and programmes. Drawing on reviews (e.g. Fujiwara and Campbell, 2011), the synthesis provides a critique of the two methods and recommendations on the application of the methods in the valuation of marine and coastal goods. Although most relevant at a local level, the empirical evidence may also be informative to decision-makers working at a national scale. As stated by Maxwell and Lovell (2017), "there is a lack of evidence specifically designed to inform the development of policy and interventions, including evaluation demonstrating which interventions work, for whom, in what circumstances, and why" (p30). But, there appears to be a strong case for evaluations that provide evidence of what nature can and cannot do for human well-being.

As suggested previously, there is awareness of the value of natural environments (e.g. parks and coastal areas) within the UK government (HM Government, 2011; Maxwell and Lovell, 2017). For example, one of the focuses of the 25 Year Plan to Improve the Environment (25 YEP) is "Connecting people with the environment to improve health and wellbeing" (HM Government, 2018, p13). But to date, there has been limited percolation of valuation evidence into marine and coastal policy and this has been attributed to methodological issues with existing methods, amongst others factors (Pendleton *et al.,* 2007; Hanley *et al.*, 2015; Torres and Hanley, 2017). However, the LSA is based on experiences and provides an *ex-post* valuation of the intervention. Therefore, it might be an attractive feature for policy-makers (OECD, 2018). Such evidence, may help further the case for the value of these environments in terms of the contributions and benefits they deliver across diverse policy agendas, including health and environmental policy (Wheeler *et al.*, 2015).

First, it may be relevant to public health policy. Although a small coastal site with a low-cost intervention, Teat's Hill may act as a public health resource. This may be significant in the UK as one third of the UK population live within 5km of the coast and 17% are part of coastal communities (Government Office for Science, 2018). There are also significant numbers of visitors to UK coastlines each year. For example, in England, it was estimated that 271 million recreational visits were made to coastal environments annually (Elliott *et al.*, 2018). Together, the findings reaffirm evidence that coastal environments may have important specific properties in terms of the that they might convey for well-being and therefore public health (White *et al.*, 2017).

Furthermore, it provides an indication of the well-being benefits that can be achieved if access and recreation are prioritised for communities in need of the benefits (Elliott *et al.*, 2018). This reinforces the idea that benefits may be gained irrespective of socio-economic status (e.g. income) and highlights the importance of making nature widely accessible. As discussed previously by Wyles *et al.* (2017) such understanding helps to provide a case for the prioritisation of access to natural environments to maintain well-being benefits for people. This may be useful at a national scale because the quality of the Teats Hill site prior to the regeneration and socio-demographics of the area fit with the general finding that natural spaces in poorer areas tend to be of lower quality and are less maintained, which may exacerbate health inequalities (Allen and Balfour 2014). This has been acknowledged as a national issue (HM Government, 2011). Therefore, this research may provide evidence in support of policies that aim to increase coastal access in the UK (e.g. *Marine & Coastal Access Act*, 2009).

Second, this research may also contribute to the case for the conservation and protection of natural environments. This study provides an indication of the value of a coastal regeneration project and recognises that such interventions may support well-being. This may provide another reason for the protection and conservation of natural environments. The evidence may be significant for the case for marine and coastal environments, in particular. Recent projections suggest that marine and coastal environments may be vulnerable due to increasing anthropogenic pressure and climate change (Depledge *et al.*, 2017; Government Office for Science, 2018). This has been acknowledged by the Natural Capital Committee (2019) who recommended that the UK's marine environment and natural capital should be protected and improved to deliver increased economic and social benefits. They also suggested that the UK government should promote the value of blue spaces (e.g. psychological health and well-being benefits) and improve public access to these environments.

9.4.2. Planning

This research is equally relevant to marine and terrestrial planning. However, there has been increasing acknowledgement of the need to incorporate health and well-being evidence into marine planning, as it may contribute to tackling key health challenges, for example to reduce morbidity and diseases associated with sedentary lifestyles (Elliott *et al.*, 2018). It has been considered that well-being could represent a measurable outcome for marine planning and may have the ability to connect political narratives with people's everyday lives, in contrast with common indicators such as GDP. However, at this stage, few national marine planning systems have engaged with well-being extensively or set up an established metric to evaluate this outcome. This may be because the

concept is insufficiency advanced for it to be embedded within marine planning (McKinley *et al.*, 2019). As discussed earlier there has been no consensus as to the definition of well-being upon which to base decision-making (Butler and Oluoch-Kosura, 2006; McGillivray, 2006; Daw *et al.*, 2011; Agarwala *et al.*, 2014; King *et al.,* 2014).

The relevance of well-being to marine planning has been acknowledged in England by the Marine Management Organisation (MMO). The MMO considers that information on the broad social value of the area as well as assessment of the social value of health and well-being is important for marine plan development, implementation and monitoring and should be a priority area of research (Marine Management Organisation, 2015). At this current stage, there has been limited consideration of this type of evidence in the development of marine plans in England. Therefore, the LSA research may not have a large application currently. However, there may be future opportunities for this type of data to support monitoring of marine plans when they have been implemented (Marine Management Organisation, 2018).

The review of literature and discussion in Chapter 8 may also be useful for advancing the evidence base and agenda for the use of well-being as an outcome for marine planning. Chapter 8 (section 8.4) showcased how each of the methods might be used to value different ES at different spatial and temporal scales. This might be useful in the future for the prioritisation of research needs for marine spatial planning. For example, scoping studies could examine how existing datasets (e.g. MENE survey) could be used to provide monetary and non-monetary well-being data (i.e. from the LSA) for marine spatial planning.

9.5. Limitations

Prior chapters have examined the individual limitations of the CVM (Chapter 6; section 6.6) and LSA studies (Chapter 7; section 7.7). Table 9.1 makes reference to the limitations encountered by each study and highlights that there are mutual limitations. This section examines these mutual limitations, discussing: (i) sample size, (ii) missing observations and multiple imputation and (iii) the complexity of the intervention.

Table 9.1: Summary table displaying the key limitations of the CVM and LSA studies.

CVM	LSA
Sample size	Sample size
Missing observations (e.g. income) and potential issues with use of multiple imputation	Missing observations (e.g. income) and potential issues with use of multiple imputation
Complexity of the intervention	Complexity of the intervention
Lack of information on level of education	Priming effects (question order)
	Lack of control site
	The use of a repeat-cross-sectional design
	Short exposure period
	Lack of delayed-post assessment
	Potential that factor not controlled for in study.
	No adaptation

9.5.1. Sample size

As a result of the closure of the Sutton Harbour Bridge, the sample (n=653) was smaller than the original target (n=900; T1= 450, T2= 450; discussed in Chapter

5; section 5.4). The sample size was relatively small compared to previous CVM, LSA and comparative well-being studies. Also, missing cases for income and additional individual level and visit specific controls, led to the sample size being lowered in the regression analyses for the two methods: CVM (n=133) and LSA (n=220). Prior CVM studies have described comparable sample sizes as "relatively modest" (Bateman *et al.*, 2006,p453). The sample size is, however, comparable with LSA studies such as Jarvis *et al.* (2017) (n=245), Dolan and Metcalfe (2008) (n=308) and Bertram and Rehdanz (2015) (n=316), but is significantly smaller than other primary data studies, such as Fields in Trust (2018), which had a maximum sample size of 3109, and previous comparative well-being studies (see Chapter 8; Table 8.3). Subsequently, the effect sizes may be been influenced by the sample size.

9.5.2. Missing observations and Multiple Imputation

There were missing observations for a number of explanatory variables (e.g. income), as well as for one of the dependent variables (LS). Therefore, the issue of sample size may have been further augmented by missing cases. Income was a particular issue, as it is a key variable for use in the statistical analysis for the LSA to estimate WTP. Although it is not central to the estimation of WTP in the CVM, it is a key variable used in the assessment of construct validity. The presence of missing cases for income has been observed previously in both CVM and LSA studies (Whitehead, 1994; Bertram and Rehdanz, 2015; Pennington *et al.,* 2017). However, issues of income disclosure are far less common or influential, in general, in LSA analyses as the majority of studies use large-scale surveys with higher sample sizes (discussed in Chapter 3; section 3.4).

It is hypothesised that the high non-disclosure of income may have resulted from issues associated with sensitivity, confidentiality or the choice of income question. The resulting sample had a positively skewed distribution for income and a similar household income to the UK Census Data (2011), before tax, despite being an estimate of income after tax. Subsequently, MICE was used as a robustness check for estimates in the CVM and LSA. As part of MICE, the process imputed for missing cases on all variables, including income. However, there are potential issues to consider. First, there are still a scarcity of tools for checking the adequacy of imputation models in Stata and a lack of best practice guidelines (Nguyen *et al.,* 2013). Second, there is need for caution with the use of predictive mean matching (PMM), especially for small sample sizes (Gaffert *et al.,* 2016). Third, there was high standard error for income, in the original and MI analyses, which may have affected robustness of associations in the CVM and LSA.

9.5.3. Complexity of the intervention

The regeneration at Teat's Hill involved a bundle of goods, which aimed to make physical improvements and social or behavioural improvements. It was a highly complex intervention, composed of various different factors. As discussed in Chapter 8 (section 8.2), the potential beneficial effects for well-being may have resulted from the combined influence of the physical improvements and community involvement during the project, or just one of the bundle of goods. Consequently, it is difficult to disentangle these components and draw learning points for the design and development of future interventions in other areas. This has been acknowledged as a limitation in preceding studies (National Institute for Health and Care Excellence, 2018; Slater *et al.*, 2016). An

understanding of these mechanisms is an important area for further investigation drawing on research by Panter and Ogilvie (2015).

9.6. Future research

This thesis has provided insight into multiple areas for further research. Recommendations for the application of the two methods in the valuation of well-being changes resulting from marine and coastal environments and the natural environment more generally are discussed below.

9.6.1. Comparison of the two methods

The review of literature provided an overview of the current evidence base on the validity and reliability of the two methods (see Chapter 4; sections 4.4-4.6). Only one study (Humphreys *et al.*, 2017) had compared the accuracy (validity and reliability) of the two methods in practice. Future experimental studies may wish to undertake a detailed examination of the accuracy of the two methods for environmental goods.

For example, experimental studies could investigate the influence of context effects on the CVM and LSA. The review of literature (Chapter 4) highlighted that context effects are a major area of debate when comparing the two methods. The LSA is commonly promoted as an alternative to the CVM due to concern over influence of context effects on the CVM (e.g. Smith *et al*., 2008; Sugden, 2005). However, there is insufficient evidence on the impact of context effects on the CVM and LSA. This is particularly the case for focusing effects and priming effects (see section 4.6). Priming effects have been presented as a potential reason for the high value estimate from the LSA within the current

research (Chapter 8; section 8.3) and the source of issues in previous research (e.g. Bakhshi *et al.*, 2015).

This research found that two methods produced vastly different estimates for the coastal regeneration. Only one other study has compared the CVM and LSA, in the valuation of an environmental good (Fields in Trust, 2018). This presents an opportunity for future comparative studies. The thesis also examined the complementarity and commensurability of the two methods. However, further research effort needs to be paid to examining the complementarity and commensurability of the two methods in the valuation of environmental goods. The current research highlighted that there are challenges with jointly presenting and interpreting the values from the two methods, particularly, when they produce largely different estimates. It was also questioned as to how the figures can be used in CBA and by policy-makers (e.g. local authorities) and planners. An examination of this topic area is a worthwhile avenue for future work, as it may aid the theoretical literature and the design and interpretation of empirical research.

9.6.2. Additional analyses for Teat's Hill

As discussed in section 7.7, there were complexities associated with the use of the regeneration variable in the LSA analysis. Examination of the reasons or factors driving the differences in LS between T1 and T2 should be the basis of future study. Additional research is also required to establish whether such variables can be used in LSA analyses to value well-being changes resulting from interventions. Alternative specifications could also be developed and tested, to disentangle the relationship between LS and the coastal regeneration.

The repeat cross-sectional survey for Teat's Hill included a range of questions that were not included within the core analyses for the CVM and LSA. This offers a number of opportunities for further analysis. In the T2 survey, respondents were asked for their willingness to pay for the maintenance of Teat's Hill, following the regeneration. Therefore, a future extension would be to conduct an analysis to investigate willingness to pay for the maintenance of the site and to examine the determinants of WTP. As far as the author is aware, this is the only study to have valued the maintenance of a coastal site. The most similar study was carried out by Fields in Trust (2018), which estimated people's willingness to pay to support the maintenance and preservation of local parks and green spaces in the UK. Spaces such as Teat's Hill require continual maintenance and upkeep costs. Therefore, this type of evidence may be useful for creating a business case to ensure continued investment in the maintenance of blue and green spaces. As suggested in Fields in Trust (2018), with reliable data on the maintenance and upkeep costs of environmental spaces (e.g. Teat's Hill) it may also be possible to perform a CBA.

The current research selected LS as the outcome for the LSA. However, LS measures may not allow the researcher to investigate how the various dimensions of life were accounted for and aggregated by respondents (OECD, 2018). As discussed in Chapter 7 (section 7.7), the survey also included questions relating to the three domains of LS: community, health and safety. The community domain may be particularly important in the case of Teat's Hill. The LSA not only valued structural components, but also the social intervention (e.g. public engagement events). This may have had implications for social and community cohesion. Domain measures have not been used previously in LSA studies and far less is known about the factors that control for these domains of

well-being. Therefore, future analysis could be extended to examine the association between the coastal regeneration and domains of LS, in addition to exploring their potential for use in the LSA, to value the coastal regeneration. However, one foreseen limitation is the lack of an established IV approach for the domains of LS, which would limit the ability to account for endogeneity.

9.6.3. Future application of the LSA to marine and coastal environments

Only a few studies at present have used the LSA to value marine and coastal goods (Cuñado and de Gracia, 2013; Kopmann and Rehdanz, 2013; Jarvis *et al.*, 2017). Therefore, a logistical extension of the LSA research (Chapter 7) would be to apply the method to the valuation of other types of marine and coastal goods and case studies.

A primary dataset was used in the current study and there were challenges associated with missing data and the reduced sample size (see section 9.5). In addition to this, an unbiased coefficient from Fujiwara *et al.* (2014) was used in the LSA to place a monetary value on the coastal regeneration. As discussed in Chapter 4 (section 4.4), there has been previous concern about the validity of estimates from studies using small LS datasets (Bakhshi *et al.*, 2015; Humphreys *et al.*, 2017; Johns and Ormerod, 2007). Bakhshi *et al.* (2015) and Humphreys *et al.* (2017) contend that large datasets with spatial variation are required to provide statistical significance for determinants of LS and therefore detect the impact of goods on LS. Hence, one avenue for research would be to exploit the use of secondary datasets. Although, secondary datasets cannot be used to value physical interventions (e.g. Teat's Hill) they can be used to examine the current provision of goods.

A researcher could use a dataset such as the BHPS or the MENE survey to calculate the trade-off people would be willing to make between income and a range of marine or coastal goods. The current study used a single SWB measure, but these surveys include a range of different well-being measures (e.g. LS, GHQ-12, happiness, anxiety and worthwhileness) and environmental characteristics. These measures have been used less frequently than LS in the LSA (e.g. GHQ-12 and happiness; Kim and Jin, 2018; Tsurumi *et al.,* 2018). Drawing on previous research in the UK (e.g. White *et al.*, 2013; Wyles *et al.*, 2017), a quantitative-spatial approach could be used to place a monetary value on neighbourhood exposure to the coast, beaches or protected areas. This is similar to the approach undertaken by Cuñado and de Gracia, (2013) in Spain.

A secondary dataset could be also be used to value visits to blue and green spaces in England. Previous research using the MENE data has shown that visits to nature yesterday is associated with a higher likelihood of reporting high levels of positive experiential wellbeing (happiness). Additionally, that people who visit nature regularly feel their lives are more worthwhile (White *et al.*, 2017). Fields in Trust (2018) used a primary dataset to value visits to urban green spaces and parks in the UK. However, datasets such as the MENE have not been used previously to value visits to blue and green spaces.

9.7. Overall conclusions

This thesis has compared and contrasted two environmental valuation methods (the Contingent Valuation Method and the Life Satisfaction Approach), which can be used to capture the well-being changes resulting from the provision of marine and coastal goods. Through a theoretical and empirical examination, this thesis has provided evidence that the two methods have different

conceptualisations of well-being and may be incommensurable in the valuation of non-market marine and coastal goods. The research also highlighted the potential value of a coastal regeneration project in Plymouth (UK) and provided an initial indication of the potential well-being benefits of such interventions within areas of relative socio-economic deprivation. Environmental change is inextricably linked to changes in well-being. Therefore, continued investigation into the importance and value of the marine and coastal environment for well-being will be vital for the protection of these vulnerable environments.

Appendices

Appendix A.

Postcard (2 sided) delivered to respondents within the 7 LSOAs ahead of survey period (T1: May 2017, T2: May 2018).

Have your say on local waterfront improvements

What's happening?

- Plymouth City Council are working with a research team to better understand local people's views on local waterfront improvements.
- One local area under discussion is Teat's Hill.

Where?

Teat's Hill (Coxside, Plymouth):

- Used by American soldiers in World War Two.
- Previous centre for maritime industry (e.g. rope making, ship building and repairs)
- Supports a range of wildlife on land and in the sea.

How to have your say:

- In June and July, interviewers from a professionally accredited company (Marketing Means) will be contacting your household to better understand local people's views.
- We would really appreciate your views, however, you do not have to take part if you do not want to.
- Please contact Marketing Means on 01364 654485 if you do not wish to be contacted.
- For more information, see https://www.facebook.com/ActiveNeighbourhoodsProject/ or contact the research team (L.R.Elliott@exeter.ac.uk)

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Appendix B.

Feedback from the HEPE group (n=4; November 2016).

1. What did you think of the interview script as a whole?

Could we have any comments that you have regarding:

- Structure
- Flow
- Content

1. Structure

- 1.1 This felt well-structured & logical to me (except for comment below (3.1.2) on the 2-part Q6, which I believe should be separate question numbers).

2. Flow

- 2.1 I think an interviewer would feel comfortable moving from item to item and this would probably put the interviewee at ease.

3. Content

- 3.1 Typographical errors:
- 3.1.1 Introduction, 2nd para:
- 1st line: add "a" between "to" and "number"
- Sub-para 2: add "about" between "ask" and "your"
- Last phrase in capital letters to the interviewer: "THROUGHLY" should be spelt "THOROUGHLY"
- 3.1.2 Question 6: shouldn't the phrase describing the 1-10 scale be placed at the beginning of the first part of the question rather than between parts 1 & 2? For that matter, shouldn't the 2nd part have been given a separate number ("7") and all the rest advanced by one? It makes no sense to me to have two parts. The first part is clearly to obtain an initial view of how the interviewee is feeling about life as a whole now. The second part is drilling down into 7 topics.
- 3.1.3 Question 26: should read "children", not "adults".
- 3.1.4 Page 12, 4th para, last sentence: remove "to" between "also" and "reduce".
- 3.1.5 Page 21, 3rd row down under "Description", 2nd bullet point: insert "of" between "improvement" and "paths".
- This depends on how you plan to recruit your participants, the script may be too long if you plan to stop people in the street and ask them to complete the questionnaire with you there and then. I am not sure if I would spend 25-30 minutes answering questions without previously having agreed a time/day to do this. But perhaps you have already identified people/places to conduct interviews.
- Apart from this, the introductory information is fine. Although it could be reduced a little so you don't lose the respondent's interest before you get to the questions.
- Part 1: define well-being. Are you referring to health, wealth and/or happiness? Perhaps give examples from the chart which follows to clarify for those that don't understand.

- I'm not too sure about the 'how worthwhile is your life' type of question (Q7). How does it differ from the previous question (Q6)? Think about the can of worms that may open. How will you stop someone who launches into the story of their life without offending them?
- Interview script as a whole: the structure and flow were ok . Re the content, some of the question maybe need redrafting. E.g quite a few questions perhaps should have don't know or no response categories, in particular questions 6 , 22, 23, 24 and 33.
- Question 27 perhaps is a leading question and the second sentence could be drafted differently.
- Question 29 could be seen as ambiguous. Question 33, on access to a garden , respondents may have a garden yard etc but might not be able to access it due to disability etc. also the schedule seems to assume ableism generally e.g. in the question about time taken to travel to Teat's Hill.
- Question 36 could include a response category of 'other' and doing unpaid or voluntary work.

2. Do we provide enough information about the coastal site, Teat's Hill?

- Do we provide enough information in the: (1) introduction (page 1) and (2) Part 2 (including Card A)?
- If not, what further information could we provide, at this stage of the interview?

- It seemed adequate to me, considering the need to not consume too much time during the interview.
- Perhaps there is too much info.
- Information about Teat's Hill seemed fine to me though a bit wordy. I don't know the area at all but got a good picture of it all from this. maybe people who know the area already might not need to have the full spiel.

3. What did you think of the introduction (scenario) that introduces the Teat's Hill renovation project (Part 3)?

- Was the introduction easy to understand?
- Do you have any suggestions to improve the text?
- Do the information cards (Cards B and C) provide enough information about the project?

- Although I do not know the site, the introductory text made sense to me and tied in with the photos.
- No further suggestions for improvement.
- The information contained in Cards B & C fully supports the overall description.
- The intro is a bit lengthy. I would summarise and simplify what you say.
- The photo cards are useful for highlighting the site's condition and for summarising proposals for site 'clean-up'.

- Use of an artist's impression to show how the site may change.

4. **What did you think of Q27 (Part 3), which asks for people's willingness to pay for the Teat's Hill renovation project?**
   We are interested in understanding how much people are willing to pay for the Teat's Hill renovation project.

   - Was it clear what was asked of you?
   - How did you feel about the nature of the task (i.e. being asked to put a monetary value on the coastal renovation)?

- I assume you mean Q 27 – which includes mention of extra council tax, not just the general willingness to pay – see 5 below.
- I'm guessing this will be the first time that most interviewees have been asked such a question, and there are likely to be a range of initial reactions. It would be good to somehow capture that reaction (e.g. did they come up with an immediate, confident answer, were they flummoxed, didn't have a clue?). It may be an idea for the interviewer to have an additional piece of information up his sleeve (or another question) relating to some other well-known cost to the council-tax payer, for cases where the interviewee is clearly having difficulty with putting a value on something ; e.g. "Would it help if I told you that each Plymouth council tax payer presently pays £x towards the upkeep of AN Other structure?".
- Confidentiality could be emphasised a little more.
- Q28 to which period of the respondent's time does this relate?
- On putting a monetary value on the improvements. Re how much more council tax would you pay etc: not all respondents may pay council tax, or be aware of how much it is, also council tax has acquired a bit of a negative connotation, so maybe another question along the lines of how much per year would you be prepared to pay to access the facility might be considered. Or maybe include in the question a very brief statement about roughly how much per head people already pay for public space access in the city.

5. **What did you think about being asked to contribute more to council tax per year, to fund the renovation (Part 3, Q45)?**
   We are interested in understanding how much people are willing to pay for improvements to Teat's Hill. We have asked respondents to state how much extra council tax they would be willing to pay per year, for the Teat's Hill renovation project to be realised. A supplement to council tax is the payment type used in this interview script.

   - How did you feel about this?
   - Do you think it will make people feel upset or angry?
   - Do you think there is another payment type that we could use? For example, asking people to contribute to the project, through an increase in water rates, a beach charge or an increase in car parking charges?

- I’m not sure of the difference between 4 and 5 – see my comments on 4, which also apply to 5.
- Repeated: I’m guessing this will be the first time that most interviewees have been asked such a question, and there are likely to be a range of initial reactions. It would be good to somehow capture that reaction (e.g. did they come up with an immediate, confident answer, were they flummoxed, didn’t have a clue?). It may be an idea for the interviewer to have an additional piece of information up his sleeve (or another question) relating to some other well-known cost to the council-tax payer, for cases where the interviewee is clearly having difficulty with putting a value on something; e.g. “Would it help if I told you that each Plymouth council tax payer presently pays £x towards the upkeep of AN Other structure?”.
- Yes, there may be some anger, which is why you might need to put it into context by illustrating what tax payers already pay to maintain other well-known amenities.
- You could add the options of paying via other means (water rates, beach charges, car-parking etc.).
- It will be interesting to see what respondents say they would pay for the clean-up, as additions to Council Tax may be frowned upon by many people. I think you may encounter some people who do not agree that this is good use of their Council Tax money.
- Perhaps you could include a question asking what the respondents believe to be the monetary value of such a resource. For example, if they are users of the beach and access was taken away, what would it cost them (or what would they pay) to go to another place like it.
- On putting a monetary value on the improvements. Re how much more council tax would you pay etc: not all respondents may pay council tax, or be aware of how much it is, also council tax has acquired a bit of a negative connotation, so maybe another question along the lines of how much per year would you be prepared to pay to access the facility might be considered. Or maybe include in the question a very brief statement about roughly how much per head people already pay for public space access in the city.

6. Was the payment range on the payment card (CARD D) suitable (0-£200+)?

- Are the amounts on the card suitable or are they too high or too low?
- Would you prefer to see the amounts in terms of: additional council per tax per annum or additional council tax per month?
- Would you prefer to see the amounts in the form of: (1) interval amounts, e.g. £1 and £2 (version 1, as in CARD D), or (2) payment ranges, e.g. £0.01-£0.50 and £15.01-£20.00 (version 2).

Version 1:

○	0
○	£0.50
○	£1
○	£2
○	£3
○	£4
○	£5
○	£7.50
○	£10
○	£12.50
○	£15
○	£20
○	£30
○	£40
○	£50
○	£75
○	£100
○	£150
○	£200
○	Over £200

Version 2:

○	0
○	£0.01-£0.50
○	£0.51-£1.00
○	£1.01-£2.00
○	£2.01-£3.00
○	£3.01-£4.00
○	£4.01-£5.00
○	£5.01- £7.50
○	£7.51-£10.00
○	£10.01- £12.50
○	£12.51-£15.00
○	£15.01-£20.00
○	£20.01-£30.00
○	£30.01-£40.00
○	£40.01- £50.00
○	£50.01-£75.00
○	£75.01- £100.00
○	£100.01- £150.00
○	£150.01-£200.00
○	Over £200

- Version 2 seems better to me. The choice between monthly or annually might well depend on how the interviewee pays this/her council tax
- The upper value should bear some reasonable relationship to the tentative overall cost of the project, bearing in mind the total number of tax payers

and the fact that the payment will last for 5 years. [£200 seems very high; i.e. £1000 total for every single tax payer].

- If they are additions to Council Tax, then the upper limits on the card are too high.
- It may help to explain the proportion of the contribution in relation to overall council Tax (i.e. If you pay £1000 a year in Council Tax, would you be prepared to pay an additional £5 towards the project).
- I prefer version1 for its simplicity.
- Of the two scales you have in relation to this section, I think version 1 is preferable.

Appendix C.

Socio-demographic characteristics of focus group participants (n=24; March 2017).

ID	Focus group no	Sex	Age (years)	Social grade	Employment status	Marital status	Plymouth ward
1	1	Male	25-29	C2	Part time	Single	Sutton and Mt Gould
2	1	Female	20-24	C1	Unemployed	Single	Lipson
3	1	Female	20-24	-	Student	Single	St Peter and the Waterfront
4	1	Male	25-29	C2	Full time	Single	Drake
5	1	Female	60-65	B	Full time	Married	Plymstock Radford
6	1	Female	30-44	C2	Full time	Married	Stoke
7	1	Male	45-59	C1	Full time	Married	Devonport
8	1	Male	75-84	-	Retired	Divorced	Plymstock Radford
9	2	Female	20-24	-	Student	Single	Efford
10	2	Female	25-29	C2	Full time	Single	Devonport
11	2	Male	25-29	B	Full time	Single	Sutton and Mt Gould
12	2	Male	30-44	C2	Full time	Married	Plymstock Radford
13	2	Male	30-44	B	Full time	Married	St Peter and the Waterfront
14	2	Male	45-59	B	Part time	Married	Drake
15	2	Female	45-59	C1	Full time	Divorced	Stoke
16	2	Male	65-74	-	Retired	Married	St Peter and the Waterfront
17	3	Female	20-24	-	Student	Single	Efford
18	3	Female	20-24	-	Part time	Single	St Peter and the Waterfront
19	3	Female	25-29	C2	Full time	Single	Drake
20	3	Male	30-44	C1	Full time	Married	Devonport
21	3	Male	45-59	C1	Full time	Married	Stoke
22	3	Male	45-59	C2	Full time	Married	St Peter and the Waterfront
23	3	Male	45-59	C2	Full time	Divorced	Plymstock Radford
24	3	Female	45-59	C2	Part time	Married	Sutton and Mt Gould

Appendix D.

Summary of results from the focus groups (March 2017).

Valuation scenario

The focus group participants were asked to feedback on the valuation scenario (including the show cards). A number of the focus group participants thought that the valuation scenario was too long for the door-step interviews, in particular and it needed to be more engaging. Participants made the following comments in relation to the scenario: “too longer description for interviews if knocking on doors. Condense it”, “need to keep information short, to keep people’s attention span” and “make it more of a conversation and minimise this information as much as you can”. The majority of participants thought that details about the environment and history of Teat’s Hill were interesting, e.g. “held interest (e.g. world war two, wildlife, rope making etc.)”, but it could be shortened as “it was better shown in the photos” or added to a leaflet, which would be delivered ahead of the interview. For example, participants commented that the information “would engage people, but perhaps not make them donate money” and “it could mention some of the environmental and historical aspects in the leaflet”. They also made a number of suggestions for additions to the scenario, including more about information about reasons for the disrepair, the site ownership and details of how the area will be maintained after the Teat’s Hill renovation project was complete.

A number of participants also perceived that the scenario and show cards provided differing perspectives on the condition of the site. Some participants thought that the scenario made the site sound more high quality than the photos, for example, “doesn’t sound run down in that description” and “you make it sound like a place worth visiting”. In contrast, others thought that the

scenario communicated that the site was lower quality than the photos, e.g. “description makes it sound worse than it is in the photos”. There were also recommendations to improve the show cards, in terms of their quality and focus, particularly Show card B. In terms of photo quality, they perceived that the quality and colour differed across the photos. Comments included: “colours were dull in some photos”, the photos “contradicted each other, as they were quite different” and “Picture 2 is from another angle and looks like a different place”. They suggested taking new photos, which were “taken in the same season”. A number of respondents also perceived that Show card B did not effectively visualise the issue of litter on the site, e.g. “can only just see litter and rubbish in the photo” and “most photos are seaweed rather than rubbish”. They suggested adding close up photos to visualise the litter issue, to “showing what rubbish is on the site” and “to emphasise the issue”.

Payment vehicle

The participants were asked to feedback on the Plymouth Parks Foundation as a payment vehicle for the survey. There were mixed comments on the Plymouth Parks Foundation. There were a number of “protest-style” comments, in relation to why the public were being asked to pay into a fund. For example “It should be something at Plymouth City Council is doing already. The council should be paying for this work” and “Knowing the council own it, makes them think that the council should be maintaining the site. Why are they not doing their bit?” On the other hand, others perceived the fund to be positive, e.g. “Good that the fund could fill the void for council cuts”, particularly if the fund was used across Plymouth, not just Teat’s Hill (e.g. “it shows that it will go

beyond just this one project. It could help other areas, and people are more inclined to do this when it benefits them").

Following this discussion, participants were also presented with alternative payment vehicles which have been used previously in the CVM literature, including an increase in water rates, a beach charge or an increase in car parking charges. A number of the payment vehicles were not deemed to be suitable, particularly water rates, council tax and car parking charges. Comments included: "Public wouldn't like higher parking charges, or increase in council tax. Feels like you are forcing people to pay for the project", "Don't use council tax or car parking- it's contentious in Plymouth". However, there were also some positive perspectives on visit charges and council tax, e.g. "Couple of quid to go to visit the beach and park, people would do this, if it's worth it" and "it's ok to have an increase in council tax, if it's dedicated to a local project. You see where the money goes".

But, the majority of participants perceived that the Plymouth Parks Foundation was a more suitable payment vehicle for the survey, in comparison to the other proposed vehicles. Participants commented: "the Parks foundation is better than increase in council tax, parking, beach charge" and "Parks foundation is a good idea and sounds personal". They also provided suggestions for improving public understanding of the Plymouth Parks Foundation and acceptance of the vehicle. For example, they suggested adding in text, which illustrated that the Council and other organisations had already made a contribution (e.g. "If showed that council and other organisations are contributing they would be more likely to contribute to the fund"). They also suggested that the payment vehicle would be better framed as a one off payment, rather than a payment

each year for the next five years. One participant stated “five years is quite a long commitment, use a one-payment”.

Elicitation question and format

Participants were asked to reveal how much they stated they would be WTP on the payment card. 14 participants (58.3%) stated a positive WTP, with payments ranging from a minimum of £2 to a maximum of £50. For example, one participant commented “it is £20 per year, it is worth, as it’s for this project and will improve area for children”. Another commented: “they felt like they should, because the person next to them put £20”.

However, 10 of the 24 participants (41.7%) had a zero WTP. Many perceived that the project was of value, but it shouldn’t be funded by them/ the public through the Plymouth Parks Foundation fund. Participants stated “It’s the Council’s land, it should be paid for by them”, “I didn’t want to be asked to pay money and it’s the council’s job”, “We pay enough now and council tax keeps going up” and “If owned by these organisations, why should Joe public pay?”. Instead, a number of participants thought that the project should be funded by other means, including: sponsorship by local businesses, rental charges (e.g. coffee-shop rent), crowdfunding, service charges from local flats and donations as part of entrance fees for local attractions (e.g. National Marine Aquarium) or undertaken by volunteer work.

There were also objections to the CVM task itself; for example, participants stated that said that it was a “difficult situation being asked this on the doorstep (i.e. cold calling) and feel pressured”. Another stated that the task “made him feel guilty, feel like I should want to contribute to improve the local area. But feel like the onerous has been put on him and the public”. Furthermore, others

reasoned that they needed more information before they provided a positive WTP (e.g. “I wouldn’t part with any money unless had full amount of information, e.g. what other organisations/landowners were contributing)” or were concerned about the details of the project (e.g. “What if not happy with the end result or end product?”). Whilst, others did not place value on the improvements, i.e. provided a zero WTP response, for example, “the area is too out of the way”.

Participants were asked whether the payment card was acceptable for use in the survey, considering format and clarity. Participants thought that the payment card would be acceptable with a few changes, including reducing the number of payment values on the card. They were then presented with an alternative version of the payment card (Version 2) that displayed range values, and were asked for their preferred payment card version (Version 1 or 2). The majority of participants preferred version 1 of the payment card that displayed interval values, instead of range values (Version 2). Participants thought that version 1 was easier to understand and clearer for the purpose of door-stepping.

Appendix E.

Pre-assessment survey (T1), door-stepping version (June 2017).

DOORSTEP VERSION_FINAL: Instructions to interviewers:

1. Please read out only the text in *italics*.
2. Question numbers are indicated in squared brackets.
3. Text in capitals and/or in squared brackets represent instructions.
4. Questions Qi and Qii do not require a response from participants, but should be coded by you. Likewise the final three questions should be coded by yourself.
5. All responses should be recorded by yourself on the tablet computer, unless stated otherwise.
6. Showcards B,C,D and E will be integrated into one handout.

Introduction to interview:

INTERVIEWER: *Hello, I'm [NAME] from Marketing Means and I'm conducting a survey on behalf of Plymouth City Council and various other organisations across the South-West.*

Did you receive the leaflet that we delivered to your home about the Teat's Hill project? [SHOW LEAFLET AND RESPOND TO Qiii].

IF "YES": *Did you have a look at the link that was mentioned on the leaflet?* [RESPOND TO Qiv]

IF "NO": [READ LONGER TEXT IN PARAGRAPH BELOW]

IF "YES": *Great, then you already know a bit about the project. Are you able to help me with an interview about this? It should only take a maximum of 15 minutes.*

IF "NO" TO INITIAL QUESTION: *No problem at all, we will tell you a bit more about the project. We are interested in how people in Plymouth relate to their local 'green' spaces like parks and woodland, and 'blue' spaces like the coast and rivers, and the effects they may have on people's health. We are interested in Teat's Hill in particular and are interviewing people in the area about this. The interview is confidential, you can withdraw at any time and your survey answers will be anonymous. Are you able to help me with an interview about this? It should only take a maximum of 15 minutes.*

IF “NO” TO INTERVIEW: END THE INTERVIEW IN THE AGREED WAY.

IF YES TO INTERVIEW: *Can I just ask if you have been involved in any public or community engagement events surrounding Teat's Hill in the last 6 months?*

IF "NO" CONTINUE TO CONSENT FORM

IF "YES" END THE INTERVIEW IN THE AGREED WAY.

[IF INTERVIEW PROCEEDED WITH, INTERVIEWER SHOULD ALSO CODE THE FOLLOWING AT THIS POINT]:

[Qi]. Weather [CHECK ALL THAT APPLY]: □ Sunny □ Rainy □ Cloudy □ Windy □ Hot □ Cold

[Qii]. Sex of respondent: □ Male □ Female

[Qiii]. Saw postcard? □ Yes □ No

[Qiv]. Visited link? □ Yes □ No

[Qv]. Watched video? □ Yes □ No

[Qvi]. Door knock attempts: [ENTER NUMBER – by checking the number of previous calls on the address contact record sheet]

Consent procedure for participants (the interviewer will read the following and check corresponding boxes on their tablet device - these will also be saved as data fields).

INTERVIEWER: *Before we begin, I just need to check that you're happy with a few things. Can you confirm the following?*

[Qvii] *Firstly, can I just check that you are over 18 years old?*

IF "NO," PLEASE THANK THE RESPONDENT FOR THEIR TIME AND END THE INTERVIEW IN THE AGREED WAY.

IF "YES" SAY: [Qviii] *Secondly, do you understand that your participation is entirely voluntary and that you can withdraw at any time you wish?*

IF "NO," REMIND INTERVIEWEE THAT THEY DO NOT HAVE TO TAKE PART AND CAN WITHDRAW AT ANY TIME AND THEIR RESPONSES WILL NOT BE SAVED. REITERATE QUESTION.

IF "YES" SAY: [Qix] *Thirdly, do you understand that your data will remain confidential and secure at all times?*

IF "NO," REMIND INTERVIEWEE THAT THEY DO NOT HAVE TO TAKE PART AND CAN WITHDRAW AT ANY TIME AND THEIR RESPONSES WILL NOT BE SAVED. REITERATE QUESTION.

IF "YES" SAY: [Qx] *Lastly, do you understand that while results of the research may be published, your identity will always remain anonymous?*

IF "NO," REMIND INTERVIEWEE THAT THEY WILL NEVER BE ABLE TO BE IDENTIFIED FROM THE RESPONSES THEY GIVE. REITERATE QUESTION.

IF "YES" SAY: *If you have no further questions, we can begin the interview.*

[FOR EACH "YES" RESPONSE GIVEN, CHECK THE CORRESPONDING BOX ON THE TABLET INTERFACE].

Main interview script. Note that arrowed brackets indicate the number which should be used in the data file. Includes debrief and showcards.

PART 1: GREEN AND BLUE SPACES

This section will ask you about 'green' spaces like parks and woodland, and 'blue' spaces like the coast and rivers, and any visits you've made to Teat's Hill.

[Q1]. *In the last 12 months, how often, on average, have you spent your leisure time at green and blue spaces? This does not include indoor locations, places which you visit as part of your job, or private locations such as your own garden, land, pond, or swimming pool. Would you say it was:*

<6> *Every day*

<5> *Several times a week*

<4> *Once a week*

<3> *Once or twice a month*

<2> A few times *in the last 12 months; or*

<1> *Not in the last 12 months*

[Q2]. *And in the last 4 weeks, how many times have you visited Teat's Hill? This could include stopping there or just passing through. It can also be the beach or the park area* [INDICATE THIS USING SHOWCARD A]*. Would you say it was:*

<1> *Not at all in the last four weeks* [**ASK Q3 BUT THEN SKIP TO PART 2**]

<2> *Once or twice in the last four weeks*

<3> *Once a week; or*

<4> *Several times a week*

Has the Sutton Harbour bridge closure affected how often you visit Teat's Hill?

<1> Yes

<0> No

[Q3]. *Overall, how would you describe the quality of this location? Would you say it was:*

<5> *Very good*

<4> *Good*

<3> *Neither good, nor bad*

<2> *Bad; or*

<1> *Very bad*

SKIP TO PART 2 IF Q2='Not at all in last few weeks'

You'll now be asked a few more details about your most recent visit in your leisure time to Teat's Hill. This could be anything from a few minutes to all day.

[Q4]. *Firstly, before today, on what date did your most recent visit to Teat's Hill take place?*

<INSERT DATE ON TABLET AS DD/MM/YYYY>

[Q5]. *And approximately how much time did you spend at Teat's Hill?*

<ENTER PARTICIPANTS RESPONSE IN MINUTES>

[E.G. "AN HOUR AND A HALF" WOULD BE 90"]

[Q6]. *On this visit which of these activities, if any, was the main activity you did?* [SHOW LIST ON TABLET. SELECT ONE ONLY]

<1> Walking with a dog

<2> Walking without a dog

<3> Playing with children

<4> Informal games and sport (e.g. Frisbee, bat and ball, beach ball)

<5> Running

<6> Cycling

<7> Fishing (including angling, crabbing)

<8> Swimming

<9> Sunbathing

<10> Quiet activities (e.g. reading)

<11> Eating or drinking

<12> Socialising with friends

<13> Conservation activity (e.g. litter-picking)

<14> Any other activity not in the list

[Q7]. *How many adults, aged 16 and over, including yourself, were on this visit?* [DO NOT READ RESPONSE OPTIONS, JUST CODE ANSWER].

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

[Q8]. *And how many children aged under 16 were on this visit?*

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

<11> None

How much do you agree with the following statements below about your most recent visit to Teat's Hill? You can answer on a scale from 1 meaning 'strongly disagree' to 7 meaning 'strongly agree'.

[Q9]. *"I was satisfied with the visit"*
[Q10]. *"I felt part of nature"*
[Q11]. *"I felt safe (i.e. protected from danger)"*
[Q12]. *"The area was free from litter/vandalism"*
[Q13]. *"There were good facilities"*

<1> Strongly disagree
<2> Disagree
<3> Slightly disagree
<4> Neither agree nor disagree
<5> Slightly agree
<6> Agree
<7> Strongly agree
Don't know/ Can't say

[DO NOT READ RESPONSE OPTIONS INDIVIDUALLY. SAME REPSONSE OPTIONS FOR EACH ITEM. REMIND RESPONDENT OF RESPONSE OPTIONS IF NEEDED].

PART 2: TEAT'S HILL RENOVATION

We are now going to talk more about Teat's Hill, its current condition, and a potential renovation project in the area. [PROVIDE HANDOUT WITH SHOWCARDS B,C,D AND E ON IT].

- *As you can see from these photos, Teat's Hill has a beach, park, and children's area.* [POINT TO PHOTOS 1-3]

- *Teat's Hill is home to wildlife on land and in the sea. These include: birds, fish and seals.* [POINT TO PHOTO 4]

- *Over recent years, Teat's Hill has suffered damage, which has affected access, facilities and the environmental quality of the site.*

- *The current condition of Teat's Hill is shown in the following photos.*

- *There has been damage to the public slipway and access points.* [POINT TO PHOTO 5]

- *There has been a build-up of litter on the beach and in the water, including plastic and glass.* [POINT TO PHOTOS 6 AND 7]

[Q14]. Were you aware of the condition of Teat's Hill before this interview?

<2> Yes

<1> No

- *As a result of the condition of Teat's Hill, Plymouth City Council and a research team are thinking about a project that would improve Teat's Hill. The project would be called the Teat's Hill renovation project.*

- *The project would focus on three main areas of improvement: environmental quality, access and facilities. The proposed plans for the project are shown here.*

SHOW CARD C, AND GIVE THE RESPONDENT TIME TO READ THROUGH – OR READ IT TO THEM IF REQUESTED

- *The Teat's Hill renovation project would be organised by a number of institutions.*

SHOW CARD D

- *These institutions have all contributed towards the project, however more funding is required to put the plans into action.*

- *One possible way of financing this project is through the establishment of an independent charitable organisation, called the Plymouth Parks Foundation.*

- *The Plymouth Parks Foundation would raise funds for the improvement of outdoor spaces across Plymouth. Teat's Hill would be the first outdoor space to be improved.*

- *All Plymouth households would be asked to contribute a one off payment to the Plymouth Parks Foundation fund. This payment could be made by cash, cheque or direct debit.*

- *All contributions to the fund would go directly towards the practical renovation of Teat's Hill, not towards administration or maintenance. Maintenance costs will be covered by Plymouth City Council.*

[Q15]. *Considering the benefits of this project for you and your household, what is the maximum that you would be willing to contribute to this fund, as a one off payment, for these improvements? If the overall funds people state they are willing to contribute in this survey do not cover the costs of the project, the plans cannot be put into action.*

Before you decide on your contribution, please carefully consider whether the cost is acceptable to your household. When considering this, keep in mind your household budget and all the other demands you have on your budget.

SHOW CARD E ON TABLET AND ASK RESPONDENT TO RESPOND USING THE TABLET.

[Q16]. How difficult was it for you to come to a decision regarding the amount of money you would be willing to contribute to the Plymouth Parks Foundation fund?

<1> Very Difficult

<2> Difficult

<3> Neutral

<4> Easy

<5> Very Easy

[Q17]. *Which one of these areas of improvement is most important to you? Please select one area of improvement only.* [POINT TO CARD C].

<1> Environmental quality

<2> Access

<3> Facilities

For the next question, we would like you to answer how strongly you agree with the following statements about your contribution to the Teat's Hill renovation project. You can answer on a scale from 1 meaning 'Strongly Disagree' to 7 meaning 'Strongly Agree'.

[Q18]. *"I have the right to enjoy the improvements to Teat's Hill, and should not have to pay extra for the renovation".*

[Q19]. *"I don't want to pay for the Teat's Hill renovation project, as I don't go there".*
[Q20]. *"Any improvements to Teat's Hill are not important to me"*
[Q21]. *"I object to the Teat's Hill renovation project going ahead, under any circumstances".*
[Q22]. *"I approve of the Teat's Hill renovation project but I object to paying into the 'Plymouth Parks Foundation' fund for it".*

<1> Strongly disagree
<2> Disagree
<3> Slightly disagree
<4> Neither agree nor disagree
<5> Slightly agree
<6> Agree
<7> Strongly agree

PART 3: BACKGROUND INFORMATION

This final section asks you some background information about yourself, your household and your family. The questions are not meant to be intrusive, but will assist in understanding the kinds of people who visit green and blue spaces. Again, the survey is anonymous – we will not be able to identify you as an individual.

[Q23]. *Firstly, how old are you?*

[ENTER A WHOLE NUMBER]

[Q24]. *Do you have a dog?*

<2> Yes

<1> No

[DO NOT READ RESPONSE OPTIONS]

[Q25]. *And how many years have you lived in Plymouth?*

[ENTER A WHOLE NUMBER]

[Q26]. *And which of the following best applies to you?*

<4> *I have access to a private garden*

<3> *I have access to a private communal garden*

<2> *I have access to a private outdoor space, but not a garden (e.g. balcony, yard, patio area)*

<1> *I don't have access to a private garden or outdoor space*

[Q27]. *Including yourself, how many people – including children – live in your house regularly as members of the household?*

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

Refused

[Q28 – ASK ONLY IF Q27>1]. *And how many of these are children that are aged under 16?*

<0> 0
<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

Refused

We would now like you to tell us a little about your health in general. We are interested in your health so that we can explore any links between general levels of health and the kinds of environments people spend their leisure time in. Please remember that your responses will not be linked to yourself or your home location..

For these four questions, I will ask you how satisfied you are and you can respond on a scale of 0 to 10 where 0 means 'not at all satisfied' and 10 means completely satisfied.

[Q29]. *Firstly, all things considered, how satisfied are you with your life as a whole nowadays?*

[Q30]. *Secondly, how satisfied are you with your health?*

[Q31]. *Thirdly, how satisfied are you with how safe you feel?*

[Q32]. *Lastly, how satisfied are you with feeling part of your community?*

<0> Not at all satisfied
<1>
<2>
<3>
<4>
<5>
<6>
<7>
<8>
<9>
<10> Completely satisfied
Refused

[DO NOT READ RESPONSE OPTIONS]

Please indicate for each of the following five statements which is closest to how you have been feeling over the last two weeks. You can choose from: At no time, some of the time, less than half of the time, more than half of the time, most of the time, or all of the time.
ROTATE STATEMENTS (TABLET WILL HANDLE THIS AUTOMATICALLY]

[Q33]. *"I have felt cheerful and in good spirits"*

[Q34]., *"I have felt calm and relaxed"*
[Q35]., *"I have felt active and vigorous"*
[Q36]., *"I woke up feeling fresh and rested"*
[Q37]. , *"My daily life has been filled with things that interest me"*

<1> At no time

<2> Some of the time

<3> Less than half of the time

<4> More than half of the time

<5> Most of the time

<6> All of the time

Refused

[REMIND RESPONDENT OF RESPONSE OPTIONS IF NEEDED]

[Q38]. *How is your health in general? Would you say it is:*

<5> *Very good*

<4> *Good*

<3> *Fair*

<2> *Bad, or*

<1> *Very bad*

Refused

[Q39]. *During the last 7 days, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?* [DO NOT READ RESPONSE OPTIONS]

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8>None

Refused

[Q40]. *Which of these descriptions applies to what you have been doing for the last 7 days? Please select only one.* [SHOW LIST TO RESPONDENT ON TABLET - DO NOT READ RESPONSE OPTIONS]
<1> In paid work (or away temporarily) (employee, self-employed, working for your family business)
<2> In education, (not paid for by employer) even if on vacation

<3> Unemployed and actively looking for a job

<4> Unemployed, wanting a job but not actively looking for a job

<5> Permanently sick or disabled

<6> Retired

<7> Doing housework, looking after children, or other persons

<8> Other

<9> Don’t know

[Q41]. *Do you think you belong to a minority ethnic group in the UK?* [DO NOT READ OUT RESPONSE OPTIONS]

<2> Yes
<1> No
<3> Don't know
<4> Prefer not to answer

[Q42]. *And which of the following best describes your marital status now?*

<4> *Married, in a civil union, or living with your partner (cohabiting)?*

<3> *Single, separated/divorced/civil union dissolved or widowed/civil partner died*?

<2> *Neither of these;*

<1> *Prefer not to answer?*

[Q43]**.** *Which of the following describes your household's total annual income after tax and compulsory deductions, from all sources? If you don't know the exact figure, please give an estimate.*

<1> *Less than £10,858*

<2> *£10,858 to under £14,548*

<3> *£14,548 to under £18,132*

<4> *£18,132 to under £21,715*

<5> *£21,715 to under £25,994*

<6> *£25,994 to under £30,754*

<7> *£30,754 to under £36,691*

<8> *£36,691 to under £44,714*

<9> *£44,714 to under £58,620*

<10> *£58,620 or more*

<11> *Prefer not to answer*

Thank you, that completes the interview. To check that all of the interviews I do are genuine, our office staff will call back about 10% of the people that we interview. You won't be contacted for any other reason as a result of taking part. To allow us to do this, please could you tell me:

(i) Your name _____

(ii) Contact telephone number _____

INTERVIEWER DECLARATION: I declare that I have carried out the interview with the named person, face-to-face, in accordance with the Market Research Society Code of Conduct.

Interviewer initials: _____

Interviewer name: _____

PART 4: TO BE COMPLETED BY THE INTERVIEWER

[Qxi]. Was the respondent alone during the interview? □ Yes □ No
[Qxii]. Do you think the respondent understood the valuation exercise (Part 2)?
□ Yes □ No
[Qxiii]. In the event that the respondent stopped the survey, do you think that the respondent [TICK ALL THAT APPLY]:
□ Did not understand the survey

□ Was annoyed by the content of the survey

□ Was annoyed by the length of the survey

□ Other: [ENTER RESPONSE AS FREE TEXT]

Appendix F.

Pre-assessment survey (T1), in-site version (June 2017).

IN-SITE VERSION: Instructions to interviewers:

7. Please read out only the text in *italics*.
8. Question numbers are indicated in squared brackets.
9. Text in capitals and/or in squared brackets represent instructions.
10. Questions Qi and Qii do not require a response from participants, but should be coded by you. Likewise the final three questions should be coded by yourself.
11. All responses should be recorded by yourself on the tablet computer, unless stated otherwise.
12. Showcards B,C,D and E will be integrated into one handout.

Introduction to interview:

INTERVIEWER: *Hello, I'm [NAME] from Marketing Means and I'm conducting a survey on how people in Plymouth relate to their local 'green' spaces like parks and woodland, and 'blue' spaces like the coast and rivers, and the effects they may have on people's health. Would you be able to spare 10 minutes to help me with this?*

IF "NO" TO INTERVIEW: END THE INTERVIEW IN THE AGREED WAY.

[Screen1a]. *Firstly, please could you tell me whether you live in Plymouth? [WE MEAN THE AREA COVERED BY PLYMOUTH CITY COUNCIL - THEY'D NEED TO PAY COUNCIL TAX TO PLYMOUTH CITY COUNCIL.]*

<1> No - CLOSE

<2> Yes - CONTINUE

IF YES TO INTERVIEW: *Great. We are interested in this area, Teat's Hill in particular and are interviewing people in the area about this. The interview is confidential, you can withdraw at any time and your survey answers will be anonymous.*

Can I just ask if you have been involved in any public or community engagement events surrounding Teat's Hill in the last 6 months?

IF "NO" CONTINUE TO CONSENT FORM

IF "YES" END THE INTERVIEW IN THE AGREED WAY.

[IF INTERVIEW PROCEEDED WITH, INTERVIEWER SHOULD ALSO CODE THE FOLLOWING AT THIS POINT]:

[Qi]. Weather [CHECK ALL THAT APPLY]: □ Sunny □ Rainy □ Cloudy □ Windy □ Hot □ Cold

[Qii]. Sex of respondent: □ Male □ Female

Consent procedure for participants (the interviewer will read the following and check corresponding boxes on their tablet device - these will also be saved as data fields).

INTERVIEWER: *Before we begin, I just need to check that you're happy with a few things. Can you confirm the following?*

[Qvii] *Firstly, can I just check that you are over 18 years old?*

IF "NO," PLEASE THANK THE RESPONDENT FOR THEIR TIME AND END THE INTERVIEW IN THE AGREED WAY.

IF "YES" SAY: [Qviii] *Secondly, do you understand that your participation is entirely voluntary and that you can withdraw at any time you wish?*

IF "NO," REMIND INTERVIEWEE THAT THEY DO NOT HAVE TO TAKE PART AND CAN WITHDRAW AT ANY TIME AND THEIR RESPONSES WILL NOT BE SAVED. REITERATE QUESTION.

IF "YES" SAY: [Qix] *Thirdly, do you understand that your data will remain confidential and secure at all times?*

IF "NO," REMIND INTERVIEWEE THAT THEY DO NOT HAVE TO TAKE PART AND CAN WITHDRAW AT ANY TIME AND THEIR RESPONSES WILL NOT BE SAVED. REITERATE QUESTION.

IF "YES" SAY: [Qx] *Lastly, do you understand that while results of the research may be published, your identity will always remain anonymous?*

IF "NO," REMIND INTERVIEWEE THAT THEY WILL NEVER BE ABLE TO BE IDENTIFIED FROM THE RESPONSES THEY GIVE. REITERATE QUESTION.

IF "YES" SAY: *If you have no further questions, we can begin the interview.*

[FOR EACH "YES" RESPONSE GIVEN, CHECK THE CORRESPONDING BOX ON THE TABLET INTERFACE].

Main interview script. Note that arrowed brackets indicate the number which should be used in the data file. Includes debrief and showcards.

PART 1: GREEN AND BLUE SPACES

This section will ask you about 'green' spaces like parks and woodland, and 'blue' spaces like the coast and rivers, and any visits you've made to Teat's Hill.

[Q1]. *In the last 12 months, how often, on average, have you spent your leisure time at green and blue spaces? This does not include indoor locations, places which you visit as part of your job, or private locations such as your own garden, land, pond, or swimming pool. Would you say it was:*

<6> *Every day*

<5> *Several times a week*

<4> *Once a week*

<3> *Once or twice a month*

<2> *A few times in the last 12 months; or*

<1> *Not in the last 12 months*

[Q2]. *And in the last 4 weeks, how many times have you visited Teat's Hill? This could include stopping there or just passing through. It can also be the beach or the park area* [INDICATE THIS USING SHOWCARD A]*. Would you say it was:*

<1> *Not at all in the last four weeks* [**ASK Q3 BUT THEN SKIP TO PART 2**]

<2> *Once or twice in the last four weeks*

<3> *Once a week; or*

<4> *Several times a week*

Has the Sutton Harbour bridge closure affected how often you visit Teat's Hill?

<2> Yes

<1> No

[Q3]. *Overall, how would you describe the quality of this location? Would you say it was:*

<5> *Very good*

<4> *Good*

<3> *Neither good, nor bad*

<2> *Bad; or*

<1> *Very bad*

SKIP TO PART 2 IF Q2='Not at all in last few weeks'

You'll now be asked a few more details about your most recent visit in your leisure time to Teat's Hill. This could be anything from a few minutes to all day.

[Q4]. *Firstly, before today, on what date did your most recent visit to Teat's Hill take place?*

<INSERT DATE ON TABLET AS DD/MM/YYYY>

[Q5]. *And approximately how much time did you spend at Teat's Hill?*

<ENTER PARTICIPANTS RESPONSE IN MINUTES>

[E.G. "AN HOUR AND A HALF" WOULD BE 90"]

[Q6]. *On this visit which of these activities, if any, was the main activity you did?* [SHOW LIST ON TABLET. SELECT ONE ONLY]

.

<1> Walking with a dog

<2> Walking without a dog

<3> Playing with children

<4> Informal games and sport (e.g. Frisbee, bat and ball, beach ball)

<5> Running

<6> Cycling

<7> Fishing (including angling, crabbing)

<8> Swimming

<9> Sunbathing

<10> Quiet activities (e.g. reading)

<11> Eating or drinking

<12> Socialising with friends

<13> Conservation activity (e.g. litter-picking)

<14> Any other activity not in the list

[Q7]. *How many adults, aged 16 and over, including yourself, were on this visit?* [DO NOT READ RESPONSE OPTIONS, JUST CODE ANSWER].

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

[Q8]. *And how many children aged under 16 were on this visit?*

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

<NONE>

How much do you agree with the following statements below about your most recent visit to Teat's Hill? You can answer on a scale from 1 meaning 'strongly disagree' to 7 meaning 'strongly agree'.

[Q9]. *"I was satisfied with the visit"*
[Q10]. *"I felt part of nature"*
[Q11]. *"I felt safe (i.e. protected from danger)"*
[Q12]. *"The area was free from litter/vandalism"*
[Q13]. *"There were good facilities"*

<1> Strongly disagree
<2> Disagree
<3> Slightly disagree
<4> Neither agree nor disagree
<5> Slightly agree
<6> Agree
<7> Strongly agree
Don't know/ Can't say

[DO NOT READ RESPONSE OPTIONS INDIVIDUALLY. SAME REPSONSE OPTIONS FOR EACH ITEM. REMIND RESPONDENT OF RESPONSE OPTIONS IF NEEDED].

PART 2: TEAT'S HILL RENOVATION

We are now going to talk more about Teat's Hill, its current condition, and a potential renovation project in the area. [PROVIDE HANDOUT WITH SHOWCARDS B,C,D AND E ON IT].

- *As you can see from these photos, Teat's Hill has a beach, park, and children's area.* [POINT TO PHOTOS 1-3]
- *Teat's Hill is home to wildlife on land and in the sea. These include: birds, fish and seals.* [POINT TO PHOTO 4]
- *Over recent years, Teat's Hill has suffered damage, which has affected access, facilities and the environmental quality of the site.*
- *The current condition of Teat's Hill is shown in the following photos.*
- *There has been damage to the public slipway and access points.* [POINT TO PHOTO 5]
- *There has been a build-up of litter on the beach and in the water, including plastic and glass.* [POINT TO PHOTOS 6 AND 7]

[Q14]. Were you aware of the condition of Teat's Hill before this interview?

<2> Yes

<1> No

- *As a result of the condition of Teat's Hill, Plymouth City Council and a research team are thinking about a project that would improve Teat's Hill. The project would be called the Teat's Hill Renovation Project.*
- *The project would focus on three main areas of improvement: environmental quality, access and facilities. The proposed plans for the project are shown here.*

SHOW CARD C , AND GIVE THE RESPONDENT TIME TO READ THROUGH – OR READ IT TO THEM IF REQUESTED

- *The Teat's Hill renovation project would be organised by a number of institutions.*

SHOW CARD D

- *These institutions have all contributed towards the project, however more funding is required to put the plans into action.*
- *One possible way of financing this project is through the establishment of an independent charitable organisation, called the Plymouth Parks Foundation.*
- *The Plymouth Parks Foundation would raise funds for the improvement of outdoor spaces across Plymouth. Teat's Hill would be the first outdoor space to be improved.*
- *All Plymouth households would be asked to contribute a one off payment to the Plymouth Parks Foundation fund. This payment could be made by cash, cheque or direct debit.*
- *All contributions to the fund would go directly towards the practical renovation of Teat's Hill, not towards administration or maintenance. Maintenance costs will be covered by Plymouth City Council.*

[Q15]. *Considering the benefits of this project for you and your household, what is the maximum that you would be willing to contribute to this fund, as a one off payment, for these improvements? If the overall funds people state they are willing to contribute in this survey do not cover the costs of the project, the plans cannot be put into action.*

Before you decide on your contribution, please carefully consider whether the cost is acceptable to your household. When considering this, keep in mind your household budget and all the other demands you have on your budget.

SHOW CARD E ON TABLET AND ASK RESPONDENT TO RESPOND USING THE TABLET.

[Q16]. *How difficult was it for you to come to a decision regarding the amount of money you would be willing to contribute to the Plymouth Parks Foundation fund? Would you say it was:*

<1> Very Difficult

<2> Difficult

<3> Neutral

<4> Easy

<5> Very Easy

[Q17]. *Which one of these areas of improvement is most important to you? Please select one area of improvement only.* [POINT TO CARD C].

<1> Environmental quality

<2> Access

<3> Facilities

For the next question, we would like you to answer how strongly you agree with the following statements about your contribution to the Teat's Hill renovation project. You can answer on a scale from 1 meaning 'Strongly Disagree' to 7 meaning 'Strongly Agree'.

[Q18]. *"I have the right to enjoy the improvements to Teat's Hill, and should not have to pay extra for the renovation".*
[Q19]. *"I don't want to pay for the Teat's Hill renovation project, as I don't go there".*
[Q20]. *"Any improvements to Teat's Hill are not important to me"*
[Q21]. *"I object to the Teat's Hill renovation project going ahead, under any circumstances".*
[Q22]. *"I approve of the Teat's Hill renovation project but I object to paying into the 'Plymouth Parks Foundation' fund for it".*

<1> Strongly disagree
<2> Disagree
<3> Slightly disagree
<4> Neither agree nor disagree
<5> Slightly agree
<6> Agree
<7> Strongly agree

PART 3: BACKGROUND INFORMATION

This final section asks you some background information about yourself, your household and your family. The questions are not meant to be intrusive, but will assist in understanding the kinds of people who visit green and blue spaces. Again, the survey is anonymous – we will not be able to identify you as an individual.

[Q23]. *Firstly, how old are you?*

[ENTER A WHOLE NUMBER]

[Q24]. *Do you have a dog?*

<2> Yes

<1> No

[DO NOT READ RESPONSE OPTIONS]

[Q25]. *And which of the following best applies to you?*

<4> *I have access to a private garden*

<3> *I have access to a private communal garden*

<2> *I have access to a private outdoor space, but not a garden (e.g. balcony, yard, patio area)*

<1> *I don't have access to a private garden or outdoor space*

[Q26]. *Including yourself, how many people – including children – live in your house regularly as members of the household?*

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

Refused

[Q27 – ASK ONLY IF Q26>1]. *And how many of these are children that are aged under 16?*

<0> 0
<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

Refused

We would now like you to tell us a little about your health in general. We are interested in your health so that we can explore any links between general levels of health and the kinds of environments people spend their leisure time in. Please remember that your responses will not be linked to yourself or your home location.

For these four questions, I will ask you how satisfied you are and you can respond on a scale of 0 to 10 where 0 means 'not at all satisfied' and 10 means completely satisfied.

[Q28]. *Firstly, all things considered, how satisfied are you with your life as a whole nowadays?*

[Q29]. *Secondly, how satisfied are you with your health?*

[Q30]. *Thirdly, how satisfied are you with how safe you feel?*

[Q31]. *Lastly, how satisfied are you with feeling part of your community?*

<0> Not at all satisfied
<1>
<2>
<3>
<4>
<5>

<6>
<7>
<8>
<9>
<10> Completely satisfied
Refused

[DO NOT READ RESPONSE OPTIONS]

Please indicate for each of the following five statements which is closest to how you have been feeling over the last two weeks. You can choose from: At no time, some of the time, less than half of the time, more than half of the time, most of the time, or all of the time.
ROTATE STATEMENTS (TABLET WILL HANDLE THIS AUTOMATICALLY]

[Q32]. *"I have felt cheerful and in good spirits"*
[Q33]., *"I have felt calm and relaxed"*
[Q34]. *"I have felt active and vigorous"*
[Q35]. *"I woke up feeling fresh and rested"*
[Q36]. *"My daily life has been filled with things that interest me"*

<1> At no time

<2> Some of the time

<3> Less than half of the time

<4> More than half of the time

<5> Most of the time

<6> All of the time

Refused

[REMIND RESPONDENT OF RESPONSE OPTIONS IF NEEDED]

[Q37]. *How is your health in general? Would you say it is:*

<5> *Very good*

<4> *Good*

<3> *Fair*

<2> *Bad, or*

<1> *Very bad*

Refused

[Q38]. *During the last 7 days, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?* [DO NOT READ RESPONSE OPTIONS]

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> None

Refused

[Q39]. *Which of these descriptions applies to what you have been doing for the last 7 days? Please select only one.* [SHOW LIST TO RESPONDENT ON TABLET - DO NOT READ RESPONSE OPTIONS]
<1> In paid work (or away temporarily) (employee, self-employed, working for your family business)
<2> In education, (not paid for by employer) even if on vacation

<3> Unemployed and actively looking for a job

<4> Unemployed, wanting a job but not actively looking for a job

<5> Permanently sick or disabled

<6> Retired

<7> Doing housework, looking after children, or other persons

<8> Other

<9> Don’t know

[Q40]. *Do you think you belong to a minority ethnic group in the UK?* [DO NOT READ OUT RESPONSE OPTIONS]

<2> Yes
<1> No
<3> Don't know
<4> Prefer not to answer

[Q41]. *And which of the following best describes your marital status now?*

<4> *Married, in a civil union, or living with your partner (cohabiting)?*

<3> *Single, separated/divorced/civil union dissolved or widowed/civil partner died*?

<2> *Neither of these;*

<1> *Prefer not to answer?*

[Q42]**.** *Which of the following describes your household's total annual income after tax and compulsory deductions, from all sources? If you don't know the exact figure, please give an estimate.*

<1> *Less than £10,858*

<2> *£10,858 to under £14,548*

<3> *£14,548 to under £18,132*

<4> *£18,132 to under £21,715*

<5> *£21,715 to under £25,994*

<6> *£25,994 to under £30,754*

<7> *£30,754 to under £36,691*

<8> *£36,691 to under £44,714*

<9> *£44,714 to under £58,620*

<10> *£58,620 or more*

<11> *Prefer not to answer*

[Q43c]. [IF YES TO Screen1a] *And how many years have you lived in Plymouth?*

[Q43d]. [IF YES TO Screen1a] *Could you tell me the name of the street you live on, and the part of Plymouth where you live? This will only be used for the purposes of measuring how far you live from Teat's Hill.*

<ENTER RESPONSE AS FREE TEXT – IF THEY REFUSE TO GIVE A STREET NAME ASK THEM TO AT LEAST TELL YOU THE PART OF PLYMOUTH THAT THEY LIVE IN>

Thank you, that completes the interview. To check that all of the interviews I do are genuine, our office staff will call back about 10% of the people that we interview. You won't be contacted for any other reason as a result of taking part. To allow us to do this, please could you tell me:

(i) Your name _____

(ii) Contact telephone number _____

INTERVIEWER DECLARATION: I declare that I have carried out the interview with the named person, face-to-face, in accordance with the Market Research Society Code of Conduct.

Interviewer initials: _____

Interviewer name: _____

PART 4: TO BE COMPLETED BY THE INTERVIEWER

[Qxi]. Was the respondent alone during the interview? □ Yes □ No

[Qxii]. Do you think the respondent understood the valuation exercise (Part 2)? □ Yes □ No

[Qxiii]. In the event that the respondent stopped the survey, do you think that the respondent [TICK ALL THAT APPLY]:

□ Did not understand the survey

□ Was annoyed by the content of the survey

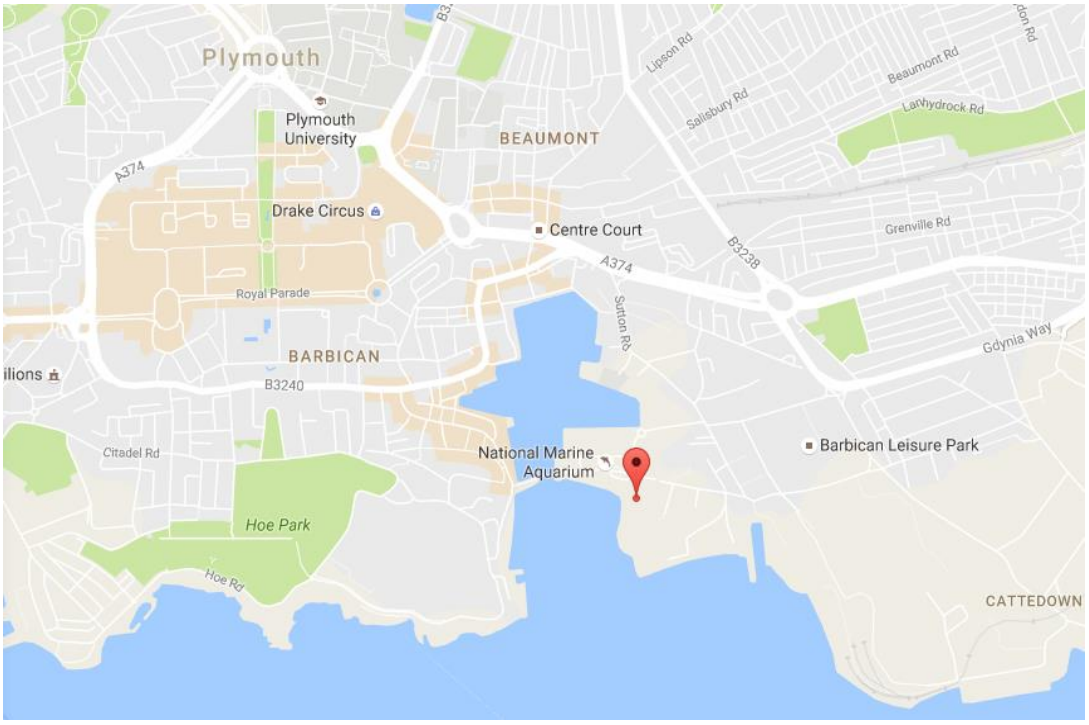
□ Was annoyed by the length of the survey

□ Other: [ENTER RESPONSE AS FREE TEXT]

Appendix G.

Show cards and debrief for pre-assessment (June 2017).

CARD A: Location of Teat's Hill.



CARD B: Photos of Teat's Hill (April 2017)

PHOTO 1:

PHOTO 2:

PHOTO 3:

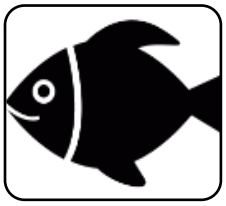
PHOTO 4:

PHOTO 5:

PHOTO 6:

PHOTO 7:

CARD C: Table showing potential improvements to Teat's Hill, as part of the Teat's Hill renovation project. There are three areas of improvement: environmental quality, access and facilities.

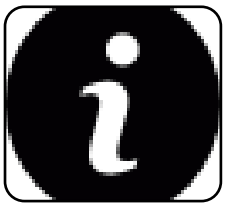


Improvements to environmental quality:

- Conservation efforts and clean-ups to remove litter and debris from the beach.
- Reducing pollution and risks to wildlife.

Increased access to the coast for recreation:

- Improvements to paths and access throughout the site to allow pedestrian, buggy, wheelchair and mobility scooter access.



Improvements to facilities:

- Improve seating area and viewing points over Plymouth Sound and the Barbican.
- Improve park and children's play area for families.
- New signs and education boards throughout the site, describing the local environment and history of the area.

CARD D: list of institutions involved

- Plymouth City Council

- Plymouth University

- National Marine Aquarium

- Plymouth Marine Laboratory

- University of Exeter

CARD E: Payment Card

Please select the amount on this card which most closely relates to how much you would contribute to the fund.

	One-off contribution	
○	0	<0>
○	£1	<1>
○	£2	<2>
○	£5	<5>
○	£10	<10>
○	£15	<15>
○	£20	<20>
○	£30	<30>
○	£40	<40>
○	£50	<50>
○	£75	<75>
○	£100	<100>
○	£150	<150>
○	£200	<200>
○	£300	<300>
○	£400	<400>
○	Over £400	<999>

Debrief:

Thank you for taking part. The interview's main aim was to find out how people use Teat's Hill. The findings will help us understand how better access to, and contact with, natural spaces is associated with better health in Plymouth, Devon.

We asked you to give a figure indicating how much money you would be willing to contribute to "parks and recreation" fund. To reassure you, the improvements will be going ahead regardless and will be undergoing public consultations which you can partake in. You will not have to pay any money into a fund for these improvements. The purpose of the question was so that we can compare the figure you give with monetary estimations of changes in health that are experienced as a result of the renovation of Teat's Hill.

Do you have any questions?

If you wish to know about the outcomes of the survey, please email Dr Lewis Elliott on L.R.Elliott@exeter.ac.uk.

If you have any complaints about the way in which this study has been carried out please contact Marketing Means and the Chair of the University of Exeter Medical School Research Ethics Committee:

Marketing Means

Email: info@marketingmeans.co.uk

Ruth Garside, PhD

Chair of the UEMS Research Ethics Committee

Email: uemsethics@exeter.ac.uk

[PROVIDE DETAILS ON BUSINESS CARD].

Appendix H.

Post-assessment survey (T2), door-stepping version (June 2018).

DOORSTEP VERSION_FINAL: Instructions to interviewers:

13. Please read out only the text in *italics*.
14. Question numbers are indicated in squared brackets.
15. Text in capitals and/or in squared brackets represent instructions.
16. Questions Qi and Qii do not require a response from participants, but should be coded by you. Likewise the final three questions should be coded by yourself.
17. All responses should be recorded by yourself on the tablet computer, unless stated otherwise.
18. Showcards will be integrated into one handout.

Introduction to interview:

INTERVIEWER: *Hello, I'm [NAME] from Marketing Means and I'm conducting a survey on behalf of Plymouth City Council and various other organisations across the South-West.*

Did you receive the leaflet that we delivered to your home about the Teat's Hill project? [SHOW LEAFLET AND RESPOND TO Qiii].

IF "YES": *Did you have a look at the link that was mentioned on the leaflet?* [RESPOND TO Qiv]

IF "NO": [READ LONGER TEXT IN PARAGRAPH BELOW]

IF "YES": *Great, then you already know a bit about the project. Are you able to help me with an interview about this? It should only take a maximum of 15 minutes.*

IF "NO" TO INITIAL QUESTION: *No problem at all, we will tell you a bit more about the project. We are interested in how people in Plymouth relate to their local 'green' spaces like parks and woodland, and 'blue' spaces like the coast and rivers, and the effects they may have on people's health. We are interested in Teat's Hill in particular and are interviewing people in the area about this. The interview is confidential, you can withdraw at any time and your survey answers*

will be anonymous. Are you able to help me with an interview about this? It should only take a maximum of 15 minutes.

IF “NO” TO INTERVIEW: END THE INTERVIEW IN THE AGREED WAY.

[IF INTERVIEW IS PROCEEDED WITH, INTERVIEWER SHOULD ALSO CODE THE FOLLOWING AT THIS POINT]:

[Qi]. Weather [CHECK ALL THAT APPLY]: □ Sunny □ Rainy □ Cloudy □ Windy □ Hot □ Cold

[Qii]. Sex of respondent: □ Male □ Female

[Qiii]. Saw postcard? □ Yes □ No

[Qiv]. Visited link? □ Yes □ No

[Qv]. Door knock attempts: [ENTER NUMBER – by checking the number of previous calls on the address contact record sheet]

Consent procedure for participants (the interviewer will read the following and check corresponding boxes on their tablet device - these will also be saved as data fields).

INTERVIEWER: *Before we begin, I just need to check that you're happy with a few things. Can you confirm the following?*

[Qvii] *Firstly, can I just check that you are over 18 years old?*

IF "NO," PLEASE THANK THE RESPONDENT FOR THEIR TIME AND END THE INTERVIEW IN THE AGREED WAY.

IF "YES" SAY: [Qviii] *Secondly, do you understand that your participation is entirely voluntary and that you can withdraw at any time you wish?*

IF "NO," REMIND INTERVIEWEE THAT THEY DO NOT HAVE TO TAKE PART AND CAN WITHDRAW AT ANY TIME AND THEIR RESPONSES WILL NOT BE SAVED. REITERATE QUESTION.

IF "YES" SAY: [Qix] *Thirdly, do you understand that your data will remain confidential and secure at all times?*

IF "NO," REMIND INTERVIEWEE THAT THEY DO NOT HAVE TO TAKE PART AND CAN WITHDRAW AT ANY TIME AND THEIR RESPONSES WILL NOT BE SAVED. REITERATE QUESTION.

IF "YES" SAY: [Qx] *Lastly, do you understand that while results of the research may be published, your identity will always remain anonymous?*

IF "NO," REMIND INTERVIEWEE THAT THEY WILL NEVER BE ABLE TO BE IDENTIFIED FROM THE RESPONSES THEY GIVE. REITERATE QUESTION.

IF "YES" SAY: *If you have no further questions, we can begin the interview.*

[FOR EACH "YES" RESPONSE GIVEN, CHECK THE CORRESPONDING BOX ON THE TABLET INTERFACE].

Main interview script. Note that arrowed brackets indicate the number which should be used in the data file. Includes debrief and showcards.

PART 1: GREEN AND BLUE SPACES

This section will ask you about 'green' spaces like parks and woodland, and 'blue' spaces like the coast and rivers, and any visits you've made to Teat's Hill.

[Q1]. *In the last 12 months, how often, on average, have you spent your leisure time at green and blue spaces? This does not include indoor locations, places which you visit as part of your job, or private locations such as your own garden, land, pond, or swimming pool. Would you say it was:*

<6> *Every day*

<5> *Several times a week*

<4> *Once a week*

<3> *Once or twice a month*

<2> A few times *in the last 12 months; or*

<1> *Not in the last 12 months*

[Q2]. *And in the last 4 weeks, how many times have you visited Teat's Hill? This could include stopping there or just passing through. It can also be the beach or the park area* [INDICATE THIS USING SHOWCARD A]*. Would you say it was:*

<1> *Not at all in the last four weeks* [**ASK Q3 BUT THEN SKIP TO PART 2**]

<2> *Once or twice in the last four weeks*

<3> *Once a week; or*

<4> *Several times a week*

Has the Sutton Harbour bridge closure affected how often you visit Teat's Hill?

<1> Yes

<0> No

[Q3]. *Overall, how would you describe the quality of this location? Would you say it was:*

<5> *Very good*

<4> *Good*

<3> *Neither good, nor bad*

<2> *Bad; or*

<1> *Very bad*

SKIP TO PART 2 IF Q2='Not at all in last few weeks'

You'll now be asked a few more details about your most recent visit in your leisure time to Teat's Hill. This could be anything from a few minutes to all day.

[Q4]. *Firstly, before today, on what date did your most recent visit to Teat's Hill take place?*

<INSERT DATE ON TABLET AS DD/MM/YYYY>

[Q5]. *And approximately how much time did you spend at Teat's Hill?*

<ENTER PARTICIPANTS RESPONSE IN MINUTES>

[E.G. "AN HOUR AND A HALF" WOULD BE 90"]

[Q5a] *Is there a particular feature of Teats Hill that motivates you to visit and/or use the space?*

<1> *The open air theatre seating*
<2> *The beach*
<3> *Pathways*
<4> *Views/scenery*
<5> *Play area*
<6> *Open grass area*
<7> *Other*

[Q6]. *On this visit which of these activities, if any, was the main activity you did?* [SHOW LIST ON TABLET. SELECT ONE ONLY]

<1> Walking with a dog

<2> Walking without a dog

<3> Playing with children

<4> Informal games and sport (e.g. Frisbee, bat and ball, beach ball)

<5> Running

<6> Cycling

<7> Fishing (including angling, crabbing)

<8> Swimming

<9> Sunbathing

<10> Quiet activities (e.g. reading)

<11> Eating or drinking

<12> Socialising with friends

<13> Conservation activity (e.g. litter-picking)

<14> Any other activity not in the list

[Q7]. *How many adults, aged 16 and over, including yourself, were on this visit?* [DO NOT READ RESPONSE OPTIONS, JUST CODE ANSWER].

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

[Q8]. *And how many children aged under 16 were on this visit?*

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

<11> None

How much do you agree with the following statements below about your most recent visit to Teat's Hill? You can answer on a scale from 1 meaning 'strongly disagree' to 7 meaning 'strongly agree'.

[Q9]. *"I was satisfied with the visit"*
[Q10]. *"I felt part of nature"*
[Q11]. *"I felt safe (i.e. protected from danger)"*
[Q12]. *"The area was free from litter/vandalism"*
[Q13]. *"There were good facilities"*

<1> Strongly disagree
<2> Disagree
<3> Slightly disagree
<4> Neither agree nor disagree
<5> Slightly agree
<6> Agree
<7> Strongly agree
Don't know/ Can't say

[DO NOT READ RESPONSE OPTIONS INDIVIDUALLY. SAME REPSONSE OPTIONS FOR EACH ITEM. REMIND RESPONDENT OF RESPONSE OPTIONS IF NEEDED].

PART 2: TEAT'S HILL RENOVATION

We are now going to talk more about Teat's Hill, its current condition, and a renovation project in the area. [PROVIDE HANDOUT WITH SHOWCARDS B, C ,D, E, F, AND G ON IT].

- *As you can see from these photos, Teat's Hill has a beach, park, and children's area.* [SHOW CARD B, POINT TO PHOTOS 1-3]

- *Teat's Hill is home to wildlife on land and in the sea. These include: birds, fish and seals.* [POINT TO PHOTO 4]

- *Over recent years, Teat's Hill suffered damage, which affected the environmental quality, access and facilities at the site.*

- *This led to the establishment of the Teat's Hill renovation project, a project which improved the Teat's Hill green space during Spring 2018.*

- *I am now going to show you a series of before and after photos to show you the changes made as part of the Teat's Hill renovation project.*

- *The project improved the environmental quality of the site by organising regular beach cleans to remove litter from the site and by planting a wildflower meadow* [SHOW CARD C].

- *The project improved paths and access to the site to allow pedestrian, buggy, wheelchair and mobility scooter access.* [SHOW CARD D].

- *The project also improved existing facilities and added new facilities to the site.* [SHOW CARD E].

- *A small open air theatre was carved from the existing slopes surrounding the slipway for community events and outdoor teaching. The theatre also acts as a viewpoint over Plymouth Sound and the Barbican. The children's play area was also improved, with the addition of a new piece of play equipment, themed around the nautical history of the area. New signs and education boards were also added throughout the site, which describe the local environment and history of the area.*

- *The Teat's Hill renovation project was organised by a number of institutions.* [SHOW CARD F].

- *The institutions contributed towards the project, however more funding is required to maintain the quality of the site.*

- *One possible way of financing the maintenance of the site is through the establishment of an independent charitable organisation, called the Plymouth Parks Foundation.*

- *The Plymouth Parks Foundation would raise funds for the maintenance of outdoor spaces across Plymouth, including Teat's Hill.*

- *All Plymouth households would be asked to contribute a one off payment to the Plymouth Parks Foundation fund. This payment could be made by cash, cheque or direct debit.*

- *All contributions to the fund in the first instance would go directly towards the maintenance of Teat's Hill.*

[Q14]. *Were you aware of the improvements to Teat's Hill before this interview?*

<2> Yes

<1> No

[Q15]. *Considering the benefits of this site for you and your household, what is the maximum that you would be willing to contribute to this fund, as a one off payment, for the maintenance of Teat's Hill? If the overall funds people state they are willing to contribute do not cover the costs of maintenance, the plans cannot be put into action.*

Before you decide on your contribution, please carefully consider whether the cost is acceptable to your household. When considering this, keep in mind your household budget and all the other demands you have on your budget.

[SHOW CARD G ON TABLET AND ASK RESPONDENT TO RESPOND USING THE TABLET.]

[Q16]. *How difficult was it for you to come to a decision regarding the amount of money you would be willing to contribute to the Plymouth Parks Foundation fund?*

<1> Very Difficult

<2> Difficult

<3> Neutral

<4> Easy

<5> Very Easy

[Q17]. *Which type of improvement is most important to you? Please select one area of improvement only.* [REFER RESPONDENT BACK TO CARDS C, D AND E.]

<1> Environmental quality

<2> Access

<3> Facilities

For the next questions, we would like you to answer how strongly you agree with the following statements about your contribution to the maintenance of Teats Hill. You can answer on a scale from 1 meaning 'Strongly Disagree' to 7 meaning 'Strongly Agree'.

[Q18]. "*I have the right to enjoy the improvements to Teat's Hill, and should not have to pay extra for the maintenance of the site".*

[Q19]. *"I don't want to pay for the maintenance of the Teat's Hill site, as I don't go there".*

[Q20]. *"The maintenance of Teat's Hill is not important to me"*

[Q21] *"I object to the maintenance of Teat's Hill, under any circumstances"*

[Q22]. *"I approve of efforts to maintain the Teat's Hill site, but I object to paying into the 'Plymouth Parks Foundation' fund for it".*

<1> Strongly disagree
<2> Disagree
<3> Slightly disagree
<4> Neither agree nor disagree
<5> Slightly agree
<6> Agree
<7> Strongly agree

PART 3: BACKGROUND INFORMATION

This final section asks you some background information about yourself, your household and your family. The questions are not meant to be intrusive, but will assist in understanding the kinds of people who visit green and blue spaces. Again, the survey is anonymous – we will not be able to identify you as an individual.

[Q23]. *Firstly, how old are you?*

[ENTER A WHOLE NUMBER]

[Q24]. *Do you have a dog?*

<2> Yes

<1> No

[DO NOT READ RESPONSE OPTIONS]

[Q25]. *And how many years have you lived in Plymouth?*

[ENTER A WHOLE NUMBER]

[Q26]. *And which of the following best applies to you?*

<4> *I have access to a private garden*

<3> *I have access to a private communal garden*

<2> *I have access to a private outdoor space, but not a garden (e.g. balcony, yard, patio area)*

<1> *I don't have access to a private garden or outdoor space*

[Q27]. *Including yourself, how many people – including children – live in your house regularly as members of the household?*

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

Refused

[Q28 – ASK ONLY IF Q27>1]. *And how many of these are children that are aged under 16?*

<0> 0
<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

Refused

We would now like you to tell us a little about your health in general. We are interested in your health so that we can explore any links between general levels of health and the kinds of environments people spend their leisure time in. Please remember that your responses will not be linked to yourself or your home location..

For these four questions, I will ask you how satisfied you are and you can respond on a scale of 0 to 10 where 0 means 'not at all satisfied' and 10 means completely satisfied.

[Q29]. *Firstly, all things considered, how satisfied are you with your life as a whole nowadays?*

[Q30]. *Secondly, how satisfied are you with your health?*

[Q31]. *Thirdly, how satisfied are you with how safe you feel?*

[Q32]. *Lastly, how satisfied are you with feeling part of your community?*

<0> Not at all satisfied
<1>
<2>
<3>
<4>
<5>
<6>
<7>
<8>
<9>
<10> Completely satisfied
Refused

[DO NOT READ RESPONSE OPTIONS]

Please indicate for each of the following five statements which is closest to how you have been feeling over the last two weeks. You can choose from: At no time, some of the time, less than half of the time, more than half of the time, most of the time, or all of the time.
ROTATE STATEMENTS [TABLET WILL HANDLE THIS AUTOMATICALLY]

[Q33]. *"I have felt cheerful and in good spirits"*
[Q34].*, "I have felt calm and relaxed"*

[Q35]., *"I have felt active and vigorous"*
[Q36]., *"I woke up feeling fresh and rested"*
[Q37]. , *"My daily life has been filled with things that interest me"*

<1> At no time

<2> Some of the time

<3> Less than half of the time

<4> More than half of the time

<5> Most of the time

<6> All of the time

Refused

[REMIND RESPONDENT OF RESPONSE OPTIONS IF NEEDED]

[Q38]. *How is your health in general? Would you say it is:*

<5> *Very good*

<4> *Good*

<3> *Fair*

<2> *Bad, or*

<1> *Very bad*

Refused

[Q39]. *During the last 7 days, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?* [DO NOT READ RESPONSE OPTIONS]

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8>None

Refused

[Q40]. *Which of these descriptions applies to what you have been doing for the last 7 days? Please select only one.* [SHOW LIST TO RESPONDENT ON TABLET - DO NOT READ RESPONSE OPTIONS]
<1> In paid work (or away temporarily) (employee, self-employed, working for your family business)
<2> In education, (not paid for by employer) even if on vacation

<3> Unemployed and actively looking for a job

<4> Unemployed, wanting a job but not actively looking for a job

<5> Permanently sick or disabled

<6> Retired

<7> Doing housework, looking after children, or other persons

<8> Other

<9> Don’t know

[Q40a]. *What is the highest level of education that you have completed?*

<1> I have no formal qualifications

<2> GCSEs / O-levels

<3> A-levels / International Baccalaureate

<4> Diploma / NVQ / other technical qualification

<5> Undergraduate degree

<6> Master’s degree (or higher)

[Q41]. *Do you think you belong to a minority ethnic group in the UK?* [DO NOT READ OUT RESPONSE OPTIONS]

<2> Yes
<1> No
<3> Don't know

<4> Prefer not to answer

[Q42]. *And which of the following best describes your marital status now?*

<4> *Married, in a civil union, or living with your partner (cohabiting)?*

<3> *Single, separated/divorced/civil union dissolved or widowed/civil partner died*?

<2> *Neither of these;*

<1> *Prefer not to answer?*

[Q43]**.** *Which of the following describes your household's total annual income after tax and compulsory deductions, from all sources? If you don't know the exact figure, please give an estimate.*

<1> *Less than £10,858*

<2> *£10,858 to under £14,548*

<3> *£14,548 to under £18,132*

<4> *£18,132 to under £21,715*

<5> *£21,715 to under £25,994*

<6> *£25,994 to under £30,754*

<7> *£30,754 to under £36,691*

<8> *£36,691 to under £44,714*

<9> *£44,714 to under £58,620*

<10> *£58,620 or more*

<11> *Prefer not to answer*

[Q43a]**.** *Has your income changed since last year?*

<1> *Yes*
<2> *No*

[Q43b]**.** *Which of the following describes your household's total annual income after tax and compulsory deductions, from all sources in 2017? If you don't know the exact figure, please give an estimate.*

<1> *Less than £10,858*

<2> *£10,858 to under £14,548*

<3> *£14,548 to under £18,132*

<4> *£18,132 to under £21,715*

<5> *£21,715 to under £25,994*

<6> *£25,994 to under £30,754*

<7> *£30,754 to under £36,691*

<8> *£36,691 to under £44,714*

<9> *£44,714 to under £58,620*

<10> *£58,620 or more*

<11> *Prefer not to answer*

[Q44]. *Would you be willing to take part in any of the following activities to help maintain and care for the Teat's Hill green space?* [CHECK ANY THAT APPLY]

<1> *Activities, for example beach cleans and wildlife improvements (e.g. sowing wild flowers)*

<2> *Activities as a 'friend' of the Teat's Hill site, undertaking maintenance and supporting future improvements (e.g. attending community meetings and carrying out habitat management and litter picks)*

SKIP TO THANK YOU IF NEITHER ARE SELECTED

[Q45]. *How often would you be willing to volunteer to maintain and care for the Teat's Hill green space?*

<1> A few times a year

<2> Every month

<3> Every week

[Q46]. Approximately how many hours would you be willing to volunteer each year/month/week [READ AS APPROPRIATE].

<INTERVIEWER ENTERS NUMBER OF HOURS>

Thank you that completes the interview. To check that all of the interviews I do are genuine, our office staff will call back about 10% of the people that we interview. You won't be contacted for any other reason as a result of taking part. To allow us to do this, please could you tell me:

(i) Your name _____

(ii) Contact telephone number _____

INTERVIEWER DECLARATION: I declare that I have carried out the interview with the named person, face-to-face, in accordance with the Market Research Society Code of Conduct.

Interviewer initials: _____

Interviewer name: _____

PART 4: TO BE COMPLETED BY THE INTERVIEWER

[Qxi]. Was the respondent alone during the interview? □ Yes □ No

[Qxii]. Do you think the respondent understood the valuation exercise (Part 2)? □ Yes □ No

[Qxiii]. In the event that the respondent stopped the survey, do you think that the respondent [TICK ALL THAT APPLY]:

□ Did not understand the survey

□ Was annoyed by the content of the survey

□ Was annoyed by the length of the survey

□ Other: [ENTER RESPONSE AS FREE TEXT]

Appendix I.

Post-assessment survey (T2), in-site version (June 2018).

IN-SITE VERSION: Instructions to interviewers:

19. Please read out only the text in *italics*.
20. Question numbers are indicated in squared brackets.
21. Text in capitals and/or in squared brackets represent instructions.
22. Questions Qi and Qii do not require a response from participants, but should be coded by you. Likewise the final three questions should be coded by yourself.
23. All responses should be recorded by yourself on the tablet computer, unless stated otherwise.
24. Showcards will be integrated into one handout.

Introduction to interview:

INTERVIEWER: *Hello, I'm [NAME] from Marketing Means and I'm conducting a survey on how people in Plymouth relate to their local 'green' spaces like parks and woodland, and 'blue' spaces like the coast and rivers, and the effects they may have on people's health. Would you be able to spare 10 minutes to help me with this?*

IF "NO" TO INTERVIEW: END THE INTERVIEW IN THE AGREED WAY.

[Screen1a]. *Firstly, please could you tell me whether you live in Plymouth? [WE MEAN THE AREA COVERED BY PLYMOUTH CITY COUNCIL - THEY'D NEED TO PAY COUNCIL TAX TO PLYMOUTH CITY COUNCIL.]*

<1> No - CLOSE

<2> Yes - CONTINUE

IF YES TO INTERVIEW: *Great. We are interested in this area, Teat's Hill in particular and are interviewing people in the area about this. The interview is confidential, you can withdraw at any time and your survey answers will be anonymous.*

[IF INTERVIEW PROCEEDED WITH, INTERVIEWER SHOULD ALSO CODE THE FOLLOWING AT THIS POINT]:

[Qi]. Weather [CHECK ALL THAT APPLY]: □ Sunny □ Rainy □ Cloudy □ Windy □ Hot □ Cold

[Qii]. Sex of respondent: □ Male □ Female

Consent procedure for participants (the interviewer will read the following and check corresponding boxes on their tablet device - these will also be saved as data fields).

INTERVIEWER: *Before we begin, I just need to check that you're happy with a few things. Can you confirm the following?*

[Qvii] *Firstly, can I just check that you are over 18 years old?*

IF "NO," PLEASE THANK THE RESPONDENT FOR THEIR TIME AND END THE INTERVIEW IN THE AGREED WAY.

IF "YES" SAY: [Qviii] *Secondly, do you understand that your participation is entirely voluntary and that you can withdraw at any time you wish?*

IF "NO," REMIND INTERVIEWEE THAT THEY DO NOT HAVE TO TAKE PART AND CAN WITHDRAW AT ANY TIME AND THEIR RESPONSES WILL NOT BE SAVED. REITERATE QUESTION.

IF "YES" SAY: [Qix] *Thirdly, do you understand that your data will remain confidential and secure at all times?*

IF "NO," REMIND INTERVIEWEE THAT THEY DO NOT HAVE TO TAKE PART AND CAN WITHDRAW AT ANY TIME AND THEIR RESPONSES WILL NOT BE SAVED. REITERATE QUESTION.

IF "YES" SAY: [Qx] *Lastly, do you understand that while results of the research may be published, your identity will always remain anonymous?*

IF "NO," REMIND INTERVIEWEE THAT THEY WILL NEVER BE ABLE TO BE IDENTIFIED FROM THE RESPONSES THEY GIVE. REITERATE QUESTION.

IF "YES" SAY: *If you have no further questions, we can begin the interview.*

[FOR EACH "YES" RESPONSE GIVEN, CHECK THE CORRESPONDING BOX ON THE TABLET INTERFACE].

Main interview script. Note that arrowed brackets indicate the number which should be used in the data file. Includes debrief and showcards.

PART 1: GREEN AND BLUE SPACES

This section will ask you about 'green' spaces like parks and woodland, and 'blue' spaces like the coast and rivers, and any visits you've made to Teat's Hill.

[Q1]. *In the last 12 months, how often, on average, have you spent your leisure time at green and blue spaces? This does not include indoor locations, places which you visit as part of your job, or private locations such as your own garden, land, pond, or swimming pool. Would you say it was:*

<6> *Every day*

<5> *Several times a week*

<4> *Once a week*

<3> *Once or twice a month*

<2> *A few times in the last 12 months; or*

<1> *Not in the last 12 months*

[Q2]. *And in the last 4 weeks, how many times have you visited Teat's Hill? This could include stopping there or just passing through. It can also be the beach or the park area* [INDICATE THIS USING SHOWCARD A]*. Would you say it was:*

<1> *Not at all in the last four weeks* [**ASK Q3 BUT THEN SKIP TO PART 2**]

<2> *Once or twice in the last four weeks*

<3> *Once a week; or*

<4> *Several times a week*

Has the Sutton Harbour bridge closure affected how often you visit Teat's Hill?

<2> Yes

<1> No

[Q3]. *Overall, how would you describe the quality of this location? Would you say it was:*

<5> *Very good*

<4> *Good*

<3> *Neither good, nor bad*

<2> *Bad; or*

<1> *Very bad*

SKIP TO PART 2 IF Q2='Not at all in last few weeks'

You'll now be asked a few more details about your most recent visit in your leisure time to Teat's Hill. This could be anything from a few minutes to all day.

[Q4]. *Firstly, before today, on what date did your most recent visit to Teat's Hill take place?*

<INSERT DATE ON TABLET AS DD/MM/YYYY>

[Q5]. *And approximately how much time did you spend at Teat's Hill?*

<ENTER PARTICIPANTS RESPONSE IN MINUTES>

[E.G. "AN HOUR AND A HALF" WOULD BE 90"]

[Q5a] Is there a particular feature of Teats Hill that motivates you to visit and/or use the space?

<1> The open air theatre seating
<2> The beach
<3> Pathways
<4> Views/scenery
<5> Play area
<6> Open grass area
<7> Other

[Q6]. *On this visit which of these activities, if any, was the main activity you did?*
[SHOW LIST ON TABLET. SELECT ONE ONLY]
.

<1> Walking with a dog

<2> Walking without a dog

<3> Playing with children

<4> Informal games and sport (e.g. Frisbee, bat and ball, beach ball)

<5> Running

<6> Cycling

<7> Fishing (including angling, crabbing)

<8> Swimming

<9> Sunbathing

<10> Quiet activities (e.g. reading)

<11> Eating or drinking

<12> Socialising with friends

<13> Conservation activity (e.g. litter-picking)

<14> Any other activity not in the list

[Q7]. *How many adults, aged 16 and over, including yourself, were on this visit?* [DO NOT READ RESPONSE OPTIONS, JUST CODE ANSWER].

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

[Q8]. *And how many children aged under 16 were on this visit?*

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

<NONE>

How much do you agree with the following statements below about your most recent visit to Teat's Hill? You can answer on a scale from 1 meaning 'strongly disagree' to 7 meaning 'strongly agree'.

[Q9]. *"I was satisfied with the visit"*
[Q10]. *"I felt part of nature"*
[Q11]. *"I felt safe (i.e. protected from danger)"*
[Q12]. *"The area was free from litter/vandalism"*
[Q13]. *"There were good facilities"*

<1> Strongly disagree
<2> Disagree
<3> Slightly disagree
<4> Neither agree nor disagree
<5> Slightly agree
<6> Agree
<7> Strongly agree
Don't know/ Can't say

[DO NOT READ RESPONSE OPTIONS INDIVIDUALLY. SAME REPSONSE OPTIONS FOR EACH ITEM. REMIND RESPONDENT OF RESPONSE OPTIONS IF NEEDED].

PART 2: TEAT'S HILL RENOVATION

We are now going to talk more about Teat's Hill, its current condition, and a renovation project in the area. [PROVIDE HANDOUT WITH SHOWCARDS B, C ,D, E, F, AND G ON IT].

- *As you can see from these photos, Teat's Hill has a beach, park, and children's area.* [SHOW CARD B, POINT TO PHOTOS 1-3]

- *Teat's Hill is home to wildlife on land and in the sea. These include: birds, fish and seals.* [POINT TO PHOTO 4]

- *Over recent years, Teat's Hill suffered damage, which affected the environmental quality, access and facilities at the site.*

- *This led to the establishment of the Teat's Hill renovation project, a project which improved the Teat's Hill green space during Spring 2018.*

- *I am now going to show you a series of before and after photos to show you the changes made as part of the Teat's Hill renovation project.*

- *The project improved the environmental quality of the site by organising regular beach cleans to remove litter from the site and by planting a wildflower meadow* [SHOW CARD C].

- *The project improved paths and access to the site to allow pedestrian, buggy, wheelchair and mobility scooter access.* [SHOW CARD D].

- *The project also improved existing facilities and added new facilities to the site.* [SHOW CARD E].

- *A small open air theatre was carved from the existing slopes surrounding the slipway for community events and outdoor teaching. The theatre also acts as a viewpoint over Plymouth Sound and the Barbican. The children's play area was also improved, with the addition of a new piece of play equipment, themed around the nautical history of the area. New signs and education boards were also added throughout the site, which describe the local environment and history of the area.*

- *The Teat's Hill renovation project was organised by a number of institutions.* [SHOW CARD F].

- *The institutions contributed towards the project, however more funding is required to maintain the quality of the site.*

- *One possible way of financing the maintenance of the site is through the establishment of an independent charitable organisation, called the Plymouth Parks Foundation.*

- *The Plymouth Parks Foundation would raise funds for the maintenance of outdoor spaces across Plymouth, including Teat's Hill.*

- *All Plymouth households would be asked to contribute a one off payment to the Plymouth Parks Foundation fund. This payment could be made by cash, cheque or direct debit.*

- *All contributions to the fund in the first instance would go directly towards the maintenance of Teat's Hill.*

[Q14]. *Were you aware of the improvements to Teat's Hill before this interview?*

<2> Yes

<1> No

[Q15]. *Considering the benefits of this site for you and your household, what is the maximum that you would be willing to contribute to this fund, as a one off payment, for the maintenance of Teat's Hill? If the overall funds people state they are willing to contribute do not cover the costs of maintenance, the plans cannot be put into action.*

Before you decide on your contribution, please carefully consider whether the cost is acceptable to your household. When considering this, keep in mind your household budget and all the other demands you have on your budget.

[SHOW CARD G ON TABLET AND ASK RESPONDENT TO RESPOND USING THE TABLET.]

[Q16]. *How difficult was it for you to come to a decision regarding the amount of money you would be willing to contribute to the Plymouth Parks Foundation fund?*

<1> Very Difficult

<2> Difficult

<3> Neutral

<4> Easy

<5> Very Easy

[Q17]. *Which type of improvement is most important to you? Please select one area of improvement only.* [REFER RESPONDENT BACK TO CARDS C, D AND E.]

<1> Environmental quality

<2> Access

<3> Facilities

For the next questions, we would like you to answer how strongly you agree with the following statements about your contribution to the maintenance of Teats Hill. You can answer on a scale from 1 meaning 'Strongly Disagree' to 7 meaning 'Strongly Agree'.

[Q18]. "*I have the right to enjoy the improvements to Teat's Hill, and should not have to pay extra for the maintenance of the site".*

[Q19]. *"I don't want to pay for the maintenance of the Teat's Hill site, as I don't go there".*

[Q20]. *"The maintenance of Teat's Hill is not important to me"*

[Q21] "*I object to the maintenance of Teat's Hill, under any circumstances"*

[Q22]. *"I approve of efforts to maintain the Teat's Hill site, but I object to paying into the 'Plymouth Parks Foundation' fund for it".*

<1> Strongly disagree
<2> Disagree
<3> Slightly disagree
<4> Neither agree nor disagree
<5> Slightly agree
<6> Agree
<7> Strongly agree

PART 3: BACKGROUND INFORMATION

This final section asks you some background information about yourself, your household and your family. The questions are not meant to be intrusive, but will assist in understanding the kinds of people who visit green and blue spaces. Again, the survey is anonymous – we will not be able to identify you as an individual.

[Q23]. *Firstly, how old are you?*

[ENTER A WHOLE NUMBER]

[Q24]. *Do you have a dog?*
<2> Yes

<1> No

[DO NOT READ RESPONSE OPTIONS]

[Q25]. *And which of the following best applies to you?*

<4> *I have access to a private garden*

<3> *I have access to a private communal garden*

<2> *I have access to a private outdoor space, but not a garden (e.g. balcony, yard, patio area)*

<1> *I don't have access to a private garden or outdoor space*

[Q26]. *Including yourself, how many people – including children – live in your house regularly as members of the household?*

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

Refused

[Q27 – ASK ONLY IF Q26>1]. *And how many of these are children that are aged under 16?*

<0> 0

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> 8

<9> 9

<10> 10 or more

Refused

We would now like you to tell us a little about your health in general. We are interested in your health so that we can explore any links between general levels of health and the kinds of environments people spend their leisure time in. Please remember that your responses will not be linked to yourself or your home location.

For these four questions, I will ask you how satisfied you are and you can respond on a scale of 0 to 10 where 0 means 'not at all satisfied' and 10 means completely satisfied.

[Q28]. *Firstly, all things considered, how satisfied are you with your life as a whole nowadays?*

[Q29]. *Secondly, how satisfied are you with your health?*

[Q30]. *Thirdly, how satisfied are you with how safe you feel?*

[Q31]. *Lastly, how satisfied are you with feeling part of your community?*

<0> Not at all satisfied
<1>
<2>
<3>
<4>
<5>
<6>
<7>

<8>
<9>
<10> Completely satisfied
Refused

[DO NOT READ RESPONSE OPTIONS]

Please indicate for each of the following five statements which is closest to how you have been feeling over the last two weeks. You can choose from: At no time, some of the time, less than half of the time, more than half of the time, most of the time, or all of the time.
ROTATE STATEMENTS (TABLET WILL HANDLE THIS AUTOMATICALLY]

[Q32]. *"I have felt cheerful and in good spirits"*
[Q33]., *"I have felt calm and relaxed"*
[Q34]. *"I have felt active and vigorous"*
[Q35]. *"I woke up feeling fresh and rested"*
[Q36]. *"My daily life has been filled with things that interest me"*

<1> At no time

<2> Some of the time

<3> Less than half of the time

<4> More than half of the time

<5> Most of the time

<6> All of the time

Refused

[REMIND RESPONDENT OF RESPONSE OPTIONS IF NEEDED]

[Q37]. *How is your health in general? Would you say it is:*

<5> *Very good*

<4> *Good*

<3> *Fair*

<2> *Bad, or*

<1> *Very bad*

Refused

[Q38]. *During the last 7 days, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?* [DO NOT READ RESPONSE OPTIONS]

<1> 1

<2> 2

<3> 3

<4> 4

<5> 5

<6> 6

<7> 7

<8> None

Refused

[Q39]. *Which of these descriptions applies to what you have been doing for the last 7 days? Please select only one.* [SHOW LIST TO RESPONDENT ON TABLET - DO NOT READ RESPONSE OPTIONS]
<1> In paid work (or away temporarily) (employee, self-employed, working for your family business)
<2> In education, (not paid for by employer) even if on vacation

<3> Unemployed and actively looking for a job

<4> Unemployed, wanting a job but not actively looking for a job

<5> Permanently sick or disabled

<6> Retired

<7> Doing housework, looking after children, or other persons

<8> Other

<9> Don’t know

[Q40]. *Do you think you belong to a minority ethnic group in the UK?* [DO NOT READ OUT RESPONSE OPTIONS]

<2> Yes
<1> No
<3> Don't know
<4> Prefer not to answer

[Q40a]. *What is the highest level of education that you have completed?*

<1> I have no formal qualifications

<2> GCSEs / O-levels

<3> A-levels / International Baccalaureate

<4> Diploma / NVQ / other technical qualification

<5> Undergraduate degree

<6> Master's degree (or higher)

[Q41]. *And which of the following best describes your marital status now?*

<4> *Married, in a civil union, or living with your partner (cohabiting)?*

<3> *Single, separated/divorced/civil union dissolved or widowed/civil partner died*?

<2> *Neither of these;*

<1> *Prefer not to answer?*

[Q42]**.** *Which of the following describes your household's total annual income after tax and compulsory deductions, from all sources? If you don't know the exact figure, please give an estimate.*

<1> *Less than £10,858*

<2> *£10,858 to under £14,548*

<3> *£14,548 to under £18,132*

<4> *£18,132 to under £21,715*

<5> *£21,715 to under £25,994*

<6> *£25,994 to under £30,754*

<7> *£30,754 to under £36,691*

<8> *£36,691 to under £44,714*

<9> *£44,714 to under £58,620*

<10> *£58,620 or more*

<11> *Prefer not to answer*

[Q43a]**.** *Has your income changed since last year?*

<1> *Yes*
<2> *No*

[Q43b]**.** *Which of the following describes your household's total annual income after tax and compulsory deductions, from all sources in 2017? If you don't know the exact figure, please give an estimate.*

<1> *Less than £10,858*

<2> *£10,858 to under £14,548*

<3> *£14,548 to under £18,132*

<4> *£18,132 to under £21,715*

<5> *£21,715 to under £25,994*

<6> *£25,994 to under £30,754*

<7> *£30,754 to under £36,691*

<8> *£36,691 to under £44,714*

<9> *£44,714 to under £58,620*

<10> *£58,620 or more*

<11> *Prefer not to answer*

[Q43c]. [IF YES TO Screen1a] *And how many years have you lived in Plymouth?*

[Q43d]. [IF YES TO Screen1a] *Could you tell me the name of the street you live on, and the part of Plymouth where you live? This will only be used for the purposes of measuring how far you live from Teat's Hill.*

<ENTER RESPONSE AS FREE TEXT – IF THEY REFUSE TO GIVE A STREET NAME ASK THEM TO AT LEAST TELL YOU THE PART OF PLYMOUTH THAT THEY LIVE IN>

[Q44]. *Would you be willing to take part in any of the following activities to help maintain and care for the Teat's Hill green space?* [CHECK ANY THAT APPLY]

<1> *Activities, for example beach cleans and wildlife improvements (e.g. sowing wild flowers)*

<2> *Activities as a 'friend' of the Teat's Hill site, undertaking maintenance and supporting future improvements (e.g. attending community meetings and carrying out habitat management and litter picks)*

SKIP TO THANK YOU IF NEITHER ARE SELECTED

[Q45]. *How often would you be willing to volunteer to maintain and care for the Teat's Hill green space?*

<1> A few times a year

<2> Every month

<3> Every week

[Q46]. Approximately how many hours would you be willing to volunteer each year/month/week [READ AS APPROPRIATE].

<INTERVIEWER ENTERS NUMBER OF HOURS>

Thank you, that completes the interview. To check that all of the interviews I do are genuine, our office staff will call back about 10% of the people that we interview. You won't be contacted for any other reason as a result of taking part. To allow us to do this, please could you tell me:

(i) Your name _____

(ii) Contact telephone number _____

INTERVIEWER DECLARATION: I declare that I have carried out the interview with the named person, face-to-face, in accordance with the Market Research Society Code of Conduct.

Interviewer initials: _____

Interviewer name: _____

PART 4: TO BE COMPLETED BY THE INTERVIEWER

[Qxi]. Was the respondent alone during the interview? □ Yes □ No
[Qxii]. Do you think the respondent understood the valuation exercise (Part 2)?
□ Yes □ No
[Qxiii]. In the event that the respondent stopped the survey, do you think that the respondent [TICK ALL THAT APPLY]:
□ Did not understand the survey

□ Was annoyed by the content of the survey

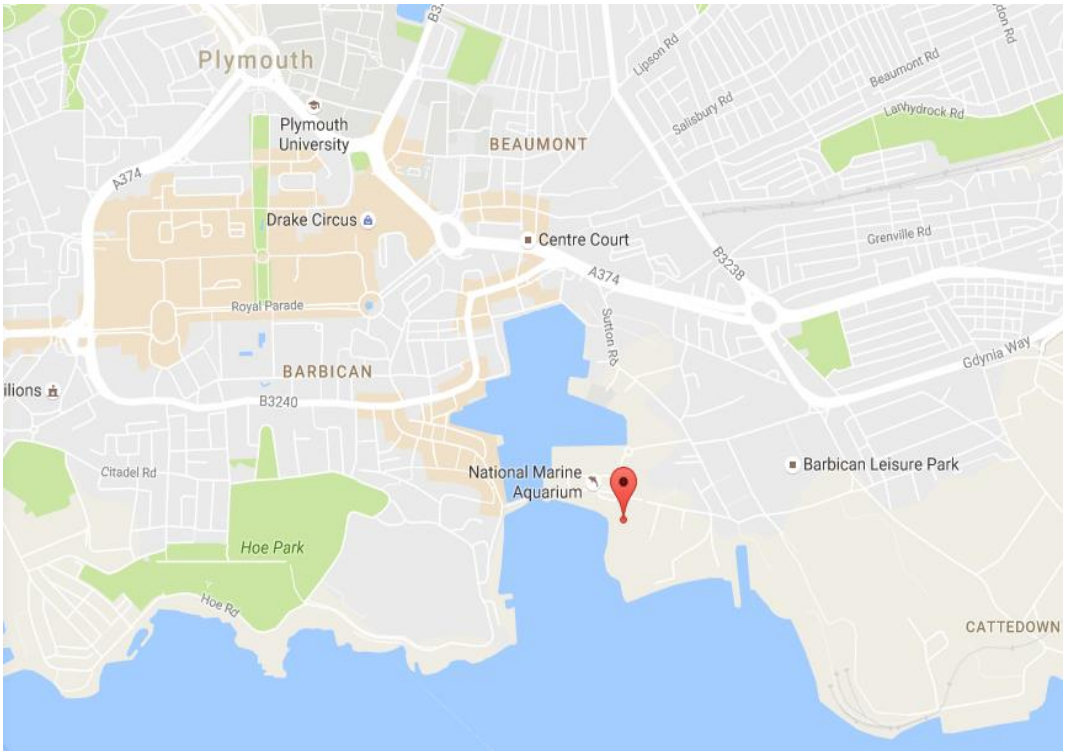
□ Was annoyed by the length of the survey

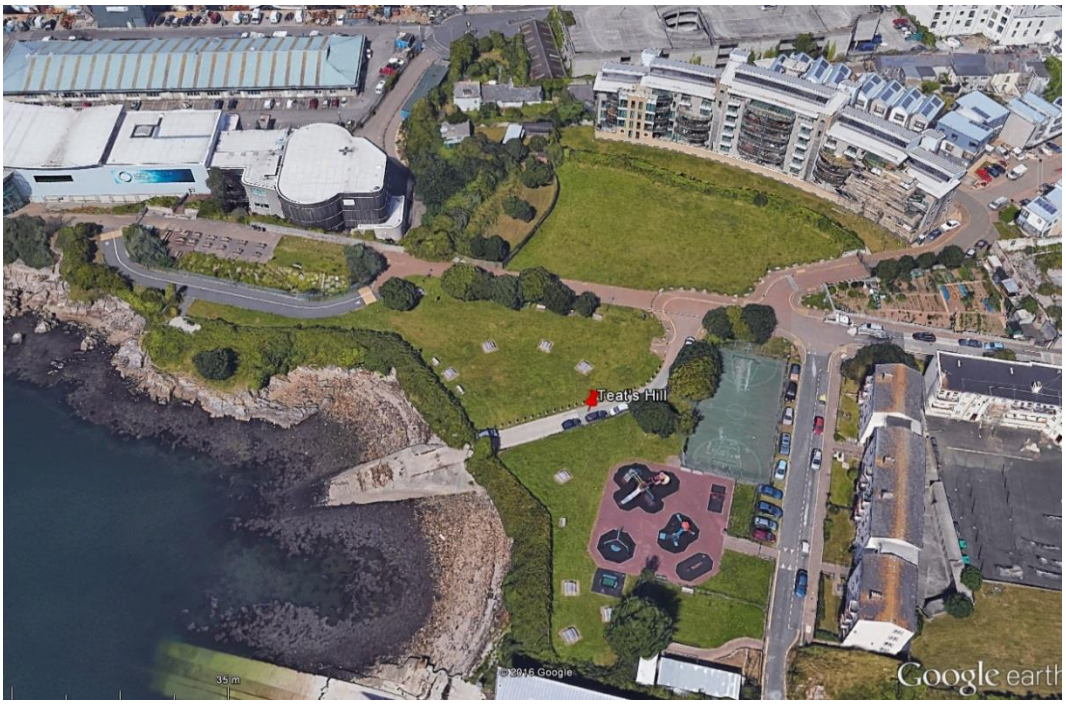
□ Other: [ENTER RESPONSE AS FREE TEXT]

Appendix J.

Show cards for post-assessment (June 2018).

CARD A: Location of Teat's Hill.





CARD B: Photos of Teat's Hill (April 2017)

PHOTO 1:

PHOTO 2:

PHOTO 3:

PHOTO 4:

Environmental Quality

Card C: Environmental quality- Before (2017) and After (2018).

Before renovation (2017)	After renovation (2018)
	
	

Card D: Access- Before (2017) and After (2018)

Access

Before renovation (2017)	After renovation (2018)
	
	

Facilities

Before renovation (2017)	After renovation (2018)
	
	

Facilities

Card E: Facilities- Before (2017) and After (2018)

Before renovation (2017)	After renovation (2018)
	 

CARD F: list of institutions involved in the Teat's Hill renovation project

- Plymouth City Council

- Plymouth University

- National Marine Aquarium

- Plymouth Marine Laboratory

- University of Exeter

CARD G: Payment Card

Please select the amount on this card which most closely relates to how much you would contribute to the fund.

	One-off contribution	
○	0	<0>
○	£1	<1>
○	£2	<2>
○	£5	<5>
○	£10	<10>
○	£15	<15>
○	£20	<20>
○	£30	<30>
○	£40	<40>
○	£50	<50>
○	£75	<75>
○	£100	<100>
○	£150	<150>
○	£200	<200>
○	£300	<300>
○	£400	<400>
○	Over £400	<999>

Debrief:

Thank you for taking part. The interview's main aim was to find out how people use Teat's Hill. The findings will help us understand how better access to, and contact with, natural spaces is associated with better health in Plymouth, Devon.

We asked you to give a figure indicating how much money you would be willing to contribute to "parks and recreation" fund. To reassure you, the improvements will be going ahead regardless and will be undergoing public consultations which you can partake in. You will not have to pay any money into a fund for these improvements. The purpose of the question was so that we can compare the figure you give with monetary estimations of changes in health that are experienced as a result of the renovation of Teat's Hill.

Do you have any questions?

If you wish to know about the outcomes of the survey, please email Dr Lewis Elliott on L.R.Elliott@exeter.ac.uk.

If you have any complaints about the way in which this study has been carried out please contact Marketing Means and the Chair of the University of Exeter Medical School Research Ethics Committee:

Marketing Means

Email: info@marketingmeans.co.uk

Ruth Garside, PhD

Chair of the UEMS Research Ethics Committee

Email: uemsethics@exeter.ac.uk

[PROVIDE DETAILS ON BUSINESS CARD].

Appendix K.

Ethical Approval letter from the University of Exeter Medical School Research Ethics Committee (1/7/2017).

Please reply to:

Ruth Garside, PhD

Chair, UEMS Research Ethics Committee

University of Exeter Medical School

c/o Carol Barkle

Administrator to UEMS REC

Knowledge Spa

Royal Cornwall Hospital

TRURO

Cornwall

TR1 3HD

Tel: 01872 256460
Email: c.barkle@exeter.ac.uk

Our Ref: RG/ME/16/11/112

1st June 2017

Lewis Elliott

University of Exeter

Knowledge Spa

Royal Cornwall Hospital

Truro

Cornwall

TR1 3HD

Dear Lewis

Application Number: 16/11/112 (1)

Project Title: The marine environment, human well-being and environmental valuation

I am writing to confirm that I have reviewed and approved this project under Chair's Action and have pleasure in enclosing your Certificate of Approval.

Approval of my action will be formally ratified by the University of Exeter Medical School Research Ethics Committee at its next meeting on the 29th June 2017

Good luck with your study.

Yours sincerely

Ruth Garside, PhD
Chair
University of Exeter Medical School Research Ethics Committee

University of Exeter Medical School Knowledge Spa Royal Cornwall Hospital Truro Cornwall TR1 3HD UK

Tel +44 (0)1872 256460 Email : c.barkle@exeter.ac.uk

Pro Vice Chancellor and Dean **Professor Clive Ballard**

Appendix L.

Certificate of Ethical Approval from the University of Exeter Medical School Research Ethics Committee (1/7/2017).

University of Exeter Medical School Research Ethics Committee

Certificate of Ethical Approval

Research Institute/Centre: European Centre for Environment and Human Health

Title of Project: The marine environment, human well-being and environmental valuation

Name(s) of Project Research Team member(s): Lewis Elliott, James Grellier, Mathew White, Caroline Hattam, Rebecca Shellock and Tobias Borger

Project Contact Point: Lewis Elliott

This project has been approved for the period

From: February 2017

To: June 2020

University of Exeter Medical School
Research Ethics Committee approval reference: Nov16/B/112

Signature: 

Date: 01 June 2017

Name of Chair:
Ruth Garside, PhD

Your attention is drawn of the attached paper "Guidance for Researchers when Ethics Committee approval is given", which reminds the researcher of information that needs to be observed when Ethics Committee approval is given.

Application Reference Number 16/10/107

Appendix M.

Sample characteristics for full sample of respondents (n=314).

	Survey sample (n)	Mean / %	SD
Age (years)	309	46.86	19.17
Male (%)	314	48.41	-
Household size (people)	312	2.51	1.39
Work status (%)			
Employed	306	f49.35	-
Unemployed	306	5.88	-
Retired	306	8.82	-
In education	306	25.49	-
Otherwise not working	306	10.46	-
Long term relationship status (%)			
In long relationship	232	41.38	-
Other	232	58.62	-
Total household annual income (£ GBP)	167	22,447.02	16,078.98

Appendix N.

Summary of responses to protest statements (Likert scale: Strongly disagree to Strongly agree). Results displayed for all respondents, regardless of their WTP response.

	Protest statement 1		Protest statement 2	
	Frequency	**%**	**Frequency**	**%**
Strongly disagree	6	2.01	23	7.72
Disagree	29	9.7	44	14.77
Slightly disagree	17	5.69	32	10.74
Neither agree nor disagree	45	15.05	34	11.41
Slightly agree	49	16.39	35	11.74
Agree	71	23.75	47	15.77
Strongly agree	82	27.42	83	27.85
Total	299	-	298	-

Appendix O.

Results of descriptive analysis examining different criteria for identifying protest responses.

Identification rule	Number of protest responses	% of protest responses	Sample remaining (N)
Agree to one or more protest statements	130	43.48	169
Agree to both protest statements	98	32.78	201
Strongly agree to one or more protest statements	94	31.44	205
Strongly agree to both protest statements[a]	57	19.06	242

[a] Identification rule selected for the analysis

Appendix P.

Table displaying all variables examined for inclusion in the final regression models.

Variable name	Alternative format
Log income	Income Income disclosure
Age	Age^2
Distance in km	
Employed	Employment status
Children in household	Number of children in the household
Male	
Number of years living in Plymouth	Living in Plymouth since birth
Recent visit	Frequency of visit
Aware of condition	
Survey method	

Appendix Q.

Spearman's correlation matrix (n=225) for the CVM, including income disclosure.

	Age	Male	Distance in km	Employment status	Stated income	Aware of condition	Recent visit	Years in Plymouth	Method
Age	1.000								
Male	-0.078	1.000							
Distance in km	-0.257***	0.021	1.000						
Employment status	0.456***	-0.010	-0.206***	1.000					
Stated income	-0.198***	0.028	0.038	-0.153**	1.000				
Aware of condition	-0.084	0.019	0.022	0.009	-0.051	1.000			
Recent visit	0.067	0.072	-0.211***	0.112*	0.031	0.025	1.000		
Years in Plymouth	0.668***	-0.020	-0.057	0.231***	-0.233***	-0.079	-0.048	1.000	
Method	-0.186***	0.027	0.590***	0.103	0.107	-0.016	0.173***	-0.222***	1.000

Spearman's correlation

***, **, * mean significant at the 1%-, 5%- and 10%-level, respectively

Appendix R.

Spearman's correlation matrix (n=131) for the CVM, including Log Income.

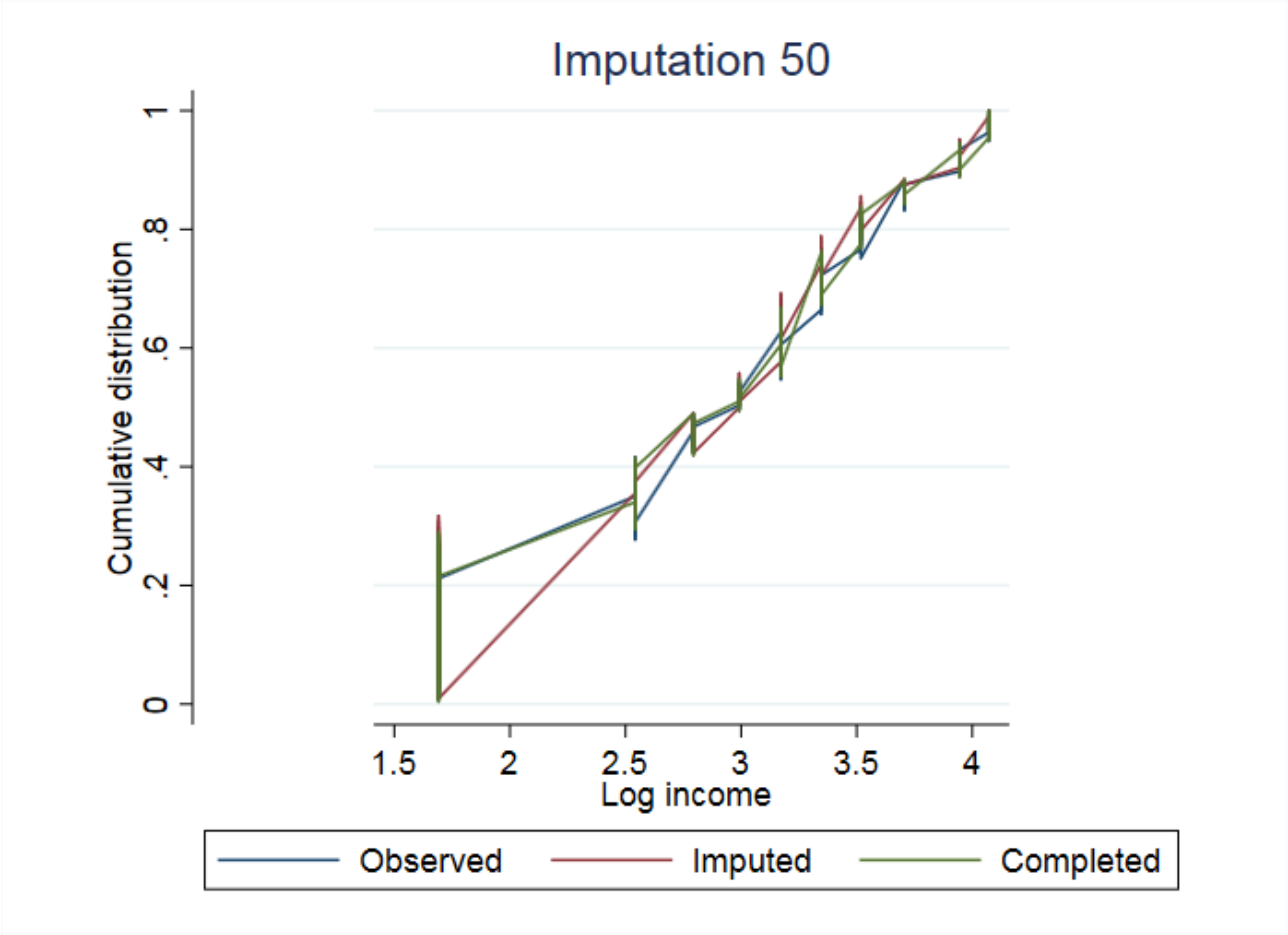
	Age	Male	Distance in km	Employment status	Log income	Awareness of condition	Recent visit	Years in Plymouth	Method
Age	1.000								
Male	-0.146*	1.000							
Distance in km	-0.264***	0.028	1.000						
Employment status	0.324***	-0.009	-0.255***	1.000					
Log income	0.141	0.049	-0.003	-0.358***	1.000				
Awareness of condition	-0.129	-0.024	-0.030	-0.034	-0.035	1.000			
Recent visit	0.039	-0.040	-0.296***	0.036	-0.095	-0.105	1.000		
Years in Plymouth	0.632***	-0.103	-0.020	0.085	0.028	-0.110	-0.104	1.000	
Method	-0.197**	0.057	0.617***	0.082	-0.020	-0.179**	0.056	-0.210	1.000

Spearman's correlation

***, **, * mean significant at the 1%-, 5%- and 10%-level, respectively

Appendix S.

Diagnostic plot for the sample following Multiple Imputation (MICE). Plot displayed for log income and is based on the 50th imputation ($m = 50$).



Appendix T.

Results of post-estimation tests for the OLS regression.

The post-estimation tests indicated that the OLS model was specified correctly, based on the results from two tests. The first was the Ramset RESET test, which tests the null hypothesis that the model has no omitted variables ($F_{(3,120)}$=0.52, p=0.669). The second was the link test, $\hat{y}_2$ which detects specification error and works on the principle that additional explanatory variables should not be able to be found by chance. It generates the variable $\hat{y}_2$ (variable of squared prediction), which should not be significant. $\hat{y}_2$ was not significant ($\hat{y}_2$ t=0.11, p=0.913), therefore the model was specified correctly. There were also no issue of multicollinearity, tested using Variance Inflation Factors (VIF; Mean VIF=1.51). The skewness and kurtosis test for normality and Shapiro-Wilk test (z=7.648, p=0.000) indicated that the residuals were not normally distributed (p=0.000). This may be as a result of the dependent variable (amount of WTP) or explanatory variables (e.g. income) and does not prevent unbiased estimates of regression coefficients being obtained. The models were also identified to be heteroscedastic (Breusch-Pagan/Cook-Weisberg test; χ^2= 29.06, p=0.000), indicating that the variance of the residuals was not constant and therefore violated one of the assumptions of OLS regression. To account for this, all three types of regression model (OLS, Tobit and Probit) were reported using heteroscedasticity-robust standard errors (StataCorp, 2013). Overall, the model appeared in most senses to be accurate for the sample and generalizable to the population.

Appendix U.

Means, proportion (%) and standard deviations of socio-demographic variables for the sample (max n=643). This is compared to the mean statistics for 7 LSOAs and Plymouth Unitary Authority.

	Survey sample			7 LSOAs (mean)[a]	Plymouth Unitary Authority (mean)[a]
	N	Mean/ %	SD		
Age	637	46.93	18.73	35.56	38.96
Male (%)	643	46.03	0.50	52.79	49.41
Household size	640	2.48	1.36	2.21	2.29
Work status (%)					
Employed	634	49.85	-	61.68	57.72
Unemployed	634	6.62	-	5.96	4.24
In education	634	6.78	-	11.86	13.01
Other inactive	634	36.75	-	20.50	25.02
Long term relationship status (%)					
In term long relationship	558	47.13	-	30.90	43.13
Other	558	52.87	-	69.10	56.87
Total household annual income	298	20,915.08[b]	14,518.51	20,162.00[c]	20,162.00[d]

[a] Data derived from the UK Census (2011; retrieved from UK Census Data 2011a,b) http://www.ukcensusdata.com)

[b] Household annual income after tax (mid-point in £)

[c] Data unavailable for income at the LSOA scale. Used total annual income before tax (2011; retrieved from UK Census Data 2011c)

[d] Data unavailable for annual income after tax. Used total annual income before tax (2011; retrieved from UK Census Data, 2011c).

Appendix V.

List of potential explanatory variables tested within the model.

Variable name	Alternative format
Log income	Income
Log equivalised disposable household income	Equivalised disposable household income
Age	Age^2
Distance in km	Distance (categories)
Employment status	Employed
Number of children in household	Children in household (dummy)
Male	
Recent visit	Frequency of visit (categories)
General health	Good health (dummy)
Survey method	
Minority ethnic group (dummy)	

Appendix W.

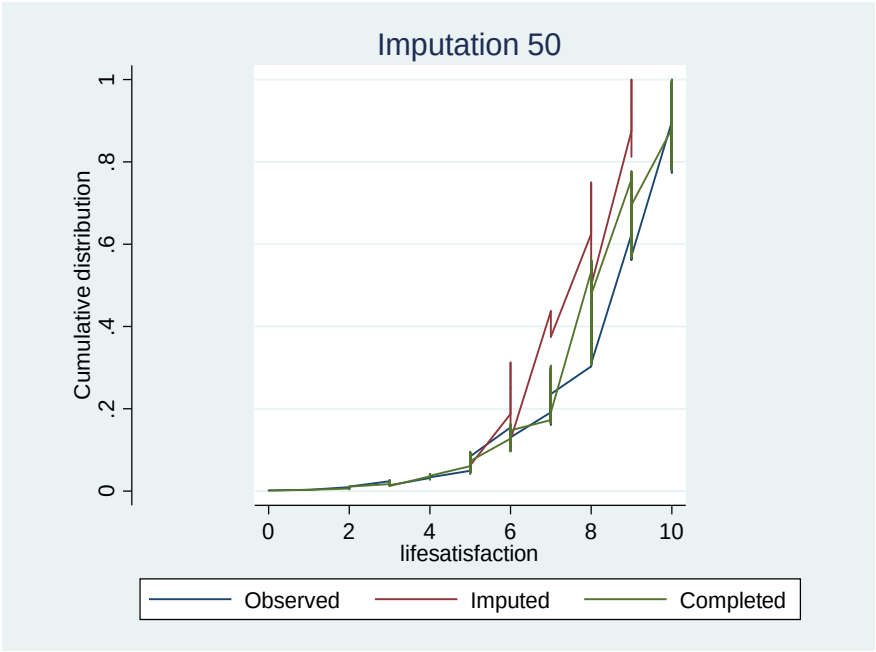
Spearman's correlation matrix (n=220) for the LSA.

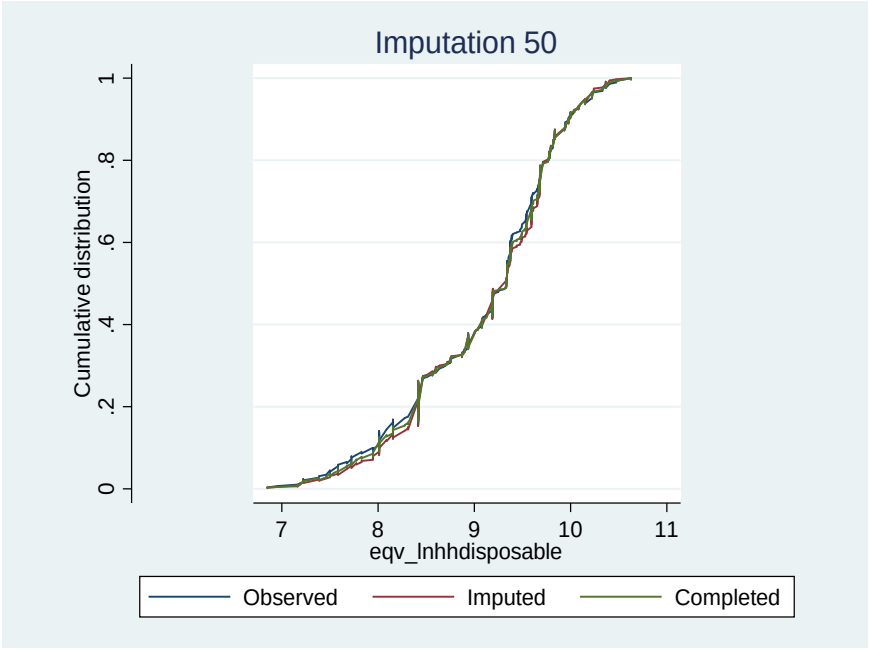
	Regeneration	Distance in km	Male	Age	Long term relationship	Employment status	Equivalised household income	Recent visit	Physical activity	General health	Access to private outdoor space	Dog owner	No of children in household
Regeneration	1.000												
Distance in km	0.044	1.000											
Male	-0.038	0.148**	1.000										
Age	0.119*	-0.174***	-0.197***	1.000									
Long term relationship	0.117*	0.001	0.051	0.102	1.000								
Employment status	0.055	-0.140**	-0.123*	0.403***	-0.068	1.000							
Equivalised household income	0.050	-0.028	0.095	0.166**	0.264***	-0.286***	1.000						
Recent visit	-0.025	-0.175***	-0.059	-0.010	-0.062	-0.018	-0.033	1.000					
Physical activity	-0.237***	0.099	0.126	-0.216***	0.051	-0.118*	0.094	0.127*	1.000				
General health	-0.064	0.194***	0.139**	-0.305***	0.126*	-0.298***	0.264***	0.124*	0.271***	1.000			
Access to private outdoor space	0.037	-0.056	-0.154**	0.166**	0.245***	0.029	0.177***	0.001	-0.019	0.043	1.000		
Dog owner	-0.261***	0.101	0.081	-0.026	-0.057	-0.032	-0.073	0.119*	0.135*	-0.061	-0.024	1.000	
No of children in household	-0.130*	0.053	-0.134**	-0.340***	0.147**	-0.163**	-0.230***	0.107	0.083	0.127*	-0.209***	0.132*	1.000

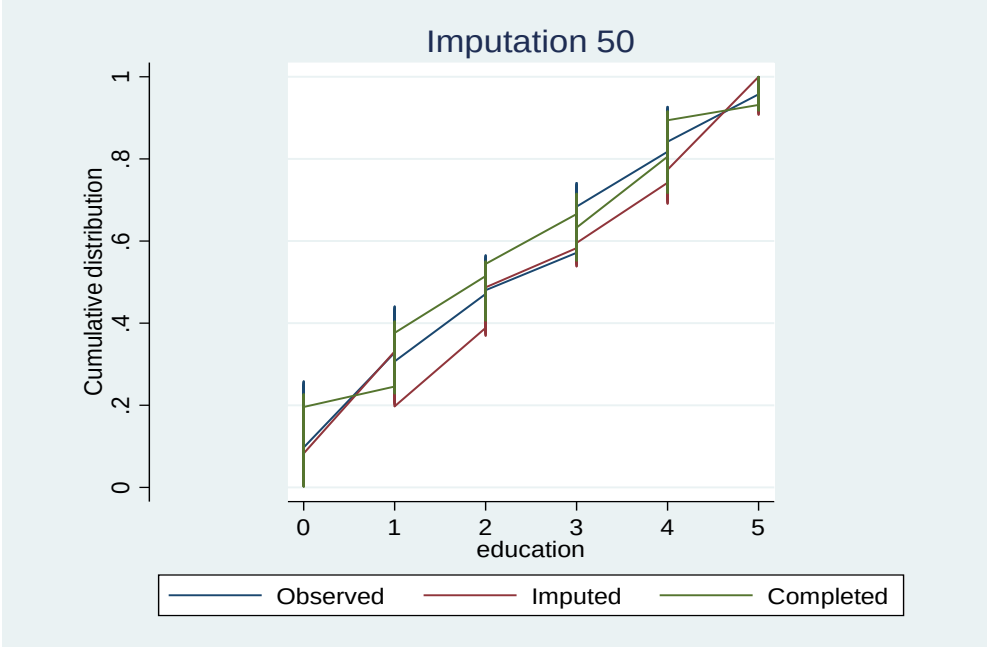
Spearman's correlation
***, **, * mean significant at the 1%-, 5%- and 10%-level, respectively

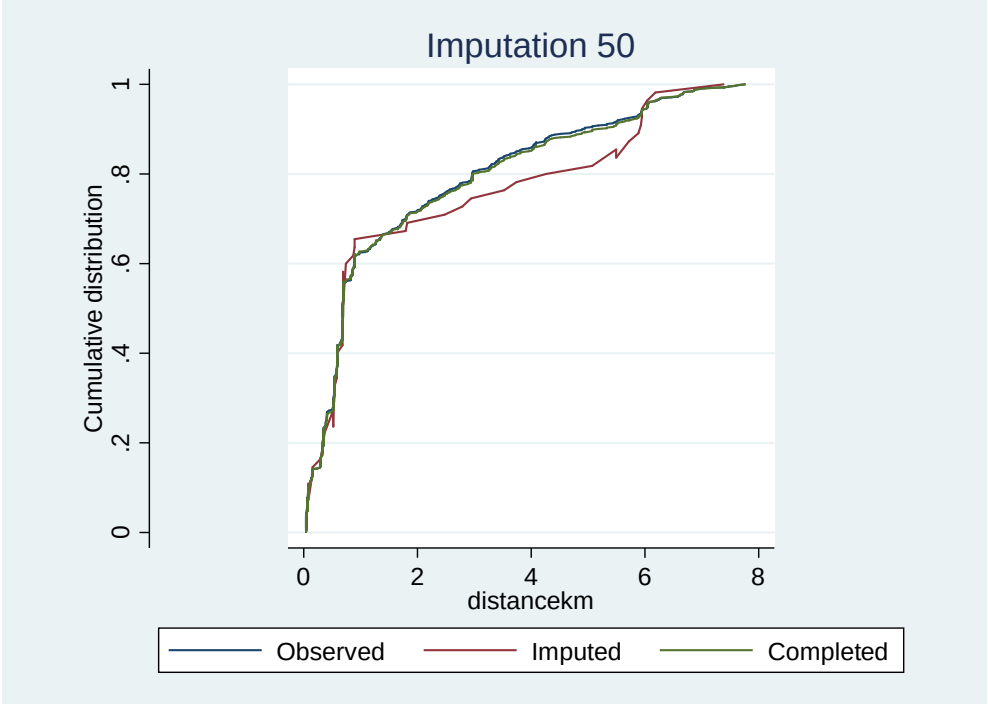
Appendix X.

Diagnostic plots for the sample following Multiple Imputation (MICE). Plots are displayed for the (i) dependent variable and variables with a high proportion of missing cases: (ii) log of equivalised disposable household income, (iii) education, (iv) distance in km and (v) long term relationship. The plots are based on the 50th imputation ($m = 50$).









Proportions of married for m=50

```
Number of observed   =        558
Number of imputed    =         85
Number of completed  =        643
```

RECODE of maritalstatus	Observed	Imputed	Completed
Not married	0.529	0.600	0.538
Married, in a civil union, or living wit	0.471	0.400	0.462

Appendix Y.

Multiple Imputation then Deletion (MID) analysis (n=627).

	Model 1: Unadjusted		Model 2: Adjusted	
Life Satisfaction (LS)	β	(SE)	β	(SE)
Regeneration	0.199	0.142	0.298	0.133
Log Equivalised disposable household income			-0.148	0.136
Distance (km)			-0.010	0.033
Male			-0.021	0.126
Age			0.066***	0.022
Age^2			0.001***	0.000
Long term relationship			0.466***	0.135
Employment status				
Employed (ref.category)	-	-	-	-
In education			-0.471*	0.262
Unemployed			-0.549	0.348
Other inactive			-0.539***	0.188
Recent visit to Teat's Hill			0.067	0.125
Physical activity				
None (ref.category)	-	-	-	-
1-4 days			0.509***	0.176
5+ days			0.762***	0.178
General health				
Very Bad (ref.category)	-	-	-	-
Bad			1.174	0.823
Fair			1.673**	0.745
Good			2.420***	0.738
Very Good			3.146***	0.742
Access to private outdoor space			0.091	0.171
Dog owner			0.098	0.146

No of children in household			0.158**	0.075
Constant	7.923***	0.111	6.975***	1.414
N	627		627	
AIC	-		-	
R^2	0.003		0.300	
Adj R^2	0.002		0.277	

***, **, and * mean significant at the 1%-, 5%-, and 10%-level
OLS regression model. Heteroscedasticity-robust standard errors used.
R^2 and Adj R^2 for MI analysis is based on the average across 50 imputations

Appendix Z.

Multiple Imputation analysis (MICE) with model including interaction term (n=642).

	Model 1: Unadjusted model		Model 2: Inclusion of interaction term	
Life Satisfaction (LS)	*B*	(SE)	*B*	(SE)
Regeneration	0.186	0.141	0.243	0.168
Log Equivalised disposable household income			-0.132	0.136
Distance (km)			-0.010	0.031
Male			-0.013	0.127
Age			-0.067***	0.022
Age^2			0.001***	0.000
Long term relationship			0.479***	0.140
Employment status				
Employed (ref.category)			-	-
In education			-0.456*	0.267
Unemployed			-0.521	0.338
Other inactive			0.518***	0.186
Recent visit to Teat's Hill			0.008	0.199
Physical activity				
None (ref.category)			-	-
1-4 days			0.499***	0.176
5+ days			0.765***	0.178
General health				
Very Bad (ref.category)			-	-
Bad			1.169	0.819
Fair			1.678**	0.741
Good			2.411***	0.735

Very Good			3.145***	0.737
Access to private outdoor space			0.092	0.172
Dog owner			0.110	0.147
No of children in household			0.161**	0.077
Regeneration x recent visit to Teat's Hill			0.116	0.251
Constant	7.925***	0.110	6.879***	1.419
N	642		642	
AIC	-		-	
R^2	0.003		0.300	
Adj R^2	0.001		0.276	

***, **, and * mean significant at the 1%-, 5%-, and 10%-level

OLS regression model. Heteroscedasticity-robust standard errors used.

Appendix AA.

Multiple Imputation then Deletion (MID) analysis including interaction term (n=626).

	Model 1: Unadjusted model		Model 2: Inclusion of interaction term	
Life Satisfaction	*B*	(SE)	*B*	(SE)
Regeneration	0.193	0.142	0.245	0.168
Log Equivalised disposable income			-0.136	0.140
Distance (km)			-0.010	0.031
Male			-0.009	0.126
Age			-0.067***	0.022
Age^2			0.001***	0.000
Long term relationship			0.478***	0.141
Employment status				
Employed (ref.category)			-	-
In education			-0.450*	0.265
Unemployed			-0.535	0.346
Other inactive			-0.522***	0.189
Recent visit to Teat's Hill			0.006	0.200
Physical activity				
None (ref.category)			-	-
1-4 days			0.499***	0.176
5+ days			0.763***	0.178
General health				
Very Bad (ref.category)			-	-
Bad			1.168	0.823
Fair			1.676**	0.744
Good			2.408***	0.736
Very Good			3.144***	0.739

Access to private outdoor space			0.090	0.171
Dog owner			0.109	0.147
No of children in household			0.162**	0.076
Regeneration x recent visit to Teat's Hill			0.123	0.251
Constant	7.923***	0.111	6.910***	1.446
N	626		626	
AIC	-		-	
R^2	0.003		0.302	
Adj R^2	0.001		0.278	

***, **, and * mean significant at the 1%-, 5%-, and 10%-level
OLS regression model. Heteroscedasticity-robust standard errors used.

Appendix BB:

Examples of events used to engage local residents in discussions about the proposed plans and designs for the Teat's Hill intervention (2017) (© Plymouth City Council).

FREE FAMILY FUN

AT TEATS HILL

11-2PM

SAT 14TH OCTOBER

JOIN US FOR NATURE BASED GAMES AND A GUIDED BEACH CLEAN, PLUS MAKE YOUR VERY OWN ROPE!

HAVE YOUR SAY ON THE PROPOSED PLANS TO DEVELOP THE TEATS HILL OPEN SPACE AND TAKE A LOOK AT THE LATEST DESIGNS

CALL KIERAN FOR MORE INFO ON:01752 304737

OR

VISIT OUR FACEBOOK PAGE

www.facebook.com/ActiveNeighbourhoodsProject

LOTTERY FUNDED

PLYMOUTH CITY COUNCIL

THE wildlife TRUSTS

Devon Wildlife Trust

Appendix CC:

Details of family events and volunteering activities at Teat's Hill in 2018 (© Plymouth City Council).


For all events meet on the green opposite the National Marine Aquarium PL4 0LU
Regular Wildlife Volunteering and Training
Help us to improve Teats Hill and learn new skills with Devon Wildlife Trust's Urban Ranger
April
12th Great British Spring Clean - Join people around the country in getting Britain's beaches tidy
10:00 - 11:00
May
15th & 17th Come and spot butterflies on our new wildflower meadow, followed by a beach tidy up
10:30 - 3:30
Don't forget to check out the Urban Rangers monthly updates, with the latest seasonal goings on and more event details.
Adults and accompanied children welcome.
Training, equipment and tea/biscuits provided!
Want to know more...
Call Tim 07826874891 or email Tim.Russell@plymouth.gov.uk
Join us for free family fun activities this Easter and May half-term
Apr 9th 11:30 - 2:00
Join the NMA hosts for curious sea creatures and clay creations, followed by nature based games and an egg hunt with the Active Neighbourhoods team!
May 28th 11:00 - 2:00
Join the Urban Ranger for fun family volunteering, followed by nature based games and an egg hunt with the Active Neighbourhoods team!
Jun 16th 11:30 - 2:00
Join the NMA hosts for curious sea creatures and clay creations, followed by nature based games and an egg hunt with the Active Neighbourhoods team!
Want to know more...
Call Ash 07780339194 or email Ashley.Tod@plymouth.gov.uk
www.facebook.com/ActiveNeighbourhoodsProject

LOTTERY FUNDED

Devon Wildlife Trust

EarthJump

Summer 2018

JUL

TEATS HILL

SEP

Free family events and wildlife volunteering for all ages

For all events meet on the green opposite the National Marine Aquarium PL4 0LU

Regular Wildlife Volunteering and Training

Help us to improve Teats Hill and learn new skills with Devon Wildlife Trust's Urban Ranger

Jul
Tue 24th - Wildflower Hedgerow management
10:30 - 3:30

Sep
Tue 18th - Beach clean
10:30 - 3:30

Don't forget to check out the Urban Rangers monthly updates, with the latest seasonal goings on and more event details.

Adults and accompanied children welcome.
Training, equipment and tea/biscuits provided!
Want to know more...
Call Tim 07826874891 or email Tim.Russell@plymouth.gov.uk

Join us for free family fun activities this Summer

July 31st 11:00 - 3:00
Family-friendly volunteering with DWT's Park Patrol in the morning followed by activities from bushcraft week like wild baking and pizza making!

Aug 7th 11:00 - 3:00
Family-friendly volunteering with DWT's Park Patrol in the morning followed by activities from Bug Week like mini-beast safaris and magnificent mud monsters!

Aug 14th 11:00 - 3:00
Family-friendly volunteering with DWT's Park Patrol in the morning followed by activities from Art Week like gorilla gardening with seed bombs and clay creature creations!

Aug 21st 11:00 - 3:00
Family-friendly volunteering with DWT's Park Patrol in the morning followed by activities from Woods Week like build your hammock and wild pizza making!

Aug 28th 11:00 - 3:00
Family-friendly volunteering with DWT's Park Patrol in the morning followed by activities from Food Week like Foraging for edible free food and wicked wild baking!

Want to know more...
Call Ash 07780339194 or email Ashley.Tod@plymouth.gov.uk

www.facebook.com/ActiveNeighbourhoodsProject

Appendix DD:

Table displaying the coefficients for the non-market good from comparator studies. Note: coefficients are derived from a non IV model, with exception of Dolan and Fujiwara (2012).

Study	**Non-market good**	**Geographical scope**	**Coefficient**
Current study	Coastal regeneration	Site-level (Teat's Hill, UK)	0.389
Fields in Trust (2018)	Urban parks and green spaces	National (UK)	0.125
Del Saz-Salazar *et al.* (2017)	Contemporary art archives and Collection	Site-level (Faculty of Fine Arts of the city of Cuenca, Spain)	0.166
Humphreys, Johnson and Whitehead (2017)	Winter Olympic medal success	National (Canada)	0.00-0.044
Dolan and Fujiwara (2012)	Adult learning courses	National (UK)	0.045
Dolan and Metcalfe (2008)	Urban regeneration	Site-level (Hafod, UK)	0.646

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