Spatial effects in stated preference studies for environmental valuation

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2011

document version
Publisher's PDF, also known as Version of record

7. Summary and conclusions

7.1 Introduction

Water is the cornerstone of life on earth. Water resources provide a wide range of environmental services with associated human benefits. In spite of the importance, the quality and quantity of water resources are increasingly under pressure from pollution and overexploitation. One of the key reasons that water resources are overexploited is related to the common-pool property of water, which often makes it impossible to prevent people who have not paid for using the water resource from enjoying its benefits. The negative externalities of water use result in an inefficient allocation of the water-related environmental services over different uses in time and space. One of the reasons is that prices do not reflect the socio-economic value of these services held by the human population.

Water pricing can provide incentives to use water resources more efficiently. Effective pricing policies have to reflect the costs of water use including those of environmental externalities. This requires the economic valuation of the market and non-market goods and services of water quantity and quality changes. The value of a resource is reflected by the Willingness-To-Pay (WTP) for a marginal change in the (potential) use of a resource. The individual WTP is aggregated over the relevant population to estimate the total WTP reflecting the social welfare change resulting from the change in the provision of services of water quality and quantity. The total WTP estimate can for instance be used in cost-benefit analyses to account for the market and non-market benefits of water resources.

Understanding the spatial nature of the environmental services and the spatial distribution of the associated benefits is paramount for reliable estimation of both individual and total WTP and the identification of the relevant population of beneficiaries. However, most existing stated

preference (SP) studies have paid little attention to the spatial context of the goods under valuation. A limited number of empirical SP studies account for the spatial dimension underlying natural resource valuation through the effect of distance on WTP and find that WTP decays as people live further away from the study site. In the economic literature, this so-called distance-decay effect is attributed to the increased travel costs involved in visiting a site and enjoying the environmental goods and services it provides. But the existing SP studies pay little to no attention to additional spatial heterogeneity due to heterogeneous respondent profiles and different distance-decay rates across sites, across environmental goods and services or across regions with different substitute availability. Ignoring the heterogeneity in the distribution of the benefits of ecosystem services could potentially reduce the reliability of aggregate WTP estimates. Even more surprising is the lack of consideration of substitution effects in SP research. While choice experiments offer a good possibility in SP research to assess substitution between spatially distributed environmental goods and services, most studies have so far focused on single sites, ignoring possible substitution effects and hence likely reducing the reliability of the WTP results. The neglect of the SP literature on water resource valuation to address the effects of the spatial dimension was the main rationale for undertaking the research resulting in this thesis.

7.2 Main research question and objectives

The main objective of this thesis was to assess to what extent accounting for the spatial aspects of preferences for ecosystem goods and services provided at different locations would increase the validity and reliability of stated preference studies. The main research question was:

Can the design and analysis of stated preference studies be improved to increase the validity and reliability of WTP results by accounting for the effects on preferences and choices of the spatial context of the provision of environmental goods and services?

Several sub-questions were addressed in order to answer the main research question:

a. Which (implicit) assumptions do standard economic models make regarding choices for environmental goods and services and to what extent might the validity and reliability be compromised in case of spatial choices?
b. How does the perception of the spatial characteristics of environmental goods and services and their spatial context influence preferences and choices in stated preference research?
c. How have existing studies accounted for the effect of distance on WTP in study design and analysis and how do existing practices affect the validity and reliability of the resulting WTP estimates?

d. How have existing studies accounted for the effects of the availability and characteristics of substitutes on the WTP for environmental goods and services provided by a study site and how do existing practices affect the validity and reliability of the resulting WTP estimates?
e. How can the characteristics of spatial choices be more adequately addressed and which statistical models are suitable so that the validity and reliability of stated preference studies for the valuation of spatially defined environmental goods and services can be improved?

Chapter 2 provided an overview of the standard neoclassical economic literature on rational choice behaviour and existing SP methods. It highlighted that existing sensitivity-to-scope studies fail to adequately address the effect of substitutes on stated preferences and WTP. The limited attention paid in SP studies to substitution effects may cause anomalies and biases in WTP estimates. To identify potential violations of rationality assumptions in spatial choices (sub-question a), the concepts and methods from other disciplines analysing spatial behaviour and preferences, such as social and economic geography and environmental psychology, were reviewed. These disciplines address the effect of spatial perceptions on choice behaviour (sub-question b). They put forward that spatial perceptions are embedded in the so-called cognitive map. This map reflects spatial cognition and perception, including spatial information and emotional attachments to locations. A hierarchical formation and storage of spatial knowledge may affect distance decay as well as substitution effects and may lead to violations of rationality assumptions. The cognitive distance as reflected in the cognitive map may be different from the objective distance based on the road network and influence distance-decay effects in WTP. Hierarchical spatial cognition may also lead to different choice behaviour in complex spatial choice situations and affect substitution patterns between locations. Finally, the effect of spatial proximity on spatial relationships, and the statistical techniques used in spatial analysis to address these relationships, were shortly discussed. The relevance and importance of a two-dimensional conceptualisation of space in SP research was stressed, as this permits accounting for spatial heterogeneity in observations and distance-decay relationships in the analysis.

Insights about spatial choice behaviour from the other disciplines formed the basis for adapting the standard neoclassical economic framework for spatial preferences and choices elicitation procedures by accounting for the psychological and physical context of spatially defined environmental values. Based on theoretical considerations and insights from existing empirical research, it was hypothesised that addressing the effect of spatial cognition and perception in the analysis and adopting a two-dimensional conceptualisation of space would increase the validity and reliability of spatial choice studies. Different methodological approaches to operationalise the

proposed framework and to capture spatial heterogeneity in distance decay and substitution patterns influencing preferences and choices were discussed in Chapters 3 and 4.

Two case studies were carried out to test if and to what extent spatial aspects in SP studies focusing on water services valuation influence WTP results. In both cases, choice experiments were used, as these were considered to be the most flexible SP technique for the assessment of substitution effects between sites, especially when respondents are asked to choose between these sites presented as labelled alternatives[1]. In the first case study in Chapter 5, a labelled choice experiment was developed in which respondents were asked to express their WTP for achieving improved ecological quality at three alternative study sites: the beaches near Breskens, the Braakman-creek and the tidal mudflats of Saeftinghe. These sites are located in a confined geographical area along the Dutch part of the Scheldt estuary and are well-known among the local population. In the second case study in Chapter 6, the effects of distance and substitutes were further explored. Special attention was paid to directional heterogeneity in distance decay and the effect of spatial scale on choice complexity and decision-making processes. In this labelled choice experiment, conducted in the Rhine basin in the Netherlands, respondents were asked to choose among different ecological improvement scenarios at eleven lakes at the expense of paying extra taxes. The study sites provide a wide range of environmental services and related nature amenity and recreational values. The biophysical characterisation of the study sites was informed through a consultation process of external experts and colleague ecologists at IVM (Gilbert et al. 2007; Gilbert and Schaafsma 2007).

[1] It was argued in this thesis that including multiple sites in a CE ensures that respondents account for substitutes when stating WTP for a single site. However, no empirical evidence was given for this statement by comparing the presented results to a CE in which one site was offered as the only possibility besides the opt-out. This was because according to the literature, such a CE is not expected to lead to reliable WTP estimates. Van Haefen et al. (2005) find that such a CE design can lead to non-participation. According to Breffle and Rowe (2002) and Rolfe and Bennett (2009), a CE with only one hypothetical option and the opt-out might be more difficult for respondents to answer, as the low variation in the options makes trade-offs difficult to make. These studies suggest that it is difficult to separate the effect of ignoring substitutes from the non-participation or complexity in a CE with only one alternative site. In fact, these studies provide another reason to include multiple alternatives in SP studies.

7.3 Main results and insights

The analytical framework and the empirical analysis of the two case studies focused on three interrelated subjects: (1) site-specific values, (2) distance decay, and (3) substitution effects.

7.3.1 Site-specific values

In the first case study, the selected study sites along the Scheldt offered different types of environmental services based on different ecosystem characteristics under ecological quality improvement scenarios. The results showed, as expected, that WTP values for achieving improved natural amenities and bathing conditions were site-specific and dependent on the physical context of the environmental goods and services under valuation. These site-specific values hamper the transfer of WTP values for specific ecosystem goods and services from one site to another.

In the second case study, the lakes in the Rhine-basin offered similar environmental services. Consequently, no site-specific WTP values were found for achieving better ecological quality at these lakes. Moreover, the results indicated that WTP for achieving good ecological status (the highest quality level) was not significantly different from WTP for the goods and services provided at an intermediate quality level. Achieving higher quality in terms of species richness and ecosystem health at the study sites would only be possible if existing recreational activities were restricted. It was expected that this trade-off between use and non-use values resulted in similar WTP estimates for the two quality levels.

7.3.2 Distance decay

The second subject was distance decay. In Chapter 3, a conceptual distance-decay function was formulated, including all variables that influence distance decay according to the theory, such as the type of values provided by the study site, familiarity, place attachment, mode of transport and the accessibility of substitutes. The chapter also discussed the statistical form of the distance-decay function and its behavioural interpretation (sub-question c), which may guide future empirical distance-decay analyses.

In both case studies of this thesis, the results showed that distance had a significant negative impact on public preferences for the sites. In the study of the Scheldt basin, the distance-decay effects proved to be site-specific. The differences in distance decay across the sites could be explained by the different ecosystem services and associated use and non-use values the sites provided. An important difference between the case studies was that distance-decay estimates found in the case study in the Rhine basin were much higher than those in the Scheldt. One reason may be that the distance-decay rates in the Rhine study reflected the effect of substitutes more accurately, as respondents were asked to trade-off more alternative sites than in the Scheldt survey. The distance-decay rates in the Rhine study were also higher than those found in existing SP studies,

which focus on single sites. This comparison hence suggests that distance-decay estimates may be biased if respondents focus too little on available alternatives and are not asked to choose between a site and its substitutes. The main conclusion is that differences in distance decay across sites may compromise the validity and reliability of WTP estimates in SP research. Transferring distance-decay estimates from one site to another, especially when the type of ecosystems or the availability of substitutes between the sites is different, could lead to significant transfer errors.

Significant differences in distance decay were also found between users and non-users in both case studies. In addition, the results of the Rhine study showed that non-use dominated values are subject to significantly lower distance decay than WTP values based on other motivations. Users and non-users were identified based on past visitation behaviour and experience with the study sites. Knowledge and familiarity were highly correlated with past visitation and hence not included as additional variables in the WTP-models. No evidence was found in the case studies that the means of transport affected distance decay. Place attachment, a variable specifically related to spatial perception and cognition, had a significant impact on choices in the Scheldt study. This result implies that, in addition to travel costs, emotional attachment to locations may cause spatial heterogeneity in WTP and bias distance-decay estimates if ignored.

In Chapter 3, two gaps in the SP literature were distilled, namely the effects of cognitive distance errors and spatial heterogeneity on distance decay and WTP. Cognitive distance errors reflect the difference between the cognitive and the objective distance. They may arise, for instance, when locations are considered to be landmarks or for (un)familiar locations. Cognitive distance errors can bias distance-decay functions estimated based on the objective distance measures if ignored. Their effect was tested in the choice model in the Rhine study. Accounting for the effect of cognitive distance errors improved the model fit but did not result in significantly different WTP estimates compared to a model that ignored the errors. Differences WTP values were found, however, between respondents who overestimated and underestimated travel distances. The study sites included in this choice experiment were all located nearby and relatively familiar to respondents. Stronger effects are likely to result with less familiar or more distant locations.

Next, the presence of spatial heterogeneity in distance-decay effects and WTP values for ecological improvement scenarios was tested. This heterogeneity is expected to occur when spatial differences exist in the availability of substitutes or respondent characteristics. In Chapter 3, three methods were proposed to capture spatial heterogeneity in distance decay: (1) the spatial expansion method, (2) the use of directional dummy variables, and (3) the distance to alternative sites in WTP models. The methods were tested in the case studies.

Significant directional heterogeneity was found in choice probabilities and in the distribution of WTP values across the study areas in both case studies, in addition to distance decay. Accounting for directional heterogeneity led to significantly better model fit and significantly different WTP values across areas compared to models that ignored additional spatial heterogeneity. In the Scheldt study, the results of a model including the distance to substitute beaches showed that lower WTP values for the beach location were found among respondents living closer to coastal substitutes compared to those living further inland. No significant effect was found for other sites or for the distance to (other) respondent-selected sets of substitutes. The results of the spatial expansion method revealed a similar spatial pattern in WTP. The spatial expansion method allows for accounting for directional heterogeneity by specifying distance decay as a function of the geographical coordinates of the location of each respondent. The results also disclosed additional spatial heterogeneity in WTP, which could not be captured by accounting for the distance to substitutes. In the Rhine study, the inclusion of directional dummy variables in the choice model revealed that significant differences in distance-decay rates were present across different directions from the study sites, mainly explained by the non-random spatial distribution of substitutes. The analysis showed that directional heterogeneity can lead to significant differences in the market size reflecting the relevant population over which the individual WTP estimates can be aggregated to assess the total WTP.

7.3.3 Substitution effects

The third and final topic addressed in this thesis was substitution effects, where substitutes were defined as sites that provide similar environmental goods and services. Chapter 4 outlined the theory regarding substitution effects. The limited attention paid to substitution effects in SP studies was explained by acknowledging three common problems in study design. First, there are practical limitations when using surveys, which require, for instance, making a trade-off between survey length and providing a comprehensive description of the study sites as well as additional substitutes. Secondly, the researcher has to consider the limitations to the cognitive ability of respondents, who have to evaluate all alternatives simultaneously when stating their WTP for a proposed environmental change at study sites. Finally, researchers face problems in selecting the complete relevant set of substitutes that is considered by each individual, also referred to as the consideration set.

In both case studies, substitution patterns between the sites were subject to heterogeneity and correlation among adjacent sites. The results imply that the WTP for ecological quality improvements at the study sites depends on changes in ecological quality at other sites. Estimating the WTP using single sites and ignoring the effect of substitutes may reduce the validity of SP results.

Similarly, adding up WTP estimates from single-site studies to estimate the WTP for a combination of changes in the provision of ecosystem services at different sites may lead to ill-informed policy decisions.

Chapter 4 argued that conventional discrete choice models, including mixed logit models, provide flexibility in capturing substitution patterns between alternatives, but suffer from two limitations. First, they may not be flexible enough when choice sets include sites of which some are closer substitutes than others. Second, the possibilities for the parameterisation of the effect of proximity of the alternatives on choice probabilities are limited. Alternative modelling approaches to overcome these limitations were tested in the case studies.

In the Scheldt study, a mixed logit model with random parameters and error-components to allow for correlation between alternatives was extended with cross-effects based on a universal logit approach. These cross-effects reflect the additional impact of the changes in attributes of an alternative on the probability that the site of interest is chosen. Accounting for these cross-effects resulted in significantly different WTP estimates for some of the policy scenarios, overestimating WTP up to 40 percent. The results point out the necessity to pay adequate attention in future spatial choice studies to possible disproportional substitution patterns due to differences in the characteristics across substitute sites. The extended mixed logit model also showed that existing mixed logit models may not be flexible enough when some of the alternatives in the choice set are closer substitutes than others. Existing models used in discrete choice analysis, such as nested and cross-nested logit models, which are unable to capture the panel data structure of SP surveys, were not considered to be applicable in the case studies. The results of the extended mixed logit model provide another reason to question the validity and reliability of existing welfare estimates from single-site studies in which site-specific and disproportional substitution effects have been ignored.

The effect of the spatial proximity of alternatives on substitution patterns was tested in the Rhine case study by evaluating the specification of additional error-components in a mixed logit model against the applicability of the competing destinations model. Including additional error-components that grouped together quality improvement scenarios at nearby lakes improved the model fit. The results suggested that the spatial distribution of the alternatives in the choice set affects choices for environmental quality improvement scenarios. Different substitution rates were hence found between nearby and more distant lakes. Error-component specifications based on other characteristics of the lakes related to their accessibility, such as the size and visitation rates of the lakes, resulted in similar or even slightly better model fit than geographical clustering. Hence, other characteristics of the alternatives may better capture the underlying substitution patterns between the alternatives than geographical proximity. However, none of the error-component

specifications resulted in significantly different WTP estimates. This suggests that potential biases in WTP when ignoring spatial proximity might be limited.

The competing destinations model has the advantage of explicitly accounting for the distance between alternatives and has been used in migration and recreation studies. The model includes an accessibility indicator, which reflects the proximity of alternatives in the choice set and can include other site characteristics, such as size. The model has also been argued to be able to capture hierarchical decision-making strategies, in which respondents group a large number of alternatives in perceptual regions before selecting an alternative in their preferred region. This strategy is expected to be applied to simplify choices in complex choice situations when the task of evaluating all alternatives simultaneously is too demanding and exceeds the cognitive abilities of the respondents. In the Rhine case study, the competing destinations model did not produce significant results for the accessibility indicator.

Based on the results of the competing destinations model and error-component models, the case study did not provide convincing evidence for the hypothesis that a hierarchical decision-making process was employed for spatial choices between environmental improvements associated with use and non-use values at multiple lakes at a large spatial scale in a stated CE. Two possible explanations are as follows. It might be that for choices involving use and non-use values, the geographical proximity of alternatives and the embedding of alternatives in spatial perceptual regions is not as important as in migration choices where hierarchical processes have been detected. Non-use values may form a considerable part of individual WTP, but are not expected to be highly distance-dependent and hence the spatial proximity of alternative sites providing substitutable non-use values may be less influential.

Another explanation is that the choice tasks were not considered too complex and respondents were able to evaluate the alternatives simultaneously without much cognitive burden. The effect of choice task complexity was further tested in the CE in the Rhine by increasing the geographical scale of the choice set, thereby expanding the choice set size. Choices between larger numbers of alternatives were expected to be more complex and result in different choice behaviour if the complexity exceeded the cognitive ability of respondents to evaluate all alternatives simultaneously as assumed under rational behaviour. By comparing choice tasks consisting of four alternatives to choices between seven alternatives (out of a total set of eleven lakes), the transitivity and completeness of preferences were examined. The results indicated that the larger choice set was associated with higher error variance indicating higher perceived choice task complexity, but preferences for the attributes were nevertheless found to be complete and transitive. Furthermore, hardly any evidence for preference learning was identified in the choices among the four nearest

lakes after the evaluation of all study sites in the larger choice set. The results suggested that respondents are capable of evaluating different combinations of seven alternatives out of a total set of eleven in a SP survey, at least if all alternatives are thoroughly introduced, respondents are asked to state their perception of these lakes before going through the CE and are first offered a subset of alternatives. Such a study design gives respondents the opportunity to learn about the choice alternatives before entering the full choice set of the CE, which reduces the possibility that increasing the geographical scale of the choice set leads to violations of rationality assumptions.

It may be that the small number of attributes in the CE in the case study in the Rhine basin has simplified the choice task. However, choice task complexity is also affected by the subject of the choice. Besides the quantitative dimensions of the choice task design in terms of the number of alternatives, attributes and attribute levels, the inclusion of environmental attributes such as water or ecological quality, are likely to increase the choice complexity compared to evaluating the characteristics of daily consumed products. The choice tasks in the Rhine case study may therefore not have been easy in spite of the small number of attributes due to the complexity of the subject.

In summary, the effects of the physical context of environmental changes, such as site-specific values, distance decay and related substitution effects, came out somewhat stronger than the psychological effects of cognitive distance and hierarchical choice behaviour in the empirical results. The results of the case studies show that the validity and reliability of SP studies can be improved by accounting for spatial preferences, distance decay and substitution effects. This requires careful design of the survey instrument with questions about relevant substitutes, the availability of different types of substitutes and asking respondents to make explicit trade-offs between payments and improvements in ecosystem service provision at alternative sites.

7.4 Policy relevance

The European Water Framework Directive (WFD) formed the policy context of the ecological quality changes that respondents were asked to value in the two case studies. The WFD was adopted in 2000 with the aim to guarantee a good ecological status (GES) of all surface and ground water bodies in the EU by 2015 and ensure safe access for different uses to this important resource. Water pricing is one of the policy instruments put forward in Article 9 of the WFD to stimulate efficient resource allocation and take environmental externalities into account. For the development of a water pricing strategy and the assessment of disproportionate costs as specified in Article 4, environmental valuation is to this end necessary as it can capture the perceived benefits of the WFD implementation. As the WFD implementation is expected to yield both use and non-use values, stated preference techniques are required. In the case studies, respondents were asked to pay extra for water quality improvements through an increase in their annual water board tax. Thereby, the

institutional context of the WFD was captured in the payment vehicle of the studies. The results of the studies are relevant to policy development related to the WFD as they provide insight into public support and financial commitment to its implementation. In a broader perspective, the results are relevant to the development of pricing schemes aiming for a sustainable use of environmental goods and services.

The results of the case studies provide insight in the spatial distribution of WTP values for environmental quality changes under the WFD. First of all, values for environmental quality changes were found to be site-specific. Whereas generic values may be sufficient for policy development at national scale, regional policy-makers likely need more spatial detail. The analysis of site-specific values of water quality changes can help policy makers to allocate limited budgets and prioritise investments in quality improvements at those sites with the highest public benefits.

Furthermore, the Rhine study showed that public WTP for achieving GES does not necessarily exceed values for smaller ecological quality improvements, especially when achieving GES imposes limitations on certain recreational activities. The main policy implication of this result is that the marginal public benefits of achieving the highest ecological level may not exceed the marginal costs of investments needed to achieve this high level, over and above the intermediate level as specified in this study. If achieving GES comes at the expense of a loss of recreational amenities, projects to achieve GES may not pass a cost-benefit test.

A second impediment to the unconditional use of generic values is the site-specific distance-decay effects found in both case studies. The main objective of distance-decay analysis is to define the population over which individual WTP estimates can be aggregated to calculate the total WTP for policy scenarios of ecological quality improvements. Accounting for distance decay can be considered an important validity check of the results of valuation studies and were proven to increase the reliability of WTP estimates significantly. Distance-decay effects were shown to vary across sites in their functional specification and magnitude, across users and non-users and across directions from the study sites. Hence, the empirical results do not allow an average distance range to be taken from a site providing ecosystem services or an administrative unit to delineate the area in which the population benefiting from these services lives. Distance-decay estimates are dependent on the physical context including the availability of substitutes and the psychological perception of this context.

In the presence of areas with many different water bodies, policy-makers should be cautious when using the results of single-site studies, because substitution possibilities can have a significant impact on WTP estimates for environmental quality changes at a single site. As a result, WTP values of existing studies may be biased upwards. Substitution effects can be assessed by including the

distance to substitutes in the model or preferably by asking respondents to choose among environmental changes at different sites.

Finally, the substitution and distance-decay effects found in this study show that benefits resulting from the implementation of the WFD may fall well beyond the political borders of the area for which a water board is responsible. Hence, water boards of adjacent affected areas are advised to collaborate in the development of efficient pricing schemes. Such coordinated implementation and cost-sharing between water boards representing benefitted areas is expected to results in more efficient implementation of the WFD.

7.5 Suggestions for further research

Although the case studies presented in this thesis have covered a broad range of spatial effects in WTP values for water-related environmental changes, a number of issues remain open for further research. The empirical results of this thesis are based on water-related studies. The findings and proposed methodologies are expected to be applicable to other types of environmental goods and services, especially when these are non-randomly distributed over space. Future studies on the WTP for non-water related ecosystems are necessary to confirm the general applicability of the findings of this thesis.

Although the CV method was not used in this thesis, the proposed methods to account for distance to sites or substitutes as well as spatial perception and cognition effects on distance decay can be incorporated in CV studies. Future CV studies may test the impact of these factors when assessing distance decay in WTP estimates.

Furthermore, the theoretical and empirical literature on environmental psychology suggests that distance decay is affected by the perceived risk of the provision of ecosystem goods and services in the future as a result of a policy change. Future research may shed more light on this relationship between risk and WTP. More research is also needed on the effect of the mode of transport on distance decay. No significant effect of transport mode was found in this thesis, but this contradicts the results of studies on other types of spatial choices, such as daily commuting to work.

Chapter 2 stressed the importance of spatial cognition and the violations of rational behaviour that might follow from using cognitive maps in spatial decision-making. The effects of place attachment and cognitive distance errors deserve further research. Despite a better model fit, the cognitive distance errors did not lead to significantly different WTP estimates, which may be due to the study sites included in this choice experiment being all nearby and relatively familiar to respondents. The effect of under- and overestimating travel distances to study sites may play a more prominent role in choices between alternatives that vary more in their familiarity and distance to respondents than the case study sites in this thesis.

The hierarchical theory in the geography literature suggests that spatial choice are subject to anomalies resulting from hierarchical decision-making and empirical studies have found evidence for differences in choice-behaviour as the number of alternatives increases. However, no evidence was found in the empirical studies presented in this thesis for hierarchical decision-making strategies when using the competing destinations model. Understanding spatial choice behaviour and the decision-rules employed by respondents is an important branch of future research. It may require the application of additional methods complementing SP surveys, such as asking detailed questions discussing how interviewees make choices in order to reveal subconscious choice processes through more qualitative approaches. To understand how people make choices among environmental quality changes at different locations in experimental settings, new statistical methods for spatial choice studies for environmental valuation may be needed which help to reveal different patterns or changes in decision-making strategies. More research on scale heterogeneity could help to better understand preference heterogeneity and changes in decision-making strategies. Future research could test the relevance of decision-making strategies other than utility optimisation, such as other non-compensatory strategies for environmental valuation, which have been put forward in different choice contexts. However, the possibilities to capture conscious and especially subconscious choice processes using statistical analysis of observed choices remain an important challenge.