Improving the quality and usability of the economic valuation of ecosystem services : Conceptualization and implementation of a deliberative monetary valuation of ecosystem services bundles in the Cévennes valleys

Marcus Kieslich

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THÈSE POUR OBTENIR LE GRADE DE DOCTEUR DE L'UNIVERSITÉ DE MONTPELLIER

En Économie de l'environnement

École doctorale Economie Gestion

Unité de recherche Center of Environmental Economics – Montpellier – UMR

Améliorer la qualité et l'utilité de l'évaluation économique des services écosystémiques : conceptualisation et application d'une évaluation délibérative monétaire des bouquets des services écosystémiques dans les Cévennes

Présentée par Marcus KIESLICH

Le 1 octobre 2021

Sous la direction de Jean-Michel SALLES

Devant le jury composé de

Tina RAMBONILAZA, Directrice de recherche, INRAE Dijon	Rapporteure
Olivier CHANEL, Directeur de recherche, CNRS, Aix-Marseille School of Economics	Rapporteur
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Jean-Michel SALLES, Directeur de recherche, CNRS, Université de Montpellier	Directeur de thèse

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Introduction

"Deliberate choices are the only sacred things in the universe. Everything else is just hydrogen."
James Alan Gardner, science-fiction author, 2014

The scientific discussion about the capacity of traditional economic approaches to assess the value of ecosystem services (ES), is often related to a conceptual, *elementary* basis. Deliberative valuation is seen as a possible way to adjust current shortcomings such as the assumption of fixed preferences, the integration of social and deeper-held values and the account for the complexity of environmental goods.

In this context, elements such as discussions about values and experiences, value juries and storytelling are seen as sources to generate valuations from enriched preferences. These would be more suitable to the context in which the valuation takes place and which shapes the value of the ES. Nevertheless, the empirical evidence is growing but still insufficient to draw general conclusions on how these deliberative approaches are to be implemented in specific contexts and in which way they shape the preferences underlying the outcomes of valuations, which, of course, are more than hydrogen for both concepts. Furthermore, the salience of deliberative valuation for decision makers and implementing practitioners needs to be investigated in order to define contexts for possible applications for these approaches.

This PhD thesis aims to contribute to broaden the understanding of how deliberation affects valuation of ES by conducting an experimental study about the ES generated by Cévennes landscapes using deliberative valuation workshops. Moreover, implications for decision makers and practitioners are drawn.

Current environmental problems caused by humanity are related to the fact that choices with regard to natural resources are not accounting for the value derived from the environmental good for the whole society. Due to this public good character, natural resources are either not or not efficiently traded in markets, such that valuations are needed in order to assign or demonstrate the value to society such as a market would do for private goods. If valuation identifies a surplus derived from a change in the provision of the environmental good or service, a or more informed, efficient decision could be taken ([PMMC03] p. 408ff).

Two main approaches of economic valuation for environmental services are applied ([PMMC03] p. 411; [Sal11]). First, revealed preferences approaches use existing data about private goods that are close substitutes or components to the environmental good. This allows to conclude

on the individual attribution of value to it. Nevertheless, this attribution is only possible if individuals are aware of the value and are changing their behavior in response to it [BR15a].

Second, in order to integrate values from the environmental assets (i) that are not directly used, (ii) that provide options for future use or (iii) whose pure existence generates value, stated preference methods have to be applied [JBA+17]. Here, markets are constructed or simulated, and individuals are asked to imagine the exchange of goods and state their choices. Again, mainly two methods are applied: contingent valuation (CV) and discrete choice experiments (DCE). The first interrogates respondents for their willingness to pay (WTP) to obtain a certain (environmental) good. In DCEs, several alternatives are proposed to an individual, which are composed of several attributes, with one of them representing a payment associated to the alternative. With changing compositions of these attributes over choice sets, a WTP can be determined for the different components of the good. Both methods can account for other than use-values if integrated into the simulated market. Whereas the CV method allows a detailed description of the environmental good and avoid misunderstandings, the DCE has the advantage to allow the determination of values for several components of the environmental good and being less affected of hypothetical and systematic bias [HMW01].

The application of stated preference methods and especially DCEs for the valuation of environmental goods became popular, but conceptual evolutions on how to integrate the complexity and interrelation of environmental processes are still needed [Hoy10].

An interdisciplinary concept to assess these complexities is the ecosystem service concept. Initially proposed by Millennium Ecosystem Assessment (MEA) 2005, it is used to refer to the "benefits that people obtain from ecosystems" ([MEA05]; p. 9) and is therefore going beyond goods or their close substitutes already valued in markets.

In a first approach, ES are further classified into provisioning, regulating, cultural or non-material and finally supporting ecosystem services (MEA 2005; CICES, 2017). Further effort has been undertaken in order to mainstream the use of the ES concept (e.g. [DPG+09]) by establishing interdisciplinary platforms that further refine definitions of ES categories and propose standards and guidelines for their assessment and valuation. The most important ones are The Economics of Ecosystems and Biodiversity initiative (TEEB, 2007), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2012), and the Common International Classification of Ecosystem Services project (CICES, 2015).

Some authors proposed to evolve the ES concept into "Nature's contribution to people" (NCP) in order to foster social sciences and other knowledge systems ([DPS+18]; p. 270) within a view of nature as being also an "aesthetic-symbolic phenomena" instead of solely representing a "natural-scientific entity", especially when it comes to non-material ES ([Kir19]; p. 220). Nevertheless, this approach is criticized by other authors to be still connected to the utilitarian view of a flow of benefits from nature to humanity [MGB21].

Rather than entering or contributing to this discussion in either direction, this thesis is concerned with the salience of the ES concept and especially the economic valuation of ES for decision makers.

The scope of this PhD thesis

1) Complementing the aim of economic valuation of ES to serve decision makers' needs by an investigation of needs of practitioners and implementing agents:

Often, valuations of ES are published in the scientific literature expressing the willingness to serve for decision making without actually assessing the pertinence of their approach and results for a given decision making context [LRB+13a].

It is regretted that policy has not (yet) been adapted to scientific evidence provided by valuation [OJT+18]. A hypothesis investigated is therefore that decision makers are anticipating possible problems in implementation, leading to a delay. The question is whether this delay could be avoided if structural and informational needs for implementation would already be included by the way the valuation of concerned ES is conducted and communicated. This includes an analysis of the role of transdisciplinary organization of research, implementation research as well as the complementarity of valuation approaches to account for differences in implementation contexts. That does also imply a careful investigation of guidelines for the experimental design and how they are adapted to the valuation context.

2) Integrating interactions and interdependencies into environmental valuation by applying the ES bundles concept with the help DCEs:

As outlined above, it has to be avoided that the account for interrelations among ES is veiled behind a "complexity blinder" [Nor10] provoked by the classification of several benefits into ES categories [BPPV14].

The concept of bundles of ES, that represents ES as sets "that repeatedly appear together across space or time" [RHPB10] is proposed as suitable method to assess the interrelations of ES. One important driver for bundles of ES is human land use [SMM+17]. An economic valuation of the bundles of ES generated by a landscape is therefore a promising approach to have a socio-cultural assessment of interrelated environmental benefits.

Despite its popularity for environmental valuation, the application of DCEs to assess bundles of ES is still limited [TBLH16]. An experimental study about preferences for landscape patterns in the Cévennes, using a DCE together with complementing indicator statements and clustering, will test its suitability for an economic ES bundles valuation. Especially the interplay of the different methods as well as the outcome concerning the preferences of participants are of particular interest.

3) Integrating deliberative elements into environmental valuation:

Although the debate on the salience of deliberative valuation is about conceptual issues, its practical implementation is another field of ongoing research.

The specific cultural identity of the Cévennes is particularly interesting for the valuation of deeper-held and transcendental values [KJW+16] associated to the landscape. In general, it is proposed to assess non-material ES with the help of deliberative valuation ([CSG12a]; [SGC+13]).

Consequently, the experimental study is conducted in deliberative workshops in order to test whether and how the preferences stated within the valuation are enriched and if the setting is beneficial to the inclusion of non-material ES. Furthermore, it is investigated how study protocols are adapted to deliberative valuation and if conclusions for traditional valuation approaches can be drawn.

The discussions organized within the deliberative setting have been be recorded and qualitative analysis of transcripts can further enrich the quantitative results from the DCE. Moreover, it allows to derive further recommendation on how the process of preferences construction is shaped within the discussion. As for all questions revealed within this section, the suitability of the approaches for decision making and practitioners' needs has to be elicited.

Structure of this thesis

The first part of this thesis is devoted to theoretical work on the first research question: how to enhance the practical use of ESV and the ES concept in general? A detailed literature review is conducted in chapter 1. It answers the research question by situating the problem in the interface between ES-based research, public decision making and implementing practitioners, and proposes as possible solution more transdisciplinary work in science-policy interfaces.

The second part treats the empirical work of the thesis and englobes all research question which are in relation to our field study on the valuation of ES in the Cévennes landscape:

— Which further development of the cultural landscapes in the Cévennes is preferred?
— Which bundles of ES are considered within each of the DCE attributes by respondents and which of them are most aware to them?
— Does deliberation enhances the recognition of non-material services within stated preference valuation?
— How does deliberative valuation affect the valuation of ES?

Although I call this part "empirical" here, the associated chapters 2 to 4 also deal with theoretical and methodological issues. Nevertheless, I chose that nomenclature to point out the fact that the questions and methods in this part interrelate (at least partly) via our field study. Their treatment determined the way we conducted our empirical work and are therefore pooled in this "empirical part".

As in the first part, I start with discussing the scope of the research questions by presenting the literature and determining how these questions should be answered methodologically [1]. Subsequently, I will outline how we designed our experimental study (protocol, focus groups,

1. The literature review is detailed for the research questions 2 (valuation of bundles of ES), 3 (preference for landscape elements in DCEs) and 4 (valuation of non-material services by deliberation), whereas a detailed literature review for question 5 (contribution of deliberation to valuation of ES) is delegated to chapter 4. I opted for this order because the literature on deliberation had only limited influence on the way we organized our empirical study and I wanted to keep these organizational thoughts isolated for the ease of clarity. Indeed, the

DCE, etc.) and I will explain why I think it is capable to furnish satisfactory responses to our research questions.

Then, chapter 2 presents all methods we applied during our field experiment and complements the organizational choices we made to respond to our research questions by those, which we made during the implementation of the study. I first introduce the study area, the Cévennes landscape before presenting how to conduct focus groups. I then detail the experimental design of our DCE and the underlying econometrical theory. The chapter closes with a description of principal component analysis.

The results of the DCE are presented in chapter 3. As this chapter will respond to the research question about the valuation of ES bundles and how they can be integrated as a result of preferences for landscape elements within a DCE, the literature about ES bundles presented at the beginning of part 2 is investigated in detail. Furthermore, the literature on landscape preferences in DCEs is deepened. I then turn to the results of the DCE by presenting the descriptive statistics and judging the representativeness of our sample. It is followed by the analysis of the econometric models (logit, mixed logit) explained in chapter 2. The analysis is complemented by a principal component analysis which seeks to determine the preferences of respondents with regard to the services included in each landscape attribute of our DCE. This is then used as the point of departure for a nested logit model. Finally, a discussion summarizes the results and comments on them with regard to our research questions.

Deliberative approaches are the main concern of chapter 4. Firstly, the literature on deliberative approaches is discussed and main advantages and concerns such as group pressure and dominant individuals among participants are explored. Having already provided the main part of the analysis of the DCE in chapter 3, this chapter will investigate these results with respect to that literature. This includes the ability to integrate non-material services into valuation as well as the inclusion of minority positions. The quantitative results of the DCE are then coupled with a qualitative analysis indicator statements in order to investigate the contribution of deliberation to the valuation of ES.

Finally, a general summary will resume the findings of our study, give drawbacks from own experiences during the implementation of our deliberative study and develop how research on the valuation of ES can evolve in the context of these findings.

Supplementary material such as the Ngene code used for the analysis, the complete questionnaire, descriptive statistics, estimation results and outputs and an example of a transcribed discussion will be provided in the appendix.

results of our empirical studies are important for this 5th research question about deliberation which justifies its placement within in this second part of the thesis (and not an in additional, 3rd part).

Résumé

L'évaluation économique des services écosystémiques (ecosystem services, ES) est de plus en plus utilisée dans le domaine de la recherche et au-delà, afin de permettre une gestion efficiente des ressources naturelles.
Dans ce contexte, les approches traditionnelles des évaluations basées sur les préférences déclarées et qui reposent sur la théorie d'économie néoclassique, sont critiquées pour ne pas intégrer une partie importante des valeurs incluses dans les préférences individuelles, en plus de présenter un problème de légitimité.
Les approches délibératives sont proposées comme des alternatives possibles qui, en incluant plus de temps pour réfléchir, en autorisant les participants à poser des questions et d'interagir ensemble, permettent de construire et d'enrichir leurs préférences pour ces biens environnementaux souvent complexes et peu familiers.
Alors que les évaluations sont faites plus fréquemment, leur utilisation concrète en prise de décision publique reste limitée. La question se pose de saisir comment le concept de l'évaluation des ES devrait évoluer pour augmenter leur pertinence pour les acteurs en charge de gérer ces ressources.
L'objectif de cette thèse est de contribuer à déterminer l'effet de la délibération sur les préférences des individus dans le cadre d'une étude expérimentale et de fournir une analyse qui détermine comment les évaluations des ES deviennent plus utiles pour la prise de décision publique.
Pour ces raisons, la thèse

— complète la vision des évaluations comme moyen d'information avec une démarche qui anticipe des problèmes d'implémentation,
— effectue une évaluation économique des services d'un paysage en prenant en compte les interrelations entre différentes caractéristiques,
— révèle si l'expérience de choix discrète (discrete choice experiment, DCE) est un outil pour intégrer ces interrelations, en supposant qu'un attribut peut représenter un bouquet des ES,
— détermine l'effet de la délibération sur les préférences des individus ainsi que sur la qualité de l'évaluation dans le cadre d'une étude sur la perception des ES générée par les paysages cévenols, et
— demande si l'évaluation délibérative monétaire (deliberative monetary valuation, DMV) a la capacité de renforcer la considération des ES non-matériels dans les préférences des individus.

Afin de connaître les avantages qui font que le concept des ES est appréhendé dans le domaine de la prise de décision publique, une revue de bibliographie sur la présence du concept dans des documents stratégiques est effectuée dans le chapitre 1. Ceci est complété par la littérature de la recherche sur l'implémentation d'une politique ("implementation research") ainsi que sur le rôle des interfaces science-politique (science-policy interfaces, SPI) dans ces processus.
Ces investigations sont réalisées dans l'objectif de proposer des protocoles d'évaluations économiques plus pertinents pour la prise de décision.

La revue bibliographique identifie deux approches principales d'implémentation : des approches descendantes et des approches ascendantes avec des capacités respectives différentes de pouvoir imposer des décisions des niveaux supérieurs et d'inclure des acteurs divers dans la mise en œuvre des mesures.
En utilisant des retours d'expériences d'autres études, il est ensuite démontré que les approches traditionnelles monétaires disposent des caractéristiques théoriques qui correspondent aux besoins des approches descendantes alors que les approches délibératives d'évaluation sont théoriquement mieux capables de soutenir un processus ascendant.
De manière générale, des SPIs sont capables de promouvoir une mise en œuvre dans plusieurs contextes. Pour cette raison, le choix de la méthode d'évaluation a aussi des conséquences sur son utilité dans la mise en œuvre. Dans ce contexte, les deux approches sont complémentaires et cette complémentarité devrait être exploitée par le chercheur en proposant un protocole adapté.

La mise en œuvre de notre étude expérimentale sur la perception des ES générés par les paysages cévenols est communiquée dans le chapitre 2. Ce chapitre détaille les informations préalables collectées ainsi et fournit une présentation des méthodes utilisées dans la partie empirique de la thèse.
Une attention particulière est portée sur la détermination du protocole de l'étude ainsi que sur la création du questionnaire. Dans ce cadre, la méthode des focus groups est introduite et appliquée.
De manière générale, l'étude déploie un DCE dans le cadre d'ateliers d'évaluation. Dans la moitié de ces ateliers, les participants discutent de leurs perceptions des paysages cévenols avant de répondre au questionnaire, y compris le DCE.
Dans l'autre moitié, cet ordre est inversé pour pouvoir comparer les résultats par rapport à l'effet de la discussion. De surcroît, l'étude est effectuée à Montpellier et en Cévennes afin de pouvoir aussi comparer les différences entre ces deux localisations, concernant les préférences et leurs affectations par une délibération.

Dans ce contexte, l'apport des focus groups comprendrait une vérification du contenu de l'étude ainsi que la détermination des attributs du DCE, des recommandations par rapport aux défis logistiques et des suppositions pour des déclarations indicatives utilisées dans le questionnaire pour identifier les ES associés aux différents attributs.

En utilisant des affiches et flyers, des annonces sur les supports de communication des collectivités, un article dans la presse locale ainsi qu'un entretien à la radio, 243 personnes ont participé à nos ateliers. En Cévennes, cinq groupes ont été établis suivant le protocole d'un groupe délibératif et six groupes ont été non délibérés pour un total de 122 individus dans cet échantillon.
Les autres 121 personnes ont assisté à nos ateliers à Montpellier, où six groupes de chaque catégorie (délibérative, non délibérative) ont été formés.
Les perceptions exprimées dans les discussions et les questionnaires peuvent être considérés comme une bonne représentativité de la population. En terme de caractéristiques socio-culturelles, un biais envers des femmes et au détriment des personnes âgées de 30 à 55 ans ainsi que des catégories ouvriers et employés est observée.
Ce chapitre constitue également la volonté de donner un exemple de la façon dont les bonnes pratiques sont mises en œuvre dans ce contexte particulier et de discuter le processus d'arbitrage entre différentes options pour le design de l'étude. Ceci est important pour garantir une qualité de l'évaluation accompagnée par une standardisation des approches pour augmenter la comparabilité entre des études.
Le besoin d'arriver à cette homogénéisation des diverses approches est la raison pour laquelle un ouvrage comme celui de Mariel et al (2021) représente des opportunités pour le domaine. Notre étude illustre également l'importance d'une préparation approfondie afin d'améliorer la qualité de l'étude et la façon d'adapter les bonnes pratiques au contexte individuel.

Un aspect important pour la gestion des paysages et des ES qui y sont générés, est de saisir comment une collaboration entre différents acteurs peut être atteinte. Afin de pouvoir identifier tous les bénéficiaires des processus affectés, la détermination, la compréhension et la communication des interrelations entre les ES sont nécessaires.
Le concept des bouquets des ES est proposé comme une solution pour illustrer le rapport entre différents ES et pour encourager des parties prenantes à collaborer au niveau des paysages. Un bouquet des ES est un ensemble d'ES qui apparaissent simultanément au travers de l'espace et du temps (Raudsepp-Hearne et al, 2010 ; p. 5242).
Dans le chapitre 3, notre étude expérimentale est alors analysée par rapport aux capacités des DCE de pouvoir fournir une estimation de la valeur économique perçue par des bouquets de ES des paysages cévenols.
Par rapport aux préférences pour l'évolution des paysages, les estimations des modèles logit multinomial ainsi que logit mélangé montrent un soutien pour des espaces agropastoraux au lieu d'une reforestation naturelle, une gestion des forêts en faveur des feuillus (notamment des châtaigneraies), un renfort moyen pour des infrastructures touristiques ainsi qu'une conservation du patrimoine historique.

Ensuite, une analyse des correspondances multiples (multiple correspondance analysis, MCA) suivi d'une analyse de clusters par rapport à la considération des ES décrits par des expressions

indicatrices a démontré la présence d'un premier groupe important (47,0%) qui reporte d'avoir intégré une grande partie des ES dans ses choix. Le deuxième groupe (34,3%) considère un bouquet avec moins de services dans ses choix, à l'exception des services générés par l'agropastoralisme. Le dernier cluster (18,7%) regroupe des personnes qui ne considèrent que faiblement la majorité des ES. Seulement des ES qui appellent aux valeurs transcendantes ainsi que la séquestration du carbone sont considérables dans leur bouquet.
De manière générale, les préférences entre les deux localisations sont moins importantes que celles entre différents âges. Une analyse des volontés à payer (willingness-to-pay, WTP) dévoile un support pour une politique de conservation des espaces naturels, comparé à une politique de soutien des secteurs économiques ou un scenario qui correspond à l'évolution actuelle.
En conséquence, l'étude a montré que différents services sont considérés par des individus au sein d'un attribut du DCE. Une évaluation économique des bouquets de ES est alors envisageable, si elle est accompagnée par d'autres méthodes qualitatives comme la MCA ou une analyse de cluster qui pourront se baser sur des expressions indicatrices en utilisant une échelle de Likert.

L'apport des approches délibératives aux évaluations économiques des ES est étudié dans le chapitre 4. En plus, leur capacité de soutenir la prise en compte des ES non-matériels est analysée. En séparant les échantillons des régions par rapport au fait d'avoir eu une discussion ou non et de comparer les intervalles de confiance des estimations respectives, cela a permis de suggérer (sans le prouver) la présence d'un effet significatif.
Les données indiquent que la délibération a baissé les préférences des individus pour le tourisme et particulièrement le support pour des améliorations conséquentes de l'infrastructure touristiques. Pour l'échantillon montpelliérain, une diminution du coefficient associé au patrimoine historique est observée en plus.
Une investigation de la considération des ES et d'autres enjeux associés aux expressions indicatrices, a témoigné une prise en compte élevée des services non-matériels dans les choix des individus en s'amplifiant pour les groupes cévenols.
De manière générale, l'effet de la délibération se distingue entre les deux échantillons : alors que la discussion entre individus entraîne une augmentation de la quantité d'informations prises en compte pour les habitants de Montpellier, elle semble encourager l'intervention, l'expression et l'intégration des valeurs transcendantes dans les préférences des habitants en Cévennes.
Sur ce point s'ajoute une corrélation de la délibération avec d'autres caractéristiques indiquant une certaine expertise lors de l'analyse des clusters dans le chapitre 3. Ces points suggèrent que le dégrée d'expertise ou de familiarité est crucial pour que la délibération provoque une économisation ou une moralisation des préférences (Lo et Spash, 2013) au sein des participants à la discussion.
Un autre effet de la délibération concerne la qualité générale de l'évaluation. Avoir discuté sur le sujet augmente la satisfaction générale parmi les individus par rapport au questionnaire et augmente aussi la disposition à relever ses préférences lors du DCE. Néanmoins, des préférences

lexicographiques peuvent aussi se construire pendant ce processus, comme les données pour les groupes cévenols l'indiquent.
De manière générale, ce chapitre démontre que la délibération est un moyen capable d'enrichir les préférences des individus et de compenser certaines insuffisances des approches d'évaluation monétaire traditionnelles.

En conclusion, la thèse représente trois apports principaux au domaine de l'évaluation économique des ES qui constituent en même temps des champs de recherche future.
D'abord, la nécessité d'un élargissement des études empiriques est identifiée. Cela permettra de donner des exemples d'adaptation des bonnes pratiques ainsi que de fournir l'évidence sur l'effet de la délibération, difficile à obtenir à cause des faibles tailles de l'échantillon dans ce type d'étude. Ce besoin concerne particulièrement la manière dont les préférences sont exactement construites et affectées pendant une discussion.
Ensuite, les évaluations doivent inclure les besoins des décideurs publics ainsi que des organismes en charge de la mise en œuvre. Le soutien ou l'utilisation des établissements transdisciplinaires en est une alternative prometteuse. En ce qui concerne des approches conceptuelles, une méthode interdisciplinaire comme les bouquets des ES incite aux collaborations entre chercheurs, agents publics et parties prenantes. Adapter des méthodes d'évaluation tel que le DCE aux bouquets des ES est proposé en tant que démarche.
Finalement, la délibération enrichi les préférences des individus et permet une meilleure considération des ES non-matériels. Il est ainsi possible de compenser quelques insuffisances des approches traditionnelles et de compléter leurs résultats d'une manière qualitative. Néanmoins, de la recherche est encore nécessaire sur (i) les approches d'agrégation des préférences en conservant une partie de la nature contextuelle des valeurs élevées lors d'une évaluation délibérative monétaire et (ii) sur l'élaboration des processus de délibération et la façon dont cela impacte les préférences afin d'augmenter la pertinence pour les acteurs de décisions et de leur mise en œuvre.

Part I.

Theoretical part

This theoretical part [1] of the thesis is composed of a literature review, that assesses how valuation approaches could become more pertinent to decision makers and practitioners. The main supposition during the review is that valuation should not solely be focused on the needs of decision makers, but simultaneously account for the requirements of agents responsible for the implementation of environmental rules or measures. Findings from implementation research is used to flesh out this hypothesis and the role of science-policy interfaces for implementation is investigated.

In the context of these analyses, possible implications for ecosystem service valuation are discussed.

This literature review presented in chapter 1 was published in a peer-reviewed journal under the following reference ([KS21]):

Kieslich, M., Salles, J. M. (2021). Implementation context and science-policy interfaces: Implications for the economic valuation of ecosystem services. *Ecological Economics, 179, 106857.*

1. "Theoretical" in this context refers less to a theoratical modeling but more as a distinction to the second part of the thesis that deals with the empirical study about the ES derived by the Cévennes landscapes.

1. Literature review: Implementation context and science-policy interfaces: Implications for the economic valuation of ecosystem services

Highlights:

- A review of content analyses assesses the implementation gap of ecosystem services
- Science-policy interfaces and transdisciplinarity can enhance knowledge transfer
- Better consideration of conceptual findings from implementation research is needed
- Ecosystem service valuation should consider needs of implementing actors
- Using complementarities of valuation methods contributes to this consideration

Abstract Economic valuation has been presented as an important tool for enhancing the consideration of ecosystem services (ES) in decision-making. Recent literature provides evidence that an implementation gap between theoretical findings, consideration in the policy sphere, and measurable action in practice persists. Our paper aims to contribute to its closure. First, we assess why this gap exists by reviewing the literature on how the ES concept is adopted in policy documents and the legal system. Secondly, we present tools and structures that enhance better information transfer from valuations among actors in order to achieve transdisciplinary collaboration. Therefore, this article complements literature on science-policy interfaces (SPI) with elements from implementation research. It shows that SPIs are beneficial for different implementation contexts. Thirdly, we analyze case studies that reveal how ES valuation (ESV) could integrate the needs of various actors to get relevant to decision-makers and practitioners. We find that opportunities of different implementation contexts are not sufficiently accounted for in the design of ESV. This could be achieved by combining traditional monetary valuation with deliberative techniques whose capacities to communicate and transfer information varies with implementation contexts. Exploiting this complementarity will help researchers, decision-makers and practitioners to close the implementation gap.

Keywords: Ecosystem Services Valuation, Deliberative Valuation, Implementation Research, Science-Policy Interface, Decision-Making, Implementation Gap

1.1. Introduction

The ecosystem services (ES) concept has become an important tool to support the integration of environmental needs in public policy ([DPG+09]; [GPL+15]; [vOAB+18]). Relevant information, maps, classifications and scenarios are used in order to enhance the process of decision-making to include environmental stakes in their choices ([PTR15]; [SMM+17]; [FSSs+18]). The ecosystem service valuation (ESV) can help highlight effects on human well-being [Sal11], achieve mainstreaming ES in public decision-making ([CdDG+97]; [SP18]) and information transfer ([dGBvdP+12]; [WP11]). Although a growing literature exists on the importance of ESV, [LRB+13b] raised the issue of the effective use of ES valuation in decision-making; the answer being that this use remains limited. They pointed out the existence of a literature gap concerning this issue: "The common rule is to present an economic valuation, then suggest that it [may] be used for decision-making, but without this use being either explicited or contextualized, and without concrete examples being provided nor analyzed" ([LRB+13b]; p. 217). As a possible interpretation the authors suggest that researchers are not really interested in the use of ecosystem services valuation by practitioners in decision-making at all ([SV06]; [LM14]; [OJT+18]). Sharing the viewpoint which is also expressed in [MB19], we refer here to a "demand-driven use of ESV" where valuations are not offered by scientist hoping to contribute to the overall issue. Instead, ESV is actively demanded or proposed by decision-makers, practitioners or trans- or interdisciplinary institutions. This gave rise to what some authors argue to be an "implementation gap" of ESV [LCF+17]. Our paper aims to contribute to closing this gap in four ways. First, we attempt to figure out this "implementation gap". A significant literature about the use of the ES concept in policy documents (e.g. [RVFGA18]; [DSC+18]), among practitioners [PBWC18] and in legislation ([JD18]; [SFR+18]) has emerged recently. We provide a review of this literature in order to assess and summarize how the ES concept is applied in practice and what promotes or harms its efficient use. Second, many necessary guidelines on how to conduct and promote results of ES research to enhance implementation among decision-makers have emerged (e.g. [FTM09]; [RVM+15]; [OJT+18]). Nevertheless, the theoretical foundations of implementation research have not been sufficiently accounted for in the ES literature yet. We present this literature and link it to the existing literature about ESV. We therefore define implementation context of ES policy as a situation in which a decision about ES governance (or more general issues) has to be either enforced or assessed. This includes in particular how this process is affected by external factors such as the institutional setting, data availability, human capital, etc. In this article we will mainly focus on the institutional setting. The question here is how valuation can address the various implementation contexts and needs of science-policy interfaces (SPI). The use of several types of valuation techniques has been shown to be beneficial to account for different value dimensions [JMLB+18]. Given the current decision-making processes, how can valuation techniques evolve to meet the needs of the authorities charged with the implementation? Third, we include institutional vehicles such as SPI that can considerably improve information transfer ([CM00]; [SNT+14]; [YWS+14]) into our analysis. SPI are structures of processes aiming to use

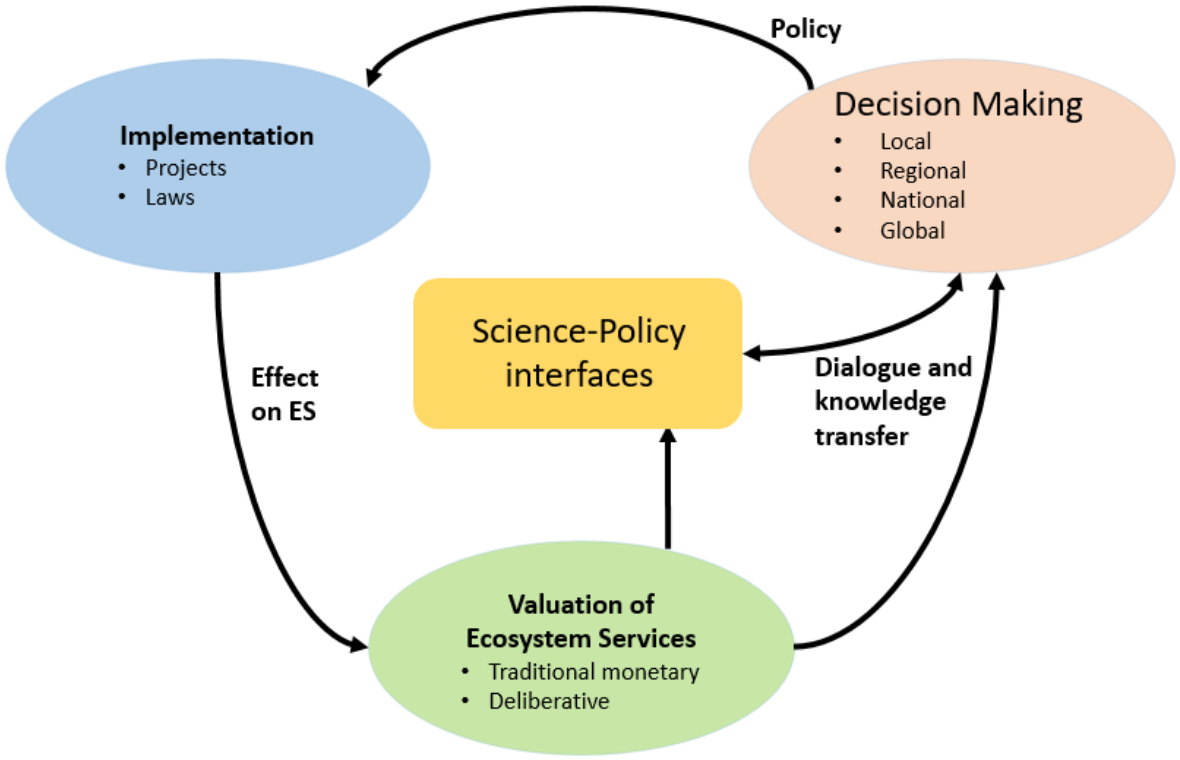

Figure 1.1. – Classical view in the literature on the relation between the spheres of ecosystem services valuation, decision-making and implementation.

the intersection between science and policy to support decision-making by exchange, co-evolution and joint construction of knowledge (adapted from [vdH07]). Based on these better-informed decisions, policy implementation affects the ES initially assessed and valued [GPL$^+$15]. Figure1.1 illustrates this "classical view" on the role of ESV within the decision-making process: Valuation is produced by researchers and expert consultants or co-produced in SPIs and delivered to the "decision-making sphere" at different scales (local, global, etc.) The latter decide on a policy by using or not using this knowledge. As illustrated, this is the step where scarce interest of the use of ESV is observed by [LRB$^+$13b]. The policy is applied by administrations and charged organizations (the implementation sphere) and affects the ES initially valued.

As an example, The Economics of Ecosystems and Biodiversity (TEEB) framework which created considerable attention (although criticized from an academic point of view, [Tis14]) for conceptualizing and standardizing ES valuation [WG12], states in its study report for local and regional policy-makers that it is "intended to guide policy-makers in designing their own processes for appraising and considering nature's benefits" ([WG12]; p.7). Hence, decision-making processes are seen as having to be adapted in order to better integrate the results of valuation. Therefore, we propose a complementary process to that one in figure 1.1 to be considered. Our analysis shows that the uptake of ES within policy depends - of course - on decision-making, but

on implementation context as well. It recapitulates how a transdisciplinary interplay between implementation contexts, science-policy interfaces and ESV (e.g. [MOPJB+15]) can enhance the uptake of ESV within decision-making. In consequence, this might contribute to the closure of the implementation gap. In exploring this we modify figure 1.1 to illustrate the potential pivotal role of ESV and transdisciplinary research, see figure 1.2. The article is organized as follows: We firstly summarize the main findings on why the ES concept is seen as a possible vehicle to integrate ES in decision-making and how it is already integrated in policy documents and law (section 1.2). Being already broadly discussed in the literature, a short overview of science-policy interfaces follows, while focusing on implications for research on economic valuation of ES (section 1.3). We then introduce theoretical elements from implementation research and how transdisciplinarity connects to bottom-up and top-down implementation. Finally, we use these theoretical findings to discuss opportunities, limitations and complementarities of different valuation techniques for policy implementation by using exemplary case studies. We conclude with reflection on the role of empirical experience, SPIs in transmitting information and the role of deliberative valuation approaches in providing policy makers and practitioners with relevant information.

1.2. Evidence of the mainstreaming of the ecosystem services concept

As pointed out in the introduction, much effort is undertaken to inform decision-making about the management of ES by using economic valuation. Therefore, it is necessary to assess whether the concept of ES is well known and applied among decision-makers and practitioners. This so-called mainstreaming helps to transmit theoretical evidence into concrete action and to consider impacts of policies on ecosystem services ([DPG+09], [MHP+13]). Adoption of the concept is expected to improve understanding for environmental problems and to promote sustainable solutions within local decision-making [PMR16]. In this section we focus on how far the mainstreaming of the ES Concept got and what advantages and caveats exists (i) in policy design and public administration and (ii) in jurisdiction and law.

1.2.1. Use within policy and public administration

The following section presents drawbacks from studies dealing with the implementation of ES within policy and administration by using either content analysis of policy documents or surveys of practitioners. Table 1.1 presents significant articles assessing the integration of the ES concept. These articles were selected from a web search of Google Scholar using the terms "Ecosystem Services" coupled with either "Content Analysis" or "policy documents". They were complemented by papers appearing in the references of our first sample. The resulting selection covers a wide range of different policy contexts, study areas and administrative scales, ranging from local to international. Integration of ES is mostly measured by the degree of explicitness (using the term

"Ecosystem Services" or near substitutes or no explicit term at all) or by the degree of detail used to describe the concept or specific services (e.g. [NHO17]). They provide consistent results on how ES are included and where policy integration of the concept is confronted with barriers. We identified five main issues which are addressed individually.

1.2.1.1. Explicitness and implicitness

Nearly all papers of table 1.1 report that ES are increasingly mentioned within policy context ([BSP+17]; [RVFGA18]), but often implicitly (referring generally to the role and function without using a specific term). Rarely, these benefits are called explicitly "Ecosystem Services" (or equivalently), or specific ecosystem services (e.g. maintenance of wildlife habitat, flood control, etc.) are mentioned. This lack of explicitness can be seen as an indicator for existing gaps in understanding within administrations and the need for clear definitions in order to diminish ambiguity ([HFM+15]; [MMPK+16]). Accordingly, possible trade-offs among different services are more difficult to address [RVFGA18]. These findings confirm the analysis of Kettunen et al (2014) that a solid conceptual base within policy spheres and administration exists and is growing, but not yet translated into proactive outcomes.

1.2.1.2. Interdisciplinarity and transdisciplinarity

Regarding the broad range of ways in which human well-being is affected by ES, it becomes important to resolve trade-offs and synergies across different sections and domains [BSP+17]. Two concepts have to be distinguished: interdisciplinarity, where collaboration among several disciplines brings multiple views on the same issue, and transdisciplinarity that aims not only to cooperate, but to create a "common knowledge" among disciplines. This systematic use of the ES concept is still limited, complicating cooperation among different administrative departments and disciplines ([HBC14]; [PBWC18]). This finding is particularly noteworthy, given that interdisciplinary communication, a common ground for dialogue among stakeholders, and awareness-rising are seen as important merits of the ES concept ([HBC14]; [MMPK+16]; [LC18]). Possible solutions to foster this broader view could be to involve more stakeholders and strengthen transdisciplinary capacities within administrations. Research agencies and universities can play a role as knowledge brokers, notably for establishing practicable indicators and common knowledge ([HFM+15]; [DSC+18]; [RVFGA18]).

1.2.1.3. Differences among ecosystem services

The consideration of ES depends on their nature: most studies examining different types find a higher recognition of regulating services than it is the case for provisioning or nonmaterial services ([MMPK+16]; [RVFGA18]). The latter are mostly considered in the context of tourism and recreation ([BSP+17]; [NHO17]). The same difference is identified by Lam and Conway (2018) but on different scales. At municipal level, recreation is the most frequently mentioned

service whereas at regional scale regulating services appear more often. Only Hansen et al (2015) find no disparity among ES types within documents. The limited integration of nonmaterial services other than recreation and tourism is possibly due to the relatively low coverage of content analyses assessing other domains than those already closely related to ES (e.g. flood risk management, land use planning, urban planning, economic affairs, etc.) Interestingly, this retraces the same lack of less tangible nonmaterial services as is found in the ESV literature in general (see [CVLU19]). The frequently observed integration of regulating services corresponds to an adaptation of the concept of ecological function ([PYCL$^+$17]): they represent ecological processes necessary for an ecosystem to be in condition to provide services. For economic valuation, this stimulates the debate about the correct specification of intermediate and final services ([JR11]; [PYCL$^+$17]).

1.2.1.4. Spatial scales

As seen above, different contexts and spatial scales are important to understand the use of the ES concept within policy documents and possible barriers for their implementation [CMKtB18]. Given the diverse valuation methods, many studies are not easily adaptable to local contexts or to be aggregated or disaggregated in order to fit into administrative borders of practitioners ([HBC14]; [DSC$^+$18]). Moreover, this limits the possibility to link ES to their service providing units (SPU), which would be necessary for environmental-economic accounting ([LC18];[Eur13]). The inclusion of ES within the policy sphere depends on the spatial scale as well. In interviews with practitioners, the latter seem to infer particular importance to regional and national scales [PBWC18]. Content analysis confirms this finding, by acknowledging that regional and national scales are connecting local to global management and help to enforce a top-down application of higher-scaled policy goals ([MMPK$^+$16]; [RVFGA18]). For EU policy, this top-down application depends on the type of policy: regulations are difficult to be reframed and adapted to local and regional environmental contexts [BSP$^+$17] whereas directives depend on the necessary uptake at national and regional level [KtBUS14]. However, regulations from upper-level institutions have been proven to be a possible motivation to adopt the ES concept in practice [Rau18].

1.2.1.5. Conceptual and operational integration

In order to judge whether the ES concept is represented conceptually in long-term visions or operationally in short-term binding policy, Kettunen et al (2014) suggest distinguishing more precisely between conceptual and operational integration. For Scotland and the EU, policy documents provide a good level of conceptual integration of ES, which is important for general communication and information, notably for NGOs and local officials. Both cases show lacks of operational integration, which is needed to guide decision-makers and administrations ([HBC14]; [BSP$^+$17]; [CMKtB18]). This discrepancy is underlined by Rozas-Vasquez et al (2018) and Nordin et al (2017) who detect no ES completely covered over the whole process from conceptual description to concrete policy measures in environmental planning documents in Chile and

Sweden. Hence, the holistic development of alternatives to trade off within ES management is inhibited. Only in Ontario (Canada) it is found that the ES concept is explicitly used to motivate and design policy action [LC18].

Authors	Method	Area	Concepts used	Scale	Interdisciplinarity	Different ES
Bouwma et al (2017)	Content analysis (12 EU policies)	Europe	Explicit / implicit ; Level of integration	International	yes	yes
Claret et al (2018)	Content analysis (224 Scottish policy documents)	Scotland / Europe	Conceptual / operational integration	Regional	yes	no
Hansen et al (2015)	Content analysis (5 international cities), stakeholder interviews	Occidental cities	Explicit / implicit	Local	no	yes
Kettunen et al (2014)	Content analysis of EU policies (44 documents)	Europe	Conceptual / operational	International	yes	no
Lam and Conway (2018)	Content analysis of urban plans of 10 municipalities in Ontario	Canada	Explicit / implicit ; Level of integration	Local, regional	no	yes
Hatton MacDonald et al (2014)	Content analysis and interviews of follow-up ES assessment within river basin	Australia	Credibility-Salience-Legitimacy-Framework	Regional	yes	no
Maczka et al (2016)	Content analysis of 46 Polish policy documents and 9 stakeholder interviews	Poland	Explicit / Implicit	National	yes	yes
Nordin et al (2017)	Content analysis 39 policy documents of 6 Swedish municipalities	Sweden	Explicit / implicit ; Level of integration	Local	yes	yes

Continued on next page

Authors	Method	Area	Concepts used	Scale	Interdisciplinarity	Different ES
Poljanec-Boric et al (2018)	Questionnaire to 600 public service agents working in domains relevant for ES	Croatia	None	Regional, national	yes	no
Rozas-Vasquez et al (2018)	Content analysis (15 Strategic Environmental assessment reports)	Chile	Explicit / implicit	Local, regional	no	yes
Teixeira da Silva et al (2018)	Content Analysis on soil services (urban plans of 7 international cities) and review of Case Studies	International cities	Explicit / implicit; Level of integration	Local	no	no

Table 1.1. – Articles assessing the use of the ES concept in practice, either by content analysis of policy documents or by interviews of managers (Column "Method"). The other columns indicate the study area, what concept is used to evaluate integration, the scale of analysis, whether integration was measured beyond environmental policy departments ("Interdisciplinarity") and whether several ES have been part of the analysis.

1.2.2. Ecosystem services concept in the legal system

The efforts to preserve ES are not only seen as a manner of public decision-making and legislature. Moreover, the enforcement of environmental law is another important step and can help to empower marginalized parts of the population often affected by environmental degradation [KGBZ13]. A general problem is the public good character of ES. Naturally, not having an owner whose rights have been affected, a judgment on their legal distribution, provision or conservation is a source of complications. Furthermore, the intrinsic value attributed to ES cannot be taken into account [Bea18]. This change if nature is defined as a legal subject with its own rights, as it is the case in a few countries e.g. in Bolivia, Ecuador, India or New Zealand [SB18]. Several works reviewed and explained the place of the ES concept and valuation techniques within legal enforcement. First, the implicitness of ES in environmental law is underlined, confirming the analysis for policy documents in section 1.2.1 [Mau17]. The concept is mostly used in so-called soft law (long-term visions, guidelines) than in enforceable law [ML17]. Sharon et al (2018) find 67 cases in common law in English-speaking countries where specific ES are explicitly mentioned, but rather as help to interpret specific cases than as a whole concept. In France, ES are explicitly defined in the National Environmental Law ("Code de l'environnement") since 2004 in order to account for damages on protected natural resources [Dou18]. Secondly, the use of ES depends on the scale. Given that environmental and urban planning is more often treated by courts at regional or even municipal level, most appearances of the concept are found at this stage rather than in higher-level courts [SFR$^+$18]. This raises the question whether the complexity and interconnectedness of ES, going beyond administrative borders, can be fully assessed. It is proposed to face this problem by shifting the focus on the habitats and ecosystems, as within the legislation on the Natura 2000 Network [Fèv18]. The underlying assumption is that the protection of ES can be achieved by a systemic approach by protecting the environmental "functionality" at the origin of each single ES [Fèv18]. At this point, the discussion on the concept of ecological functions [PHY16] re-emerges. Thirdly, the economically based interpretation of ecosystem services is reflected in most contexts. Several authors report an increasing use of the concepts in combination with questions of valuation [SFR$^+$18] or production function based modeling needed for liability litigation restoration measures in the US [JD18]. In the latter case, authors take the case of using choice experiments to judge the adequacy of restoration to offset losses in other habitats. This expands the use of stated preference methods from purely economic applications such as the determination of liability from the Exxon Valdez oil spill [CMH$^+$03] to other domains. Furthermore, the current focus on economic benefits from ES constitutes a reductionist frame and risks considering less tangible benefits as providing less usefulness for jurisprudence [Dou18]. Here, the inclusion of the expertise of multiple actors such as proposed in most bottom-up implementation frameworks (see section 1.5) might be helpful. Although literature provides evidence for influences and needs for the ES concept in jurisdiction, its concrete use is still limited. Mauerhofer and Laza (2017) show in the analysis of expert questionnaires and interviews that the most advanced use of ES in the European Union is

within the Invasive Species Act. Meanwhile, the aim of biodiversity is judged to constitute a more important guideline to enforce conservation efforts than associated ES. The use of the ES concept itself will not necessarily change jurisprudence, but can support actual applications and measurement, and motivate additional advocacy from stakeholders, producers and beneficiaries [Dou18].

1.3. Decision-making support by science-policy interfaces

As stated in the introduction, science-policy interfaces (SPI) bring together different actors and scientists from different disciplines and administrative levels. By enhancing effective bidirectional transfer of information between knowledge production and decision-making, they are a key element for ES mainstreaming ([SNT+14], [YWS+14]). Before discussing their role in the process of implementation in section 1.5, we introduce a brief overview of the SPI literature and link it the ES concept. More and more publications present empirical experiences from discussions of peoples involved in these fora (e.g. [HGV+13]; [RMT+15]; [OJT+18]). We will then especially focus on how Economic Valuation can contribute to SPIs by benefit transfer (section 1.3.2). Meanwhile, a close relationship between valuation conducting researchers and decision-making (through SPIs) can provoke suspicion about the validity of their work [BB19]. This advocacy-credibility trade-off is addressed at the end of this section (see section 1.3.3).

1.3.1. Challenges and roles of science-policy interfaces

Most difficulties to include environmental findings in policy-making stem from three kinds of issues [CM00]. Firstly, an institutional fit problem arises if the management in charge does not operate at the geophysical scale of the environmental issue. Secondly, a scale discordance problem exists when the scale of information assessment is not meeting the informational needs of decision-making. Finally, Cash and Moser (2000) identify cross-scale dynamics as spatial or temporal interdependencies demanding collaboration of institutions at several levels. In order to address these problems, a unidirectional "pipeline model" is proposed: Information is transferred to the highest possible scale, expecting that the institution in charge is powerful enough to compel institutions at lower scales to tackle the problem appropriately. A second information transfer model to support a policy goal formation is science-policy interfaces, as defined in the introduction. In this regard, broader intergovernmental platforms such as the MEA (Millennium Ecosystem Assessment), TEEB or the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) are seen as typical examples of SPIs because they combine different actors from different disciplines and from different administrative levels ([NTW+13], [CM00]). SPIs can serve as a knowledge broker between science, decision-makers and practitioners to solve cross-disciplinary solutions ([TTF05], [LWB+12]). This is especially useful for boundary objects such as ES, if the limits of existing structures and their current functioning can slow down effective solutions ([Tho04]; [Mob10]). Another main objective consists of including

decision-making into research agendas to enhance relevance and easy use of research outcomes by practitioners ([PGR16], [OJT+18], [PSVS+18]). Several concrete actions are proposed to strengthen SPIs with most authors emphasizing to focus on processes and projects instead of structures ([NTW+13]; [SNT+14]; [YWS+14]). First, incentives for policy and science have to be created, such as citation measures including gray literature for scientists. This would create appreciation for SPI work in general ([Gus01]; [SNT+14]; [YWS+14]). Secondly, given that decision-making is often relegated from higher-ordered institutions, approaches like compatibility with superior regulations and possible affordance have to be taken into account [Gus01]. This would increase relevance for lower-level decision-makers and support faster implementation at higher scales, as possible problems are anticipated and accounted for in the research stage. Thirdly, if results are accompanied by the presentation of several policy options, greater scope for negotiation within the policy sector is created ([Wat05]; [PGR16]) and decision-makers are forced to demand and apply a more "holistic understanding" in order to discriminate among alternatives. It is argued that these decisions would be more "robust" in the long run (Hirsch and Luzadis, 2013). Others suggest changing publishing mechanisms by more interdisciplinary and inter-domain co-authorship and cross-reviewing between scientists, decision-makers and practitioners ([CK12]; [YWS+14]). However, the effective inclusion of SPIs needs in research agendas also provoke a "quality-feasibility trade-off" [OJT+18] with respect to diverging time horizons between science and decision-making. For example, the demand for quick results by managers limits the use of time-consuming in-depth analyses and participative approaches by researchers [SNT+14]. This contradicts recommendations of the SPI literature which underlines the importance of participation, deliberation and stakeholder integration as a way to include local knowledge in the decision-making and implementation process ([SV06]; [PGR16]; [LMD+19]). Possible long-lasting conflicts harming an effective application could be anticipated and mitigated ([Die13]; [Rog13]). This would favor better outcomes in shorter time horizons. Linked to SPIs, the ES framework serves as an important boundary object that provides a base for collaborative work and creates mutual understanding among working domains and scientific disciplines ([Gus01]; [YWS+14]; [SHE+18]). Distinctions could be made among different types of ES: whereas provisioning and regulating services are relatively standardized among disciplines, nonmaterial services still deliver a flexible framework for different interpretations and discussions ([Ree08]; [SHE+18]). It is argued that standardization is beneficial for successful interdisciplinary collaboration and effective implementation. In the case of non-material benefits, different notions and understandings still exist. Here, pressure for standardization could overweight the majority point of view and marginalize minority positions ([HCD16]; [SHE+18]).

1.3.2. Informational use of ecosystem services valuation: benefit transfer

The aim to use economic valuations to inform decision-makers and to stress the importance of ES for human well-being is the most common reason to conduct valuation studies and referred to as its main purpose ([Sal11]; [CGB+12]; [LRB+13b]; [RKP+14]). However, research gaps

in combining findings from decision-making theory with ESV are still highlighted [OJT+18]. Therefore, SPIs are mandatory to connect experts in each of these domains and summarize the most important facts for decision-makers and the general public [YWS+14]. To support the information transfer among different spatial scales and applications, benefit transfer is seen as a potentially practical and useful approach ([JADS17]; [NSM+18]). The problems of transferring benefits arise from the scarcity of data from the initial valuations ([Plu09]; [SDE+11]) but also from the fact that the relationship between the dependent and independent variables may not be the same between the study and policy sites [RLKC15]. Studies aiming to reproduce or confirm these valuations in order to create a more solid, comparable database as a primary source, are not relevant for publication as they cannot - per se - provide methodological innovations ([EWM+12]; [OJT+18]). This also harms the determination of reliance and validity of initial valuations [BB19]. Other caveats are the inclusion of a holistic set of values into benefit transfers ([SV06]; [ABM12]; [CGB+12]; [CAC+16]) and the ecological comparability of spatially different study areas [SS10]. In summary, SPIs are seen as powerful ways to support constructive dialogue and collaboration. Valuations can serve as a way to present economic consequences of several policy options and inform decision-makers. Although several authors mentioned the role of SPI for the implementation stage in general, a methodological classification of implementation contexts is still missing. Implementation research can deliver these theoretical insights.

1.3.3. Researchers and advocacy for ES management

The willingness to mainstream ES in general and to make individual research findings relevant to decision-making in particular, raises the question of how much advocacy for own research interests is necessary or wanted [LM14]. In their key article, [LRB+13b] distinguished among three different ways of how ESV is actually used. First, decision-makers need valuations to trade off different alternatives and finally decide on one of them to be implemented ("decisive"). It retraces how economists aim to deliver relevant cost-benefit analyses. Secondly, in a "technical" setting, valuations are demanded to deliver a specific monetary value which is used for compensations or liabilities (e.g. [JD18]). Finally, "informative" valuations are used to demonstrate value (e.g. [CdDG+97]; [CFC+12]; [GBB13]) and to convince policy-makers to act in favor of the maintenance of ES ([Rau18]; [SP18]). Especially with the last point, researchers are entering a trade-off between credibility and relevance ([SNT+14]; [PGR16]), if they focus solely on communicating results they think of being of most concern to the public [Wat05]. The risk would be to evolve in a direction of either "politicization of science" or "scientification of politics" ([Gus01]; [FR94]; [Lin13]). To sustain credibility, researchers are demanded to provide information on their own involvement in NGOs, which could influence the presentation and communication of their findings [PVES17]. Given the biases introduced by the choice of valuation method [JMLB+18] of associated aggregation tools [MM18] or the way results of ES studies are presented [WEG17], this transparency appears to be important. In fact, further progress by adopting best practice guidelines in the valuation literature (e.g. [JBA+17]) is needed to increase the reliability of results

and the validity of approaches [BB19]. Test-retest experiments, open access to (meta-) data and a general willingness to publish reproducibility studies without methodological innovations are possible steps to strengthen credibility ([OJT+18], [BB19]). Figure 1.2 (section 1.5) illustrates our analysis about how a better implementation process can be achieved. It contains the same elements as figure 1.1, with the same relations as dotted black arrows. It is turned by 90 degrees so that the key elements of our analysis are in the middle: The consideration of an independent implementation stage leads us to propose a complementary way to enhance decision-making: by especially accounting for caveats in the implementation phase (1), decision-makers might be encouraged to engage in favor of ambitious environmental policy (2). This consideration of implementation needs is supported by SPIs as pointed out in this section. The following section describes what basic approaches have been proposed in implementation research literature and what consequences this could have on the decisions.

1.4. Implementation research

In the previous section, we focused on how the ES concept is mainstreamed in decision-making and how it is supported by SPIs. As discussed in the introduction, these steps have to be complemented by an analysis of how these public decisions can be implemented by responsible practitioners. This section provides a short overview about Implementation Research and its main theories and findings. Implementation research is concerned with finding methods that describe and study policy implementation [Mat95]. The term "implementation" can be defined as the "Development between the establishment of an apparent intention on the part of government to do something, or to stop doing something, and the ultimate impact in the world of action" ([OJ00], p.266). A first review summarizing related literature was provided by Sabatier (1986) and O'Toole (1986). They both divide implementation into two different natures. First, a top-down approach, where a policy goal is defined on a large scale by decision-makers who aim to implement this policy on a more local scale. Secondly, if a policy goal is arising within in a local context and it is tried to create a network to communicate this goal to higher scales, implementation is realized in a bottom-up context. Both approaches will be analyzed in the following two subsections. Historically, after initial theoretical reflections in the 1970s, implementation research became popular in the 1980s with several models dealing with the top-down/bottom-up controversy [OJ00]. Whereas more and more variables influencing policy implementation in one of the two contexts were determined, research focused on the provision of parsimony within the framework (e.g. conflict-ambiguity model in [Mat95]). Actually, two main research topics can be distinguished ([Mat95]; [OJ00]): the analysis of policy goals within a top-down or bottom-up approach, and the proposition of a new inclusive framework. We want to contribute to this last point, showing how transdisciplinary work on ESV relates to the traditional framework.

1.4.1. The top-down approach

As described and analyzed by Sabatier (1986), the top-down approach deals with the question whether goals initially defined by policy-makers are achieved and how potential deviation can be explained and limited. Clear policy formulation and a strong bureaucratic sector are seen as important for the successful implementation ([HNH14], [Pov15]). A key variable is the so-called "framing" of the policy process. It refers to the power of policy-makers to select implementing organizations, administrations and agencies such as their organizational, legal (section 1.3), human or technological capacities and responsibilities either support or slow down the effective implementation [Mat95]. Especially the last point underlines the institutional fit problem identified in the model of information transfer of Cash and Moser (2000): for essentially political reasons, controlling or managing establishments may not be capable of covering the responsibility for the entire spatial scale or the methodological complexity of the concerned ES. Consequently, effective environmental policy to conserve or manage ES might be complicated ([CGB+12]; [RKP+14]). The modeling of framing is considered as a major strength of the top-down framework [Sab86]. Meanwhile, an important concession to bottom-up approaches is the integration of learning processes among project participants within the framework [RF05]. They are seen as facilitators for better integration of ES in decision-making [CEK+08]. Sabatier (1986) highlighted several weaknesses of the top-down approach. Firstly, although theoretical progress has been made, top-down models cannot reflect the diversity of possible interactions among agents such as deviations by bureaucrats (e.g. [MW07]) or possible subsystems and marginalized stakeholders [Rog13]. Secondly, the top-down view represents the position of a central planning institution and devotes more attention to program proponents than to possible opponents, possibly overrating the power of implementing actors in the policy process [Sab86]. Therefore, top-down approaches appear appropriate for situations where the legislator has strong formal and informal power to pursue framing.

1.4.2. The bottom-up approach

Unlike the top-down approach, the bottom-up method does not depart from an already formulated policy goal, but focuses on strategic interaction among actors to promote a specific aim expressed and pursued at a local level. It is therefore designed to identify a policy network [Sab86] and to determine most influential elements within a specific policy domain (so-called "target groups" and "service deliverers") [Mat95]. Rowe and Frewer (2005) provide a detailed review on different participative methods and identify five key factors enhancing successful implementation. First, methods should ensure large participation of relevant actors in the mechanism's sample, i. e. participants coming from the local population affected by or interested in the suggested policy. Hence, the range of impact of the supported goal predetermines the nature of participation. Secondly, facilitators managing the elicitation process need access to complete and relevant information from participants. Accordingly, participants have to be

motivated to express themselves actively and to avoid yea-saying (e.g. [Ree08]). Thirdly, a maximum of information about the project should be provided to increase transparency. This opens up possibilities for participants to deliberate and identify "information holes" such as missing data, overly technical language or uncertainties within policy. Fourthly, the participation process should guarantee effective elicitation and transfer of information, for example face-to-face interviews can non-verbal communication such as facial expressions and gestures. Finally, Rowe and Frewer (2005) underline the importance of an effective aggregation technique for communication of results to higher scales. Here the role of the facilitator is critical in ensuring participation from all participants and reporting on the elicitation process in a standardized manner. The modeling of the interaction of multiple actors is difficult in the top-down framework because of its assumption of vertical command structure, but possible (see previous section). In contrast, it is seen as a major methodological strength of the bottom-up framework, because several structures can exist parallelly and exchange on the same or on higher structural levels [OJ00]. The legal system (section 1.3) is able to protect and encourage private initiatives or decelerates bottom-up movements [DS06]. Local conditions and knowledge not yet considered by the central planner are accounted for [Mat95] and transaction costs during implementation is reduced [Rog13]. Meanwhile, indirect effects on participants or on institutional settings (e.g. framing by higher institutions) are difficult to account for within the bottom-up framework [Sab86], as some empirical examples in the discussion section will show. This becomes critical for bottom-up approaches as bureaucratic capacity has been found to have more impact in democratic systems than in top-down dominated autocratic ones [Pov15].

1.4.3. Complementary approaches: transdisciplinary research within science-policy interfaces

Bottom-up and top-down modeling give a coherent overview of Implementation Research, but several complementary approaches emerged in the literature such as the influence of bureaucrats [MW07], relations to rhetoric [Hop11] or combinations of top-down and bottom-up approaches applied to EU mandatory policy [NK14]. Although not included initially in the framework, the interaction of multiple actors is now an important component of top-down approaches. It is modeled either hierarchically (via representation) or horizontally (via participation) [HNH14]. In the first case, higher-ordered structures are not completely independent from lower institutions. This is achieved by sending representatives from the latter to the former in order to give advice for an efficient implementation design including the needs of lower-ordered institutions. In the second case, several decision-makers and implementing practitioners are involved at the same level. Overlapping responsibilities and resulting diverse interests can be modeled and anticipated. Transdisciplinarity research on ES within SPIs offers great potential to fit into this interaction model. In the horizontal case, all parties - researchers, decision-makers and practitioners - are collaborating overarchingly. This is, what Mobjörk (2010) calls "Participative Transdisciplinarity" and retraces notions of the bottom-up approach (without being limited to that case). In the

hierarchical case, several kinds of actors are represented in the conducting SPI in order to deliver common knowledge of the environmental issue. If this representation is only due to legal obligation instead of "organizational culture" [Ree08], collaboration of one party risks to be constrained to the position of giving advice. "Consultative Transdisciplinarity" is the term used by Mobjörk (2010) for this scenario. Meanwhile, close collaboration among parts of parties in SPIs can cause problems of legitimacy: scientific experts and bureaucrats in charged implementation are able to produce efficient, rational solutions but not as the legitimate result of a vote [Hup14]. In summary, top-down approaches are appropriate in situations where the legislator has strong formal and informal power to pursue framing. Bottom-up approaches are seen as adequate for situations with an interest in local dynamics or with the influence of many actors and without hierarchical power relations. Implementation Research is complemented by intermediate models and case analyses [Sae05]. In the following discussion section, we describe how valuation approaches for ES and transdisciplinary research fits well with these implementation contexts. We refer here to figure 1.2: the implementation bubble can be divided into a bottom-up case and a top-down case, having each different needs. Nevertheless, this division is not sharp as illustrated by the dashed line. In order to transfer these needs to researchers and decision-makers, SPIs have to integrate practitioners within a transdisciplinary setting (illustrated by the red arrows). Consultative transdisciplinarity corresponds mainly to the top-down approach, whereas participative transdisciplinarity corresponds to the bottom-up approach. It is noteworthy that SPIs are therefore able to enhance the decision-making and implementation process in both implementation contexts.

1.5. Policy implementation and valuation methods: empirical evidence

As pointed out in the introduction, there are numerous discussions about the limitations and advantages of deliberative and traditional monetary valuation techniques in the literature. Meanwhile, [LRB$^+$13b] showed that limited focus has been put on whether valuations have been used for decision-making at all. In this section, we want to widen the discussion about appropriate valuation methods to the question of how they correspond to the needs and key variables of different implementation approaches. Beginning with the bottom-up approach, we will assess whether deliberative and traditional monetary valuations meet criteria for successful implementation. We will show that implementation context has diverging impacts on the effectiveness of information transfers from different valuation approaches. Meanwhile, adaptation of the valuation to the needs of SPIs regardless of implementation contexts seems to be an even more important issue.

1.5.1. The bottom-up case

For every key factor identified by Rowe and Frewer (2005), we analyze whether empirical deliberative studies facilitate the implementation and dedicate how traditional monetary techniques would perform. First, regarding the maximization of relevant participants, two main techniques in deliberative approaches can be distinguished. The first one is the use of focus groups to improve valuation surveys, which is widely recommended ([CH99], [JBA+17]). The second method is citizen juries where stakeholders get directly involved in the valuation process or invited to give share their view (e.g. [HBHB+15], [Ree08]). Hence, the question is not primarily about the choice of the valuation method but rather about the design and preparation of the final empirical study. Indeed, Rowe and Frewer (2005) stress that not only representation of main ideas is important for bottom-up success, but that a high proportion of affected and interested population should be actively involved in the process. Given that deliberation entails higher administrative and organizational costs for a given intended sample [RW06], traditional monetary techniques can help to reach a larger sample, especially in the context of budgetary constraints [JADS17]. Hence, it provides advantages if local policy aims are affecting a high number of individuals and demands elaboration of a large sample, which would also contribute to a better modeling of the reliability of results [BB19]. Secondly, for the maximization of the amount of relevant information, several indicators are used: (i) an increasing mental connection to the environmental good raised in group discussions [VL16]; (ii) lower protest response rates and motivation to active participation in deliberative settings ([PM05]; [Sza11]) or (iii) higher satisfaction with the process of discussion, the outcomes or motivation to get voluntarily involved in the topic ([GW01]; [Sza11]). Meanwhile, discussion in deliberative approaches can also lead to the monopolization or the domination of certain views (e.g. [DSD09]; [HBHB+15]) and exclusion of minority positions in the process (e.g. [ITK+09]). Again, attention has to be paid to design issues in deliberative valuation, such as the moderator effect [LV16]. A widely discussed problem of traditional monetary is value monism. The focus on the provision of monetary values could marginalize incommensurate and intrinsic values ([GBML15]). Consequently, parts of plural value dimensions and local knowledge (especially about nonmaterial ES) are not adequately assessed and used. Thirdly, the quantity of relevant information given from organizers to respondents can be modulated in deliberative approaches. Possible solutions are to give participants more time to think [MPHAF02] or to mobilize expert opinion such as in citizen juries. This contributes to trust-building [HBHB+15], which is especially important for possible applications in SPIs. This flexibility corresponds to a varying perception of the "optimal" information quantity among participants in valuation studies [LM07]. It contrasts traditional valuation, in which given information is mostly predetermined by the researchers. The fourth point mentioned by Rowe and Frewer (2005) concerns the inclusion of non-verbal communication. As before, this is a question of the practical design of valuation studies independent from methodological issues. Finally, effective aggregation is important to combine findings from individuals [RF05]. Deliberative techniques suffer from small sample sizes and therefore less representativeness than more easily

conductible traditional monetary techniques [BRL15]. Focusing on political instead of statistical representativeness can mitigate this problem [LV16], but it is unclear whether this suffices to serve as a base for aggregation. As mentioned above, aggregation undermines the incorporation of fairness and plural values ([Spa07]; [SS10]). Aggregation methods for non-monetary values exist, especially for multi-criteria assessments, but have an impact on the ordinal scale of possible management alternatives [MM18]. Meanwhile, monetary techniques facilitate aggregation but it is questionable whether "all relevant information" is included ([RF05], p. 273). Especially in the case of incommensurate data, deliberative techniques appear preferable, especially if the results do not have to be aggregated afterwards. If the analysis of local phenomena treated by a bottom-up approach implies further aggregation of outcomes, monetary techniques provide advantages in aggregation and representativeness due to higher possible sample sizes. Further investigation is needed on how information not included by this technique can be integrated in qualitative measurements and aggregated to higher scales, depending on decision-makers' preferences([MM18].

1.5.2. The top-down case

The literature on top-down implementations of environmental projects assessment is less abundant than for bottom-up approaches. Whereas the key variables suggested by Sabatier (1986) and Hupe et al (2014) are focused on different ways of framing from the central planner, empirical evidence from environmental studies involving top-down implementation is scarce. As we do not feel able to classify all the policy contexts of studies as bottom-up or top-down, we present studies which explicitly mentioned being in a "top-down" setting, whose importance is highlighted by the debate on Eco-Authoritarianism (e.g. [Gil12]; [Sha15]). Liu et al (2008) present environmental projects that improved forest cover and reduce soil erosion in China. They find positive effects on poverty alleviation due to higher diversification of activities and income sources. This could be strengthened by strategic planning concepts which include the needs of impacted individuals and stakeholders [LLO$^+$08]. Nevertheless, less participative, traditional monetary valuation is the most widely used method for ESV in China [Jia17]. Likewise, in Kyrgyzstan, [CSHN03] report the introduction of corporate forest management within a top-down and centralized decision-making tradition. They mention a lack of culture of questioning orders and missing experience with local collaborations. A comparison between the outcomes of bottom-up and top-down driven projects in Vietnam is elaborated by Castella et al (2007). Trust of stakeholders in methodologies is identified as a key element for successful implementation. To achieve this goal, they suggest establishing mediation platforms charged with (i) identification of cross-scale dynamics and (ii) interaction and coordination among stakeholders. SPI would therefore be an effective tool to combine top-down and bottom-up strengths in this context. Indeed, SPIs may fail if power structures are centralized (contrary to strong regional authorities in Vietnam, [CPD$^+$07]) or can easily be redistributed among different authorities. These risks have been revealed by two studies on a conservation program in Egypt [Sow07] and green policy

implementation in Burma and Iran [DS06]. The former describes how local Bedouin communities were successfully integrated into the elaboration of a local national park conservation program in South Sinai by the park's administration. After the transfer of responsibility to an agency in charge of tourism development, restrictions for the tourism sector were softened and local population was omitted, resulting in the loss of the conservation success achieved before. In Doyle and Simpson (2006), local environmental groups in Burma are strictly controlled by the central state and in Iran, green NGOs were seen as a possibility to support the expression of groups marginalized in society such as young women. Meanwhile, by providing insufficient financial support, the central government ensured that it was not challenged by these organizations. These examples show that the possibility to create structures comparable to SPI in top-down approaches is not sufficient to create facilities to encourage implementation or information transfer. Furthermore, they have to be fully integrated and not marginalized in the policy process [SRD+07], making them dependent on existing political power structures. As it has been shown in the example from Egypt, extensive efforts have to be made in order to get a holistic set of values, providing valuable information for decision-makers. But this additional effort might be fruitless if institutional structures and responsibilities in the political process are changed, as it is often the case in top-down contexts. A promising approach to mitigate these issues is to link top-down and bottom-up characteristics in order to exploit complementarities (e.g. [FDM+06]; [NK14]). Within a top-down context, participative methods have successfully been applied and revealed local preferences and knowledge in the establishment of national park management policies [ZSY+13]. Meanwhile, willingness to use these methods is dependent on governmental support and implementation framing ([SRD+07]; [ZSY+13]).

1.5.3. Complementarity of the valuation approaches for transdisciplinary implementation by science-policy interfaces

The analysis of the bottom-up case revealed complementarities between monetary and deliberative valuation methods. In cases where local knowledge and perception are important, the analysis benefits from deliberation. If the goods or services valued exceed the local context and if aggregation is demanded, monetary assessment should accompany deliberations. In the top-down contexts, many studies reported the willingness to establish and institutionalize classical bottom-up structures such as SPI in order to transform and adapt initially formulated policy goals at higher scales to local conditions and needs (e.g. [DS06]; [NK14]). These organizations act as multidirectional mediators in the implementation process, capable of enhancing public policies in top-down contexts, if the institutional setting allows [CPD+07]. Consequently, valuations should integrate the needs of SPIs if they are aimed to be used in practice. On the one hand, this means that deliberative elements are useful for meeting the integrative needs of transdisciplinary research. On the other hand, as power structures can change rapidly in top-down contexts [Sow07], and if effective aggregation is important, standard monetary techniques appear important in order to ensure that structured, complementary information can be transferred easily. This is retraced in

figure 1.2: the two kinds of valuation are complementary in the way they address key issues of implementation: whereas deliberative approaches are able to furnish the integrative elements needed in bottom-up approaches, traditional monetary valuation might be helpful in top-down contexts, when fast and aggregated measures are needed. As Bartkowski and Lienhoop (2017) as well as Kenter et al (2019) note, deliberative monetary valuation is a way to combine both.

1.6. Conclusion

After the identification of research needs to close the implementation gap ([LRB+13b]; [LCF+17]), a growing literature reports on empirical experiences from collaborations with decision-makers ([RMT+15]; [OJT+18]), or provides content analyses on strategic policy and planning documents (e.g. [HFM+15]; [NKK+17]; [RVFGA18]). Hence, further research is expected to contribute to the identification of opportunities to enhance dialogue and collaboration among scientists, decision-makers and practitioners, notably through science-policy interfaces [HLvV+16]. For instance, the impacts of implementation contexts are still not well elaborated, although it provides a more detailed insight into decision-makers' and practitioners' needs. This contributes to this transdisciplinary research agenda in three ways. First, we have to highlight the interest of broadening the debate from the sole question of how ecosystem service valuation (ESV) can inform decision-making to a more integrative approach of how ESV can improve decision-making and its implementation. Our aim has been to widen this stage by incorporating the needs for implementation into assessment and valuation, in particular by using different complementary valuation techniques. This may result in greater efficiency when potential problems and conflicts have been anticipated and accounted for in earlier stages. Secondly, we highlighted the potential role that science-policy interfaces (SPIs) can play in different implementation contexts: we found complementarities in their ability to meet implementation needs in top-down and bottom-up contexts. The structural needs of SPIs correspond to the aim of transmitting information from science into politics and from local evidence to global action and vice versa. Thirdly, we applied our analysis to different techniques for the economic valuation of ecosystem services. Deliberative approaches have shown to provide the integrative elements needed for science-policy interfaces, in particular by revealing a more holistic set of values than traditional monetary valuation. This is especially useful in bottom-up contexts. Nevertheless, creating tools to facilitate aggregation is a major challenge for future research ([MMM+17]; [MM18]). In top-down contexts, if existing power structures are such that the policy-making process is framed by a central authority or mainly driven by experts, valuation might be limited to solely inform about or demonstrate value. This could be adequately furnished by monetary valuation. SPIs are able to support the implementation process in either context. For ESV, the use of different methods not only gives opportunities for integrating different user groups and value types [JMLB+18], but also for exploiting complementarities between top-down and bottom-up contexts. If researchers focus on improving the relevance of their results to policy makers and

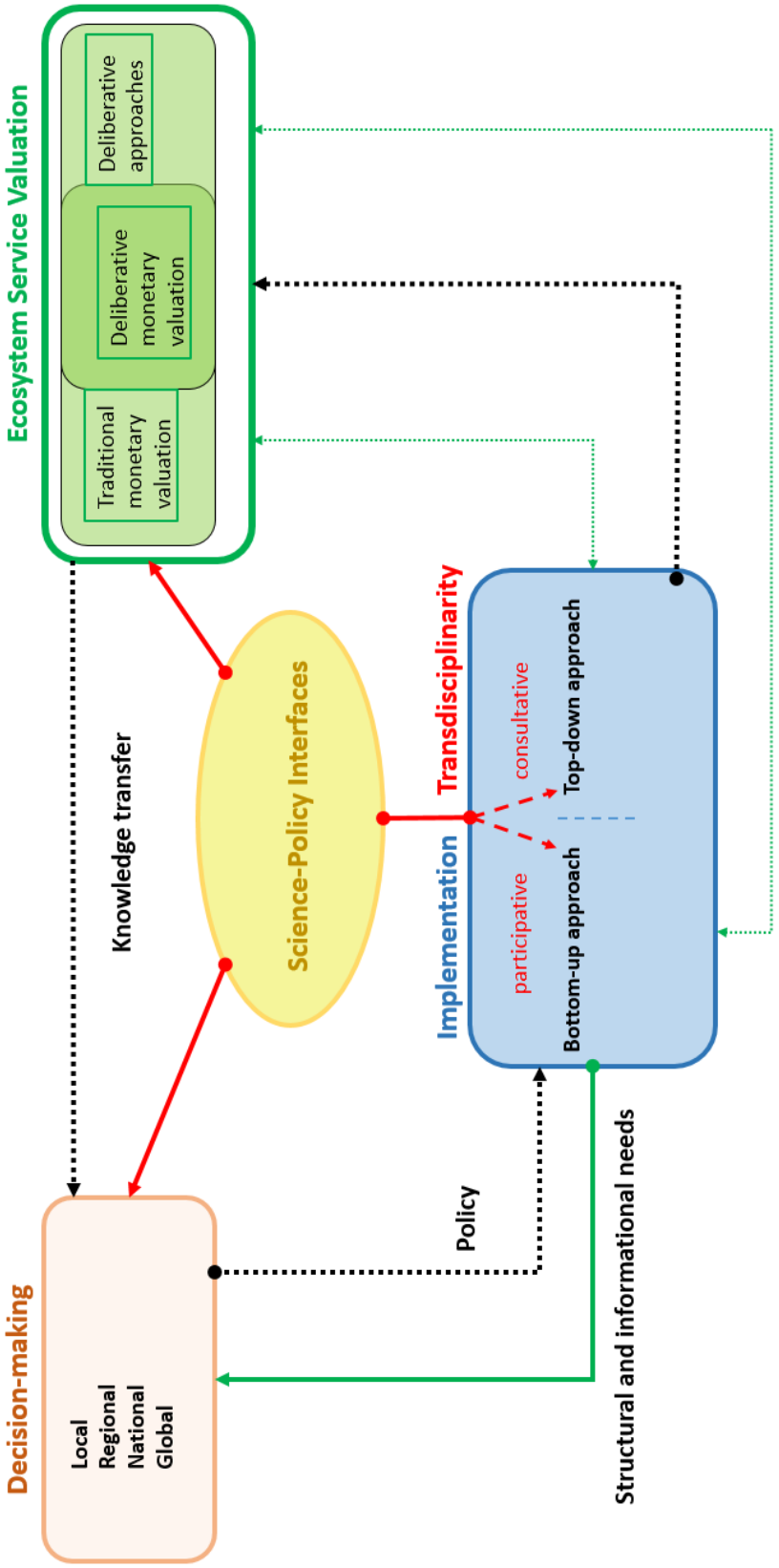

Figure 1.2. – Complementary vision of the implementation process. The initial classical process is presented by the dashed black arrows and complemented by our drawbacks from implementation research and transdisciplinary research.

practitioners, these complementarities should be used such as to enhance the transdisciplinary scope of SPI.

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Part II.

Empirical part

This second part of the thesis covers all the reflexions and methods associated to our field experiment about the Cévennes landscapes. It is therefore called "empirical part". The aim of our experiment was to conduct a discrete choice experiment that assesses preferences for the future evolution of the Cévennes landscapes.

A special interest lies in the deliberative settings in which the experiment took place, as we want to measure its impact on preferences and especially if non-material ES are particularly considered within deliberations. Its rich history and the cultural impact of humans on landscape made the Cévennes our preferred case study area. These cultural ecosystem services complement other provisioning and regulating ES in the region within interrelated bundles of ecosystem services. In the following paragraphs I highlight each of these issues and how they guided our study protocol. They are further detailed in the following chapters 2, 3 and 4.

Studying the perception of bundles of ES in the Cévennes landscapes

The aim of our valuation is to assess the bundles of ES associated with the Cévennes landscape. It is therefore necessary to clarify the link between landscape and bundles of ES.

A landscape is considered as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" [oE00].

Consequently, valuations and assessments are critical instruments in order to describe and understand landscapes. When it comes to the interactions among natural and human effects on landscapes, ES bundles is a concept that allows their modelization and visualization. Bundles of ES are ES "that repeatedly appear together across time and space" ([RHPB10]; p. 5242) and are therefore correlated by common drivers or closely affecting each other [BG09]. Assessing bundles on landscape scale provides particular interest for decision making because it enhances a representation of a wide range ES that exceeds the geographical scale where individual property rights may limit management options (farm level, residences, forest parcels, etc.) [PRS12].

Assessments of the ES associated with landscape features do often use biophysical representation of the links, whereas socio-cultural representations of these bundles are lacking [MLIAGL$^+$12]. Through our experiment, we aim to contribute to deliver such a representation: How do participants of our experiments perceive the landscape and which of its elements are associated to the ES generated?

Discrete choice experiments (DCEs) give the opportunity to integrate both, landscape elements and ES, in the form of attributes. Furthermore, they are less affected by biases, allow the

generation of higher sample sizes due to repeated choice tasks and the disaggregation of the environmental good into to several components allows to generate the according exchange values ([HMW01]; [JBA+17]).

Using graphical elements allows to visualize some of the interrelated ES behind the landscape elements [TBLH16], whereas the sole use of a detailed written or oral description as information for participants complicates their representation of the landscape. Often, it is unclear if the visual preferences for landscape elements already incorporate knowledge about underlying ES [Ste08]. DCEs are therefore providing several advantages over most of other stated preference evaluation methods [1], and are capable to provide the missing socio-cultural representation of the interplay between ES bundles and landscape elements if it is complemented by a mixed-method approach that allows participants to include and express rationales, motivations and additional knowledge into the choice process.

Therefore, we wanted to apply a two-stage valuation procedure in our DCE about the Cévennes landscape. The first valuation part is a classical choice experiment with attributes that are kept rather general so that they do not frame participants to specific value dimensions or to specific ES, but to allow a good representation of the landscape. In complement, the second task presents for each attribute indicator statements that describe particular ES or other benefits embedded in the attributes in order to identify the underlying ES or feelings that determined the choices in the DCE.

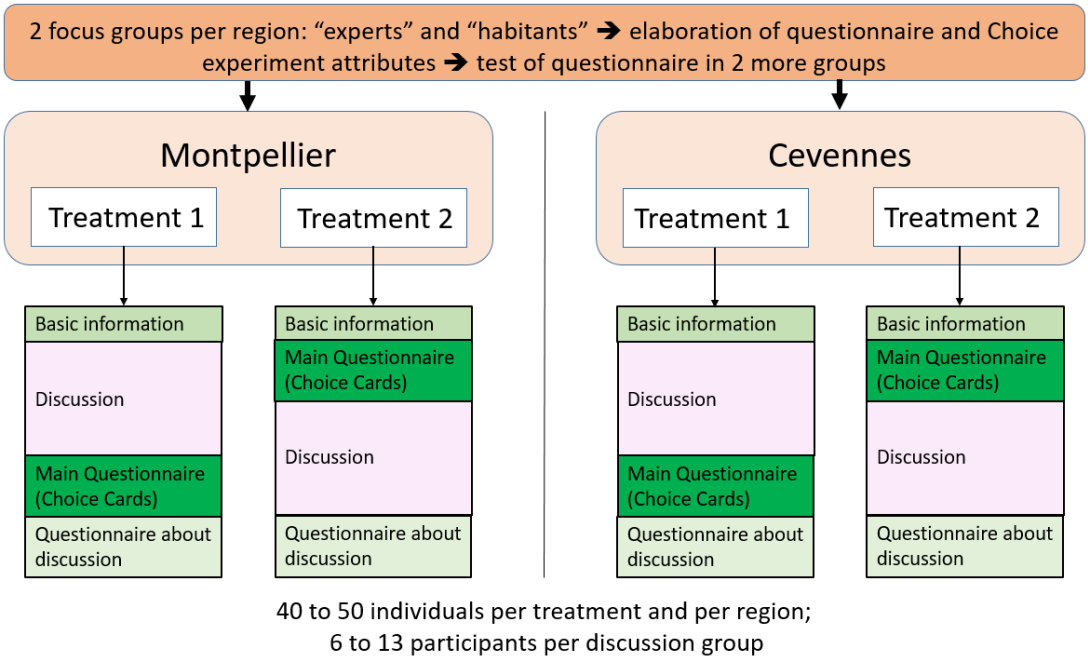
Nevertheless, the ability to respond to such a survey and deliberate on the topic might crucially depend on the level of previously acquired knowledge and personal experience. We therefore test the suitability of our approach on two different types of respondents: (i) on local inhabitants in the Cévennes and (ii) on inhabitants of the urban area of Montpellier, where people might be less informed about the Cévennes landscape, as detailed in the figure on page 45 where our study protocol is visualized. We focused on the following issues:

— Which further development of the cultural landscapes in the Cévennes is preferred?
— Does our approach achieve to combine monetary valuation with ES bundles assessment?
— What kinds of ES are considered within each of the DCE attributes by respondents and which are most aware to them?
— How do the answers to the question differ by region?

First, we conducted a literature review on the ecological, biophysical and social conditions for ES bundles in the Cévennes, using especially the Charter of the National Park [Par13]. This lead to our contextual research question of how people perceive the ongoing natural reforestation in the area. It was tested in and complemented with discussions of four focus groups each representing different types of stakeholders. A pilot study further refined our final survey.

Deliberative workshops were conducted in the Cévennes area and in the metropolitan area of Montpellier in order to compare outcomes per region. The concrete agenda within each workshop

1. As described earlier, revealed preference methods are difficult to apply due to missing markets for ES and even for substitute or complementary goods.



Protocole designed for the implementation of the study, with varying treatment concerning the order of discussion and questionnaire.

was determined by our research questions concerning the deliberation and is further detailed in the next section.

Assessing the impact of deliberation, especially on non-material ecosystem services

As described in the introduction, traditional valuation approaches are criticized for not accounting for deeper-held and transcendental values [OWKBC16], assuming fixed preferences of individuals [Spa07] and not allowing individuals to think over complex or contesting values especially important for environmental goods [MPHAF02]. Integrating deliberative elements into valuations are proposed as possible solution to these shortcomings [Spa07].

Furthermore, it is argued that non-material ES, which are only of residual interest in most ES valuation and assessments, would also benefit from deliberative valuations because they would be more often revealed, expressed and accounted for in deliberative settings [FCW16]. Nevertheless, deliberative valuation is also criticized for its degree of biases occurring in discussions or debates such as moderator effects [VL16], power imbalances [SGC+13] or possible marginalization of individuals being less confident to express own argumentation in front of others [Pel99].

Another important aim of our study is therefore to apply a discrete choice experiment within a deliberative setting and assess the impact of that format on the preferences of individuals. Permitting individuals to discuss on personal thoughts, experiences and feelings is seen as a way to reveal and construct preferences, including deeper-held or transcendental values [KJW+16].

The effect of deliberation is measured by randomly assigning to each deliberative workshop: Either the treatment with an information section, a discussion and the questionnaire, including the DCE (see figure on page 45). Or the deliberated workshop served as control group where the discussion took place after having answered the questionnaire [2]. This allows a comparison of questionnaires among deliberated groups and non-deliberated (or better "not-yet-deliberated") groups.

This impact is measured quantitatively by the results of our DCE and qualitatively by i) a factor analysis retrieving the embedded values and perception within the attributes by using indicator statements as well as ii) recording the discussion and analyzing the generated transcripts. Consequently, this might not only achieve an ex-ante/ex-post comparison of preferences, but allows to understand how possible differences were created within the discussions among participants: Are their specific rationales or kinds of values that make participants construct or change their preferences? If yes, is that due to a more holistic set of information or due to a change of deeper held feelings and commitments?

As mentioned above, framing effects easily occur in moderated discussions (see also [Kru14]). In order to avoid that participants are implicitly directed into certain values or issues related to Cévennes landscapes, we adopted a protocol that allowed to have structural elements important for analysis of responses to the DCE as well as opportunities for individuals to express and even shape the discussion to topics not initially considered by the organizers. First, an introductory round gave every person the possibility to present himself or herself and summarize their personal relationship to the Cévennes in a few sentences. This allowed to create a familiar and personal atmosphere in order to encourage the expression of feelings or personal experiences. In order to include a wide range of points of view, the second question asked participants what other issues than those mentioned before the discussion are important to them in relation to the Cévennes landscapes. This was also appealing to stimulate the discussion for the three following questions that interrogated individuals about their preferences for the attributes that (i) either already appeared, for deliberated groups or (ii) were not yet introduced in non-deliberative groups. The order of these questions was determined spontaneously in function of the evolution of the discussion. The required duration of the discussion was about one hour, with the introductory round scheduled to last approximately five minutes, the second questions about other issues was given the most time with 20 to 30 minutes. The discussions about the final three questions concerning the (future) attributes were planned to last at least five minutes, with the maximum length also decided individually in the context of each deliberation.

Finally, an analysis of follow-up questions to participants facilitates to see whether the setting was satisfying for participants, whether they felt comfortable to express their own viewpoints or if deliberation did not enhance the quality of the valuation exercise.

2. A remaining part of the questionnaire with questions about the discussion was answered by each group at the end of the workshop.

The following three chapters will treat different aspects of our experimental studies. Chapter 2 summarizes theoretical and conceptual guidelines for the methods employed as well as how they were included and implemented during the study. This concerns notably a literature review about the study area, the Cévennes, and recommendations for the application of focus groups. Furthermore, the experimental design and the underlying theory of DCEs is explained, followed by a section about factor and cluster analysis applied to the indicator statements of our questionnaire. At the end of the second chapter, the questionnaire and the employment of the study are reported and the resulting descriptive statistics are presented. In the third chapter, a literature about landscape valuation and ES bundles is presented. Subsequently, the results of the DCE and the factor analysis are presented and analyzed with regard to the preferred evolution of the Cévennes landscapes of the two samples. Before concluding on these results, an ES bundles representation is generated from the data. Finally, the fourth and final chapter of this empirical part is dedicated to the impact of deliberation and its ability to integrate non-material ES into valuation. A literature review presents the concepts and recommendations for valuations. Then, the results of the DCE and of the clustering are analyzed as to the impact of deliberation and complemented by an investigation of the responses to the indicator statements in function of deliberative status. This last chapter concludes by summarizing how deliberation influenced the outcomes of the valuation and giving directions for future research on deliberative valuation.

2. Design, preparation and application of a discrete choice experiment - Best practice and methodology for the valuation of the Cévennes landscapes

2.1. Introduction

This chapter is dedicated to the theoretical foundations of this thesis and its inherent methodology. As already stated in the general introduction, the main project of this PhD thesis is to better understand the interest of implementing discrete choice experiment (DCE) within a deliberative setting. Several considerations have led to carry out this research in the field of the ecosystem services (ES) derived from the landscapes of the Cévennes in France. This methodology allowed us to respond to our research questions. Main findings and interpretations are presented in chapter 3 and 4. First, we derived how valuations with DCEs can include a holistic set of values ([CSG12b], [KOH$^+$15]) without losing its properties of a simplistic but efficient way to enable participants to trade-off attributes of the landscape. Notably, the separation of the tasks into two separate steps, a standard choice elicitation task and an attribute association task allowed respondents to give a general coherent expression of their preferences regarding the future evolution of the Cévennes landscapes. This was complemented by a refined illustration of the ES bundles representing the precedent attributes of the choice task. Additionally, this process gave profound indication of interactions and interdependencies among ES, not from a biophysical, but from a socio-cultural perspective. Second, our experimental setting revealed important information about the process of deliberation. We assessed the impact of deliberation by comparing our deliberated treatment groups with the (not yet) deliberated control groups.
The methods mentioned above and used in our empirical study are explained in the following way: I will give general summaries of the theory underlying the different methods and issues we are dealing with. Given these theoretical elements, I will then explain which implications these theoretical elements had for trade-offs and decisions we were forced to make about the implementation of our study and why we made them this way.
In accordance with this guideline, I will first present the study area, the Cévennes National Park with its main characteristics, landscapes, current issues and the related ES. Second, the study design and scientific protocol are described and how they aim to respond to our research

questions. Third, an important method for preparation of field studies and the moderation of discussions in our deliberative workshops is presented: Focus groups. The fourth point is a basic introduction of the method of DCEs and how to construct its experimental design. The econometric foundation of DCEs, the random utility model and the properties of several models (conditional logit, mixed logit, etc.) constitute the fifth part of this chapter. Finally, in order to analyze the most important considerations of respondents regarding the attributes, I explain the factorial analysis which has been used for the second part of our preference elicitation task.

2.2. Study area: the Cévennes

The Cévennes region is an area of medium mountains in Southern France and constitute the southern border of the French Massif Central. Whereas numerous definitions (see below) of its limitations exists, it can be roughly stated that it is bounded by the Margeride in the north, the Rhône Valley in the east, the Garrigues area of the north of Montpellier in the south, and the Grand Causses surrounding the city of Millau in the west.
The region can be divided into three different geological areas: Schist valleys, granite massifs and chalk plateaus («Causses»), having each profound consequences for the structure of the landscape. There are narrower definitions of the «Cévennes» which refer to the condition that the region is solely that of the schist valleys although the Mont Aigoual (1567 m) within this schistose area is out of granite. In that case, the granite massif of Mont Lozere (1699 m) itself represents the northern boundary oh the Cévennes. We follow this last definition for the delimitation of our study area.
The Cévennes National Park and its landscape are part of the UNESCO World Heritage Site «Causses and Cévennes, Mediterranean agro-pastoral Cultural Landscape». Here, the name of the park also suggests a nominal difference between the chalky area and the schist area. Primarily by visitors coming from outside, «Cévennes» is also used as synonym for its national park, corresponding to the rough geographical characterization given at the beginning of this chapter.
A third characteristic that serves as reference for defining the area is the religion. With Protestantism as dominant religion, the Cévennes stands out from the rest of France, which is predominantly catholic. This gave also rise to the Camisard War at the beginning of the 18th century, after Protestantism having been declared to be illegal by the centralist king Louis XIV. Accordingly, the Cévennes can also be defined as being the area which is mostly protestant in the Massif Central. Traditionally, that corresponds more or less to the schist valleys, where protestants could hide during the wars of religion. In the following, the main characteristics of the Cévennes are presented with regard to landscape, population, cultural heritage and the national park. These drivers and institutional actors generate and impact the ES provided in the Cévennes and hence impacted the content of our experiment. Meanwhile, the form and procedure of our experiment was determined by the aim to respond to our research questions.

2.2.1. Landscape

Geological conditions

The landscapes of the Cévennes area are strongly related to their geological bedrocks: Erosion and inrush of precipitation change significantly with soil and rock type on its surface.
First, chalk sediments are relatively pervious for water, so that the latter infiltrates to deeper layers, dissolves parts of the chalk and creates hollows. The water resurges elsewhere and creates canyons, as it tranches into the rock (Gorges du Tarn, Gorges de la Jonte, Gorges de la Dourbie). Meanwhile, other forms of erosion than water and precipitation (wind, slights) do not affect chalk sediments strongly due to its density and solidity. Consequently, the landscape appears as elevated plains, which are crossed by vales or canyons, where water resurges (e.g. Bonheur) and recharges rivers (e.g. Tarn). At the surface, as water drains away fast and is not available for vegetation, the latter is relatively sparse. These areas are often used for extensive agriculture and pasture farming.
Secondly, schist is less affected by water inrush, but by erosion on its surface. This means that water is not draining deeply into the soil, but is running down to build watercourses relatively fast which can provoke slides. Compared to canyons in chalk regions, valleys are V-formed, which makes them impracticable for traditional agriculture. As precipitations can be captured temporarily in the upper layers of the sediments, it is available for vegetation, so that broad-leaved forests can evolve. Therefore, main human activities are agro-pastoralism, tourism, forestry and agriculture (endemic species of apples, chestnuts and onions).
Finally, granite formations are relatively solid and less affected by water formation and erosion. Consequently, the highest elevation in the whole area are granite formations (Mont Lozère, 1699 m and Mont Aiguoal, 1567 m). They are less profiled and structured than the other two geological areas and have more wetlands, fed by the highest precipitations in metropolitan France.

Human impact on the landscape

Although geological and climate conditions put constraints on their evolution, the main driver for the Cévennes landscapes has been human activity. The Cévennes National Parc was the first national park inhabited in its central area when it was created in 1970. Correspondingly, the decision of awarding the Cévennes as World Heritage Site was mainly motivated by its cultural landscape. The latter still contains elements that tells about the history of the area.
In the Middle Ages, the local population which already lived in a hardly accessible area, wanted to be even more independent from ruler. At that time, this aim could only be achieved by becoming self-sufficient in food production. Consequently, the area grew its agricultural output mainly due to the production of chestnut on numerous terraces which were constructed to allow farming where the steep relief prohibited crop production before.
Meanwhile, clearing the forest to create space for agriculture reduced its capacities to provide erosion control. This evolution lead to a growing number of landslides and material that was transported downstream by rivers. In particular, the silting up of the mouth of the Gironde,

500 km from the Cévennes, led the forester Georges Fabre to reforest the Mont Aigoual Massif with pine forests, which were chosen due to their fast development of a superficial net of roots, providing rapidly the erosion control removed beforehand. Pine forests were also used as primary energy source and construction material for the important mining industry during the 19th and the beginning of 20th century. The impact on the landscape as with multiple tunnels and entries is still visible, in particular in the region around Alès.
Another important industry having had an impact on the landscape is the silk industry or «sericiculture». Especially during the 16th and 17th century, many small silk mills («magnaneries ») developed. In order to feed silkworms, mulberry trees were cultivated in numerous locations of the region.
The cultural landscape awarded by the UNESCO is mainly formed by agro-pastoralism. In the rare valley's floors, where relief is not steep, small scale farming is possible and is used to produce fodder for cattle and other agricultural products. The cattle, mainly sheep and goats, is wrangled to the summits for transhumance. Their presence puts pressure on vegetation and prevents the landscape from becoming closed, in particular by natural afforestation of pine forests. The decrease of farming activity and cattle herd size over the last decades is therefore directly linked to the growing forest cover, especially on the Causses [LBLM15]. Meanwhile, as coppice is not cleared regularly, this growing forest cover represents a growing risk of forest fires in the region. In order to adapt transhumance to increasingly closed landscapes, cattle (especially goats) is now wrangled into clearer forests or in edges of forests (so-called sylvo-pastoralism). That activity does not only decelerate natural reforestation, but also clears coppice and prevents from forest fires.
Traces of human activities from past periods are still very visible in the landscape. Up to the summits, many walls which secured the former terraces (the «bancèls»), are still visible, although mostly abandoned. Some chestnut groves are still exploited, but they often suffer from invasive pests, which also led many owners to abandon active cultivation. Some effort is done to protect these elements of traditional agriculture, in particular by cultivating endemic agricultural products such as Cévennes onions on restored terraces.

2.2.2. Demography

Beginning with the objective of economic independence resulting in the progressive evolution of chestnut farming and terracing infrastructure, the demand for human labor lead to a population growth at the end of the Middle Ages, but was interrupted by the Camisards War at the beginning of the 18th century. Nevertheless, the willingness to be independent has been sustained by developing new economic sector pillars such as silk production and mining industry. With their decline, an exodus of the population of the territory began after WWII, with a mean annual population loss of more than 1% [NP20]. This tendency slowed down at the end of the sixties with a growing number of new arrivals attracted by the very rural and alternative way of life in the Cévennes region. Meanwhile, tourism evolved as an important economic activity and was

supported and partly regulated by the creation of the Cévennes National Park in 1970 [NP20]. Additionally, the reclusiveness that many tourists appreciated, lead to a growing number of people that installed their secondary residences in the region, increasing the total purchasing power and therefore supporting the local economy. Reaching a mean annual population growth of 0.7% at the beginning of the millennium, the positive migration tendency of the territory is currently not sufficient to compensate the natural population loss due to the growing part of elderly people in the population [NP20]. Main economic activities are tourism and small scale farming, especially pastoral economy. Nevertheless, the economy still suffers from high seasonality due to outdoor tourism (hiking, mountain-biking, canoeing, fishing) and presence of second home owners [NP20] being mainly limited to the months of may to october.

2.2.3. Cultural heritage

The original and eventful history of the territory has contributed to its rich cultural heritage. Firstly, as mentioned before, the Camisard War has been an incisive event in the collective memory of the region and its population. Many protestant churches are still conserved and attest the religious tradition of the region. Another cultural aspect stems from this period: the collective spirit of resistance. Not only the willingness to be independent from feudalistic rulers, or the resistance during the Camisard War, but also the events during WWII illustrated that character. Many Jewish people and persons actively involved in the resistance against the Nazi regime found sanctuary in the territory and were supported mentally and logistically.
Second, local traditional artisanal food production constitutes an important part of the common habits of the region. Driven by the various economic activities pursued in recent centuries the Cévennes region is known for its traditional silk production, the treatment of chestnuts (Gazette de Montpellier, 7/2020), and the commercialization of goat cheese («Pélardon»).
Finally, architecture has been affected in particular by historic and socio-cultural context. The necessity to practice terracing agriculture lead to an extensive know-how in constructing the walls securing the terraces. This traditional practice is aimed to be preserved. In order to protect cattle during harsh weather conditions at the summits, many single-standing shelters were constructed and still serve for hikers and herders. In the valleys, as agricultural surfaces have been scarce due to relief, settlement area has been limited to the construction of narrow but relatively high houses. When the silk industry developed, the production and spinning were often situated at the top of already existing houses (the so-called «magnaneries»), given the spatial constraints mentioned previously. It is noteworthy that all these buildings and architectural monuments were constructed with schist dry stones, giving a coherent example of how economic and geological constraints affected architecture.

2.2.4. Impact of the Cévennes National Park

The Cévennes National Park was created in 1970 with the aim to preserve the cultural landscape of the territory and its associated biodiversity. Since a reform in 2006, it is composed of (i) a core zone (mainly at higher altitude, on the ridges above the schist valleys, the granite peaks and on chalk plateaus), where the national park has formal executive authority, and (ii) an associated zone, where municipalities have chosen to be part to the national park by negotiating how they can voluntarily comply with the objectives of the park communicated in its charter. Nevertheless, municipalities keep all executive power in the associated zone.
Another important objective of the national park is the preservation of the cultural heritage of the territory described above, such as terracing agriculture, dry stone constructions, the Occitan language, etc.). This contributes to the promotion of sustainable tourism in the region as a way to keep economic - and therefore human - activity at place. The park has had an important moment of recognition when it was awarded as UNESCO World Heritage Site in 2011 and as Dark-Sky Reserve by the International Dark-Sky Association in 2018, increasing international visibility. Additionally, further biosphere reserves as part of the Man and Biosphere Program exists.
Meanwhile, the presence of human activity is necessary as it is the source of the cultural landscape to be preserved. It is noteworthy that the Cévennes National Park is the only one in metropolitan France that allows and even encourages human permanent presence, agriculture and hunting under certain conditions (no use of pesticides; allowances for hunting) in its core zone [NP20]. The objective is to maintain pressure on vegetation by transhumance and agriculture to prevent from natural reforestation that endangers the open agro-pastoral landscape. Consequences of encouraging hunting are two-fold: First, reducing game support efforts to diverse tree species in forest notably with bride-leaf species, whose seedlings get often damaged by game. Secondly, wild boars are often responsible for deterioration of bancèls. Therefore, to conserve this cultural heritage, wild boar population needs to be controlled.
Nevertheless, regulations and interventions by the national park remain highly contested by parts of the population, especially farmers already installed for a long period, who claim to be constrained in pursuing their activity.

2.2.5. ES and interrelations within the Cévennes

This section presents the interrelations of ES and human activity in the Cévennes, on which we based our first drafts for the choice experiment as well as the information provision within the questionnaire. It can be seen as a brief summary of the Charter of the Cévennes National Park [Par13]. We chose that document as main literature source because of its high amount of information and for the way it has been elaborated. The charter has been created in numerous discussions among scientists, the national park, stakeholders, representatives of municipalities and habitants ([Par13], p. 192). Therefore, we believe that this document provides sufficient

baseline information to be complemented by focus group discussions (see section 2.3).
The analysis of the Charter of the Cévennes National Park resulted in figure 2.1, representing the interplay of different landscape elements, ecosystem services and human activity. It can be briefly summarized as follows:

— The figure is divided into five parts, which are all illustrated by different background colors and that can partly overlap: forests (green), pastoralism (orange), aquatic systems (blue), agriculture (gray) and cultural heritage or non-material services in the middle (violet)
— Landscape features are presented in red bubbles and associated to the five main domains or their interface
— Other important issues in line with the evolution of the landscape are also mentioned in the figure
— In order to show how these different characteristics of the territory interrelate, I added flashes indicating positive feedback (green) or negative feedback or trade-offs (red). All other graphical elements will be explained in detail in the following paragraphs.

As outlined in the introduction, we focused on non-material benefits as we wanted to test, whether valuation of those services is in particular affected by deliberation. Hence, we placed non-material benefits in the middle to represent the cultural heritage of the Cévennes. Within that surface, three issues (related by three violet flashes) are centered: History and landscape, that constitute the most important heritage of the region; and tourism, as it is currently the most important economic activity in the region. We were comforted in our choice because it has often been mentioned in our focus groups discussions, especially in Montpellier. Therefore, tourism is important within our study in order to encourage active participation of the Montpellier sample that we aim to compare with discussions and valuation of local habitants and stakeholders. Finally, landscape and history are important features to incite and develop tourism in that region. Each of these three features contains several parts that are associated to landscape and history. Starting with the landscape part, the UNESCO World Heritage Site award distinguished two main parts of the Cévennes landscape: the valleys of the Cévennes, especially in the schist part of the region and the agro-pastoral landscape at the summits. Especially the latter is not only associated to human activity by tourism and the cultural heritage, but is itself the result of pastoral economy. Consequently, it is placed at the interface of "Non-material services" (violet), "Pastoralism" (orange) and "Agriculture" (gray). It is often declared to let the landscape "open", because it is endangered to get "closed" due to natural reforestation.
The history rectangle in figure 2.1 shows five main components: First, we have the aim for economic independence which resulted in the plantation of chestnut forests and the silk industry for which mulberry trees were planted. Accordingly, they are the reason (green flashes) for the presence of the landscape element "Chestnut and Mulberry Trees" (red bubble). It impacts the appearance of today's forest due to historic use and is therefore placed at the interface of the domains "Forests" (green), and "Cultural Heritage" (violet). The third component of the history rectangle is the mining industry, which is the origin of the mining landscape (red bubble) in parts

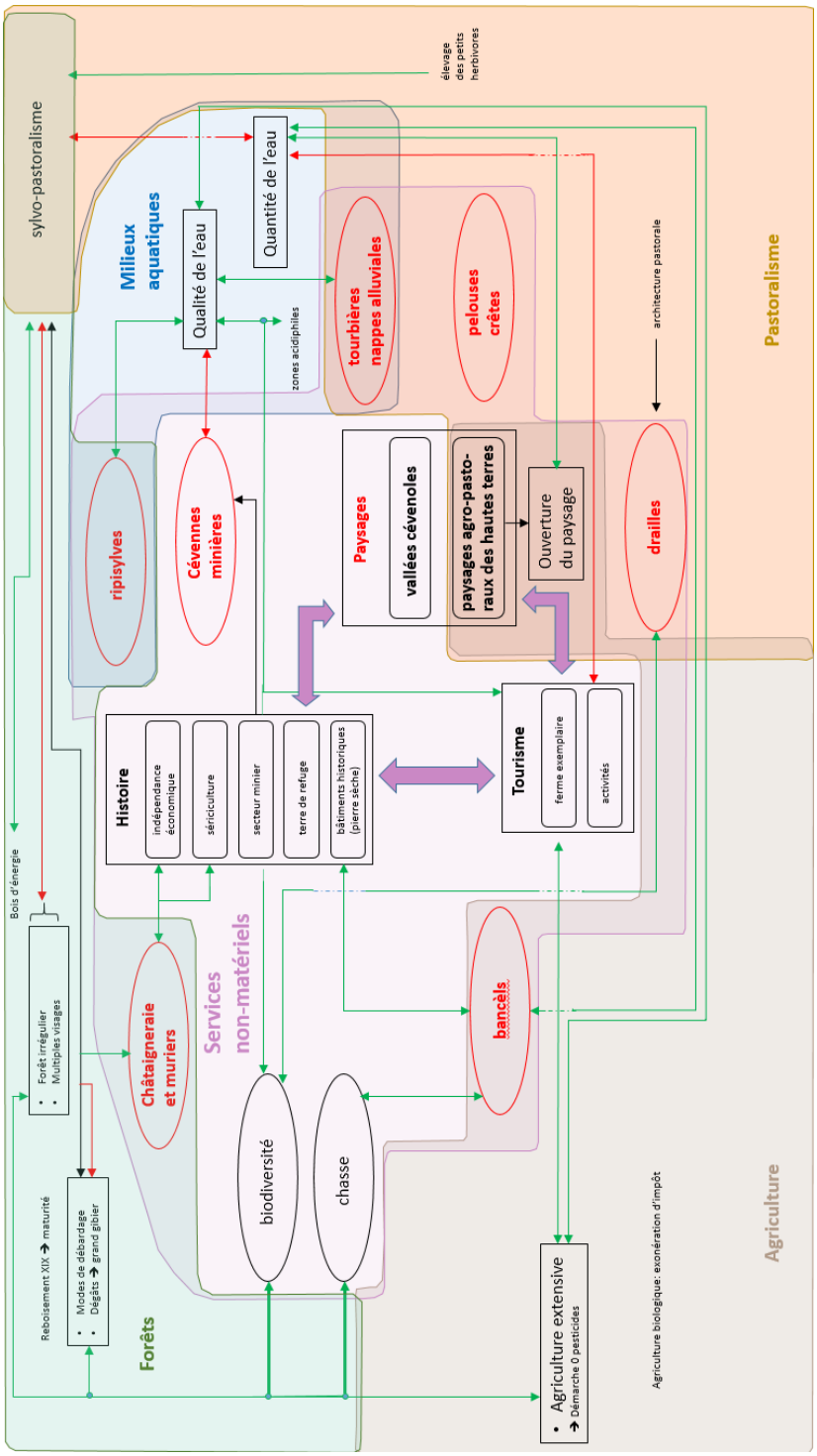


Figure 2.1. – Graphical illustration of main relationships between different landscape features and ecosystem services.

of the Cévennes. As mentioned in the previous section, the mining sector lead to the creation of several tunnels and openers and plantation of fast-growing deciduous forests (interface "Forests" and "Cultural Heritage) that served as burning material for the energy intensive industry. Fourth, "Sanctuary territory" («Terre de refuge ») refers to the time of WWII were many resistance fighters and Jews could hide in the Cévennes to escape the Germans. It is also representative for the resistant spirit of the region that found its expression during the Camisard War as well. Finally, we have the architectural heritage of dry stone constructions used for human residences as well as for agricultural or pastoral structures (such as bancèls). As mentioned earlier, the national park allows hunting, even in its core zone, which constitutes an important activity for habitants as well as for hunters coming from elsewhere. Effective hunting of wild boars contributes to the protection of bancèls structures, which are often deteriorated by these animals (green arrow).

The tourism rectangle is composed of two issues presented within the charter: First the possibility to promote the visit or even holidays at local farmers in order to present local agricultural tradition to visitors and generate additional resources for the agricultural sector. Secondly, a broad portfolio of activities is seen as important in order to attract more tourists to visit the territory.

Apart from these three rectangles representing the main issues to combine cultural heritage with economic activity, we also put biodiversity into this domain of cultural heritage, for graphical simplicity. Naturally, it interacts with all other domains (aquatic environment, pastoralism, agriculture and forests) while being also important for tourism. These links will be discussed later on.

In order to encourage participants to discuss actively, we decided to put a special focus on the controversial topic of natural reforestation (with its benefits such as recreational values, provision of timber and carbon storage) and whether the landscape should be kept open (cultural heritage, agro-pastoral activity).

In line with this focus, I further investigate the green upper left domain in figure 2.1 - Forests. The forests in the Cévennes reflect the history of the territory: by the plantation for nutritional self-sufficiency (chestnut forests), silk industry (mulberry trees) and prevention from landslides as well as provision of material for the mining industry (deciduous forests). Today, many forests reach maturity and the question about their future use emerges. Regarding biodiversity, the mode of clearing the coppice is important for wildlife near the ground and for the prevention from forest fires (positive link to biodiversity). Meanwhile, saplings are damaged by big game, emphasizing the need for hunting in the area (green arrow). Also linked to biodiversity (green arrows) is the need for irregular stands of forest, including different species and ages. In the charter, this is described as "multi-faced forests".

The second domain which is important for the question of open landscapes is the orange one at the right: Pastoralism. The willingness of the national park and the UNESCO to conserve the agro-pastoral landscape illustrates the importance of this sector for the appearance of the

landscape. Some infrastructure has only been constructed for transhumance such as small bridges in order to connect different so-called "drailles" (red bubble), small trails on which herds were driven to reach different grasslands. The green arrow indicates a positive link to biodiversity: Seeds of plants growing besides these drailles get caught up in sheep's and goat's fur and is transported to other places. This contributes to a high biodiversity along these ways. The breeding of small herbivores is widely practiced and gives opportunities for sylvo-pastoralism (upper right corner), a form of transhumance with goats or sheep that can especially contribute to clearance of underwood (black arrow) and can help to protect traditional chestnut forests and mulberry tree cultures (green arrow departing from the previous one) but can also damage young trees (departing red arrow). Accordingly, it would also harm the random distribution of the stand of irregular forests. Meanwhile, forestry would benefit from reduced costs for clearance and could redistribute parts of these saving to provide complementary income for the pastoral economy.

Closely related to pastoralism is the agricultural sector (gray, in the under left corner), as it is often complementary to the pastoral economy by the production of fodder for the winter. It constitutes another determinant for the conservation or not of the agro-pastoral landscape, especially in the valleys of the Cévennes and the plateaus of the Causses. As already mentioned in the section about history, the will for agricultural self-sufficiency lead to the construction of numerous bancèls (red bubble) onto the slopes in order to increase agricultural surface. Today, this represents a part of the Cévennes cultural heritage. The national park encourages farmers to perform extensive and organic farming in order to protect biodiversity. Meanwhile, this could be exploited for tourism by offering holidays at farms and demonstrate agricultural practices to tourists.

Finally, wetlands and the aquatic environment constitute the fifth domain represented by a blue background in figure 2.1 and to which some landscape elements are closely related. Moors and alluvial water plots are important for herders and serve as drinking spots for their cattle (interface to orange background). They also contribute to water purification that improves water quality (green arrow). The same is true for floodplain forests which constitute a boundary landscape between wetland and forests. Water quality benefits to biodiversity, especially in the case of acidic zones, which shelters a diverse wildlife in the Cévennes. Meanwhile, water quality is endangered by leachates and residuals from the mining industry (red arrow), which has to be accounted for if this part of the landscape is to be preserved. Finally, water quality would benefit from extensive agriculture (green arrow), mentioned in the previous paragraph. The second important issue for water resources is the quantity of available water. Here, natural reforestation would lead to higher water consumption of vegetation and therefore limit water availability for wetlands and human activity, as illustrated by the green arrow to "Conserve open landscape". One of the main drivers of water demand by humans stems from tourism and is expected to increase with a growing tourism activity in the future (red arrow). Another driver of water demand is the agricultural sector. Here, bancèls play an important role by limiting water

run-off from precipitation and therefore contribute to an efficient use of available water resources (green arrow).

2.2.6. Implications for our study

Given the information above, we decided to focus on the trade-off between natural reforestation and open landscapes and their associated bundles of ecosystem services. Therefore, we simplified figure 2.1 to contain the most important interactions on which we based the first draft of our DCE. It is illustrated by figure 2.2.

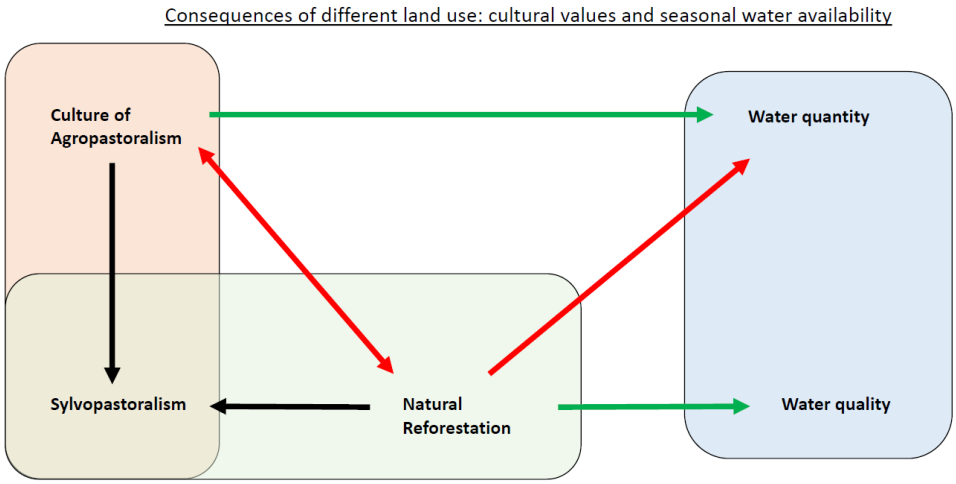


Figure 2.2. – Simplified interaction of land use scenarios in the Cévennes. Red arrows indicate a negative impact, green arrows stand for a positive impact, the black arrows show possible consequences

We still have in green, orange and blue background color the domains of forests, pastoralism and the aquatic environment. The red arrow in either direction represents the trade-off between naturally reforested, closed landscapes and open landscapes formed by agro-pastoralism. The only way to combine them is by sylvo-pastoralism. The national park outlined in its Charter that wildlife habitat of open agro-pastoral landscape is much more endangered than of forested landscapes. Accordingly, we assigned a positive impact of open agro-pastoralism on biodiversity. As explained previously, natural reforestation entails higher water consumption and therefore a negative impact on water quantity. Contrary, open, agro-pastoral landscape are permitting higher water availability. Regarding water quality, the filtering effects of forests represent a positive impact.

These basic reflections guided our first draft of the attributes for the DCE. As detailed in figure 2.3 we thought of six attributes. First, forest cover which we judged as an important one, as it represents the trade-off between open and closed landscapes. The current forest cover in the Cévennes valley part of the national park is approximately 83% ([Par17]; p.4). For the ease of simplicity, we therefore thought of levels ranging from 85% for the status quo

Attribute	Level	Status quo level
Forest cover	95%, 75%	85%
Agro-pastoral infrastructure: bancèls, drailles	A, B	
Water quantity		
Biodiversity (number of species)		
Tourism Evolution	Increase, Decrease	Stable
Monetary attribute	A, B, C, D, E, F	0

Figure 2.3. – First draft to determine attributes for the DCE. Attributes and their levels changed as a result of our focus group cisussions.

alternative to 75% in the case of a more agro-pastoral landscape to 95% in the case of an increasingly (and artificially) reforested landscape. The differences between these levels have been judged sufficiently large to be meaningful to respondents and at the same time sufficiently small to represent only "marginal" changes consistent with the aim to measure marginal rates of substitution by amounts of willingness to pay. Second, we thought of agro-pastoral infrastructure as a good indicator for the cultural heritage in general, but wanted to confirm that in our focus group discussions together with ideas about meaningful attribute levels. A third possible attribute was water quantity in relation to the trade-off between natural reforestation and agro-pastoral landscape. Fourth, biodiversity has been proposed as an attribute, with different number of endemic species as levels. Fifth, tourism evolution was proposed in order to represent the most important economic activity and as element which would probably have been requested by respondents in our Montpellier sample. As we could not find detailed quantitative data on tourism in the region, we opted for general, qualitative levels in our first draft. Finally, these five attributes have been complemented by the compulsory monetary attribute, which we wanted to contain six levels with amounts to be determined. The reason for that was to have sufficient opportunities for the algorithm to generate alternatives of similar amounts of expected utility perceived by respondents (see section 2.4.2.2).

After having discussed further about this first draft, we noticed that parts of our attributes were closely related to our open-closed landscape trade-off (forest cover, water availability and biodiversity). Although this seems justified, given the importance we accord to these issues, this provokes correlation among attributes with negative consequences for our experiment. First, as we will see in section 2.5 the basic econometric model (standard logit) requires no correlation. Otherwise results are biased and more complicated models have to be applied. Second, this correlation has to be included in the experimental design in order to prevent from creation of illogical or not meaningful alternatives in choice sets. For example, this means that high forest cover should rarely be part of an alternative which also includes high biodiversity because the latter is associated to grasslands in open landscapes. Consequently, this puts additional constraints on our algorithm for the experimental design (see section 2.4.2.2). Finally, high

correlation among attributes would risk to encourage participants to apply choice heuristics in their decision making instead of trading off attributes individually. These reasons have prompted us to be cautious about the use of all of these three attributes. For these reasons we decided to remove biodiversity and water availability from our list of attributes. We still thought of them as important issues, but did not present them as possible attributes in our focus groups discussions.

2.3. Focus groups work

Focus groups are group settings where participants discuss about an issue in a controlled form. They are intended to help the organizer to understand more about that issue in general and to gather opinions or feelings about it. Another use is to validate the scope, approach, formulation and organization of a survey by individuals sharing the same characteristics as the attended public [CH99]. Generally, different groups of about five to ten participants sharing similar characteristics are assembled and invited to share their point of view, moderated by a neutral person [Kru14]. In our case, we organized focus groups to learn more about basic notions and important topics of the Cévennes landscape, which are important to local inhabitants or inhabitants of the Montpellier metropolitan area. We also wanted to have advice on how to organize our experiment.
In general, the organization of focus groups to determine the best design of stated-preference experiments is recommended in best-practice literature ([RST+12], [JLM+13],[JBA+17]). Many publications report on using focus groups in their ES valuations (e. g. Kenter et al, 2011, [HGV+13], [OBB+15]). Nevertheless, the observation of Chilton and Hutchinson [CH99] remains true, that numerous articles still do not mention whether they used focus groups in order to determine and adapt their study design.
In the following, I will first summarize best practice advices from the standard publication of Krueger and Casey (2014) about the organization of focus groups. I split these techniques into those to be applied before, during and after the implementation. Then main criticism and caveats of focus groups are presented. Finally, I will explain the procedure for our case study and report on the results and advices we obtained from our focus groups and how they were integrated.

2.3.1. Best practice advices for focus group work

With over 34'000 citations (as at June 2021), 'Focus Groups: A practical guide for applied research' (Krueger and Casey, 5th edition, 2014) is the standard publication to inform researchers about how to apply focus groups in their research. An appeal to use focus groups in the design of stated preferences valuations has been formulated by Hutchinson (1999). Consequently, the following advices are taken from Krueger and Casey (2014) and are complemented by points from Hutchinson (1999). [1]

1. For the ease of readability, all (numerous) remarks obtained from Krueger and Casey (2014) are not referenced individually (except citations). Those presented by Hutchinson are referenced individually.

2.3.1.1. Preparation

The application of focus groups is most effective if participants "feel able to express their feelings and opinions without being judged" ([Kru14], p. 4). Accordingly, their ideas have to be treated and received neutrally so that they do not feel pressure to give a specific answer or that other voices may be preferred. In order to prevent from intimidations, which could prevent participants from expressing themselves openly, each power relation or influential position towards researchers or moderators and among individuals should be avoided. Therefore, a clear communication on the common characteristics of participants resulting in the invitation into that focus group is important, as it establishes common ground.
In order to guarantee these important conditions, a careful preparation is necessary, starting with determining the purpose of the focus groups. It includes the definition of which kind of information (written, questionnaire, quantitative or qualitative, etc.) is needed and - if many different aspects or information is to be revealed - its priorisation (which information is most important?). Departing from this general purpose, further details of the focus group composition are possible: Which type of persons are able to express and provide important advice, how should they be approached and by whom? What could motivate them to participate at the event? At which period of the year, which day during the week and daytime is most promising to have them showing up? Answers to these questions will further determine the organisation of the discussions.
One of the objectives of a careful preparation is to facilitate the revelation of the information of interest. The establishment of a questioning route is helpful to achieve that objective. A questioning route is "a set of questions in a logical sequence" ([Kru14], p. 7), encouraging participants to express themselves, notably by beginning with more general question and coming to more precise, open ended ones, where individuals may be supposed to talk about feelings and where deeper held values are asked, when they already feel comfortable with the setting. The questions should constitute a logical flow permitting to be referenced to each other and the associated answers. Hence, discussion among participants is simplified instead of forcing people to relate or answer only towards the moderator. The idea behind encouraging interaction is that comments from other individuals may reveal different memories, feelings and ideas than if each person only discusses with the moderator. The questioning route should also be constructed by using participants' and not scientific language which would automatically point on information or power differences and could lead to doubts of participants to be legitimate to contribute to the discussion.
Different types of questions are used to construct a questioning route. First, opening questions are used to get all participants to talk about the topic. Simple, factual questions are used that can be answered by everyone such as personal favourite things (products, films, places, etc.). If opening questions are too complicated or point on power differences, people get discouraged to express their own ideas as they tend to refer to more powerful or more informed participants. Second, introductory questions try to establish a link to the topic of the focus group and how

participants personally relate to it. Third, the topic is more deeply approached by transition questions. Additionally, first differences in the opinions of individuals should or could become aware. The fourth type of question is the most important one for the researcher: four to six key questions. They should be the first points to be developed while preparing the questioning as they more or less directly ask the participants the information the researcher is most interested in. The precedent questions are dedicated to make participants comfortable to give in depth answers to the key questions. Due to their importance, at least 10, better 20 minutes, should be devoted to each key question to ensure that every participant has the opportunity to give her opinion and to interact with the other participants. Therefore, key questions should start after one third and at the latest at the half of the focus groups sessions, to have enough time to discuss them deeply. Finally, the ending questions summarize the discussion and ask for additional comments or issues associated to the topic having not been raised yet. This step is important, as withdrawn persons may hesitate to intervene in the discussion to raise a different issue. Their eventually useful concern is most likely to be expressed in this step of the event.

The creation of a questioning route englobes different aspects ranging from reflections about possible feelings of participants, facts about the topic and organizational constraints which can affect the sequence of the questions. Therefore, a brainstorming of several people including researchers from inside and outside the project as well as with different experiences is recommended. Here, the question of what information is to be gathered as well as whether it is crucial or "only" helpful ("need-to-know or nice-to-know"; [Kru14], p. 61) needs to be discussed. After establishing the questioning route, timing estimation has to be done in order to ensure that the focus groups do not exceed the two hours recommended. Additionally, people being late and the important ending questions (15 minutes) should be integrated into these considerations. As mentioned above, the detailed discussion of key question should be guaranteed when estimating the timing requirements. Logically, questions devoted to revealing in-depth information should be granted with more time than others.

The success of focus groups depends on the ideas expressed during the discussion which themselves depend on the people invited. Therefore, a recruiting strategy is deployed with the goal to encourage the target audience to show up. A promising approach is to use lists of associations connected to the topic of interest. They are often used to participate to events of general interest. This should be emphasized if people are reluctant to give contact data of their members. Nevertheless, it should be noted that associations are already a first bias compared to the general population in terms of representativeness. Often the invitation with reference to a well-known or influential people (elected local politicians) represent an additional motivation. Here, local authorities can help to "nominate" people that might be helpful in the discussion. Meanwhile, these recommendations are to be communicated to invited people in a transparent manner without creating pressure to participate. Potential candidates should be contacted at least two weeks before the focus group meeting. It happens that people cancel the meeting spontaneously or do not show up without informing the organizers. Therefore, a slight over-recruiting might

prevent from failing to obtain own quantitative requirements. Nevertheless, recruiting too many people results in larger groups which tend to fraction into several whispering subgroups as they do not feel able to express themselves due to the large number of participants. The participation should be confirmed formally using a personalized confirmation letter by the organizers directly after the acceptation or one week before the focus group meeting. In addition, a reminding phone call the previous day increases the show up rate.
Another factor to increase the show up rate and facilitate recruiting are monetary or non-monetary incentives. They are necessary, because participants are blocking a specific time slot instead of doing other, eventually preferred activities and should be compensated accordingly. If they are paid, 50 Euros are advised for public and non-profit organisers in form of cash or gift cards in an envelope distributed at the end of the session. Nonmonetary incentives might be the provision of light snacks, a full meal or other gifts related to the topic. Additionally, the good cause of the focus group meeting should be underlined.

2.3.1.2. During the focus group session

Different methods are available to encourage participants to express themselves. They concern either the material used or moderating techniques.
Regarding the material, partial deviations from a pure question-discussion scheme could appeal more persons to report on their feelings and deeper held values. Picture sorting is a good method to get people to talk about something precise while addressing a personal level (what is your favorite picture and why?). When deciding on what material to be used, the kind of information accounted for should be considered: Are questions dedicated to reveal emotions or rational reflection?
Moderating techniques are important in order to have a fluent, interactive discussion, appealing every participant and using different levels of communication. Participants should be encouraged to express diverging opinions, for example by giving different statements of previous focus groups. Several types of participants, that can be expected to participate in a group discussion, have to be approached differently. Small talk before the start of the session, while welcoming the invitees can help to identify some of the types beforehand: Persons expected to have more knowledge about the topic than others should not be introduced in a way that points on these differences among participants. Everyone is to be seen as an expert whose opinions and statements are of important value.
Dominant personalities who tend to monopolize either the discussion or the expressed view should be placed next to the moderator so that the latter can control the interventions by looking to other persons in order to encourage them to express their views or by signaling that the dominant person is expected to share the speaking time. Contrary, shy participants are to be placed in vis-à-vis of the moderator so that he can invite that person by eye contact or slight head nodding to talk. Rambling participants have difficulties to express themselves efficiently. In order to save time to have other persons intervening in the discussion, the moderator has

the incentive to not establish eye contact with the former and should directly ask or repeat a question to another person.
Generally, the discussion can be directed easier if every participant is informed during the introduction that it is important to give everyone the possibility to talk and therefore it might be necessary to interrupt others if they have already talked a lot. Meanwhile, the possibility for everyone to talk does not entail that participants are required to have equal parts of talk - if a person voluntarily proposes interesting and important views, she will necessarily talk more than others.
A difficult point is the reaction and (non-verbal) communication of the moderator to the participants. Already head nodding can be ambiguous: Whereas it is mostly interpreted as encouragement to talk if done slowly and continuously, fast head nodding can be a sign of agreement and should be avoided. Otherwise, participants will tend to mainly express corresponding views. Responses of the moderator between statements should be kept short and neutral ("yes, okay, aha", [Kru14], p. 123). If participants express doubts towards the organizing team, the latter should not react directly, in order to not influence other participants. Instead, additional facts can be presented at the end of the session or it can be proposed to send supplementary material to interested persons. This retains credibility of the team which is important if other focus groups meetings are to be organized. If questions are directly asked to the moderator, he should not answer directly in order to not to be seen as an expert. Instead, he can either (i) refer to another member of the organizing team to respond, (ii) refer to a later moment of the session, if another question on the questioning route is able to reveal an answer in the discussion among participants, (iii) forward this question to the group or (iv) answer the question at the end of the session.
For the discussion to lead into helpful results, the capturing of the discussion has to be prepared beforehand. Either, a summary of the discussion from personal memory is directly made after the discussion. A debriefing of 15 to 20 minutes among organizers after the participants have left the location is useful to gather impressions from every member of the organizers. Or field notes are made by an assistant who can better concentrate on the exact order of interventions than the moderator. Furthermore, the note taker has to be familiar with the topic in order to judge the importance of each statement for the analysis. A technique to gather much information is to have two different columns that contain important quotes and the name (or an abbreviation) of the participant on the left and summary notes of her statements on the right. This is also useful for the moderator to improve his skills for the next sessions. Finally, the whole discussion can be captured in an audio file and transcripts can be made. Here, only the beginnings of each statements and the name of the speaker have to be noted in order to be easily identifiable on the audio file.

2.3.1.3. After the session

In the days following the session a thank-you letter or mail should be sent to invited people. This honors them for the important help they accorded to the project and might motivate them to nominate other persons that could be invited to future sessions. People who did not show up are eventually convinced to attend another session.
A major part of the post-meeting work consists of analyzing the data. First, a critical examination of the questioning route identifies whether key questions have been satisfactorily answered and if the estimated timing has been adequate. Different types of situations allow a deeper insight into the motivation of participants during the focus group session: Are they bored, enthusiastic, emotional or have they changed their mind in a specific moment? Second, notes from the debriefing can reveal important information about the overall setting directly after the session such as emotions, atmosphere, etc. Before getting to an in-depth analysis, the data and/or audio files should be copied and saved. Given the data from the debriefing, it should be clear if a transcript is able to furnish supplementary insights that are worth the time-consuming process of transcription. Third, data from notes or from transcripts should be analyzed in a group of researchers. If a statement is judged to be important, it is coded. Following statements are either not coded if they do not add information, they get the same code if they provide additional information for the same topic, or they get another code if they give complementary information. The different issues can then be prioritized by using indicators such as frequency, extensiveness, intensity or specificity of appearance during the discussion [CH99]. But also the importance of the issue from the participants' point of view is to be considered: Is there internal consistency or did the participant mention how important the issue is for him? Finally, the results from the analysis can be summarized in a report and sent to the participants as part of a feedback. Another, perhaps shorter version of these reports contains main ideas and findings of the focus group sessions and is used internally for later stages of the project.

2.3.1.4. Criticisms

Krueger and Casey (2014) provide some caveats of focus group settings regarding the individual level. First of all, a classical courtesy bias can arise: Participants are willing to present themselves as being rational and thoughtful in the presence of other participants and the organizations. This can even lead to inventing answers spontaneously in order to not to show lacks in knowledge compared to other group members. Additionally, the overrepresentation of rational argumentation for stated preference studies runs contrary to the fact that most parts of our consumer choices are made emotionally, non-rationally and unconsciously. Therefore, it is important to directly ask participants for feeling in order to appeal for non-rational motivations. Nevertheless, if feelings give important insights into the topic and participants do not achieve to get sufficiently open to show them, personal interviews might be a preferred method.
Chilton and Hutchinson [CH99] base their analysis on the group character of the method. First,

they recommend to organize several focus groups. As the outcome of one group is highly dependent from the statement of the individuals, it could be suggestive that a consensus in one group would be representative for the population. To avoid this misleading generalization, several independent groups should be programmed leading to a broader diversity of impressions with higher representativeness. Second, the outcome should be judged as a group outcome and not as result of individual preferences. They reflect interactions, norms and interpersonal influence.

2.3.2. Application of focus groups in our experiment

2.3.2.1. Objective and setting

We applied focus group discussions with several objectives:

— To complement our findings in the literature with feelings and emotions attached to the Cévennes landscape. It gives an indication which issues and reactions could be raised during the discussion section of each deliberative workshop and allows to prepare for these situations and deal with them.

— To associate all possible ES to the different attributes. As explained for our protocol in the introduction of the part II of this thesis, one aim is to break down the attributes of the choice sets into single ES and identify the bundles that participants had in mind when making their choice. Therefore, we noted all ES and other important notions that were mentioned in the focus groups while talking about each attribute. These were proposed as options that participants could declare to having motivated their choices regarding this specific attribute. As an example, people in focus groups talked about the carbon sequestration function of forests. We therefore included this regulating service in the list that we proposed to participants of our choice experiment and asked them if they had this service in mind while deciding on the level of the forest cover attribute within each alternative of the choice sets. Importantly, we also included notions that were not important for our analysis or that we were not sure about having a significant impact on the attribute in question. Instead, the question was if they could be important in the eyes of participants although not having any scientifically proven importance.

— Finally, to consult on effective ways to organize the workshops, approach people to participate and motivate them to show up. Related to these points are: Where, when and how the deliberative workshop should take place, how to communicate to people in order to raise interest and which type of media to use while avoiding biases in representativeness. Should we recruit on-site and which persons could help us to recruit? How should we remunerate people and how could this influence the composition of our groups, the kind of answers we get in our questionnaire or statements during the deliberations?

As has been shown in previous studies about preferences for ES supplied by a specific location, familiarity with the place is an important explanatory factor ([CSG12b], [LCH$^+$14], [FSRB19]). Therefore, we distinguished different groups of persons having a different degree of familiarity

with the Cévennes landscape so that we get prepared for the potential issues they expect to be included in a questionnaire about the Cévennes or which they would raise in discussions. For our local sample, following the experience of Deuffic [Deu05], we identified stakeholders directly acting on the landscape composition (farmers, foresters, etc.) or being impacted from that composition (beekeeper, tourism sector, photographer) as a group being particularly familiar with it. Complementary to that group are inhabitants without professional link to the services derived by the landscape, called "simple users" in Deuffic [Deu05].
For the Montpellier sample, hikers, ecologists and people originating from the Cévennes were identified as a group having a higher familiarity with the topic than the average inhabitant. This made a total of four focus groups representing each different characteristics regarding being a stakeholder or habitant or living in the Cévennes or in metropolitan area of Montpellier (figure 2.4).

Location\Groups	« Stakeholders »	Habitants
Cévennes	(Florac) • Farmers • Foresters • Tourism Sector • Beekeeper	• Habitants (Cendras)
Montpellier	Associations: (SupAgro) • Hiker • Ecologists • People originate from Cévennes	• Habitants (Castelnau)

Figure 2.4. – Focus groups programmed per region and expert status.

Each group needed a different way to be approached and contacted. The stakeholder groups were mainly contacted in collaboration with their local professional institution (Cévennes) or association (Montpellier). For the Cévennes group, we additionally had to contact local inhabitants in order to have supplementary contacts of professionals. Especially, farmers were difficult to motivate to participate in our focus group. For the Cévennes inhabitants' groups, we approached people directly in the relatively big municipality of Cendras where a local association organizes conferences about environmental issues regularly. We also put on posters in locations receiving public such as local shops, administrations and the post office. The Montpellier inhabitant focus group was a group of neighbors which we invited to discuss about our topic. The setting for all groups was the same: All groups were invited to talk in a relaxed atmosphere for about two hours. We offered a buffet and they additionally received a gift basket filled with local products from either Montpellier (for the Cévennes groups) or the Cévennes (for the Montpellier groups).
Nevertheless, it took some effort to find a sufficient number of people willing to participate in our focus groups. This and the potential bias introduced to partial self-selection will be further judged in section 2.9.

The focus group course was the same for each group:
First, an introductory round allowed each participant to present herself in order to create a familiar atmosphere that encourages people to talk also about deeper held values. Second, in order to approach the topic and to give some guidance to participants eventually less familiar with the Cévennes region, each participant received 14 pictures [2] with different landscapes and elements from the Cévennes areas (see figure 2.6). They were asked to choose the three pictures that they think give the best representation of the Cévennes and to justify their choice. We marked the frequencies of each picture having been chosen in order to have an idea if there are important elements not already considered as attributes or how these attributes could effectively be described and visualized. Additionally, this exercise allowed participants to know more of each other's viewpoint about the situation in the Cévennes and its possible evolution. Thirdly, we asked for their feelings about one picture given in figure 2.6, that - in our eyes - illustrated well the issue of reforestation. We hoped that this question could guide us on how to approach this important topic in our study and which kind of especially non-material values we had to expect concerning reforestation. Although these three types of questions were conducted as introductory and transition questions, they already fulfilled a range of important objectives for the analysis of the sessions. Fourthly came what is called 'key questions' in Casey and Krueger (2014). A total of five questions asked for (i) the way we should approach and invite people to a deliberative workshop lasting approximately two hours, (ii) the way we should approach people for participating at our questionnaire (without deliberative workshop) [3], (iii) how tourism impacts the landscape and how it should (or not) evolve; (iv) what constitutes the cultural heritage of the Cévennes area for them and (v) a possible payment vehicle for our monetary attribute. The focus group sessions ended with an open round of statements of what we could have missed and what the participants had initially expected from our study.
Overall, the focus group sessions were timed to last two hours, which would give us an idea how to program a deliberative workshop of the same length. The questioning route just described is presented by figure 2.5.

2.3.2.2. Results of the focus group discussions

I will firstly give some general impressions from the focus group discussion before reporting on each question mentioned in figure 2.5 individually.

1) General impressions

Generally, the discussions were rich and constituted a good exercise for the deliberative setting to be held. We noticed that some participants wanted to point on their particular knowledge about

2. The last two pictures were added for the second focus group meeting, following the recommendations from the first group.

3. Initially, our protocol included an additional part of our study, a DCE without any deliberative setting. We removed it due to logistical and time constraints. Consequently, this question within the focus group aimed to capture possible consequences of the self-selection bias of deliberative workshops.

Type of question	Example	Time
Opening	Introduction, link to Cévennes	Approx. 40 minutes
Introduction	Photos ➔ most characteristic for Cévennes; missing pictures?	
Transition	Question about specific pictures ➔ Afforestation	
Key questions	• Motivation to participate • Attribute for Cultural Services • Tourism ➔ prevent protest responses • Monetary attribute • Emotions related to closed landscapes • How to motivate people in Montpellier?	
Fin	Summary ➔ Missed something ? ; opinion	15 min
	➔ Debriefing	Σ 110 min

Figure 2.5. – Questioning route established for the focus group discussions.

the topic compared to other participants or the organizers. It was useful to send those comments back to the audience or to ask for other viewpoints in order to keep control over the discussion. Furthermore, the discussion revealed the caveats of discrete choice experiments: For most participants, a main characteristic of the Cévennes region is the diversity of its landscape. For them, it was counter-intuitive to break this diversity down in some attributes. Nevertheless, they confirmed that they see reforestation as the most important issue to be elaborated in our questionnaire. Apart from this topic, tourism provoked most discussions, especially in groups that were not representing clear expert opinions (inhabitants' groups in Cévennes and Montpellier). This also confirmed our thoughts that tourism would be a good anchor topic for less informed participants in our deliberative groups and should therefore be included in our questionnaire. Meanwhile, we got the advice to give the human presence in the landscape a greater space in or study, as participants missed this issue in our general introduction. Additionally, in the photo choice task (see figure 2.6), some photos with human presence (hunters and transhumance) were picked several times. Nevertheless, other pictures were chosen even more often. We wanted to keep the general introduction below 10 minutes and including more human activity would have been to the detriment of a detailed description of ES, which is the original topic of our study. Given that tourism and cultural heritage are already proposed attributes that are only indirectly related to ES, we decided to not to follow the advice of our focus group here. [4] Finally, we encountered the difficulty of heterogeneous definitions of the geographic extension of the Cévennes (see section 2.2). A good example is shown in the photo choice task (question 2). We noticed that discussions about our definitions of the Cévennes lead to even more discussions that were interesting but often time consuming and had a bad impact on our credibility and (more important) excluded less informed participants from the discussion. To prevent this problem, the

4. I admit that we received the same remark about an insufficient description of human activity in the Cévennes several times in the deliberative groups, but we still think that this was the right choice in regard of the aim of the study and timing restriction within each deliberative workshop.

technique of asking participants for their own definitions instead of giving ours (or postponing an answer to after the workshop had officially ended) proved to be efficient.

Figure 2.6. – Pictures presented to participants in focus groups within the picture choice task and in order to facilitate discussion. Pictures 13 and 14 were introduced after the first focus group.

2) Picture choice task

Figure 2.6 shows all pictures given to the participants. They were asked to choose the three pictures that - for them - give the best impression for what represents the Cévennes for them. Figure 2.7 presents to which proportion each picture has been selected by the participants. Given that three of them had to be chosen, the percentage values sum up to 300. Importantly, we analyzed these percentages category-wise, not group-wise. For example, the choices of the stakeholder group in the Cévennes are simultaneously counted for the category "Cévennes" and "Stakeholders". Accordingly, the focus group of inhabitants in Montpellier is counted in the categories "Montpellier" AND "Inhabitants". This allows a more detailed picture of the source of heterogeneity: either caused by different regional preferences (Montpellier vs Cévennes) or caused by having more or less knowledge, respectively being more or less affected by landscape changes (stakeholders vs inhabitants).

	Stakeholder	Habitants	Montpellier	Cévenols
Chasseurs	14%	8%	14%	8%
Poisson	0%	8%	0%	8%
Forestiers	0%	8%	7%	0%
Mas	14%	54%	57%	8%
Apiculteur	0%	0%	0%	0%
Bancels	36%	15%	14%	38%
Griffe	57%	46%	43%	62%
Causses	21%	8%	14%	15%
Moutons ouv	7%	23%	21%	8%
Moutons fermé	21%	38%	36%	23%
Gorges	7%	23%	21%	8%
boisé	57%	38%	43%	54%
Lingas	21%	8%	14%	15%
Châtaigne	43%	23%	21%	46%

Figure 2.7. – Proportion of focus group participants having chosen the corresponding picture per peer group.

All categories chose the commemorative plaque (picture 7), the forested landscape (12) and the chestnut forest (14) relatively often. [5]. This supported our choice of the Cévennes landscape for its high cultural value and our hypothesis that reforestation is an important issue. Furthermore, the impact of transhumance on the landscape is perceived as important (and of the endemic goat cheese of the Cévennes - Pélardon), shown by high percentages for the picture containing

5. The picture of the chestnut forest (14) and of decidious trees occupying pasture land (13) were only added after the first group - inhabitants in Montpellier, therefore their percentages are less for these two categories

sheep. Meanwhile, no clear difference exists between these pictures depending on whether they are taken in an open or a closed landscape. Interestingly, these pictures have been selected more often in "expert groups" (Cévennes and Stakeholders) than in categories supposed to have less knowledge (Montpellier and Habitants). This kind of difference is also visible for other pictures: Bancèls are picked more often by expert categories, whereas the single standing house and (to lesser extend) the gorges are more chosen by the other categories. When asked about the photos, the expert group often said that photos 4 and 11 are not from the Cévennes because it is from Mont Lozère (photo 4) and the Gorges and Causses (photo 11) and do therefore not belong to Cévennes for them. This is important to consider, because integrating or not elements of these pictures into the questionnaire will certainly provoke questions from either group. The according responses have to be prepared.

3) Feelings about reforestation

Participants were asked about their feelings about some of the pictures (8 or 13) that could illustrate the issue of natural reforestation. However, participants answered partly in a rationale manner by naming (implicitly) some of the ES generated or lost (soil acidification, higher risk for forest fires, etc.). This was used to establish the indicator statements for the follow-up questions in our questionnaire. Regarding feelings, the possible loss of authenticity such as deteriorated bancèls was most often expressed. Meanwhile, also some positive feelings were stated, such as the perception of the beauty of forests and spiritual energy. Nevertheless, these comments were often limited to the case were these forests possess a diverse flora. These were first hints that the actual composition of forests might also be an important indicator for individuals to decide on landscape elements. This culminated in an impressive statement of one participant in the last focus group that was unanimously shared by the other individuals:

«It all depends on what type of forest we are going to have. If we have these beautiful oaks and traditional chestnut forest, it's all fine. But if we have these ugly pine forests, I prefer to burn them all down!»

This statement (although extreme in its wording) summarizes some of the statements we received and gave us the impression that a choice experiments that narrows the question of natural reforestation only to the forest cover would not be sufficient. We therefore decided to add another attribute to our DCE that describes the forest in Cévennes landscapes, namely the composition of forests (tree species): either - with a continuing natural reforestation of pines - an equal proportion of deciduous forest and broad-leaved forest, or forests that includes more broad-leaved species (chestnut, oak, beech), generally appreciated by the population.

4) Motivation to respond spontaneously

Several places were proposed to find people that are motivated to answer our questions: weekly markets and events that have a link to our topic such as expositions of the Cévennes region

in Montpellier («La Lozère fait sa Comédie»). Meanwhile, this would introduce a strong self-selection bias that has to be controlled for.
Another important hint was to use precedent experiences of participants to motivate new people to show up. Accordingly, participants in deliberative groups were invited to talk to other persons that might be interested about their experience without explaining neither the specific topics nor the aim of the study. As precedent, this provokes a representation bias because participants are more likely to talk with individuals having similar profiles (age, education, preferences, etc.). To limit this inconvenient, we asked people about how they got attracted to participate when they inscribed themselves on our homepage and we asked the same question in our questionnaire. With the help of the homepage, we could control that deliberative groups were not numerically dominated by individuals that heard already of the experiment from former participants.
Finally, we adopted the strategy to communicate on the experiences of former participants by asking them for comments that could be published on our homepage. Interested people were thereby informed about the nice and familiar atmosphere they could enjoy.

5) Motivation to show up at valuation work shop

Participants in focus groups were asked how people could be motivated to participate at a deliberative workshop lasting approximately two hours. First of all, they confirmed that a payment would not primarily motivate them to show up, but more the hope of enjoying a convivial evening, including provision of food. As compensation they would prefer gifts that are related to and authentic for the topic. Accordingly, a gift basket with local products as those offered to focus group participants, is a good idea.
Another idea to have this convivial atmosphere would be to show a film in relation to our study. This would promote an "event character" and attract many people, especially in the area of Montpellier. Unfortunately, time is already relatively constrained, and having two hours of deliberation and additionally a film would perhaps take far more than three hours. We were not sure whether these relatively long sessions could also be discouraging for some people. The film would also bias responses.
This means that responses to that question mainly confirmed the setting we already planned. A point to consider was that these responses themselves are already biased. It is not surprising that people who felt motivated to show up under present conditions, tend to confirm that the same conditions would also encourage other people. I come back to that point in section 2.8 .

6) Landscape elements important for tourism

The answers on how tourism affects the landscape brought some insights on how future participants could consider this attribute and how to visualize it. The quality of hiking trails and their signposting, the offer of private holiday flats and the presence of hikers in the landscape were cited as indicators for tourism quality in the landscape.
Associated to the economic returns of tourism is the hope that public services (tourism information,

restaurants, hotels, supermarkets) are maintained even if the number of inhabitants would be shrinking in the Cévennes and would slow down life quality in the region.
Meanwhile, tourism was also seen as a driver to monetize inherent values that could be perceived or experienced without payment, for example parking lots that liable to pay in order to experience a nice view. In the eyes of the focus group members, this evolution would risk to mainstream the authenticity of the region.

7) Meaning of "cultural heritage" for the Cévennes

Knowing already that cultural heritage is important for the Cévennes region, we wanted to know which landscape elements contribute to this heritage and which values are associated to it. Especially pictures helped participants to describe what they see as typical heritage. They also named the natural heritage as important (especially the picture with the forested landscape). The attribute is visualized by a lone standing house of typical dry stone architecture (picture 4), several bancèls (picture 6) and a commemorative stone (picture 7). This group of elements are either important for all categories mentioned in point 2 (commemorative plaque), for more informed participants (bancèls) and less informed participants (lone standing house).

8) Question for monetary attribute

Based on experiences from other studies applying a DCE, we judged the pertinence of our monetary attribute as crucial in order to generate consistent estimations for the willingness to pay (WTP) of ES and to reduce protest responses. To ask participants of our focus groups for their advice on which payment vehicle should be used was therefore an important task of each session. We placed the question at the end so that participants have already gained trust and confidence in our experiment and deliberate honestly about that question.
They witnessed a lack of trust towards collective financial vehicles for public establishments (national park, municipalities, counties, etc.) to use these resources for the purpose initially announced in the experiment. Therefore, we discarded public charges or taxes from our list. [6]
The focus groups also expected a high rate of protest responses for payable services (parking lots, entrance fees, tourism charges etc.). To this point should be added that only the actual "use" or perception of the landscape would be determined in that case. Non-use values (for example from people aware but not visiting the Cévennes landscape) could not be addressed.
Meanwhile, the idea of introducing an extra charge on typical Cévennes products to be paid by customers was more appreciated. The additional money could then permit the producers to afford conservation or management strategies for the landscape. However, some focus group members recalled that a charge would risk to deteriorate the competitiveness of the producers

6. We note here that before the focus group sessions, we preferred to use an increase in regional carbon taxes as payment vehicle. During the application of our deliberative workshops, the «Gilet Jaunes»movement emerged especially in rural areas that protested for a higher purchase power in general, but the purpose of their movement was an increase in carbon taxes of the central government. A use of our initially proposed attribute would probably have caused numerous protest responses. I remind here that the choice of a payment method should have no impact on the outcome of the choice.

compared to close substitutes of Cévennes products. For us the question of the universality of this payment is also questionable: People could avoid to pay for the services they receive by just not consuming Cévennes products.
Finally, participants preferred a compulsory payment that is transferred to local associations that are engaged in the issues raised in our questionnaire: open landscapes for transhumance, forested landscapes, tourism development and cultural heritage. It was mentioned that individual involvement of volunteers is trust building for a donator so that a misuse of the financial resources is less likely. Our concern regarding the credibility of such a payment scheme was not approved, instead the focus group advised a clear communication on the compulsory nature of the payment. We followed the results emerging from our focus group and applied a donation to local associations as payment vehicle. In order to strengthen its credibility, we contacted several local associations and asked whether they accepted to figure in our questionnaire. We argued that the implementation of our study in Montpellier and in the Cévennes would promote them and their objectives. Finally, three associations accepted our offer:

— *Objective Laine* (English: "Objective Wool") is an association that supports the culture of transhumance and is therefore representative for the aim to conserve the agro-pastoral cultural landscape. They organize the annual festival of transhumance in the village of Génolhac. In order to achieve their objective, they are promoting an easier use of wool for the production of clothes so that sheep owners have an additional source of income. At the moment, several restrictions compared to cotton exists, according to the association. They run a shop in Génolhac where they sell wool products.
— *L'Association des syndicats mixte libre de Gestion des Forêts Cévenoles* is an organization that represents private owners of cévenol forests. In a short communication I had with them, they underlined that their objective is a "correct" exploitation of the forests (without having further information about their interpretation of correctness). In our study they are representing an association that could manage the employment of higher forest cover and control for the composition of the forests (tree species attribute).
— *Cévennes Ecotourism* is an association of the local tourism businesses that is engaged in supporting a sustainable evolution of their sector. Logically, it is representing know-how in managing the evolution of our tourism attribute.
— Another two associations were selected to figure in our questionnaire to represent the cultural heritage attribute but did not responded positively. The *Club Cévenol* and *Cévennes Patrimoine*. The first association did not respond several times to our messages whereas the second did not want to collaborate with us, because they were strongly engaged against the national park which they thought being at the origin of our study and refused any communication to remediate this misunderstanding. Unfortunately, we did not find other associations that are engaged in the cultural heritage in general, and operate not only on a very local scale. Therefore, no association could closely represent know-how for the last attribute.

As described earlier, we underlined the compulsory character of the payment in order to achieve the landscape scenario represented by the alternatives. Another concern was that some of the respondents may be against the implication of some of the associations, which could in turn cause protest responses. To avoid this situation, we invited participants to declare how they would distribute their donation among the associations after finishing the choice tasks.
In general, I doubt that the choice of any payment vehicle in application of DCEs is neutral in its effect on the outcome.

2.3.2.3. Conclusion on the focus group method

The focus groups were important for our study. They advised us on how to formulate our questions, confirmed most of our attributes and their discussion led to the inclusion of an additional attribute (tree species). We were informed about possible indicator statements that people have in relation to the different landscape elements and how they might possibly be willing to pay for ES. The organization of the focus groups was helpful to test also the organization of deliberative workshops and the kind of discussions we could expect. We judged that the difficulties to find participants for our project were due to our lack of experience in organizing these events. The fact that some of the participants already knew each other (especially for the inhabitant group of the Montpellier region) clearly veiled that the recruitment process would be even much more difficult during the real implementation of the study. In this point we should have paid more intention to the experiences from the focus groups. I would fully recommend to other researchers to conduct and organize focus groups carefully for similar valuation studies.

2.4. Principles of discrete choice experiments and experimental design

2.4.1. Introduction to discrete choice experiments

This section is dedicated to present the basic principles of discrete choice experiments and their experimental design.
Discrete choice experiments have emerged from conjoint analysis, applied in the domain of marketing in the 1950's to predict consumer preferences for different designs and composition of products. The theory of value states that the total value of the good is the sum of the values attributed to its different components (biophysical or not) [Lan66]. Conjoint analysis tries to predict the decision of consumers faced with a product or service made up of several components, called attributes [GKW01]. It uses experiments, where respondents choose from predefined and often hypothetical choice sets designed by researchers, to elicit the associated preferences [LFC10]. A choice set contains several alternative situations illustrated by different levels of attributes. The method is based on the theory of conjoint management, which derives predictions mathematically from former sequences of choices to future sequences of choices without aiming to

understand the underlying behavior of respondents [LFC10]. Although implemented in a closely similar experimental setting, DCEs are derived from different assumptions stemming from such behavioral theory. Thurstone (1927) proposed a utility framework, random utility theory (RUM). It states that choices from individuals are based on the maximization of utility derived from that choice [Thu27]. This utility can be separated into a systematic (often) non-random part, which is controlled or observed by the researcher (either the composition of alternatives or the observable characteristics of the individual). The other part is random and assumptions have to be made on its form and distribution. This gives not only the name to the overarching random utility theory, but also the origin to the creation of numerous models. The most important ones are presented in detail in section 2.5 Due to the fact that conjoint analysis does not focus primarily on the validity with regard to welfare measures, it is important to notice that DCEs necessarily need to provide a so-called opt-out alternative, which simply states that individuals are given the possibility to not enter the market (or consume) at all. If contrarily, respondents have to make a choice, they are possibly forced to state alternatives as being "preferred" although they do not provide additional utility. This would not be consistent with welfare maximizing behavior and therefore not reveal the inherent trade-offs of participants [JBA$^+$17]. The inherent problem of utility, that is has no measurable unit, was resolved by McFadden in 1973, who proposed to use a monetary payment as vehicle to obtain a welfare measure of the utility differences procured by the different alternatives [McF73]. Therefore, the latter are decomposed into several attributes and specified by different values of these attributes (so-called levels). One of these attributes is designated to be the payment mentioned above. The researcher needs to estimate the preference for attributes that have to be traded off against each other and the monetary attribute. This innovation provided the possibility to empirically determine the economic dimension of discrete choices faced by individuals, lead to a rapid evolution and popularity of DCE [HMW01] and the Nobel prize for D. McFadden in 2000.

Consequently, the quantitative outcome of the DCE crucially depends on the determination of the attributes and their levels *ex ante*. They should deliver the necessary information for each respondent to trace among the proposed alternatives. Expert interviews and scientific literature often give a first idea on which attributes to choose. Of course, the perception of what is "necessary" or not differs among individuals. Therefore, researchers are advised to consult focus groups composed by individuals who are representative for the intended population of the experiment (see section 2.3). Their impression and ideas often complement the prior findings. Additionally, focus groups can advise on (i) which attributes to consider in the choice experiment or whether meaningful attributes are still missing; (ii) how to present and describe attributes in an understandable way; (iii) how to approach the topic in order to create interest; and (iv) difficulties that could arise during the implementation stage of the study.

2.4.2. Experimental design

In the context of DCEs, the term "experimental design" refers to the chosen combinations of alternatives, attributes and levels to constitute so-called choice sets. Provided with visual features, these choice sets are also named choice cards. The aim of an experimental design consists of permitting to efficiently achieve a statistically measurable overview of the preferences declared within the choice sets. Consequently, the allocation of alternatives within a choice set has to reveal the inherent trade-offs participants made while deciding on which alternative provides the highest utility for them. In this case, the values obtained are (at least theoretically) closely related to marginal rates of substitution and exchange values of the included attributes can be determined.

2.4.2.1. Orthogonal designs

The dilemma faced by the researcher is as follows: First, consider if alternatives are assumed to provide similar amounts of utility to the respondent (or stated differently, the utility difference among them is small), the latter risks to decide rather randomly which alternatives seems to be the best for her because she is not able to rate one alternative above another. The inherent trade-off for the deterministic part of her utility function would therefore not be revealed. Furthermore, the random part of utility is appealed. Secondly, if alternatives seem to entail huge differences in utility (so that one alternative "dominates" another), the choice task is evident at the individual level for each (or many) respondent(s). In this case, as statistical estimation retraces the results obtained for the whole sample of respondents, the information gain risks to be small, if a huge part of respondents choose the same alternatives. It would be significant that the dominant alternative is better than another, but not why, because the unanimously stated preferences do not reveal the trade-offs made between the different levels of attributes contained in each alternative. Therefore, experimental design is supposed to provide an allocation of alternatives that guarantees close, but not too close levels of utility within each choice set.
A relatively easy way to achieve coherent combinations of choice sets consists of the use of orthogonal designs. Here, choice sets are constructed such that correlation among levels of attributes is minimized ([AAGR08]).

2.4.2.2. Determination of efficient experimental designs

Many software packages emerged to tackle this issue, I used Ngene to create the experimental design. The researcher has to declare the model he wants to apply to the choice data, as well as the expected utility function globally valid for the individuals. The program then computes all possible choice sets by combining different levels, attributes and alternatives, and their expected amounts of utilities. Consequently, all combinations of choice sets are classified with respect to their ability to provide information about the preferences of individuals represented by the pre-specified utility function in the most efficient way. The most applied classification criterion to

obtain such "efficient" designs is the D-error, which represents the determinant of a "hypothetical" asymptotic variance-covariance matrix Ω for an individual representing the whole sample of respondents [Cho14]. A small D-error is therefore an indicator for smaller scales of the error terms, whose variances constitute the diagonal axis of the variance-covariance matrix. Consequently, designs are optimized for low D-errors (D-optimality) such that the regression estimates from the DCE are convergent, conditional on the utility function and the priors specified by the researcher. Another criterion is to reach so-called S-optimality [BR05]. Here, one is interested in the necessary size of the requested sample of the DCE, so that all desired main effects and interactions are expected to be significant. As before, the calculation of the criterion is conditional on the priors and the utility function specified by the researcher. S-optimality is useful if a subset of coefficients is of particular interest (such as for WTP determination, for example). Therefore, the researcher might accept less consistency in the estimation of the other coefficients (due to lower D-efficiency) in order to guarantee significance of the coefficients of interest. The performance of the algorithm to determine efficient designs crucially depends on the specification of the expected utility function by the researcher. Pilot studies to obtain prior values to be included into the algorithm are therefore generally recommended [Hoy10].
Importance has to be addressed to the clear communication on the efficiency criteria used. Its choice can influence the results of the entire experiment although these are supposed to be asymptotically identical, due to limited sample sizes resulting from logistical or budgetary constraints [OM17].

2.4.2.3. Full factorial and fractional designs

Meanwhile, this focus on requirements for statistical efficiency of the experimental design should not cover necessary reflections on respondent's efficiency [JLM$^+$13]. The combinations of alternatives should also be clearly understandable for each respondent. Otherwise, their stated choices would be misleading for the researcher. As stated by Carson (1995), the attributes composing alternatives should be understandable, plausible and meaningful for participants. Hence, the choice and definitions of attributes are a crucial element of DCEs, but can harm comparability of studies, if empirical reasons lead to departures from protocols established elsewhere. Consequently, I report in detail what guided us while choosing our attributes and levels, especially with regard to the discussions we had in our focus groups.
One could argue that more attributes give more insight and information and therefore better choices. Meanwhile, two caveats arise: First, numerous attributes increase the cognitive burden of the valuation exercise for the respondent and risks to provoke "noisy" answers by use of heuristics, misinterpretations or protest responses ([KBS12]; [JLM$^+$13], [JBA$^+$17]). Secondly, the increase in the number of attributes or associated levels leads to an exponential increase in the number of possible combinations of experimental designs. Already in our case with five attributes composed of (i) three attributes having each three levels (ii) one attribute having two levels and finally (iii) the monetary attribute having six different levels, gives $3^3 \cdot 2 \cdot 6 = 324$ possible compositions of

alternatives. Although this guarantees good coverage, it is logistically impossible to include all these 324 alternatives into a choice experiment for each respondent. Instead of using all possible alternatives within a set (so-called "full factorial design"), it is reasonable to use only the most important alternatives, providing the highest gain of information (so-called fractional factorial design). The choice of alternatives within the efficiency criteria furnishes these factorial designs [HMW01].

2.4.2.4. Blocking

Meanwhile, the required number of choice tasks per respondent can be further reduced by creating blocks. This means that the entirety of choice sets resulting from the algorithm is further divided into so-called blocks. Each participant is faced with one block and responds only to the choice sets therein included. For the analysis, the whole sample is rebuilt by combining the responses from different blocks such that the resulting observation could have been obtained by one respondent answering the choice experiment for all blocks. Necessarily, it has to be assumed that utility functions are equivalent among different respondents and correlation between the answers has to be controlled for.

2.4.2.5. Labeled alternatives and alternative-specific constants

Another issue concerns the description of the alternatives: Especially in health science (but also in studies in environmental sciences), alternatives are separated regarding different treatments. For example, the first alternative contains attributes for one treatment (such as risks, constraints and healing evolutions) and the other alternative for the alternative treatment. In this case, they constitute labeled alternatives, so that the name of the alternative contains itself an information. For example, patient A could prefer one treatment over another for the same levels of attributes. In order to control for this interference, each alternative is given an alternative-specific constant (ASC) which captures effects solely due to the alternative. Nevertheless, even without using labels for the alternatives (such as alternative "1" and "2"), ASCs can be useful. Especially in the case when choice sets contain many alternatives, respondents perceive the exercise as complex and risk to over-proportionally drop out or choose the status quo alternative by default [MOW15]. Including ASCs in the econometric analysis allows to control for this bias. The importance of a transparent, plausible and theoretically valid process to determine the experimental design of a stated preference valuation is increasingly mentioned in the literature, although it is regretted that econometric theory is still seen as major factor to guarantee high-quality valuations [BB19].

2.4.3. Implications for our study

I established the experimental design of our study by using the information we already gained before (information from the literature and national park charter as well as from our focus group discussions). These were used to construct the attributes, guess the expected sign of their levels

and to determine which interactions among them might be important to consider in the algorithm for Ngene. Other DCEs in the literature were used to obtain rough priors for the algorithm in order to obtain a design for a pilot study.
This section reports on these processes and the choices we made using insights from the pilot study.

2.4.3.1. Preparation of the pilot study

We adapted the model of choice sets mostly found in the literature: three alternatives including one status quo option (non-labeled) in order to fulfill consistency with welfare theory. As described in the previous section, the focus group discussion led us to include five attributes (forest cover - three levels; tree species - two levels; tourism infrastructure - three levels; cultural heritage conservation - three levels, and finally a donation to local associations as monetary attribute - six levels). All levels except the monetary payment could be derived from the literature about the Cévennes (forest cover and tree species, see [Par17]; p. 4) or case studies valuating rural landscape elements in a DCE (qualitative levels for tourism and cultural heritage). For the remaining attribute, we compared the average income level of the local population to that of other regions where DCEs have been conducted and oriented our payment scheme on those studies. Nevertheless, this strategy can only be a first step to determine the final payment scheme with the help of a pilot study that incorporates a contingent valuation from which a demand curve with the necessary information for our payment levels could be established. For creating an efficient design in Ngene, additional information on the direction and strength of the effect for each attribute, represented by priors for the coefficients within the utility function, is crucial. Therefore, we already apply a short DCE within the pilot survey in order to tighten the range of our priors previously used. As a final goal, we also want to test the timing of our questionnaire and its wording to prevent some misleading understanding.
For the experimental design of the pilot study (as for each DCE in general) the utility function has to be expressed (see figure A.1 the appendix on page 243). This means that each variable of our model, its occurring levels in the choice sets as well as its (distribution of the) coefficient have to be stated. Already at this step, some logical conclusions can help to get some good priors: If the Ngene algorithm shall provide a powerful design, much methodological "space" should be devoted. This means that the utility function should be specified in a way that allows the algorithm to change attribute levels frequently while the pertinence of each alternative generated (in other words, the expected utility given the researcher's specification) should not be too unequal. As described in section 2.4.2.2, the creation of dominant alternatives will not provide much additional information about the inherent tradeoffs of individuals. Especially, the utility function should account for different scales and units of the attributes.
The following example illustrates the issue: The payment attribute contains (amongst others) the levels of €20 and €50 and another attribute contains qualitative levels (bad, medium, good) with the levels being coded as 0, 1 and 2. We assume that the coefficient for the payment vehicle would

be -0.1. Supposing that an alternative would be composed of (i) the payment being €20 and (ii) the other attribute being at the level of "medium" (value of 1). Now, another alternative for the same choice set is created, containing (i) a payment level of €50 and (ii) the other attribute being "good" (value of 2), the inherent utility difference occurred by the payment attribute would be 3 ($[50-20]\cdot(-0.1)$). Hence, the coefficient for the other attribute should be approximately at the same size (in this case 3), so that the change of the qualitative attribute from "medium" to "good" ($[2-1]\cdot 3$) approximately compensates for the loss of utility induced by demanding a higher payment from the participant. Of course, the researcher does not need to know the exact size of the coefficient, but should have a general idea. This allows Ngene to simulate the tradeoffs made by participants such that the experimental design that provides the most information is found. As a consequence, less choice sets and consequently a lower sample size are sufficient. Given the results from the literature as well as from other examples in the literature, we chose the priors for the experimental design of the pilot study in the following way:

Forest cover

In our focus group discussion, we had positive comments about the role of forests for climate change and timber production (especially in Montpellier). But the majority were testimonies about the high value of conserving the authentic open, cultural landscape of the Cévennes. The attribute is computed such that a higher level represents more forest cover (75%, 85% and 95%). Although providing information in percentage value, the attribute is not quantitative. In the specification of the representative utility function we reproduced this possibly diverging impact of the forest cover by assuming only a slightly negative coefficient of -0.2. Our illustration of forest cover within a DCE by percentage change values is regularly used in the literature ([VT13]; [LV16]; [SGM17]). Sagebiel et al [SGM17] find evidence for a heterogeneity regarding landscape elements among participants in Germany depending on familiarity and the landscape composition at their main residence. Also in Germany, Lienhoop and VÃ¶lker (2016) report a higher preference for forest cover within the landscape if people deliberate about the possible scenarios. Additionally, a broader set of values consisting of cost and benefits is incorporated. In the Italian Veneto region, forest cover is greatly appreciated in a DCE as long as it is still part of a diverse landscape [VT13]. In conclusion, the preferences for forest cover are highly dependent on location and familiarity. Hence, we closely followed the recommendations and insights from our focus group instead of using the results from other case studies for deciding on our priors.

Tree species

This attribute had particular attention: We included this attribute into our choice experiment after a profound discussion in our last focus group about the low aesthetic value of deciduous forest and the high risk for forest fires it represents. As we were not sure about the generalization of these testimonies to the whole population, the pilot survey should give a clearer picture about the pertinence of the attribute.

We specified the variable accordingly: A value of one designated the situation were forests are majoritarily composed of broad-leaved forests (chestnut, oak, beech), whereas a value of zero represented the case were forests are equally composed of broad-leaved forests and deciduous forests - a situation emerged and still emerging due to the natural afforestation of pine forests. In order to follow the general aim of having more broad-leaved forests, we attributed a positive coefficient of 1 to that variable. Additionally, we thought of that attribute to influence the choice of the forest cover attribute: people are perhaps willing to conserve less open landscape, if a higher forest cover is accompanied with a larger proportion of broad-leaved forests. But as the pilot study only served as test version to foster our vision of possible priors, this interaction was only included for illustrative reasons. The interaction had a prior of 0.2 and the main effect a prior of 0.5.
The species of trees composing a forest was not only underlined in our focus groups as being important. Regarding the provision of different bundles of ES, forest species is a main determinant [OAN19]. For example, the public perception of services provided by mixed forests compared to mono-cultural forests revealed strong preferences for the former due to a higher provision of several regulating services [AMA$^+$18]. Likewise, Pereira et al [PQPV05] report on oak forests being preferred over eucalyptus forests by local habitants in Northern Portugal because they are consuming less water.

Tourism infrastructure

The tourism variable represents preference towards more or less investment in tourism infrastructure: It is coded from 0 (low) over 1 (medium) to 2 (high). In our focus group discussion, tourism has been seen as necessary for economic reasons and largely underdeveloped. We therefore adopted a positive value only for a strong evolution of tourism with 0.25, whereas medium evolution of tourism had a prior coefficient of -0.5.
The qualitative computation of our attribute follows examples in the literature: In contrast to our impression after the focus group discussions, the tourism evolution attribute is often positively perceived in DCEs. Hearne and Salinas (2002) find positive values for eco-tourism development in Costa-Rica that are different in strength among regional or international tourists, but not in their direction. A linear relationship for better tourism infrastructure is described in Alvarez-Farizo and Hanley ([AFH06]) in a DCE about river restoration management in Spain. Especially the last case study does also report high heterogeneity in a random parameter model among participants, that shows the high controversial nature of the attribute. We therefore expect a heterogeneity for this attribute and supposed only a small mean effect.

Cultural heritage

The discussions in focus group regarding the cultural heritage attribute were less focused on the strength and direction of its effect but more on its presentation: What is the cultural heritage of the Cévennes and how could it be represented graphically? Meanwhile it should be

meaningful for participants from Cévennes as well as from Montpellier. Clearly, cultural heritage has been seen positively. As in many other studies assessing cultural heritage as an attribute in a DCE, we incorporated its degree of conservation effort by a qualitative scale (e.g. [CHS09]; [ZGS10]). Importantly, cultural heritage has often been found as being nonlinear. There are strong preferences for a base level, but the increase in utility perceived by participants for higher levels was lower. Examples are the quality of conservation of waterholes important to aboriginal people in Australia [ZGS10] and the impact of agricultural practices on old farm buildings and historical features [CHS09]. Similar elements to the bancèls in the Cévennes are stonewalls in a mountainous, rural landscape in Ireland, where the same effect of a cultural heritage attribute has been shown [CHS09]. In order to account for that non-linearity, we took priors of 0.6 and 0.8 for this attribute.

Payment

The monetary attribute had particular importance during the focus group discussions: Its kind and description is crucial to be credible for participants in order to have a more realistic simulation of real world trade-offs. It was presented as donation to local associations having particular experience about the landscape elements presented for each alternative.
For the amount, we compared our case study to those of other publications, see figure 2.8. We oriented our payment scheme to that of Meyerhoff et al (2015), as its topic of land use change seems to be close to ours. Otherwise, the cited study was conducted in more or less rural areas in Germany, where average income is higher than in Montpellier and even considerably higher than in the Cévennes. Consequently, we wanted to lower our payment scheme in absolute values. Finally, this led us to the exact payment scheme as in Meyerhoff and Liebe [ML09] conducting a DCE about forest diversity. Compared to our DCE, their forest study would likely represent a whole-sale bias because just one kind of landscape is considered for WTP, whereas our attributes embrace more landscape types. Accordingly, the WTP in our study should be higher. But as before, the general income in Meyerhoff and Liebe [ML09] which was conducted on nationwide scale in Germany is significantly higher than in the Cévennes - and therefore demands higher absolute values in their payment scheme. In conclusion, it can be said that our payment scheme is the same as in Meyerhoff and Liebe [ML09] because part-whole bias and the lower income level in our region are probably compensating each other. We used a prior of -0.01 that allowed even for the highest payment level to compensate a loss in utility by a higher level of the other attributes. For a final determination of the prior value and the payment scheme we programmed a contingent valuation (CV) exercise within our pilot study.

These priors were used to determine an efficient design for our pilot survey. Given that we wanted to ask participants spontaneously to answer and test our questionnaire we wanted to keep the necessary time below 15 minutes. Each questionnaire contained therefore only a subset of follow-up questions regarding attributes and socio-demographic questions. In the same manner, we reduced the number of choice cards per questionnaire to 6. Having expected a low sample

Study	Topic	Country	Payment Scheme in €	Mean Coefficient
Meyerhoff and Liebe (2009)	Forest diversity	Germany	5; 10; 20; 35; 50; 75	-0,029
Meyerhoff et al (2015)	Landuse Change	Germany	10; 20; 50; 80; 110; 150	-0,0062
Vecchiato and Tempesta (2017)	Conservation of Pastures in mountainous regions	Italy	15; 30; 60	-0,023
Hoyos et al (2009)	Natural area protection in Basque Country	Spain	5; 10; 15; 20; 30; 50; 100	-0,0139
Lienhoop and Völker (2016)	Specific ES in local landscape	Germany	-25; 25; 50; 75; 100; 150	-0,008
Alvarez-Farizo et al (2009)	restoration strategies after nuclear accident	Spain	0; 18; 60; 108; 150	-0,014

Figure 2.8. – Studies considered for deciding on payment scheme proposed as monetary attribute.

size for the pilot study, we also reduced the number of blocks to 2 (12 choice sets in total) so that an estimation was feasible. We used a D-efficient algorithm of Ngene to generate several design candidates. From those we picked that one (i) having a low S-efficiency (meaning that all effects are to be measured with the lowest sample size possible) in order to anticipate the low sample size of the pilot study and (ii) providing choice sets with the least relatively dominant alternatives.

2.4.3.2. Results from the pilot survey and consequences for the design of the main study

We conducted our pilot survey with 5 participants at Ganges which is situated at the border of the Cévennes region and with 12 participants at the Airport of Montpellier. We analyzed where participants had difficulties to understand questions or where they spend more time than anticipated. Before getting to the choice sets, a Contingent Valuation exercise asked for the willingness to pay for an exemplary alternative expected to provide the highest amount of utility. Additionally, we asked them for possible improvements of our questionnaire.
Generally, people enjoyed the questionnaire, but it revealed difficulties to keep the time requirements so that we knew that the discussion section at each deliberative workshop had to be shortened. Additionally, we revised some questions to be less time consuming (e.g. asking only for income classes and not the exact income, etc.)
In terms of estimation for our priors, the pilot study supported our hypotheses about the possible effects of our variables. Some of the variables became already significant (forest cover and tree species), but furthermore all coefficients got expected signs (tree species and tourism positive; forest cover, cultural heritage and payment negative).As expected, the cultural heritage attribute showed signs for non-linearity, so that we kept the effect coding scheme for this attribute. No other attribute could be supposed to have a nonlinear effect on utility.
The attribute "tree species" should be included in the choice sets. Not only it is significant, but also its inclusion into the model makes the ASCs more non-significant (from being nearly significant) beforehand, without impacting the other variables much. This indicates that this variable explains some of the respondents' behavior that is not explained by the other attributes, or in other words, that respondents paid attention to this attribute in their decision. The pilot survey therefore supports the advice from the focus group to control for the type of forest that is increasingly covering the landscape.

Regarding interactions, we had three different situations that would have been meaningful to us. Firstly, the interaction already mentioned above between forest cover and tree species. Secondly we suppose an effect between forest cover and cultural heritage with a negative direction, indicating that most of the heritage infrastructure is related to agro-pastoral practices. Consequently, higher forest cover would complicate the conservation of these practices and its associated heritage. Thirdly, cultural heritage could also be affected by tourism and vice versa: Higher tourism affluence could retrieve necessary financial resources for conservation and tourists could be better dispatched over the region if the cultural heritage to visit is in good condition. Or, in inversed temporal order, conservation efforts could incite more people to visit the Cévennes. In our pilot study, only the first interaction is significant in some specifications and with the expected sign while taking coefficients of -0.14 to -0.37. Given the low sample size and the relatively weak supposed effect, we are cautious about both, strength and direction, and compute this effect as being random and following a uniform distribution between the values of $+0.2$ and -0.4. The second interaction between forest cover and cultural heritage is never significant, but always keeps the same, negative direction, which could indicate a solely sample size problem. We therefore include this interaction into the algorithm with a prior following a random normal distribution with a mean of -0.35 and a standard deviation of 0.2. Finally, the last interaction among cultural heritage and tourism is never significant neither, but with changing signs. It seems not robust, leading us to not include it into the design algorithm. Nevertheless, we will test the interaction in the main study.
Our prior values of the main effects for the final experimental design have been adapted as follows:

Forest cover

In our pilot study, the effect of growing forest cover was always negative and without nonlinear effects, but with different strengths (coefficient ranging between -0.44 and -0.9). We therefore choose a value of -0.6 as the mean of a random normal computation with standard deviation of 0.4 in order to account for possible heterogeneity regarding preferences for positive (carbon storage) and negative (endangering of cultural landscape) effects of forest cover, that we already noticed in our focus group discussions.

Tree species

The attribute is perceived positively and relatively robust, which covers our impression from the last focus group. We therefore take a fixed prior value of 1 for a higher proportion of broad-leaved forests.

Tourism infrastructure

This attribute shows the weakest indications for significance. It is mostly negative but changes the sign if the interaction with cultural heritage is included. This may confirm the high heterogeneity expected for this attribute. Nevertheless, no non-linearity is observed. Due to the ambiguous

indications from focus groups, literature and pilot study, we only conduct a weak effect of tourism evolution so that the algorithm is not profoundly guided by this attribute without knowing its pertinence. A linear effect with a coefficient of -0.2 is retained.

Cultural heritage

The pilot study supports the hypothesis of a positive and nonlinear relationship, with values from 0.9 to 2.2 for a strong conservation effort and from 0.5 to 0.8 for a medium conservation effort. Interestingly, the coefficient decreases if more effects (interactions) are considered, meaning that some other effects may be covered by the cultural heritage attribute. Given that with higher sample sizes, more variables (and socio-demographic characteristics) will enter the utility function, we prefer values at the under bound of the pilot survey values. Therefore, we take a prior value of 0.7 for a medium level and 1.1 for the higher level.

Payment

Two issues are important for this attribute: The coefficient and the payment scheme, which itself has implications for the coefficient. Regarding the coefficient, the value is negative for all models, as necessary and consistent with welfare theory. Furthermore, its value is as high as we supposed so that the payment scheme we proposed seems to be in the right range. This is confirmed with the demand curve we obtained from our CV exercise in the pilot survey (see figure 2.9). The graph shows how many participants of the pilot survey were willing to pay a certain amount to obtain the best attribute allocation from our choice sets. The red horizontal lines illustrate the 5% and 95% thresholds of willingness to pay. They are considered as guidelines for the smallest and highest amounts proposed in a payment scheme (Meyerhoff, 2017, communication at EAERE Summer School). The fact that the curve is steep for small amounts confirmed our choice to propose several small payment amounts (€5, €10, €20) to capture utility difference for these type of respondents. In order to have not too much space among the remaining payment amounts, we did not choose the 95% threshold as highest amount (which would have been approximately €85), but kept our previous level of €75. Multiple biases in contingent valuation studies support these choices. In conclusion, the pilot survey confirmed our payment scheme already in place, so we made no changes here.

The final DCE design was then created with the algorithm of Ngene. Given the number of levels of attributes (2, 3 and 6), a smooth generation of choice sets is supported by their total number being a multiple of 6. Due to the still high number of possible choice sets, the possibly weak effects of some attributes (especially tourism) and interactions, the idea was to have as much choice cards per respondent as reasonable, without having to split the sample into too many blocks. Therefore, instead of having 48 choice sets with 8 choice sets per respondent in 6 blocks, we chose to generate a design with only 36 choice cards, but 9 choice sets per respondent in 4 blocks.

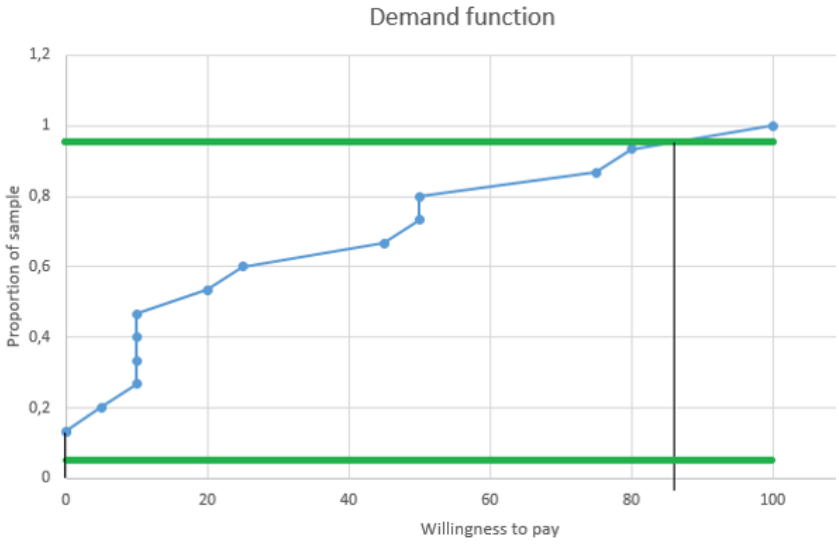


Figure 2.9. – Demand curve established with contingent valuation exercise in the pilot survey.

My program code of Ngene is presented in the appendix (see figure A.1 the appendix on page 243). It should be noticed that the consideration of randomly distributed coefficients now necessitates a mixed logit model optimization with draws from these distributions. We chose 100 Halton draws for the generation of the design (see [Tra09]; p. 221ff). A Federov algorithm ([Cho14], p. 102) was applied that does not require attribute level balance, as our status quo alternative always explicitly mentions the default levels of attribute in the Cévennes landscape, making an equal number of attribute level appearances for the entity of choice sets nearly impossible.
As with our pilot survey, the performance criterion was D-efficiency. After having run the program for 12 hours, three designs were proposed having close values for D-efficiency. Whereas model 1 had the best D-error value of 0.06243, models 2 and 3 had close D-errors of 0.06267 and 0.06269. Meanwhile, the latter models had better S-estimates (the number of times the choice sets have to be completed to have all variables significant, given the correct specification by the priors). Model 3 had an S-estimate of 120.55 and model 2 reached 121.15, while model 1 achieved 125.33. Consequently, the S-estimate always refers to the variable whose potential significance is the most difficult one to reveal which are variables with a supposed effect close to 0 and interactions or both. In our case, this was the interaction between forest cover and tree species, due to the fact of being an interaction and its low absolute prior value of -0.1. As I was particularly interested in this interaction, I investigated models 2 and 3 (lowest S-estimates) further. As for the pilot study I decided finally for the model having more choice sets where expected choice probabilities among alternatives were most (but not totally) equalized. Model 2 fulfilled this condition and was used for our choice experiment. One choice card is presented in the appendix (see appendix A.2). A detailed description of the final questionnaire is given in section 2.7. The results of our choice experiment have to be investigated with the help of

different models, each one based on specific assumptions on the behavior of respondents. The following section details these conditions and its consequences for the econometric analysis of choice experiment.

2.5. The econometrics of discrete choice experiments

This section [7] is dedicated to provide a brief introduction to the econometric assumptions and models used to estimate coefficients of discrete choice experiments. First, an overview about the key assumptions and associated models is given. Second, the standard logit model as well as its limitations are presented. In order to account for these limitations, subsequent subsections introduce more general models such as generalized extreme value (GEV) models and mixed logit models. Finally, I present reflections about our choice experiment and which models seem appropriate in our case.

2.5.1. Overview

The basic underlying model of discrete choice models can be described as follows: A decision outcome y is the result of a behavioral process implicating observed factors x and unobserved factors ϵ. This process is approached by the random utility model as described in the previous section. Among J alternatives, the decision maker n chooses that one providing her with the highest amount of expected utility.
This decision is observed by the researcher (so-called representative utility) but without being capable to control for the unobserved factors, which depend on the specification and caption of the observable factors by the researcher.
The aim of a choice experiment is to model the probability of alternative i to be chosen by decision maker n given the observed factors x and assuming unobserved factors ϵ following a particular distribution. This means that the DCE has two related tasks: a specification of a behavioral model explaining the decision process of respondents and the estimation of parameters of that model.

$$\begin{aligned} P_{ni} &= Prob\ (U_{ni} > U_{nj}\ \forall j \neq i) \\ &= Prob\ (V_{ni} + \epsilon_{ni} > V_{nj} + \epsilon_{nj}\ \forall j \neq i) \\ &= Prob\ (\epsilon_{nj} - \epsilon_{ni} < V_{ni} - V_{nj}\ \forall j \neq i) \end{aligned}$$

The probability of i is determined by the probability of the alternative to provide the highest utility to the decision maker. This is equivalent to the probability that unobserved factors are such that they do not invert the difference in observed factors (last equation, [Tra09]; p. 15).

7. This section draws heavily on [Tra09].

That question can be modeled by an indicator function I measuring whether the last inequality is true (event y conditional on observed factors x) over the distribution assumed by the researcher. To resolve that equation, the use of integrating techniques is required.

$$P(y|x) = \int_{\epsilon} I(\epsilon_{nj} - \epsilon_{ni} < V_{ni} - V_{nj} \ \forall j \neq i) \ f(\epsilon_n) \ d\epsilon_n \tag{2.1}$$

The solution depends on the assumed distribution $f(\epsilon)$ which will have important consequences for the properties of the behavioral model underlying the choices.
The necessary integration is possible, if equation 2.1 takes a closed form. In order to achieve that, restrictions have to be made on the behavioral model (see section 2.4.1). ϵ is supposed to be *iid* and extreme value (EV) distributed, which means that unobserved factors are uncorrelated and homoscedastic over alternatives. If the model follows these restrictive standard assumptions, it is referred to as standard logit or - in the multivariate case - as multinomial logit (for individual specific characteristics) or as conditional logit (for alternative specific characteristics).
The restrictive assumptions are released in the generalised extreme value (GEV) model, that accounts for correlations. A less generalized, often applied form is when alternatives are grouped so that they share equal correlation patterns within groups and differ between groups or so-called nests, which leads to the nested logit model (section 2.5.3.1).
A less restrictive assumption which accounts for correlation among attributes, is to consider unobserved factors as jointly normal distributed. Hence, the variance-covariance matrix can be modeled and integrate parameters representing diverse correlation and substitution patterns. Unfortunately, no closed form expression exists for integration, which necessitates the use of simulation. Here, numerous draws from the supposed distribution of ϵ are taken and the results are averaged to give an unbiased estimate of the true value. Probit models use this approach. As I do not attempt a probit approach, I will not investigate the model properties further in this thesis.
Finally, a medium alternative between closed form and full simulation is possible. In this case, the random term is split into two parts, a conditional (ϵ_2) and a marginal density (ϵ_1). Mixed logit models apply this technique.

2.5.2. Logit model

Standard logit is the simplest model used for the analysis of DCEs. The unobserved part of utility derived by decision maker n for the choice of alternative j, ϵ_{nj} is supposed to be *iid* extreme value distributed (Gumbel type 1). The density function f and the cumulative function F are ([Tra09]; p. 34):

$$f(\epsilon_{nj}) = e^{-\epsilon_{nj}} e^{-e^{-\epsilon_{nj}}},$$
$$F(\epsilon_{nj}) = e^{-e^{-\epsilon_{nj}}}.$$

In DCEs the determination of choice probabilities does not require the estimation of the absolute value of utility (which, additionally, has no meaning itself), but the estimation of utility differences (does alternative A provide more utility than alternative B?). An often stated principle in DCE practice is therefore "only differences in utility matter".
Taking the difference of the extreme value distributed unobserved factors of two alternatives j and i (denoted ϵ^*) then results in the logistic distribution as cumulative distribution ([Tra09]; p. 35):

$$F(\epsilon^*_{nij}) = \frac{e^{\epsilon_{nij}}}{1 + e^{\epsilon_{nij}}}.$$

The assumption of error independence requires that the unobserved parts or utility among alternatives are independent from each other. This so-called Independence of Irrelevant Alternatives (IIA) means that the specification of the observed parts of utility made by the researcher has to be sufficiently well to make the unobserved part get white noise. In the case of independence, the cumulative distribution of unobserved parts from different alternatives are simple products (due to the nonexistence of covariances), as indicated in equation 2.2. The choice probability for alternative i among J is therefore the integral of this cumulative distribution and representative utility (V) weighted by the assumed density distribution ([Tra09]; p. 36):

$$P_{ni} = \int \Big(\prod_{j \neq i} e^{-e^{-\epsilon_{ni} + V_{ni} - V_{nj}}} \Big) \underbrace{e^{-\epsilon_{nij}} e^{-e^{-\epsilon_{ni}}}}_{f(\epsilon_{ni})} \, d\epsilon_{ni}. \tag{2.2}$$

The density function of the logistic distribution has fatter tails than a normal distribution (and therefore has a higher kurtosis), which means that it allocates more probability mass to extreme events. This permits to capture possibly diverging preferences within unobserved factors among respondents.

2.5.2.1. Scale factor

The variance of the cumulative distribution of an extreme value distributed random variable is $\frac{\pi^2}{6}$. This fact is used to normalize utility by the so-called scale factor. If the researcher estimates the choice probability of his model, he supposes a specific variance of the error terms representing the unobserved part of utility. But by definition, the real variance is unknown. This means that the higher the real variance of the unobserved part, the more it interferes with the estimates of the coefficients of the observed part of utility. Consequently, the researcher is not able to identify the real parameters β^*, but only the ratio $\frac{\beta^*}{\sigma}$ of the coefficients β^* and the unknown variance of the unobserved part of utility σ. Hence, estimated coefficients represent "the effect of the observable variable, relative to the variance of unobserved factors" ([Tra09]; p. 41).
Given the assumption of an extreme value distributed error term, the researcher therefore supposes the variance of the error term $Var(\epsilon) = \frac{\pi^2}{6}$, knowing that the real variance may be increased or decreased by a factor σ, giving $\sigma\frac{\pi^2}{6}$. Then, σ is called the scale factor, as it is

the factor by which the unknown variance is multiplied and which is implicitly estimated with coefficients of the observed parts of utility. Consequently, the estimated choice probability and the resulting utility function also include this factor ([Tra09]; p. 40f):

$$P_{ni} = \frac{e^{(\frac{\beta^*}{\sigma})' x_{ni}}}{\sum_j \ e^{(\frac{\beta^*}{\sigma})' x_{nj}}} \Leftrightarrow P_{ni} = \frac{e^{\beta' x_{ni}}}{\sum_j \ e^{\beta' x_{nj}}}. \tag{2.3}$$

But as all coefficients are divided by σ, it does only impact the *scale* of utility but not the outcomes, as the ratio of utility differences stays constant ("only differences in utility matter"). σ is therefore normalizing the scale of utility in the logit model. Meanwhile, this means that regression coefficients from different case studies are not comparable, as the scale factors in the estimations are surely different.

2.5.2.2. Limits of logit

Although providing a coherent simple concept of choice analysis, the logit model has some caveats that may be heavily simplistic. It does not account for random taste variation, disproportional substitution effects and correlation of unobserved factors in the case of panel data.
Taste variation can be estimated within a logit model if it is systematic, for example as (quadratic) interactions between observable variables and personal characteristics of the respondents. One example would be a higher probability of individuals to prefer a certain attribute level if they have higher income. But if that taste variation is determined by an unobserved factor, the former observable variable is interacted with a random variable and would get random itself (and could then no longer be controlled for or estimated within the choice setting).
Disproportional substitution effects are directly linked to the IIA property. If an alternative would be removed from a choice set, the choice probability formerly attributed to that alternative is redistributed among the remaining ones according to their relative probabilities. If we take the example of four alternatives A, B, C, D having probabilities of 20%, 20%, 40% and 20%, this means that if we remove alternative D from the choice set, its 20% probability are redistributed among the remaining alternatives. To keep the choice probabilities proportional, alternative C gets the double amount of probability mass than alternatives A and B. Hence, the resulting choice set (A,B,C) would have probabilities of (25%, 25%, 50%). If the ratio of probabilities among alternatives i and k is calculated, the resulting equation

$$P_{ni} = \frac{e^{V_{ni}}}{e^{V_{nk}}}$$

does only depend on the choice probabilities themselves, as the initial denominators representing the choice on other alternatives (as indicated by the $\sum$ sign in equation 2.3) is cancelled out. Therefore, it is stated that they are independent from irrelevant alternatives. As shown in the blue-bus-red-bus example ([Tra09]; p. 45ff, citing [Chi60] and [Deb60]), this supposition is

unrealistic if - due to unobserved factors - one alternative is more closely related to the removed alternative than the other remaining alternatives.
Finally, dynamic effects in choice panel data cannot be modeled. Often, as in our case, respondents are asked to state their preferences in multiple choice sets, decreasing organizational needs for the implementation of the study significantly. Otherwise most stated preferences studies would not be feasible. This means that certain sequences of choices are correlated (those made by the same individual). This is not problematic, if the correlation concerns observed characteristics or simple time effects modeled by lagged variables such as fatigue effects.
When this correlation does also affect unobserved characteristics, error terms get correlated. This harms the basic assumption of *iid* errors in logit and would therefore result in biased estimates. Consequently, if correlation of sequences of choices is assumed, standard logit can only serve as an orientation for more complicated models such as probit or mixed logit.

2.5.2.3. Estimation and testing of logit models

The estimation of choice probabilities is achieved by the maximization of the log-likelihood function ([Tra09]; p. 61):

$$LL(\beta) = \sum_{n=1}^{N} \sum_{i} y_{ni} \; ln \; (P_{ni})$$

with y acting as indicator variable as seen in previous equations.
The resulting estimators are the values of coefficients that maximize the approximation of the model towards the actual results measured by the indicator variable y (for details on maximum likelihood estimation, see [MS14]; p. 241 ff.).
As in linear regression, a measure of goodness of fit exists also for logistic regression, the likelihood ratio index ([Tra09]; p. 68):

$$\rho = 1 - \frac{LL(\hat{\beta})}{LL(0)},$$

where the numerator in the term is the value of the log-likelihood function for estimated values whereas the denominator takes the value of the log-likelihood function if all coefficients except the intercepts were set to 0 (so called null model). Consequently, ρ takes a value close to one for nearly perfectly predicted values (likelihood is close to one, its logarithm is close to 0 and makes the ratio 0 as well). Meanwhile, the value of ρ does not provide a meaningful interpretation (such as for R^2, for example) other than a higher ρ means higher model fit.
In order to test significance of individual parameters, traditional t-statistics can be applied. More complex hypotheses can be verified with likelihood ratio tests.

Finally, as noted above, the limitations of the logit model necessitate to test the adequacy of its application or if a more complex model should be used to account for random taste variation, substitution patterns or dynamic correlation in panel data.
Hausman and McFadden [HM84] proposed a test which takes subsets of alternatives and tests

the robustness of the estimates obtained for all alternatives. If that is the case, this indicates that the IIA property is valid. Otherwise, mixed logit or GEV models may be adequate.
Additionally, McFadden [McF84] created a cross-alternative variable test, which includes utility from other alternatives as variable into regression, which should be not significant (meaning irrelevant) if in line with IIA.

2.5.3. Generalized extreme value models

As noticed in the previous section, standard logit suffers from the restrictive *iid* property which imposes no correlation among unobserved factors. Hence, if the observable part of utility does not contain all sources of correlation, the latter is automatically introduced in the unobserved part and causes the violation of the *iid* condition. In this case, generalized extreme value models (GEV models) can be used. As their name suggests, they are a generalisation of standard logit models in the sense that they relax the *iid* assumption and allow for correlation among alternatives in the unobserved part as long as the latter keeps extreme value distributed. If however, no correlation exists in the unobserved part, it drops back to standard logit. Consequently, correlation tests can be applied to determine the convenience of a standard logit model.
GEV models have in most cases a closed form which permits to resolve integration steps without being required to use simulation procedures. Being the most popular model within GEV, the nested logit is presented in detail and will also be applied in our case study. Nevertheless, a multitude of other more complicated models within the range of GEV exists.

2.5.3.1. Nested logit

The most common model derived from GEV is nested logit. Here, groups of alternatives, so-called (non-overlapping) nests, are distinguished. Within each nest, choice probabilities of alternatives are correlated and follow the IIA, so that the change in the choice probability of one alternative affects the other alternatives proportionally. For alternatives across nests, IIA is not valid, indicating that substitution patterns among them diverge in a more complex way that entails no correlation.
For a set of alternatives J, K non-overlapping subsets $B_1, ..., B_k$ can be created such that the random terms are correlated to those of alternatives within their nests k and not to those of another nest l ([Tra09]; p. 79):

$$Cov(\epsilon_{nj}, \epsilon_{nm}) = 0 \text{ for any } j \in B_k \text{ and } m \in B_l \text{ with } l \neq k.$$

The choice probability for alternative i in nest B_k is then ([Tra09]; p. 80):

$$P_{ni} = \frac{e^{\frac{V_{ni}}{\lambda_k}} \left(\sum_{j \in B_k} e^{\frac{V_{nj}}{\lambda_k}} \right)^{\lambda_k - 1}}{\sum_{l=1}^{K} \left(\sum_{j \in B_l} e^{\frac{V_{nj}}{\lambda_l}} \right)^{\lambda_l}} \tag{2.4}$$

where the numerator represents the choice of alternative i within nest k (term in brackets) and the denominator the choice of all possible alternatives in all nests. Consequently, the ratio is the choice probability of interest. The parameter λ indicates the degree of independence within each nest. $1 - \lambda$ therefore indicates the degree of correlation among alternatives within one nest. As stated before, if the error terms are *iid*, meaning that IIA would hold for all alternatives, λ would be 1 for all nests. The precedent equation would then reduce to the standard logit equation (equation 2.2).
If one is interested in the proportion of choice probabilities of two alternatives within the same nest, this ratio would contain the denominators of equation 2.4 which are the same for both alternatives and would therefore cancel out ([Tra09]; p. 80):

$$\frac{P_{ni}}{P_{nm}} = \frac{e^{\frac{V_{ni}}{\lambda_k}} \left(\sum_{j \in B_k} e^{\frac{V_{nj}}{\lambda_k}} \right)^{\lambda_k - 1}}{e^{\frac{V_{nm}}{\lambda_l}} \left(\sum_{j \in B_l} e^{\frac{V_{nj}}{\lambda_l}} \right)^{\lambda_l - 1}} \overset{k=l}{=} \frac{e^{\frac{V_{ni}}{\lambda_k}}}{e^{\frac{V_{nj}}{\lambda_l}}}.$$

In the case that alternatives are part of the same nest ($k = l$), the terms in brackets representing the choice based on attributes of the corresponding nest cancel out and result in the simple form. If alternatives are from different nests, the equation stays unchanged. It is noteworthy that only terms concerning the nests of the two alternatives are entering the formula, whereas attributes from other nests do not appear. The odds of alternatives are therefore independent from attributes of other nests, which is called the independence of irrelevant nests (IIN) property. The parameter λ can change among nests, so that the degree of independence of alternatives in one nest can change between nests. This can favor cases where the strength of relations determining the affiliation to a nest diverges.
The utility derived by an individual n can be specified to illustrate the nested structure of alternatives: The observable part is further divided into one part being constant within each alternative of nest B_k, (W_{nk}), and one part that varies among each alternative within nest B_k, Y_{nj} ([Tra09]; p. 80):

$$U_{nj} = W_{nk} + Y_{nj} + \epsilon_{nj}.$$

Following that logic, the choice probability depends on the one hand on the probability of choice of the nest B_k and on the other hand on the probability of choice of alternative j conditional on the choice of nest B_k. Both choice situations can be approached by logit in a two-step procedure ([Tra09]; p. 82f): First, the choice made among nests is determined by the variables captured in W_{nk} (the so-called "upper model"):

$$P_{nB_k} = \frac{e^{W_{nk} + \lambda_k I_{nk}}}{\sum_{l=1}^{K} e^{W_{nl} + \lambda_l I_{nl}}}.$$

Secondly, the choice among alternatives within (and conditional on) the previously chosen nest, based on the variables in Y (so-called "lower model"):

$$P_{ni|B_k} = \frac{e^{\frac{Y_{ni}}{\lambda_k}}}{\sum_{j \in B_k} e^{\frac{Y_{ni}}{\lambda_k}}}.$$

In the upper model, the term I_{nk} indicates the logarithm of the denominator of the lower model.

$$I_{nk} = ln \sum_{j \in B_k} e^{\frac{Y_{ni}}{\lambda_k}}.$$

It represents the expected utility derived from the possibility to choose among the alternatives in that nest. When doing the choice among nests, it can be interpreted as an information transfer from the lower to the upper model. Consequently, the choice among nests is based on the factors captured in W and an extra utility derived from the opportunity to have an extra choice within the nest. It is referred to as the "inclusive value of nest B_k".
A personal example will illustrate the issue: As I love ice cream, I can choose my preferred ice cream parlor among Montpellier and Aigues Mortes, where each town represents its own nest. Within each nest (so within Montpellier and Aigues Mortes) several ice cream parlors are available. Here, the choice between Montpellier and Aigues Mortes represents the upper model, and the choice among ice cream parlors for each town is the lower model. If, additionally, I know that in average ice cream parlors in Aigues Mortes are better than in Montpellier, this information is valuable for my choice in the upper model (the choice between Montpellier and Aigues Mortes). So, knowing that I can choose from either Montpellier or Aigues Mortes makes me incorporate this inclusive value of the nest "Aigues Mortes" from the lower to the upper model, represented by the term I_{nk}.
Regarding the estimation of nested logit models, it is important to note that the log-likelihood function to be maximized is not globally concave. This entails the necessity to try different starting values in order to prevent the algorithm to converge at a local maximum. The sequential estimation procedure following the upper-model-lower-model approach presented above can be useful in this case. Being consistent but not efficient compared to simultaneous ML estimation, it can serve as a generator for starting values for the latter if simultaneous estimation reveals problems.

2.5.3.2. Overlapping nests

The nested logit procedure can be extended to permit alternatives to be part of more than one nest. Two main models have been developed based on these overlapping nests.
First, paired combinatorial logit constitutes a nest for each possible pair of alternatives. Hence, correlation of unobserved factors by the parameter λ can be modelled individually for each combination of alternatives. Meanwhile, as each alternative is included in $J - 1$ nests, the

number of parameters grows rapidly with the number of alternatives and demands other forms of restrictions to keep the model manageable.
Secondly, the generalized nested logit approach assumes that every alternative is member at several nests and to different degrees by using an allocation parameter $\alpha \in [0, 1]$ that indicates to what extend the alternative belongs to that nest.

2.5.4. Mixed logit

The mixed logit model does not assume anymore that only the *error term* of the estimated utility function is random, but that coefficients of *parameters of the observed part of utility* are random as well and vary among decision makers. In a choice experiment, the preferences for attributes the researcher is controlling for (so, the observable part of utility), are following a primarily assumed distribution. Accordingly, the choice probability is calculated over these density functions of the parameters as if they would be a weighted average.
The logit model is therefore becoming a mixed function (determined by the functional form of the error terms AND the distribution of observed factors) with the latter called the mixing distribution ([Tra09]; p. 135).

$$P_{ni} = \int \left(\frac{e^{\beta' x_{ni}}}{\sum_j \ e^{\beta' x_{nj}}}\right) \ f(\beta) d\beta.$$

If the mixing distribution is not continuous but discrete, allowing the coefficients to take a set of values with associated probabilities, the model is called latent class.
As stated before, it is up to the researcher to determine the distribution of the coefficients, based on the behavioural process she assumes to be underlying the choices. Here, various criteria such as the value of the log-likelihood function, the Akaike (AIC) or Schwartz (BIC) criterion are consulted. Often, a normal distribution or a log-normal distribution for price coefficients (guaranteeing a homogeneous direction) are applied, but others such as uniform, triangular or truncated normals are also possible.
A short discussion about the possible mixing distributions in our empirical study is presented in section 3.3.3.
Regarding the error terms, they are still assumed to be *iid* EV, but one part is conditioned on the parameters (mean, variance, etc.) of the mixing distributions (so-called conditional density). An alternative specification of the utility function underlines this interference. The former observable, deterministic part ($\beta'_n x_{nj}$) is now divided into one part constituted by the mean of the mixing distribution (representing the expected value and being therefore deterministic, $\alpha' x_{nj}$) and deviations from that mean due to the random nature of the mixing distribution ($\mu'_n z_{nj}$) .

This latter part together with the noise term are stochastic ([Tra09]; p. 139):

$$U_{nj} = \beta_n' x_{nj} + \epsilon_{nj} = \overbrace{\alpha' x_{nj} + \underbrace{\mu_n' z_{nj} + \epsilon_{nj}}_{\text{stochastical part}}}^{\text{former observable part}} .$$

In standard logit, the second part is 0, which ensures that no correlation of alternatives exists and that IIA holds. In mixed logit, alternatives are related by their same mixing distribution that enters in the covariance of μ'. Random deviations from expected parameters enter the noise term, and cause a covariance of alternatives (and therefore a correlation) to be non zero. Consequently, IIA is violated.
The capacity to define individual mixing distributions gives mixed logit models such a high flexibility that any RUM related choice behavior can be approximated. Interesting for the application for DCE is the coverage of panel data structures, where choices over time (or more concrete sequences of choices) are observed. In this case, choices are correlated for the same decision maker because parameters are fixed for one individual.
Therefore, each sequence of T choices per individual is modeled as a product of subsequent choices with errors being independent over the sequence ([Tra09]; p. 146):

$$P_{ni} = \int \left(\prod_{t=1}^{T} \left[\frac{e^{\beta' x_{ni}}}{\sum_j e^{\beta' x_{nj}}} \right] \right) f(\beta) d\beta.$$

Other specification are possible such as future or lagged exogenous variables to model learning or anticipation effects or systematic change of parameters with a degree of correlation to precedent periods.
Due to the complex influence of the mixing distribution on the parameters, a closed-form calculation of choice probabilities is not possible. The researcher needs to specify simulation techniques in order to draw from the mixing distribution (random draws, Halton draws, etc.), then calculate the resulting choice probability for each draw and average he results in order to obtain a consistent estimate of the parameters.

2.6. Factorial analysis and cluster analysis

In this section, I present how quantitative and qualitative data can be analyzed without supposing any relationship *ex ante*. In contrary, regression analysis presumes the existence of a (or numerous) endogenous variable(s) and, in the multinomial case, several exogenous variables. Several techniques can be employed: principal component analysis (PCA), (single) correspondence analysis, multiple correspondence analysis (MCA) and cluster analysis (such as hierarchical cluster analysis, HCA). I will summarize all methods using the standard publication from Husson, Lê et Pagès (2016) while focusing on MCA and HCA, as they will be applied in chapter 3 and 4. The main distinction between these methods is the objective and the type of data used: Principal

Component Analysis and both types of correspondence analysis try to find linear relationships among variables and individuals (so-called factors) whose strength and direction can be interpreted. They all are summarized as factor analysis. Meanwhile, cluster analysis is not conceived to interpret any relationship among data except the belonging to a certain group or class of other variables itself.
Regarding the data type, quantitative data can be used to create a PCA, whereas qualitative data is used for correspondence analysis by exploiting the joint occurrence of certain characteristics of variables. Depending on whether the latter uses two or more variables, it is divided into single correspondence analysis or multiple correspondence analysis.

2.6.1. Principal component analysis

Principal component analysis is applied to tables with individuals (or profiles) composing the lines of the table and with quantitative variables composing the columns of the table such as in traditional cross-sectional data. To further detail the objectives announced above, it can be said that PCA tries to determine individuals that are particularly close to each other regarding the quantitative data describing them. The question is, whether groups of relatively homogenous individuals exists in the data. Regarding the quantitative variables, PCA determines linear relationships among these variables such that they can be synthesized into fewer so-called components that still describe the individuals sufficiently well. The achieved reduction of the number of variables simplifies an interpretation of the data.
The distance among two individuals i and l as indicator of their level of assimilation over $k = 1, ..., K$ variables is measured by the Euclidean distance ([HLP16]; p. 5):

$$d(i,l) = \sqrt{\sum_{k=1}^{K}(x_{ik} - x_{lk})^2}.$$

It is used because it shares advantageous mathematical properties ([HLP16]; p . 173):

— it produces a distance of 0 if individuals are equivalent
— the distance is reflexive (distance from i to j is equivalent to distance from j to i)
— triangular inequality holds for graphical illustrations (drawn on a plane, the direct distance between two individuals is less or equal to the distance created by passing by a third individual).

In order to simplify the graphical representation and to allow a comparison among variables measured in different units, original values are centered (deducted from the variable k's mean) and standardized (divided by the standard deviation of variable k).
Graphically, the distances are displayed around their gravity center (point where all distances sum up to 0) such that the projected distance ("inertia") of the individuals in plane P is maximized ([HLP16]; p. 8):

$$P \to max \sum_{i=1}^{I} OH_i^2$$

where O is the gravity center and H_i the projection of i in P. P is the plane, in which the data space is most "stretched" and therefore the most effective visual illustration in order to identify patterns and structures. Its first axis would constitute the first synthetic component whereas the second axis represents the orthogonal vector which describes the most of the variability still left over in the data. Accordingly, this second axis is called "most complementary" to the first axis. This procedure can be generalized to a sequence of planes that are all orthogonal to the precedent plane. These planes being linear combinations of the variables that compose the space, are called principal components. [8] Mathematically, the components are derived by the diagonalization of the variables' correlation matrix ([HLP16]; p. 10).
The quality of the representation as well as the strength of the variables' relationships can be judged by several indicators. First, the proportion between projected inertia and total inertia ([HLP16]; p. 17):

$$\frac{\sum_{i=1}^{I} \frac{1}{I} (OH_i^s)^2}{\sum_{i=1}^{I} \frac{1}{I} (Oi)^2} = \frac{\sum_{k=1}^{K} (OH_k^s)^2}{\sum_{k=1}^{K} (Ok)^2}.$$

It states how much of the total variability in the data is explained by a particular principal component and allows to compare their relative power. Second, outliers can be easily detected as points that are far from the gravity center in multiple components. Either, these points can be explained or they are removed in order to have a clearer focus on the main relationships within the data. Third, the contribution of one variable or one individual to the component is a measure of the stability of an axis ([HLP16]; p. 19):

$$\frac{\frac{1}{I} (OH_i^s)^2}{\lambda_s} \times 100 \ ,$$

with λ_s the variance of the component s. It gives the information how much per cent of the inertia of the component is achieved with only that variable or individual. This means that components that mainly depend on a small number of variables are less stable in relation to the whole data.
The diagonalization of the correlation matrix to construct the principal components necessitates to calculate the eigenvalues of that same matrix. Assessing these eigenvalues does also help to determine how many dimensions should be considered: If there is a clear jump in the sequence of eigenvalues, this might indicate that further dimensions do not reveal important relationships within the dataset.

8. It should be noted that the components depend on the number of components initially supposed. This means that the first two of three total components of a space are not equivalent to the two total components of the same space of quantitative variables.

2.6.2. Single correspondence analysis

Although not used furthermore in this thesis, principal component analysis already provides the necessary intuition and indicators for correspondence analysis. Here, contingency tables of variables are assessed: How many times variable I takes the modality i given that variable J takes modality j. As before, the aim is to maximize the inertia projected on axes determined by a measure of distance.
Basically, data in the contingency table is supposed to be independent under the null hypothesis. A higher frequency of each class or modality caused by a deeper relationship between the variables has therefore to be distinguished from a higher frequency due to a high relative importance of a class for that variable. With that intention, the real data is compared to a theoretical contingency table obtained with perfect independence. Thus, a distance measure for correspondence analysis is obtained by the difference of each table element from its theoretical value under the null hypothesis of independence ([HLP16]; p. 66):

$$\chi^2 = \sum_{i,j} \frac{(\text{observed frequencies - theoretic frequencies})^2}{\text{theoretic frequencies}} = n \cdot \sum_{i,j} \frac{(f_{ij} - f_{i\bullet} f_{\bullet j})^2}{f_{i\bullet} f_{\bullet j}} = n \cdot \Phi^2 \ ,$$

with $f_{i\bullet}$ ($f_{\bullet j}$) the frequency of modality j from J (i from I) and f_{ij} the joint frequency of both modalities. As with PCA, distances can be visualized as projections departing from the gravity center, the general mean. Further orthogonal dimensions to that plane are added that provide a maximum stretch of projections. The importance of each dimension and its stability is represented by its contribution. As before, the contribution of a point to an axis is ([HLP16]; p. 82) :

$$\begin{aligned} ctr_s(i) &= \frac{\text{inertia of i projected on axis s}}{\text{total inertia projected on axis s}} \\ &= \frac{f_{i\bullet}(OH_i^s)^2}{\sum_{i=1}^{I} f_{i\bullet}(OH_i^s)^2} = \frac{f_{i\bullet}(OH_i^s)^2}{\lambda_s}. \end{aligned}$$

2.6.3. Multiple correspondence analysis

MCA is the multivariate case of the correspondence analysis in the previous section. Now, the contingency table consists of the variable of interest in the lines and several qualitative variables in the columns. The distinction into individuals (lines) described by several variables (columns) becomes more obvious for that multivariate case. A good example consists in the responses of persons (individual) to several questions in a questionnaire (variables). The table elements x_{ij} contain the response or value of individual i to question j. As before, a distance measure is applied in order to determine common groups of individuals that take similar modalities of the qualitative variables. Nevertheless, it is not straightforward how to compare similarity over

several variables: How is a deviation from the modality of one variable among two individuals weighted against a deviation from the modality of another variable? The following guidelines are applied ([HLP16]; p. 129) :

— two individuals taking the same modality have a distance of 0 for that variable
— a high overlap of numerous modalities results in a small distance
— for a high overlap in frequent modalities but differences in rare modalities, distances are more significant, in order to account for the specificity of the individuals
— for an overlap in rare modalities, while possessing differences in more frequent modalities, individuals are approached so that their common specificity is underlined.

Hence, this approach accounts for the degree of rarity of modalities in order to compare individuals ([HLP16]; p. 130):

$$d^2_{i,i'} = C \sum_{k=1}^{K} \frac{(x_{i,k} - x_{i',k})^2}{I_k} \ ,$$

with I_k is the number of individuals taking modality k and C is a constant. If, as especially in PCA, the objective is to synthesize several variables, another distance measure is necessary to compare variables to each other (which variables are closer to each other so that they should be the first to be "merged"?). Here, the approach is more straightforward, because distance of modalities is simply the degree of individuals they have not in common $(I_{k \neq k'})$ [9]([HLP16]; p. 130):

$$d^2_{k,k'} = C' \frac{I_{k \neq k'}}{I_k \cdot I_{k'}} \ .$$

Due to the fact that computationally, the data is coded in a complete disjunctive table [10] (one if the individual takes modality k, zero otherwise), we have $I_{k \neq k'} = \sum_{i=1}^{I} (x_{i,k} - x_{i,k'})^2$, so that ([HLP16]; p. 131)

$$d^2_{k,k'} = C' \frac{1}{I_k \cdot I_{k'}} \sum_{i=1}^{I} (x_{i,k} - x_{i,k'})^2 = C' \sum_{i=1}^{I} \left(\frac{x_{ik}}{I_k} - \frac{x_{ik'}}{I_{k'}}\right)^2 .$$

The account for rarity of modalities causes inertia to be biased towards rare phenomena, which is especially to be considered for missing data. To limit this bias, some rare categories can also be merged into bigger classes that equilibrates the modality structure of a variable.
A second bias of this distance measure is that inertia among variables is biased towards those possessing more and therefore probably rarer modalities. Hence, the number of modalities per question in a questionnaire should be similar. In my case, the different perceptions associated to choice attributes are quantitatively higher for the forest cover attribute than for the others. This

9. Contrary to modalities, individuals are not more or less "rare".
10. A complete disjunctive table displays individuals in lines and every modality of each variable as separate column. If individual i takes modality k, the element x_{ik} is one, otherwise it is zero. In other words, a complete disjunctive table can be seen as a table where all modalities are coded as dummy variables.

means that a bias of inertia towards forest cover is to be expected and should be considered in the analysis of results.
The composition of groups can further be investigated by the distinction of active and supplementary variables. Contrary to the so-called active variable, these do not enter into the construction of the different axes, but illustrate how they are distributed over the groups determined by the active variables (e.g. [PDORB13]). For example, in our case the associations made to the choice attribute by respondents will be used as active variables in order to identify ES bundles. Socio-demographic variables are then added as supplementary variables that reveal if certain bundles are particularly composed by a certain category of individuals (age, gender, environmental attitudes, education, etc.)

2.6.4. Classification

In this section, focus is put on hierarchical clustering analysis. It is called hierarchical because in the resulting illustration as trees, the vertical level of a node (meeting point of two branches) represents the degree of dissimilarity. Each branch constitutes a group of individuals that share certain characteristics, and each of these characteristics is hold by many of the individuals. Multiple branches with few individuals are merged to a bigger branch at a higher level, where groups are less similar, which means that individuals are always part of multiple branches.
Contrary to that, partition methods are assigned to one and only one class. The most frequently used method is an allocation around moving averages.
The distance among individuals is determined by Euclidean distances, as with PCA. Non-Euclidean distances are also used (e.g. the so-called city-block distance, as if to be measured in Manhattan) in order to avoid overweighting higher dissimilarities caused by taking the square of the differences of individuals. Nevertheless, they do not share the advantageous mathematical properties described in the section of PCA.
The construction mechanism for the famous trees of hierarchical clustering works as follows: First, a dissimilarity matrix is created that contains all distances between all individuals. Then, the lowest distance within this matrix is detected (representing the most similar individuals) and these two individuals are merged into a class. The detected distance is the value of dissimilarity and determines the height at which the branches of the two individuals meet in a node. For the second step, the columns of the formerly separated individuals in the dissimilarity matrix are replaced by a new column that represents their new class. All distances of the remaining individuals towards this new class are calculated and updated. Again, the lowest distance among all elements in the matrix is identified and the algorithm continues with the same steps until only two classes of individuals are left.
When several groups have already been created and the question is how to further identify groups that could be merged without creating a graphical representation as described in the previous sentences, the theorem of Huygins becomes useful: The total inertia among two groups can be decomposed into an inter inertia (the distance that the gravity centers of each group have

towards a possible joint gravity center) and an intra inertia (the distances within each group towards its own gravity center) ([HLP16]; p. 180):

$$\text{total inertia} = \text{inter inertia} + \text{intra inertia} \ . \tag{2.5}$$

Ward's algorithm uses this equality for hierarchical clustering: By shifting total inertia stepwise towards inter inertia, individuals within classes get more and more similar whereas the dissimilarity between classes increases (by creating more and more classes). The part of total variability explained by inter inertia is an indicator for the quality of classification and for the number of classes to retain.
Another algorithm also uses equation 2.5, but with the inverse reasoning: Departing from every individual representing its own class, the aggregation by inertia method determines the classes p and q to be merged by identifying those that cause the least increase in intra inertia ($\Delta(p,q)$)([HLP16]; p. 181):

$$\Delta(p,q) = \underbrace{\frac{I_p I_q}{I_p + I_q}}_{1)} \cdot \underbrace{d^2(g_p, g_q)}_{2)} \ , \tag{2.6}$$

with g_p and g_q the gravity center of the classes and I the quantity of individuals they contain. Each term in equation 2.6 represents a particular case for merging: either small classes (first term small) or very similar classes (second term small). The aggregation quantity Δ is used to order the classes horizontally, which permits to create HCA trees without crossing branches.
As already mentioned above, the number of classes to keep at the end of the classification process has to be declared by the researcher. Several information criteria can be used: If a clear jump proportion (Ward's algorithm) or in the aggregation of inter inertia is achieved, a good level to cut further classification is possibly reached ([HLP16]; p. 184):

$$\min_{q_{min} \leq q \leq q_{max}} \frac{\Delta(q)}{\Delta(q+1)} \ .$$

Finally, the description, analysis and interpretation of relations within the data can be further increased, if factor analysis is combined with cluster analysis. This is done by replacing the variables in the original data by the factors from factor analysis. These are then further summarized by a classification procedure. so that interpretation of axes of higher dimensions is simplified. Especially, in MCA, numerous dimensions of similar importance are often generated and are therefore not easily interpretable. After a classification, the comparison of class means of variables (quantitative data) or composition of modalities within classes (qualitative data) with those of complete data simplifies interpretations of relations. Importantly, the same distance measures have to be applied (Euclidean distances) in order to have consistent results. It is

recommended to include dimensions that account for approximately 80% or 90% of inertia and where at least a rough interpretation can be given beforehand.

2.7. The final questionnaire

Having detailed the process of how it was established through literature review, focus groups and best practice guidelines, the final questionnaire will be briefly described. A complete exemplary is provided in the appendix (section A.2 on page 244).

2.7.1. Introduction and information

After an introducing cover letter that summarizes the process of the deliberative workshop (without revealing the exact protocol), participants are invited to state their motivation to attend the workshop as well as the kind of values they judge as being most important for the Cévennes landscapes. Subsequently, information about the Cévennes is given. This includes a broad definition, the benefits and ES provided by landscapes, the impact of tourism and an impression of the cultural heritage. The information section closely relates to the attributes and the indicator statements while providing images for a better visualization. Finally, the current evolution is shown with a growing natural reforestation of agropastoral surfaces and the benefits of the latter.

All this information was also presented to the groups orally.

2.7.2. DCE and follow-up questions

After the information section, the discussion was started for the deliberative groups, whereas non-deliberative groups were directly introduced to the functioning of the DCE. The first group came to this stage after having finished the deliberation. Each questionnaire included nine choice sets composed of three alternatives with one of them defined as status quo. Figure 2.10 shows the pictures illustrating each attribute level. Three choice sets are provided within the questionnaire in the appendix on page 244).

The choice tasks were succeeded by a follow-up question for participants that chose the status quo on all choice cards in order to identify protest responses. Possible reasons for this behavior that conform to welfare theory are that (i) no alternatives were perceived as advantageous compared to the status quo or (ii) the participant could not afford the necessary payment indicated by the monetary attribute for other alternatives. All other responses to that question were considered as protests.

Finally, as supplementary question for analysis and as a tool to allow individuals to decide on how their payments of the valuation would be used (hypothetically), participants were asked to allocate a fixed sum among the local non-profit organizations receiving the payment of the DCE.

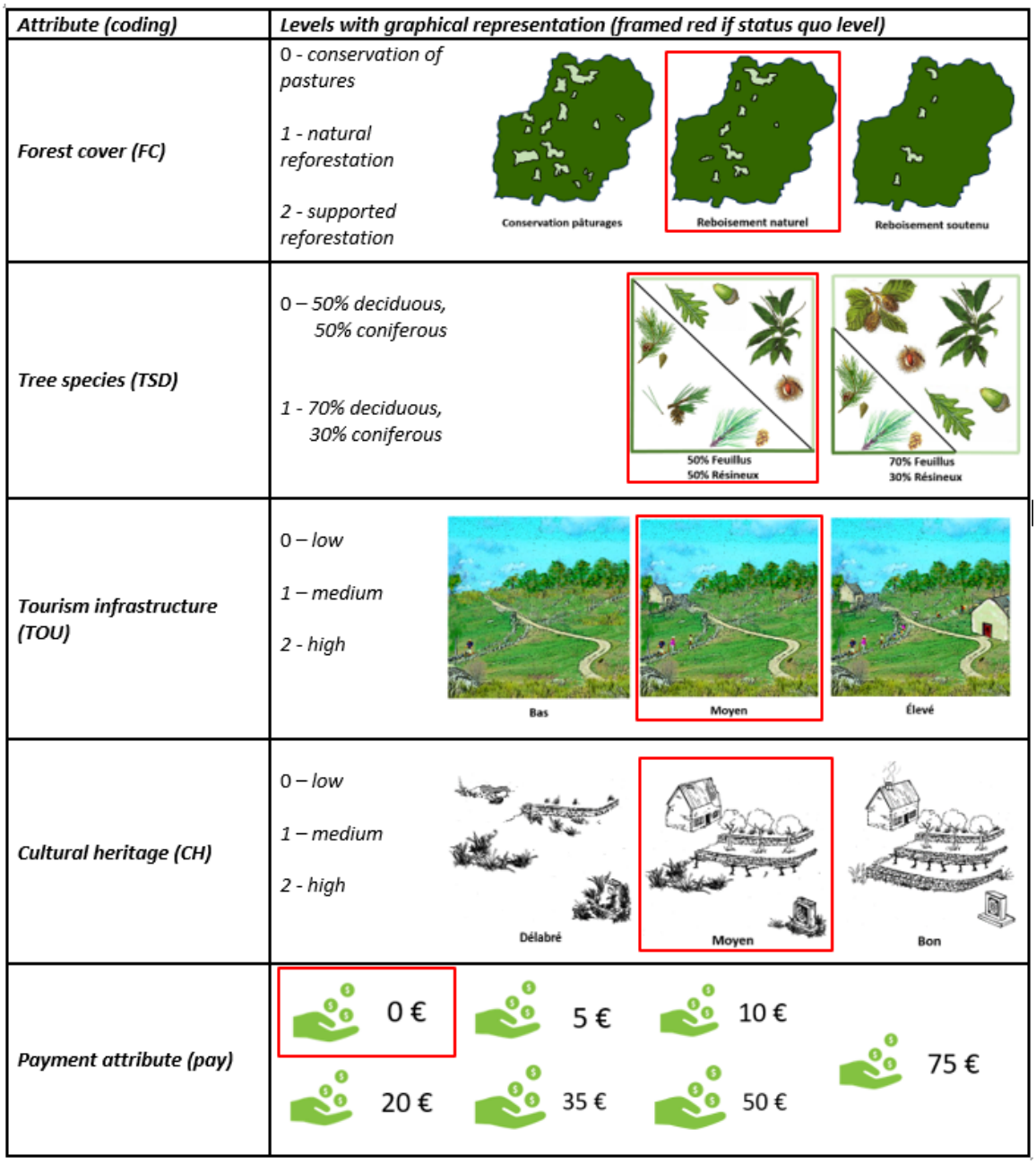


Figure 2.10. – Illustration of the DCE attributes, including the different levels per attribute and the coding scheme.

2.7.3. Indicator statements

The table shown in figure 2.11 presents the indicator statements as well as their codes used within the analysis. The focus was not on using the definition of ES, but to describe possible and meaningful consequences of the attributes. Half of the questionnaires provided a cheap talk before the statements in order to remind people to only report indicator statements they really

Statement	related benefit or ES	ES category	code
Forest cover (FC)			
An extension of forests endangers habitat for plants and animals of pastures.	pasture biodiversity	other benefit	FC_pasture_bio
With higher forest cover, I am worried about decreasing quantity of available water.	water quantity	provisioning	FC_water_quant
Forest provides us with important ressources, such as timber.	timber provision	provisioning	FC_timber
Forest Cover protects against climate change by storing carbon.	carbon sequestration	regulating	FC_carbon
I want more forest cover because the cévenol identity is related to forests.	environmental identity	non-material	FC_env_identity
I prefer agro-pastoral surfaces over forested surfaces.	preference for agropastoralism	provisioning	FC_agropast
Forests give opportunities for hiking.	recreation	non-material	FC_recreation
Forests protect against erosion and landslides.	erosion control	regulating	FC_erosion
Air in forests is pure.	air purification	regulating	FC_air_purification
Forests provide valuable habitat for wildlife.	forest biodiversity	other benefit	FC_forest_bio
For me, forests are a positive spiritual experience.	spiritual value	non-material	FC_spiritual
Transhumance can also be practiced in forests.	support for silvopastoralism	provisioning	FC_silvopast
Tree species (TSD)			
Decidous forests are part of the cévenol identity.	endemic species	non-material	TSD_idemic
Coniferous species are prone to forests fires.	risk of forest fires	regulating	TSD_fire
For me, coniferous forests have a higher ecological value.	forest biodiversity	other benefit	TSD_bio
Especially decidous forests are beautiful.	aesthetical value	non-material	TSD_aesthetical
Coniferous trees are better for forestry.	timber provision	provisioning	TSD_timber
Tourism infrastructure (TOU)			
Tourism can offer economic benefits while respecting the needs of inhabitants and nature.	economic benefits	other benefit	TOU_economy
Tourism is not respecting nature and inhabitants and endangers the authentic charcter of some locatio	loss of authenticity	other benefit	TOU_loss_authenticity
Infrastructures for tourism are often used to make someone pay for something having been for free bef	danger of monetization	other benefit	TOU_monetize
Tourism infrastructure helps to appreciate and protect nature.	incentive for conservation	other benefit	TOU_protect
Cultural heritage (CH)			
Conserving cultural heritage strengthens social cohesion.	social cohesion	non-material	CH_cohesion
Bancèls are necessary for local agriculture and part of the cévenol identity.	conservation of bancèls	non-material	CH_bancels
For the identity of the Cévennes, historical features are important.	historical features	non-material	CH_historical_feat
Conservation of culutral heritage will attract more tourists.	attractiveness for tourists	other benefit	CH_attract

Figure 2.11. – The indicator statements together with the ES or benefits they represent. Additionally, their coding is given to which refer the figures in the following chapters in the last column.

considered. This technique allows to reduce hypothetical and courtesy bias, when participants state choices only due to the hypothetical nature of the exercise or because they feel embarrassed if they state to have not considered many statements in their choices.

For each indicator statement, respondents could state whether they considered it in their choices, whether they were not aware of it, if they judged the described benefit as not important or if they even disagree with the statement or just wanted to say that they do not know. The last category was thought as possibility for participants to protest and was not included in the analysis. A particular situation arose for the statement of the tree species attribute that appealed forest biodiversity. Deliberately, this statement was wrongly formulated [11] in order to serve as test whether participants took really attention to the wording of the statements. Not only, the analysis showed that this concern was not only not justified, but created also some confusion among subjects. The answers for this statement were therefore discarded from the analysis.

In order to distinguish whether a change in values occurred due to deliberation or due to the questionnaire, participants were again asked to state the values they find most important with regard to the Cévennes landscapes.

Question	Variable	Response format	Coding
1	age	open	age
2	gender	2 categories	Female_0, Female_1
3	household compsition	18 or older; 14-17; below 14	HsH_comp_single; ...; HsH_comp_monoparental, etc.
4	membership environmental NGO	yes/no	ecolo
5	lived for more than 5 years in Cévennes	yes/no	X5Cev
6	lived for more than 5 years in Montpellier	yes/no	X5Mtp
7	Zip-Code	open	zip
8	acitivites in Cévennes	4 categories (Yes, elsewhere; Yes, in Cévennes; No)	
a	outdoor activites		outdoor_elsewhere; outdoor_yes; outdoor_no
b	canoing, angling		water_
c	gardening or agriculture		farming_
d	tourism business		tourism_
e	hunt		hunt_
9	owner status	6 categories (No; Yes of a house; Yes of a parcel; etc.)	owner_not; owner_house; ... ; owner_other
10	socio-professional categories	8 categories (Farmer; Merchant; ...; Retired; Unemployed)	CSP_farmer; ...; CSP_retired; ...; CSP_unemployed
11	disposable income	7 categories (below 1000 €; 1000-2000; ...; over 8000)	income_class-1; income_class-2; ...
12	education	6 categories (No diploma; Secondary education; ... ; Master)	educ_1; educ_2; ...; educ_6
13	valuation quality	4 categories (Yes; Rather yes; Rather no; No)	
a	possibility to express onself		express_yes; ...; express_no
b	trade-off between alternatives in DCE		tradeoff_
c	random choice in DCE		random_
d	general statisfaction with questionnaire		satis_
14	awareness source	7 categories (by friend; by poster; ...; other)	diff_friend; diff_poster; ...; diff_other

Figure 2.12. – Socio-demographic variables and how they habe been assessed in the questionnaire. Additionally, the variable coding is given to which refer the figures in the following chapters.

2.7.4. Socio-cultural characteristics

In order to assess the influence of socio-cultural characteristics of the outcomes and assess the representativeness of our sample, several questions targeted on this data. An overview including the coding is presented in figure 2.12. The questions concerned the age, gender, household composition and membership of participants in environmental NGOs. Furthermore,the respondents were asked whether they lived for a longer time in the Cévennes and in Montpellier, if they are doing specific activities in the Cévennes and whether they are owner of a certain type of property in the Cévennes. The education level and how the participants got aware of the workshop were assessed. The data allowed to further categorize into classes of age (18-29, 30-44, 45-54, 55-65, 65+), and household composition (single, couple, family, single parent, other). These transformations were established in order to correspond to the INSEE definitions and achieve a comparable data base. This concerned notably the variable of socio-professional categories (CSP) and the household composition that also served to generate data about disposable income per consumption unit within one household [12].

Finally, some additional question concerned the quality of the study in terms of choice certainty and satisfaction of participants.

11. Instead of deciduous forests, coniferous forests were presented as providing higher ecological value.
12. See sources (3) and (5).

2.8. Implementation of the study

2.8.1. Logistics

The study was implemented from June 2018 to November 2019. First, deliberative workshops were organized in the Cévennes (figure 2.13), followed by the workshops in Montpellier (figure 2.14).

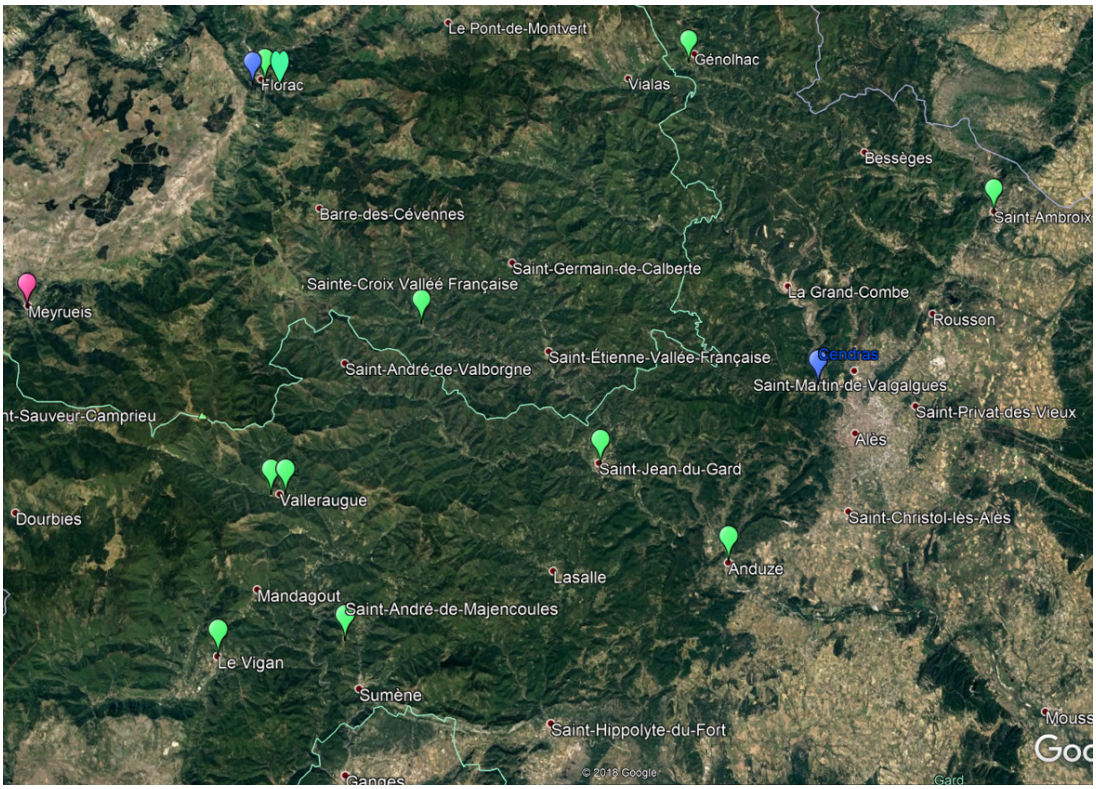


Figure 2.13. – Map showing the locations of the deliberative workshops in the Cévennes. Blue bullets indicate focus group meeting for preparation whereas green bullets represent deliberative workshops. The red bullet marks a workshop in Meyrueis which we had to cancel due to a lack of participants.

As advised by our focus groups, we used different methods and media to inform about our study and invite people to participate. The main communication channel was a website we created particularly for this study, where interested people could inform themselves about date and location of upcoming workshops, the course of the evening and how precedent participants enjoyed the setting [13]. Furthermore, people could inscribe themselves for the next workshops but had to be "accepted" by us. We attached posters at various locations with public access such as shops, libraries, supermarkets, sport clubs, public signboards for notifications, and public institutions (town halls, libraries, schools, etc.). The posters as well as flyers distributed to

13. The website: www.regards-cevennes.com

Figure 2.14. – Map showing locations of the deliberative workshops in the metropolitan area of Montpellier. Red circles indicate deliberative workshops in municipalities outside the city of Montpellier, black and red bullets show their locations inside the city borders.

random encounters at the villages and towns informed briefly about the study and referred to a phone number, e-mail and the website for further information and the inscription. A notification was put on most municipalities websites one week before a meeting, which also raised the credibility people attached to our study. Finally, an article in a local newspaper and an interview with a local radio station further increased the information provision. Some pictures in the appendix give an impression of the different communication supports and the deliberative workshops (section A.3 on page 264). The objective for having multiple options was to avoid any bias for people having no internet connection or are not used to it. In order to motivate people to show up, we also mentioned that a buffet is organized and that presents in form of local products (Montpellier products for Cévennes inhabitants and vice versa) would be provided. As mentioned for the focus groups, participants received a confirmation call or e-mail after having been inscribed and a reminder one day before the workshop.

In general, the strategy worked well, we received inscriptions by all different channels, but mostly from online inscription by our website, which was also our preferred way due to less organizational input. Sometimes we were contacted by municipality employees in order to add inhabitants that approached them in order to be inscribed. The recruitment by random encounter

was less successful than hoped. This is also regrettable, as it was thought to compensate the self-selection bias introduced by our inscription strategy. We observed a discrepancy between the hesitant willingness to participate and the enjoyment of participation witnessed by our subjects. A broader communication of the conviviality of the event, notably by a newspaper article would have been an additional useful element. Summarizing, in can be stated that our strategy had the desired effect (243 participants, 23 deliberative workshops), but not the desired efficiency: The recruitment process took more effort than expected and in some locations, we did not achieve a sufficient number of participants and had to cancel the event.

2.8.2. Selection of participants

Another concern was the representativeness of our sample. For this reason, we stratified individuals of the current sample of precedent workshops by gender and age and compared this to population statistics in order to determine socio-demographic characteristics still underrepresented. For the selection, a two-stage process was initiated: In order to ensure that sufficient individuals would participate, the first eight inscriptions were directly confirmed. Given the effort to prepare a workshop in terms of communication (i) to the municipality to find public halls and (ii) to the general public in forms of posters and flyers, we wanted to avoid to cancel our events, which, however, happened. Therefore, we wanted to have at least six participants and included a little over-recruitment ([Kru14]; [SBL18]). After the first eight inscriptions, individuals corresponding to the profiles missing in our samples were preferred in the inscriptions. The other persons were put on a waiting list and were invited to contact themselves persons with "desirable" socio-demographic characteristics that could accompany them. I admit here that this deviates our sample further from being a random sample, but increased representativeness. In order to generate conclusions that are more representative, we therefore chose deliberately to apply stratified convenience sampling as described above.

2.9. Descriptive statistics and representativeness

The following section provides a general overview about the descriptive statistics on our data obtained from our experiment. In particular, I will assess the statistical representativeness of our data with regard to the general population using data on gender, age structure, household composition, socio-professional categories and income. Unfortunately, the data about education level is largely incomplete due to a mistake at the beginning of the deployment of the experience in the Cévennes Workshop [14].

14. We were conscious about possible timing problems in the deliberative workshops. Our pilot studies revealed that the valuation exercise could last considerably longer than the two hours targeted. We therefore reduced the number of supplementary questions, including the question about the educational level. The idea was to obtain similar information by the socio-professional categories and income classes. When deliberative workshops revealed to not lasting more than two hours, we decided to reintroduce the question, from the last workshops in the Cévennes and for the whole Montpellier study.

2.9.1. Structure of the data

As presented in section 2.7, our questionnaire contained explanations about the services and attributes of our choice experiment, followed by the choice cards and two questions to capture protesters and donation preferences. After that, participants were invited to state there degree of awareness concerning indicator statements that were related to ES and other benefits or risks perceived from the attributes of the choice sets. It was followed by socio-cultural questions such as age, gender, household composition and frequency of visits or activities in the Cévennes. Finally, participants were asked to judge their satisfaction with certain criteria that evaluated different aspects of the questionnaire in general.

2.9.2. Representativeness

As described above the variables gender, age structure, household composition, socio-professional categories and income were used to judge the representativeness compared to the respective population. Sample data is illustrated by bar plots together with population data (INSEE, 2019; see source (1)). Cévennes data is colored in green whereas data representing the metropolitan area of Montpellier is blue. As already detailed at the beginning of the second chapter, our population are inhabitants in 101 municipalities in the Cévennes region (a complete list can be found in the appendix, section A.5 on page 268) as well as the 34 municipalities regrouped in the metropolitan area of Montpellier.

2.9.2.1. Gender

For the Cévennes we have slight over-representation of women (56.5%, figure 2.15) compared to their part in the population [15] (51.6%). Consequently, men are underrepresented (43.5% in our sample, whereas 48.4% in the Cévennes population). For Montpellier, this over-representation is even stronger: 61.7% of our participants in the sample are women (and 38.3% men), while the the population only contains 53.1% (46.9% men). These differences are not equally distributed over age categories, as detailed in the next subsection.

2.9.2.2. Age structure per gender

Figure 2.16 compares the distribution of age classes per gender between the population [16] and our sample for the Cévennes region. For women, our sample has similar proportions for the age classes between 30 and 64. Meanwhile, younger women are overrepresented and elder women over 64 years are underrepresented (29.5% in our sample compared to 36.7% in the population).

For men, the sample is composed of a similar proportion of younger men as in the population, but the categories above (30-44 and 45-54) are less represented than in the population. Consequently,

15. INSEE (2019), see source (1)
16. INSEE (2019), see source (1)

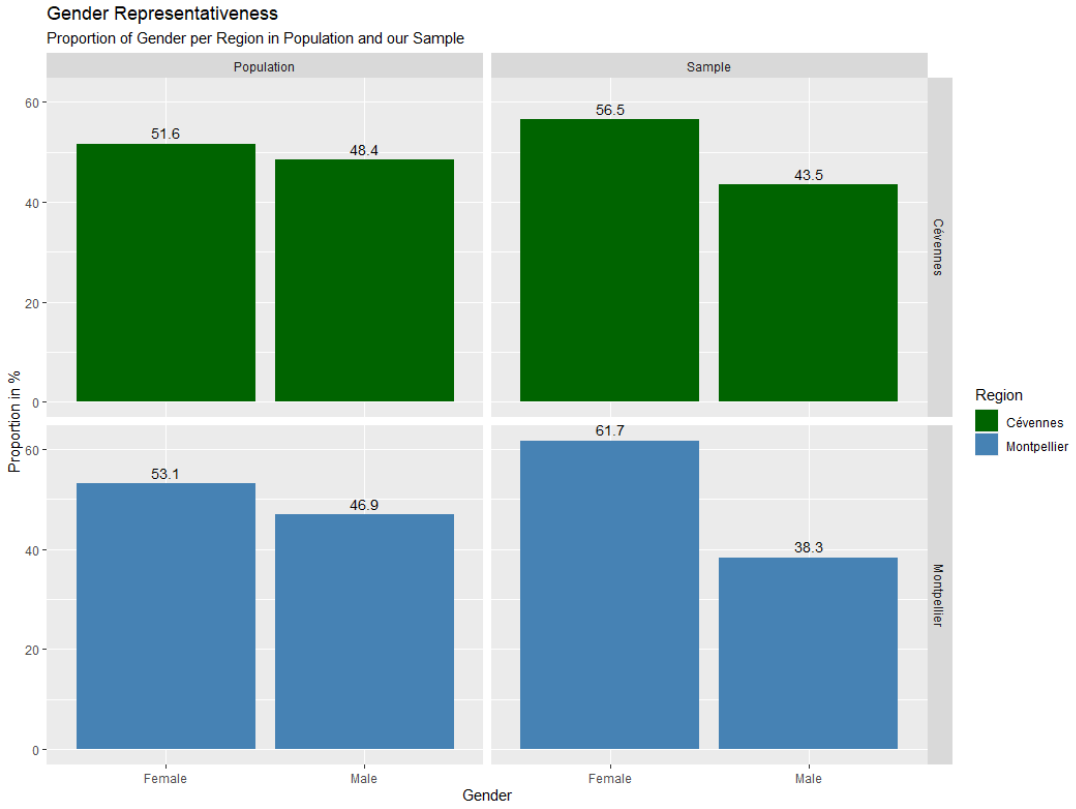


Figure 2.15. – Comparison of the gender proportion of our sample with the general population.

men of higher age categories are overrepresented (e.g. men over 64 years represent 38.3% of men in our sample but only 31% of men in the Cévennes).

Figure 2.17 for Montpellier shows that younger people take generally a larger share of the population than in the Cévennes. Compared with our sample, differences are obvious, but no clear tendency can be observed. For women, the youngest and medium age categories are overrepresented at the expense of the categories of young active women (30-44) and the oldest age class (above 64).

For men, the opposite is true: Young actives and older men are overrepresented and young men and the medium category are underrepresented.

In general, deviations from the population data is present in our sample, but these seem to be in an acceptable range.

2.9.2.3. Household composition

For the Cévennes sample, the household composition appears representative [17], with many couples and single households (figure 2.18). Nevertheless, families and especially mono-parental families are underrepresented, whereas the category of "others" (mainly shared flats) takes a

17. INSEE (2020), see source (2)

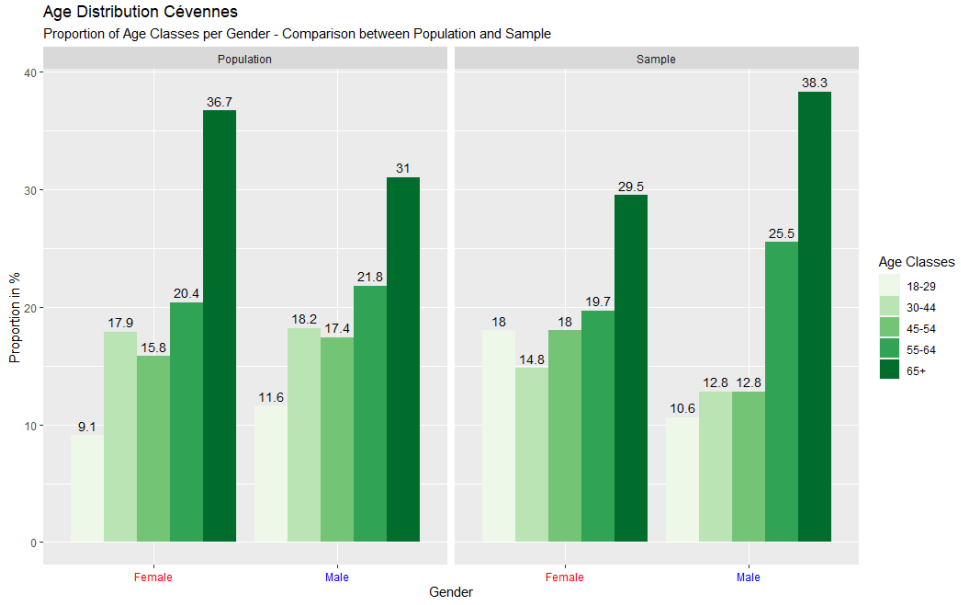


Figure 2.16. – Comparison of the age structure for the Cévennes sample.

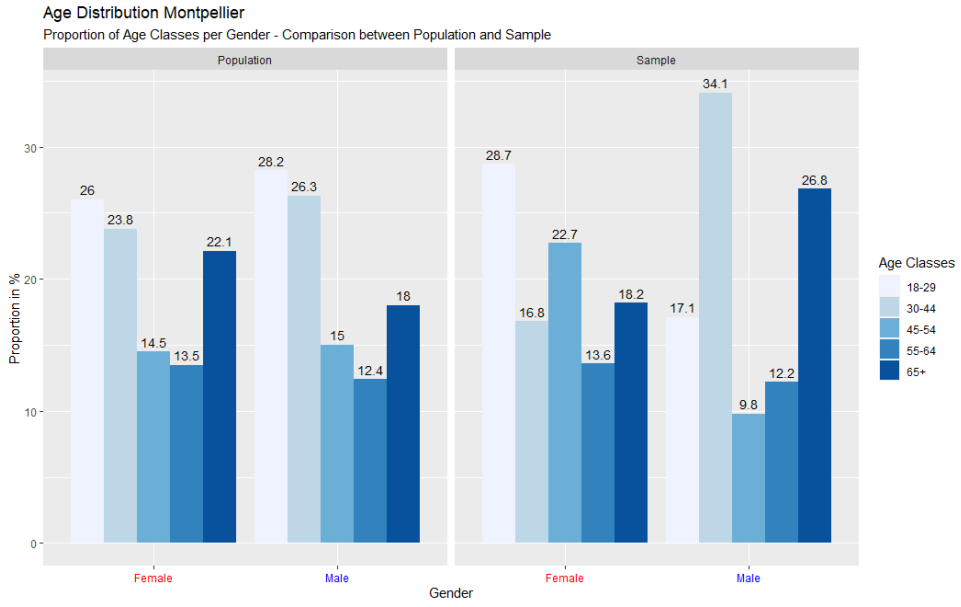


Figure 2.17. – Comparison of the age structure for Montpellier.

higher proportion of the sample. This points on a potential bias introduced by the timing of our deliberative workshops in the evening, which could be prohibitive for (single) parents to participate. As parents have been proven to have different preferences especially regarding inter-generational justice, this bias has to be considered in the analysis.

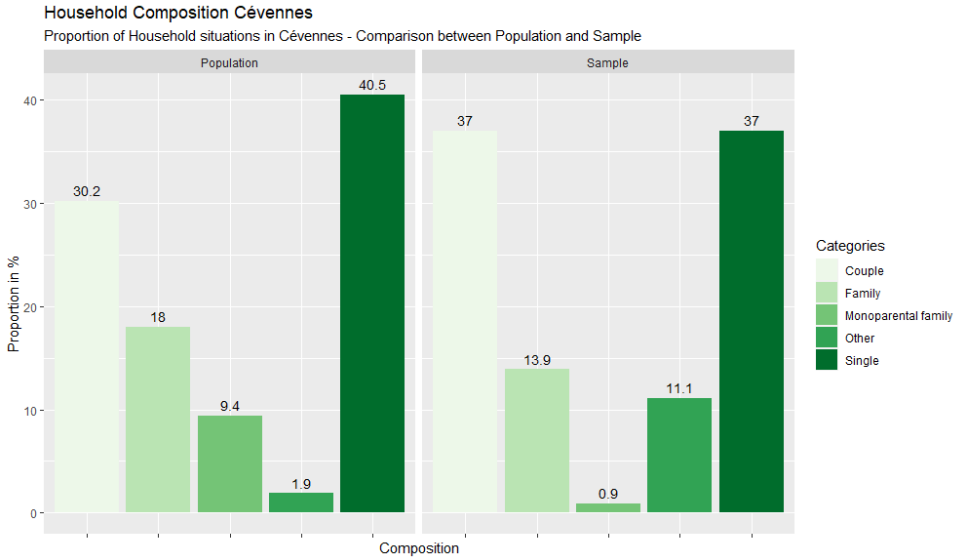


Figure 2.18. – Comparison of the household composition for the Cévennes sample.

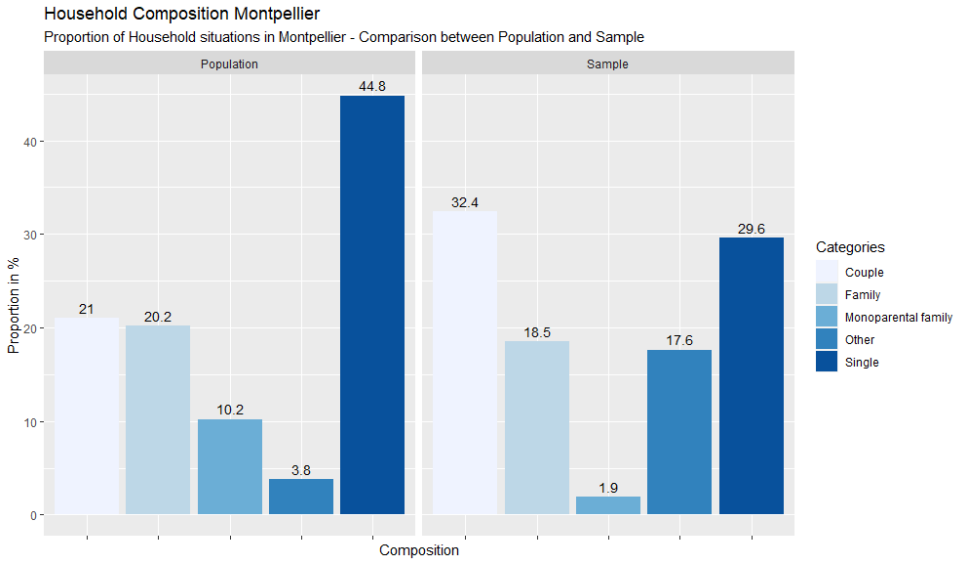


Figure 2.19. – Comparison of the household composition for the Montpellier sample.

The Montpellier sample (figure 2.19) seems to be suffering from the same bias, less monoparental households and more "other" household categories participated in our survey. Single households are also underrepresented, whereas couples are overrepresented.

2.9.2.4. Socio-professional categories

The belonging to a socio-professional category is an important indicator for the representativeness of our sample, because it can reveal similar biases as the education variable would eventually

have had. Two things have to be mentioned: The statistics that can be found on municipality level at the INSEE [18] are only for the "active population" between 20 and 50. No proportion of the "retired" category, which was necessarily also given as option in the questionnaire (see figure 2.12), is available.

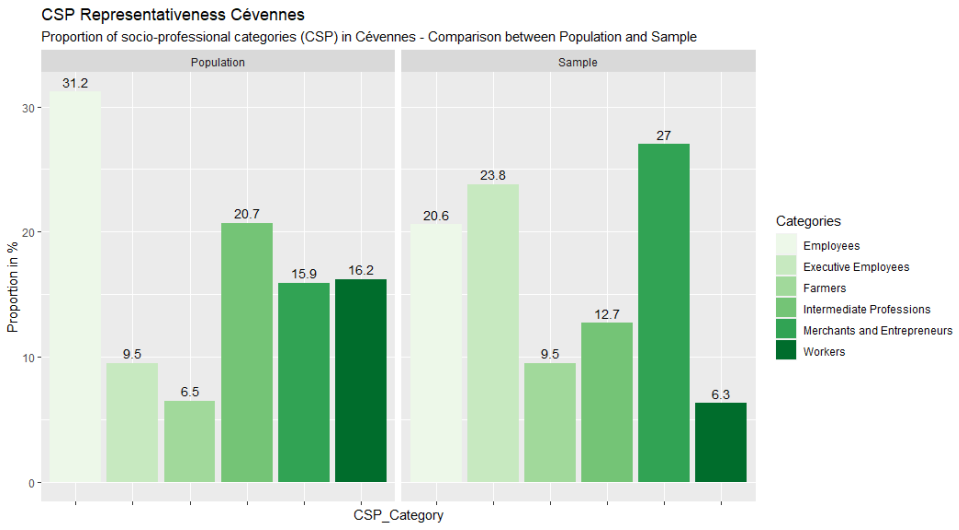


Figure 2.20. – Socio-professional categories for inhabitants from the Cévennes.

Consequently, our sample data only considers the proportion of people for each category among all people who belong to these categories. Retired persons are not part of the calculations. Meanwhile, some retired persons might have answered the question with their former socio-professional category [19].

In the Cévennes (figure 2.20), a positive surprise has been the participation of farmers, a category that we thought of being particularly difficult to motivate to participate, but finally they are even slightly more represented than in the population. Besides that, a clear bias is obvious: Employees, intermediate professions and workers are underrepresented, but executive employees and "merchants and entrepreneurs" are overrepresented.

Briefly stated, professions of often higher educated individuals participated more often in our experiment than professions that tend to have a lower share of highly-educated individuals. This points to the general critique towards deliberative approaches (such as the "discussion" to which we invited in our communication), that these are biasing preferences towards highly educated people who are more able and willing to express themselves ([Pel99]; [SGC+13], [KRF16]).

The proportion of socio-professional categories is also shifted in Montpellier as indicated in figure 2.21. Intermediate professions and workers are underrepresented, whereas employees and especially executive employees take a larger share in our sample.

18. INSEE (2019), see source (3)
19. We had questionnaires with persons over the age of 70 and even 80, who did not state to be in the "retired" category, although the formulations asked their "current" category.

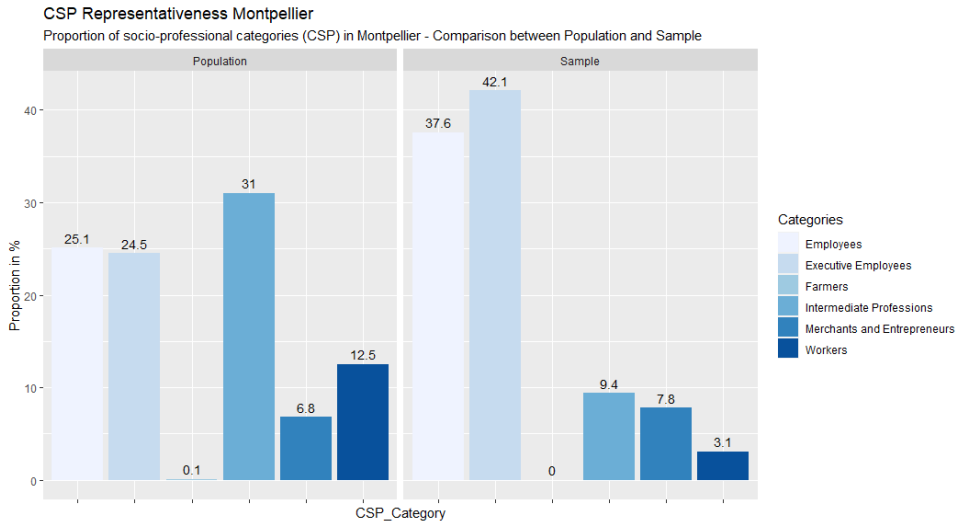


Figure 2.21. – Socio-professional categories for inhabitants of Montpellier.

A sophistication bias is eventually present in our data.

2.9.2.5. Income distribution

Judging the representativeness of the income variable has been particularly difficult for two reasons: data availability and possible misunderstanding of the question. First, for the Cévennes area, as described in section 2.2, we defined the Cévennes area as being the municipalities that cover the Cévenness valleys part within the national park. We delimited this by a horizontal line between the municipalities Florac and Génolhac in order to exclude the Mont Lozère, as argued by several members of our focus groups.

However, our definition causes a sample of municipalities that does not correspond to a higher-leveled administrative scale. This is particularly harmful for an analysis of income data. The INSEE provides data on income per municipality [20], but only about the mean (for sample size reasons), which can be highly affected by outliers and is therefore not useful for our analysis of distribution of income.

Nevertheless, for bigger municipalities (above around 2000 inhabitants), available household income per consumption unit [21] is published and disaggregated into 10%-percentiles. At the one hand, such data allows conclusions on the representativeness of income classes between a sample and the population.

On the other hand, given the relatively small size of municipalities in the Cévennes, only a few of them have income percentiles data available. Furthermore, it is questionable whether this handful of municipalities would be representative for the Cévennes region. Instead, the use of the

20. INSEE (2017), see source (4)
21. Consumption units within households is defined as follows: 1 for the first adult, 0.5 for each additional person above the age of 14 and 0.3 for each person below this age in the household (INSEE, 2021, see source (5)

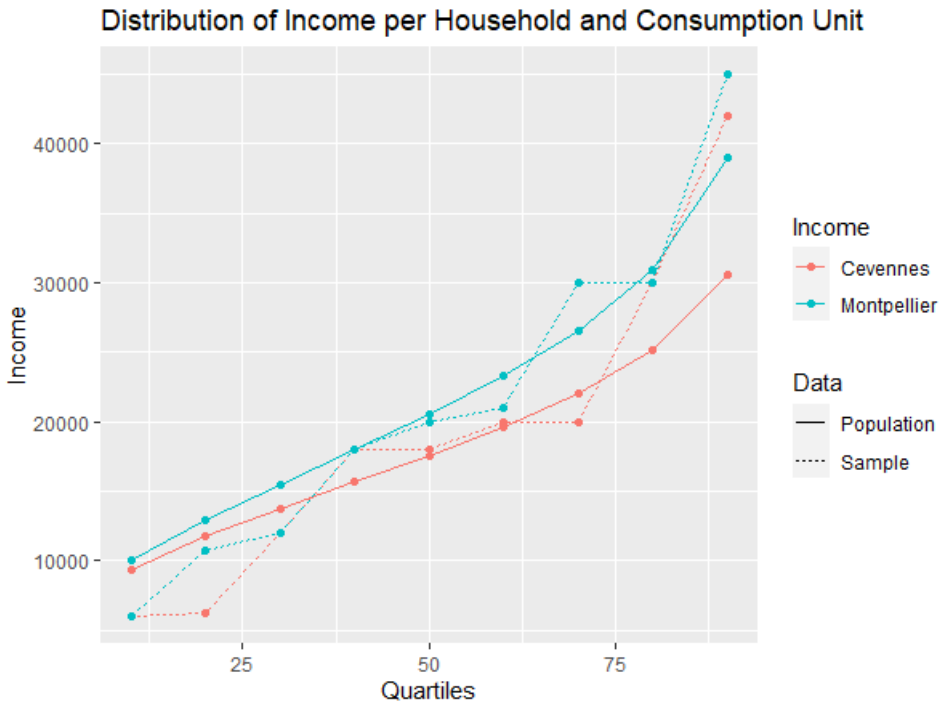


Figure 2.22. – Distribution of disposable income per consumption unit per sample compared to the general population.

inter-municipality («Intercommunalité») level is possible, because the same type of income data (10%-percentiles) is available for all of them [22]. Now, the problem mentioned above becomes important: Our sample of municipalities does not correspond to a single inter-municipality, but to parts of several of them.

Hence, the following question arises: What data level is most useful for our analysis? Should the whole inter-municipality be integrated, although parts of it are not part of our Cévennes definition? Is this inter-municipality representative for the Cévennes? And inversely, are the municipalities of our sample and within this inter-municipality well represented by the whole inter-municipality? Or is data on municipality level available for a sufficient part of the inter-municipality ? These questions were assessed and are presented in the appendix (see section A.6 on page 270). In the end, a combination of municipalities and inter-municipalities was used for this statistic.

Second, we asked for available income by giving a simple form of the INSEE definition [23] of the term. In order to make the task easier, we proposed income classes as possible responses instead of asking for a concrete number. But still, it is possible that participants have other meanings in mind while responding to this question. Furthermore, we asked for the available *household* income (in line with the INSEE data available), which might have been overseen by

22. INSEE (2020), see source (6)
23. INSEE (2014), see source (7)

some respondents. Finally, we calculated the 10%-percentiles for the income distribution by unit of consumption of our sample using the medium value per class together. We considered this the best way given the constrains we faced in data availability, but it is still partly arbitrary. Figure 2.22 displays the income distribution for the Cévennes in red and for Montpellier in blue. For the population, data is illustrated by a straight line, whereas sample data is illustrated by a dashed line. Obviously, the mean income is higher in Montpellier than in the Cévennes. The sample data is close to that of the population indicating a relatively good representativeness. Only at the extremes, the samples are showing lower least and higher highest incomes. This can be partly due to the income classification as explained above. But especially for higher incomes it could also be part of the representation bias of highly educated people (Stern, 2005) with tendency of higher incomes, as expected with the socio-professional data. Given the difficulties with this socio-economic variable, I do not claim representativeness of income distribution. But at least the careful use of available data is not pointing on a serious non-representativeness of our sample.

In general, the protocol of our study causes a self-selection bias of our sample. We deliberately chose the associated inconveniences, because the motivation, degree of interaction and therefore the quality of deliberation are supposed to be higher in this case. The sampling strategy resulted in a higher participation of women, of middle ager as well as elder men in the Cévennes and of people of professions associated with higher education. These biases are exactly those found in other participative studies on environmental valuation, especially in Aanesen et al (2015). The general invitation to a discussion about landscapes has probably discouraged people not feeling comfortable to express their thoughts in front of others [KRF16]. At least we think to have lowered this bias by actively approaching people to invite them to our workshops instead of solely relying on indirect communication by bulletins, posters and notifications on the municipalities' web sites.

Additionally, the starting time of our workshops (in the evening) has hold parents off to participate [24], which could have contributed to a marginalization of future generations (whose needs are often more accounted for by parents). Compared to traditional stated preferences elicitations, which are more easily to be fulfilled independent of timing restrictions (especially online surveys), these can achieve a higher participation in these parts of the population. Nevertheless, the deliberative character of our study often leads to the adoption of a citizen's view by participants that is supposed to incorporate future generations into the preference formation, therefore compensating (at least in parts) our bias.

In conclusion, our descriptive data shows a slightly biased sample, as do similar studies in the literature. The self-selection bias together with the small sample size (although at the upper limit of studies using deliberative workshops) permits to represent main viewpoints and trade-offs that

24. I note here, that in some workshops, parents showed up with their children to be able to participate. Studies do therefore have possibilities to adjust their protocol such that children can do other activities while their parents are participating in the discussion. In our example, we provided children with material to paint or to read children books during the workshop.

populations from the Cévennes and Montpellier face when regarding the future evolution of the landscape. This is particularly useful for public decision-making and implementation (chapter 1). Nevertheless, a generalization of concrete numbers or monetary terms to the whole population keeps questionable [BRL15].

2.10. Conclusion

In this chapter, the methodological and organizational bases for our experimental study were presented. First, the presentation of the study area based on the Cévennes national park charter allowed to identify the topics to be included when evaluating the ES of the Cévennes landscapes. Second, four focus group meetings with stakeholders and inhabitants from the Cévennes and Montpellier gave further recommendations on the design of the questionnaire, attributes for the DCE and provided valuable recommendation on wording and possible recruitment strategies. The final retained attributes are forest cover, tourism infrastructure, cultural heritage and a monetary payment represented by a one-off donation to local associations. Additionally, a tree species attribute is introduced following interventions of participants in the focus groups. Another part of the questionnaire includes so-called indicator statements that present vulgarized descriptions of ES and other benefits related to the choice attributes and that were taken as citations from focus group discussions.

Two pilot tests with a total of 21 participants were applied in the Cévennes and in Montpellier in order to improve the questionnaire, to generate the payment scheme for the monetary attribute by a contingent valuation and obtain prior values for the Ngene algorithm with the aim to find a good efficient design for the DCE. The latter consisted of 36 choice cards in four blocks, leading to nine choice sets per individual questionnaire. Third, a presentation of random utility theory and related econometric models was provided. This included multinomial logit, mixed logit and nested logit [25]. Fourth, factorial and cluster analysis were introduced, that serve as qualitative complement to the quantitative analyses undertaken in chapters 3 and 4. Then, the questionnaire was briefly presented, consisting of an informational part, a choice task, supplementary questions about choice tasks, the indicator statements, questions about socio-demographic characteristics and finally some interrogations about the survey itself and the discussion. I then report on the implementation of our survey, including sampling strategy that consisted of a self-selection of participants controlled for some stratified characteristics such as age and gender. Furthermore, the choice of the media used to inform about and invite to the study is detailed. A total of 243 individuals participated in our deliberative workshops. In the Cévennes, 122 individuals participated in 11 groups (five as deliberated treatment groups and six as non-deliberated control groups). Another 121 individuals in 12 groups (six deliberated, six non-deliberated) attended the workshops in Montpellier. Finally, descriptive statistics revealed an overrepresentation of women

25. The latter is not applied yet but can further be used to estimate parameter values by considering the cluster identified in chapter 3 as nests with similar correlation patterns.

as well as a slight underrepresentation of people between 30 and 55 years and of blue-collar workers. These self-selection biases are similar to other deliberative valuation studies in the literature (e.g. [AAC+15]).

This chapter summarized also the literature on best practice guidelines and how this has been adapted to the context of our study. Another valuable collection of recommendations has been published while this chapter has nearly been finished: The book of Mariel et al [MHM+21] is focused on the preparation, implementation, analysis and interpretation of DCEs. The methods advised in the book and applied within our study were useful and increased the pertinence and quality considerably. It is therefore necessary to communicate on how recommendations are applied and adapted to specific valuation contexts. This facilitates a process of standardization and homogenization of valuations that increases the general quality and comparability of studies without limiting the possibilities of individual, necessary adaptations.

3. Valuation of bundles of ecosystem services associated to the Cévennes landscapes

3.1. Introduction

In this chapter, I focus on the relation between landscapes and ecosystem services and why economic valuation, and especially discrete choice experiments, play an important role in that interface. Consequently, this chapter is dedicated to the analysis of the data provided by our choice experiment and the valuation of ecosystem services generated by the Cévennes landscape. The chapter is structured as follows:

First, the analysis of the literature provided at the beginning of the second part of this thesis is deepened and complemented. This includes a definition of "landscape" by the European Landscape Convention and its drawbacks on how landscapes are assessed and analyzed. This concept is then linked to the ES concept, notably by the notion of bundles of ecosystem services (ES bundles). Approaches and methods for their determination and valuation are presented. Discrete choice experiments (DCEs) are a frequently used method to assess preferences of individuals for landscape management [TBLH16]. Nevertheless, specific caveats, when landscapes are valued by DCEs, have to be considered. This concerns in particular the visuality-complexity tradeoff and endogeneity problems of valuations derived from purely visual assessments of the landscape.

Second, I place our own study within that literature and present descriptive statistics of our experiment. I particularly focus on how the data collection worked (beyond the preparing steps presented in the previous chapter) and judge the representativeness of our data.

Third, the results are presented and analyzed. The process of model selection is detailed, and the most suited multinomial logit and mixed logit models with and without interactions of socio-demographic variables are presented. I then proceed with the factor analysis of the association stated with regard to the attributes of our choice experiment [1]. Then, these models are compared and interesting relationships are determined and assessed. Additionally, their robustness is checked.

Fourth, these results are discussed and interpreted with regard to their implication on the future conservation and management of the landscape as well as the methodological consideration outlined in the literature review.

1. In the publication, this part would be treated in the supplementary material.

A conclusion summarizes our main findings and gives future research directions that our work will be beneficial to and that have to be tackled in the future about landscapes and ES.

3.2. Landscapes, bundles of ecosystem services and their valuation by discrete choice experiments

3.2.1. Landscapes and their relation to ecosystem services

3.2.1.1. Landscapes: Definition and importance for ES management

As ES, landscape is a concept that is differently approached by disciplines and political contexts, giving rise to diverse and context-driven definitions of the term ([Lif09]; [Wu13]). This receives importance when local or regional phenomena are assessed and further implementation such as management and conservation strategies are proposed to decision makers that particularly account for the diversity of landscapes ([LH09]; [VVKV14]).
Nevertheless, a high degree of standardization with regard to the definition of landscapes can be observed if research is dedicated to methodological issues such as assessments and evaluations. Numerous papers adopt the definition given by the European landscape convention [oE00] that landscapes are:

"an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (ELC, 2000);

We also adopt this definition, while underlining several aspects: First, the interdependencies of different drivers (human or natural) have to be considered [Ste08]. Second, although composed of objectively measurable biophysical components, landscape has a subjective, anthropocentric dimension, because it is based on human perception ([FDA+05]; [AMRPC19]; [VBB+19]). I will refer to these points several times within this chapter.

Assessing quantities of ES on a landscape scale is particularly relevant for public decision makers. As an example, the European Commission proposed a framework for environmental accounting (see figure 3.1) that distinguishes several scales on which ES are assessed [Eur13]: The basic spatial unit (BSU), which refers to the lowest level where ES can be quantified thanks to delimitation by artificial or natural boundaries (e.g. forest stands, small water bodies, agricultural parcels, grassland patches, etc.). These ES from the BSUs can further be aggregated to the land cover/ecosystem functional unit (LCEU), which corresponds to similar ecosystems and share similar processes generating the ES. Nevertheless, the authority charged with the environmental accounting is often not acting at this LCEU scale [PRS12] but at Ecosystem Accounting Units (EAU) such as municipality borders, catchments areas or counties. Therefore, LCEU have a pivoting role between readily available BSU and relevant EAU that consists in providing an aggregation scale for the former while being a first approximation to the latter scale. Nevertheless,

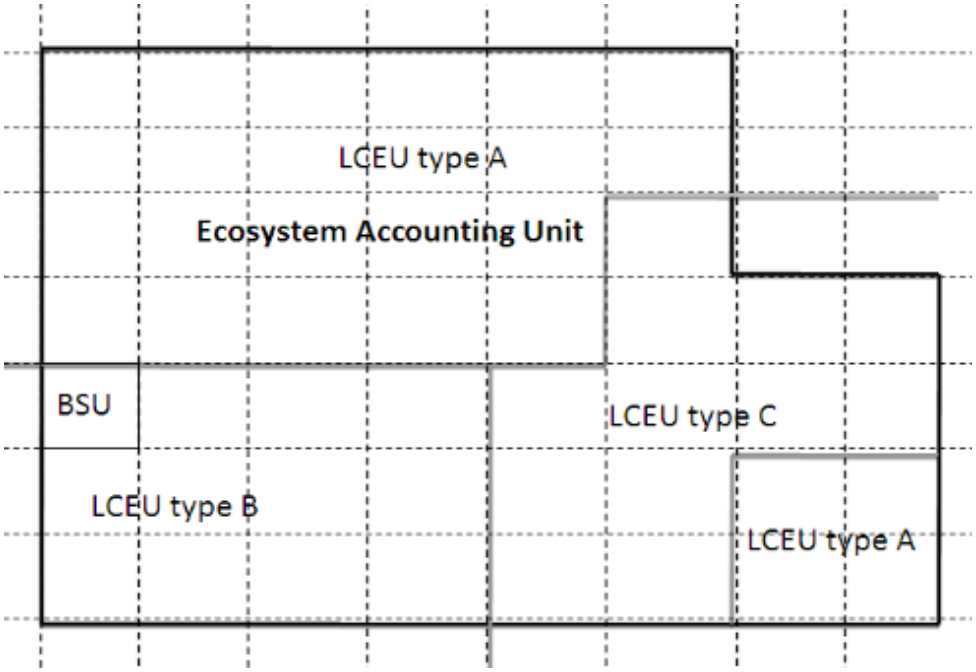


Figure 3.1. – Examples of different scales for ES accounting within the System of Environmental-Economic Accounting of the European Commission (p. 31).

a simple aggregation does not include the interactions and interdependencies mentioned above at the definition for landscapes. As Wu [Wu13] states, landscapes are in constant transformation, so that landscape planning should be less focused on its outcome, but more on its trajectory. Consequently, knowledge on interactions at landscape level impacting this trajectory is a current field of active research.

Despite these complex interrelations, several approaches have been proposed to capture landscape complexity in discrete indicators [DSC+18] or to summarize their impact on human well-being in socio-cultural dimensions [Deu05]. Necessarily, valuation itself is not sufficient to deeply understand the origin and motivation behind the values perceived from landscapes ([Bis19], [VBB+19]). That is why, only complementary assessments can reveal a profound picture that includes several value dimensions ([BG09], [ACW+18], [AMRPC19]). These have to be experimented on larger temporal and spatial scales than currently, and should integrate several ecosystems, services and stakeholders [VBB+19]. Social sciences should be used to create processes that enhance trust building among different actors [AMRPC19].

Hence, a landscape scale assessment helps the decision making and implementation sphere to foster the consideration of ES going beyond the farm levels and encourages co-production and collaboration of multiple stakeholders [PRS12]. This step would also represent a major progress in the operationalization of the ES concept itself. Transdisciplinary management could guide to efficient land use that strategically combines placement of natural and managed ecosystems and

enhances the provision of ES [FDA+05]. Necessarily, without improving personal and technical planning capacities within authorities in charge, these objectives might fail [AMRPC19].

The management of non-material ES would also benefit from assessments conducted at landscape level [CSG12a] because some spiritual values and cultural identity has been found to be related to preferences for specific landscape features ([HMFM09], [dAHM15]) or land cover types [PDORB13]. Nevertheless, it should be stated that non-material benefits are more often associated to more local features as to a wider landscape scale in general [RRO+18].

Further information about how to these requirements can be applied in landscape valuations and corresponding ES assessments are given in section 3.2.3.

3.2.1.2. The multifunctional character of landscapes

As stated with the definition, several processes and their interactions take place in landscapes, affected by various stakeholders with differing demands, which results in their multifunctional character ([DSC+18], [EPM19]). As several case studies have already demonstrated, managing these tradeoffs can generate a more resilient and sustainable provision of ES ([FDA+05]; [BG09]). Especially farmers are seen as having a primary role [Deu05] which makes agricultural landscapes with their multi-faced appearance a preferred study object for valuations [RM12].

Land use decisions (such as agricultural production practices or public policies at different scales) and natural constraints (climate, relief, etc.) shape land covers and the function that each of these cover types provides, impacting the supply of ES ([FDA+05]; [VBB+19]). Hence, landscape management and land use decisions are drivers for the spatial distribution and simultaneous presence of several ES [PDORB13]. Accounting for the interactions of these processes gave rise to new concepts such as landscape services ([Wu13], [DSC+18]) that directly link landscape features to the provision of ES. It is often included in the concept of bundles of ecosystem services (ES bundles),[2] which are quantified in their biophysical appearance, their perception within social-ecological systems and their economic value in order to achieve a holistic assessment. As assessments of landscapes perceptions in general, ES bundles are a useful concept for transdisciplinary processes with meaningful outcomes for decision makers ([TBLH16], [ACW+18]). Understanding these processes and possible methods to their detection constitute a major step to the operationalization of the ES concept in general ([LMD+19], [VBB+19]) and facilitates mediation on so-called "wicked problems" that exceed management strategies on the individual farm level [PRS12].

Although they are often used to assess biophysical interactions [MLIAGL+12], my focus on the social perception of ES bundles in landscapes is motivated by the importance of non-material benefits that are associated with landscapes [BPPV14]. A specific model, the Cultural Values Model (CVM) has been proposed to capture these benefits generated by landscape patters and to classify them as relationship, form or practice [Ste08]. A comparison of the ES framework

2. The concept itself is further defined and detailed in section 3.2.2, but in the following paragraphs I already want to underline its relevance for the assessment of landscape preferences.

with CVM in a case study on a rural landscape in Germany revealed that difficulties to associate the perceived benefits by respondents could easily be assessed with the CVM, but they could not be associated to distinct ES categories, especially if they fell in the "relationship" category in the CVM [BPPV14]. Not only this emphasizes the importance of the use of complementary approaches as stated above, it also highlights the need to retrieve non-material benefits not in distinct ES categories but in their joint appearance with other ES, such as in the ES bundles concept [BPPV14]. If such an assessment is done in the context of less instrumental values or less functioning institutions, it is argued by some authors that the nature's contributions to people (NCP) concept could capture notions of well-being that do not follow the occidental approach inherent in the ES framework [EPM19].

A bundles representation is also beneficial to the generation of information: In some cases, hotspots and coldspots can be identified that are representative for a specific area or certain landscape features. Effort can then be concentrated on indicators for the same bundles in surrounding areas as indication and approximation for the presence of similar processes. This permits the upscaling of initial land use decisions and management practices without the need of data generation at the ground [PDORB13].

Summarizing, it can be stated that the landscape scale is an important step to inform about landscape management that achieves efficient provision of ecosystem services. This includes the assessment of biophysical and socio-cultural indicators and the representation of interaction and interdependencies, possibly by using the concept of ES bundles. The latter is presented in detail in the following subsection.

3.2.2. The concept of ecosystem service bundles

The term ecosystem service bundles was first precisely defined by Raudsepp-Hearne et al (2010; p.5242) as ES that "repeatedly appear together across time and space" and I follow this definition. However, some articles referred to bundles when assessing trade-offs and synergies among specific ES, but without searching for common drivers and causal relationships, which would be required in the definition given before, in order to understand the spatial and temporal bonds [SS18].

This leads to growing confusion with the term of multifunctionality, that assesses whether ES appear consistently in a given context (often a distinct landscape), but does not require to determine causal links for this joint appearance (e.g. [BG09]). For other issues, the multifunctionality concept goes beyond the ES bundles concept, because it also integrates ecosystems functions into its assessments of trade-offs. These are also appealed by supporting or intermediate services [MEA05] in the ES framework [HBVC19], but controversial and rarely considered in the bundles concept.

Nevertheless, literature from both concepts is useful to describe relationships among multiple ES. For example, two main types of relationships have been made: First, direct interactions among ES, that can be uni- or bidirectional (service A affects service B, which re-affects or

not service A). Second, links among services can be established by common drivers. These can influence only single or multiple services in the same or in opposing directions [BG09].

A clear distinction is made between the supply side and the demand side of bundles [SS18]. The supply side describes the biophysical capacity of a landscape to provide multiple ES as well as their flow towards beneficiaries. The demand side represents the beneficiaries or stakeholders of ES and how they perceive them (e.g. [BMRVF14], [SCE+19]). Interestingly, this more or less corresponds to the two dimensions I already mentioned for the landscape definition: a primarily biophysical or material composition and a mainly socio-cultural perception of humans [3]. In order to understand drivers of ES bundle demand, it is therefore necessary to assess the motivations and socio-demographic characteristics of stakeholders and the general public behind their ES use and distinguish among several demand origins.

Therefore, a distinction between actual and potential demand for ES bundles is suggested [CBB+17].

3.2.2.1. Opportunities by adopting the ES bundles concept

Possible opportunities of the ES bundles concept can be summarized by the four objectives most mentioned within publications in the domain (review of [SS18]): First, a general aim to advance knowledge is underlined. As described in the previous section, studying simple co-occurrences and correlations for a specific geographical area are not sufficient to conclude on causal relationship and are consequently not to be generalized [CBB+17]. Only the comparison among several spatial scales and different land use types or at different points of time would fulfill the requirement of spatial and temporal coherence given in the definition of Raudsepp-Hearne et al (2010).

Second, information is valuable for environmental management and stakeholders. The range of services and embedded values integrated within bundles rises the probability that stakeholders feel affected by one or multiple services within the assessment and could create the necessary motivation to engage within or comply with participative management scenarios of ES. The bundles approach could then become a pathway towards an integration of the multifunctional character of ES into planning and assessments [PDORB13]. Nevertheless, as argued in Brunet et al [BTL+18], too much reliance on the bundles concept could encourage to treat the underlying and complex relationships among services as a "black box" that causes simplistic conclusion, similarly to criticisms towards the ES concept in general to represent a "complexity blinder" [Nor10].

Third, the impact of past land use decisions or scenarios for possible land use decisions are assessed by a bundles approach. This point has a specific importance when it comes to the identification of drivers [SS18]. An early adoption of a bundle representation could prohibit or anticipate possible biophysical regime shifts, avoid declines in hardly observable services that

3. For the ES bundles concept some constraints to this simplistic comparison will be made in some of the paragraphs below

are closely related to others and hence prevent from running into unnecessary ecological and economic trade-offs.

Finally, the fourth objective of the papers assessed in Saidi and Spray (2018) are those that want to test methodological innovations.

3.2.2.2. Assessment methods

Different approaches are used when it comes to assess ES bundles. Most often, they are results of a mapping exercise, experimental impact analyses of land use decisions, preference elicitations [SS18] or they aim to support a descriptive approach of ES interrelations [HBVC19]. The bundling procedure itself relies upon factor analysis and clustering or classification ([CBB+17], [SS18]). Meanwhile, for the determination of shared drivers, qualitative methods such as regressions and simulation or qualitative approaches such as surveys and focus group discussions are applied [CBB+17].

The choice of methods follows the distinction of demand and supply bundles. For demand, perception of individuals about the importance of ES serves as proxy [BMRVF14]. Depending on whether they are coded as quantitative or qualitative variables, either PCA or MCA is followed by classification and cluster approaches and then further analyzed with socio-economic characteristics to determine sources of heterogeneity (e.g. [BMRVF14], [PDORB13], [MLIAGL+12]). As an example, for establishing profiles of tourists' demand for extensive agriculture in pasture landscapes, contingent valuation has also been used before classifying different profiles of ES demand [MSR19].

When it comes to the assessment of the supply of bundles, GIS-based data or self-organizing maps are used to determine the spatial distribution of ES ([RHPB10]; [CMT+15]). Spatial correlation then guides the further clustering into bundles. Temporal co-occurrence of ES in mountainous regions has been analyzed in a review and then clustered into different scenarios of ES bundles provision in the future [LLS+17]. Changes in the supply on both dimensions (space and time) have been less studied: ES provision has been elicited at and aggregated to county level and associated to different bundle types in two different points of time in China [LLF+19]. Another approach was to create scenarios qualitatively with the help of stakeholder groups and project these into the future by estimating the evolution of biophysical and socio-cultural drivers [SMM+17].

Finally, some studies have assessed the evolution of supply, demand and (partly) flow of ES bundles by relying to a different degree on the perception of users. First, the potential of a landscape to supply ES has been stated by individuals and then compared to the actual use (or demand) within a survey [AK17]. In another assessment, the recognition of ES was specified by participative mapping and (i) used within a PCA in order to assess correlations in recognition as proxy for demand, and (ii) the GIS-coordinates from the mapping were analyzed in order to determine the spatial supply of services. These spatial supply was then compared with landscape patterns such that the role of landscape on ES supply bundles could be inferred [PTHF19].

Without using perception and only including biophysical indicators, simultaneous mapping of ES supply and demand bundles as well as the quantified flow between them on municipality level has also been proposed as promising alternative [SCE+19].

3.2.2.3. Main results in ES bundles research

In their review, Cord et al [CBB+17] identify three "cross-cutting themes" of applied ES bundles research that they judge as important problems to consider, if the research aims to be relevant for decision making: First, scale effects can complicate the analysis (as for ES in general, as explained in section 1.3.1), especially, when the interactions among ES appear at a local scale. Here, the inclusion of local knowledge is crucial for implementation success [AK17]. Even if the processes appear at the same scale, they may relate at spatially different places (for example up- or downstream of a river) and require supra-regional management [SCE+19].

Second, the distinction between supply and demand is needed in order to account for drivers more precisely, especially, if they are only affecting one of the two sides or in different directions [BG09]. As above, it is stressed that supply often follows biophysical processes whereas demand is driven by social decisions [CMT+15]. Another distinction has to be made whether actual or potential supply/demand are assessed or valuated. In case-studies, provisioning and regulating services are often determined as actual supply and compared with potential demand of non-material services belonging to the same bundle [CBB+17]. Asking respondents for their motivation and association regarding the different DCE attributes is therefore crucial to approximate actual demand of non-material services.

For instance, few studies achieve to assess both actual supply and demand for ES bundles. In one of them, few spatial overlaps between the supply of bundles and its demand have been observed for the European Alps [SCE+19]. Hence, a supra-regional flow between provision and use (or inverse) is reported (e.g. local tourists in rural landscapes coming from near-by urban areas). The demand bundles are often homogeneous at a local scale (impacts of possible drivers and socio-demographic characteristics of different beneficiaries are described below) but are diverging at higher scales [SS18]. Generally, assessments of perception of ES (as a proxy for demand) find that societal appreciation increases its demand independent from other contexts [PTHF19].

Furthermore, the perception of the interplay between ES is dominated by synergies within the general public, whereas biophysical assessments of ES bundles have reported a multitude of trade-offs [PTHF19].

Finally, the identification of winners and losers among stakeholders is the remaining issue that is raised by Cord et al [CBB+17] as being a potential motivation for ES bundles assessment. Losers might then especially be accounted for, which increases their chance of commitment to regional planning decisions. Trade-offs (and their users) have been highlighted between provisioning services and regulating services (and their respective users for demand bundles) in many case

studies and reviews (e.g. [CMT+15], [SS18]; [LLF+19]). Socio-demographic characteristics can partly explain this trade-off.

As an example, older stakeholders relating to the activity of fish pond farming in the French Lorraine region are judging provisioning services as more important, as they are more attached to the traditional purpose (provision of food). Meanwhile, younger stakeholders with more ecological knowledge highlight the role of recreational values and regulating services [BMRVF14]. Nevertheless, the trade-off between provisioning and regulating services gets less important if a distinction between supply, flow and demand is made [SCE+19].

Regulating services often have a critical role within bundles ([BG09], [RHPB10]; [MLIAGL+12]), as they can indicate a higher diversity of ES supply in general [RHPB10] and are more resilient to changes of biophysical and social constraints [SMM+17]. For the demand side, their frequent use and higher knowledge about their role within the ecosystem increases the perceived potential of regulating services, raising their appreciation by the local population [AK17].

Nevertheless, concentrating the analysis on specific service categories or even single services might disturb the complex system of synergies among ES and endanger the stability of the socio-ecological system as a whole [LLF+19].

The temporal dynamic of ES bundles is less studied than their spatial distribution. In a review about mountainous regions, different scenarios depending on the support and (over-)use of specific ES as well as the evolution of main drivers lead to the shift from a domination of provisioning services to states of high supply of regulating and non-material services, only regulating services or a total collapse of the system [LLS+17]. For a shorter time period, relative stability is observed for reforested landscapes in Northern China, but the synergies among ES are weakened by high pressure of common drivers [LLF+19].

Several drivers have been identified that affect ES bundles. In their review, Saidi and Spray (2018) enumerate socio-economic conditions, landscape features and institutional factors as the most important ones. This is confirmed in the case studies of Li et al (2019), and by Schirpke et al [SMM+17], although the latter find a higher influence of socio-economic drivers on bundles provision in the Austrian Alps than of climate change.

Concerning socio-economic factors, a difference in the demand for provisioning and regulating services within bundles is detected in terms of knowledge, the rural-urban gradient and gender [MLIAGL+12]. Ecological knowledge is correlated with the perceived importance of regulating and supporting services ([BMRVF14], [AK17]). When knowledge is divided into whether it originates from formal education or from own experiences, the former also benefits to the recognition of bundles containing regulating services, whereas the latter tends to support provisioning services. Nevertheless, local knowledge has also been found to be important if regulating services are managed at a very local level (e.g. water quantity for irrigation in agriculture) [MLIAGL+12]. Higher formal education also contributes to a more frequent consideration of all kinds of ES in general ([MLIAGL+12], [AK17]).

The difference in sources of education may play a role in a higher appreciation of regulating services in urban areas, while provisioning services are more often considered by inhabitants from rural areas [MLIAGL+12]. ES bundle demand and flow are driven by population and livestock density [SCE+19].

Regarding gender, a study in the Almeria region finds a higher appreciation of provisioning services by men than by women, who receive regulating services as more important. Sometimes, traditional gender role models are reflected within demand for ES bundles: Whereas men in Poland especially appreciated provisioning services related to a men-dominated sector such as forestry, the most important provisioning services for women was the provision of medical plants [AK17].

Landscape composition, features and topography are determinant for the supply and flow of ES in the European Alps [SCE+19]. The degree differs, with some ES closely related to specific landscape patterns, whereas others are provided with a variety of land uses [CMT+15]. Accordingly, a more diverse landscape does not automatically imply a higher diversity of ES supply. Land management decisions and biophysical conditions may also influence the range of ES [CMT+15].

For supply, only a limited number of socio-ecological variables is sufficient to predict ES bundles composition, which could facilitate approximative insights when primary data is difficult to obtain [SCE+19]. For the demand side, although some impacts of socio-economic variables on ES perception exists, it stays highly context dependent, even between different ES classes [PTHF19].

In conclusion, the ES bundles are affected by the landscape and land use, supporting our procedure to approach ES bundles in the Cévennes by assessing preferences for landscape evolution. The demand for these services varies then by socio-demographic variables, which are included in our questionnaire. Our valuation of ES bundles therefore provides possibilities that the trade-offs between supply and demand [SCE+19] are directly considered and discussed by individuals.

3.2.2.4. Non-materiel ES and bundles

Given the special interest dedicated in chapter 4 towards non-material services, I want to address the role of cultural benefits within the assessments of bundles of ES separately. When asked about their perception, individuals place a high priority to cultural ecosystem services (CES) within the demanded bundles [SS18]. Additionally, individuals tend to appreciate other services more when perceiving CES, highlighting their high synergy potential and multifunctional character ([dBSB+19]; [PTHF19]). Accordingly, non-material services have been demanded with regulating services and constitute trade-offs with provisioning services [MLIAGL+12] or inversely [dBSB+19].

The same bundling scenario is found for supply bundles ([CMT+15], [SS18]). The most important socio-cultural factor for the recognition of CES is education. Often, tourists and

younger people with higher ecological knowledge perceive a broader range and more frequently CES, than elder people who tend to primarily recognize them if part of their direct environment [AK17]. Nevertheless, an assessment of the perception of non-material services has to occur at a very localized scale. An integration or aggregation to higher scales is still a challenge to deal with [LLS+17], given that most links between well-being and cultural benefits are not captured by the CES classification approach in most assessments ([PDORB13], [BPPV14]).

Here, the bundles approach seems to be of particular interest because it gives the possibility to assess a wider range of possible benefits than a focus on single ES categories ([PDORB13]; [BPPV14], [dBSB+19]).

3.2.3. Inferences for the valuation of ecosystem services

The previous presentation of the literature showed the importance of landscape as well as the concept of ES bundles for future progress in ES valuation research. Both are closely related to the concept of multifunctionality: Most landscapes provide multiple services (or functions) whose links can be captured by assessing the bundles that describe ES supply and demand. The findings from previous research is therefore guiding the aim of our study, to reveal the links that exists between the Cévennes landscapes, the services they provide and how they are perceived and valued by different types of beneficiaries. In the following, I will summarize best practice advices from precedent studies before describing to which extent our study tries to respond to main caveats and which dispositions had to be included.

3.2.3.1. Recommendation for the valuation of landscapes and ES bundles

Given that studies of landscape aesthetics did not have a clear contribution to policy [Bis19], a strategy and anticipation for further implementation in policy is necessary [CBB+17]. Using a combination of methods (e.g. [SMM+17], [ACW+18]) to assess the benefits derived by landscapes and ES bundles entails a potential to engage researchers, decision makers and practitioners in a transdisciplinary process seen as particularly useful for policy design [BTL+18].

Salience of research in this domain is further increased by involving stakeholders within a local public participation process ([MLIAGL+12], [CBB+17], [Bis19]), as the municipality level is often relevant for decision-making, although not sufficient for phenomena detectable at lower scale [SCE+19]. Nevertheless, the valuation itself is impacted by the fact of being participative (as described in chapter 4):

At the one hand, participation of the general public reveal values closely related to experience and familiarity. Perceptions of landscapes integrate not only biophysical and ecological dimensions, but are also influenced by the personal and social environment [Deu05].

Interestingly, if individuals are less familiar with a geographical area, they tend to rely on the biophysical appearance, whereas personal memories, impressions and experiences are permitting to understand deeper relations and temporal dynamics within the landscape if people are more familiar with it [Ste08]. Accordingly, when the CVM of Stephenson [Ste08] is applied,

most associations between individual well-being and landscape pattern have been classified as "relationships" instead of the remaining more tangible categories of "forms" and "practices" [BPPV14].

Assessing these intangible values therefore calls for integrative approaches of valuations [Ste08]. Perception of landscape and its provisioned ES bundles is necessarily personal, expert-based surveys (or even focus group) cannot account for this personal dimension and the values only recognized with familiarity and individual experiences [Bis19].

On the other hand, participative valuations are often biased towards higher-educated individuals, who tend to be overrepresented (e.g. [HZvZ+18]; [RRO+18]). Given the importance of ecological knowledge for preferences of ES bundles, this "sophistication bias" has to be kept in mind.

Methods to allow a high number of individuals to participate are newspaper contests [IFM11] or public participation mapping [RRO+18] that are used to generate a GIS-based classification of land cover types with related ES bundles. Nevertheless, compared to traditional face-to-face interviews, obtaining information about the degree of understanding of participants is complicated [SS18]. Furthermore, an assessment of ES bundles or their perception can reveal relationships of demand and supply, such as possible flows between mountains and lowlands or between upstream and downstream areas of a river [SCE+19].

This might also imply that approaches focusing on either social or ecological factors of ES generation or benefit are not adapted to the context [BG09]. For example, social taboos and lexicographic preferences might represent an additional constraint to biophysical ones, explaining the difference between actual and potential supply or demand ([RHPB10]; [CBB+17]). Detecting these social constraints necessitates an understanding of the sources of satisfaction of different components of ES bundles. Is it motivated by immediate emotions or stemming from long-term rationales ([Ste08]; [Bis19])? Discriminating between these causes might be achieved by our assessment of associations between DCE attributes and possible benefits.

However, simultaneous biophysical and social or economic assessments risk to mutually frame each other and complicate further aggregation [BTL+18]. An attribute-based approach such as in DCEs that transfers biophysical indicators into economic terms could constitute a solution because it allows to represent features in an unbundled way [BCF17] and then possibly asks for interdependencies with follow-up questions in order to determine anthropocentric representations of the bundling structure. Such an approach might achieve to combine landscape perception, bundling of ES and economic valuation seen as important support for decision making and design of landscape management tools [TBLH16].

For instance, in France most of the studies use hedonic pricing analyses to assess the economic value of landscape aesthetics [RM12].

3.2.3.2. Inclusion of visual aspects in stated preference studies

The visual appearance of a landscape is important for individuals if they are asked to state their preferences about how the landscape should evolve in the future. More heterogeneous landscapes

have been found to contribute to higher aesthetic values [DSC+18]. Theory-driven indicators for aesthetics applicable to local contexts have been proposed: complexity, coherence, historicity and ephemera, disturbance, stewardship, imageability, visual scale and naturalness [OTF08]. Understandably, using pictures to illustrate alternatives and their changes is recommended ([TBLH16], [SROE19]), otherwise respondents could not make an informed decision. But when it comes to bundles of ES derived from the considered landscape, the inherent complexity and uncertainty of the underlying ecological, hydrological and geological processes make it more difficult to present attributes in clear, holistic and intelligible way. Often, more information could be needed, which complicates the control for equal amounts of information of each participant, being necessary to have consistent estimates of individual WTP. This constitutes a visuality-complexity trade-off of giving clear visual indications with sufficient information of marginal changes of the ES to be valued.

3.2.3.3. Literature on images and valuation

Researchers aim to reduce the cognitive burden of respondents in order to increase the consistency of their WTP estimates in choice experiments [HMW01]. Pictures can contribute to a better understanding of each attribute and a clearer representation of each alternative [ALM+14].

Especially for choice experiments carried out to capture preferences for visual aspect of landscapes, the use and division of pictures into composing elements has been found to be highly significant [VVKV14]. Two types of elements can be distinguished: Linear elements which are structuring the landscape (roads, fields, hedge rows or forest edges) and point elements (buildings, freestanding trees, small watersheds) which increase the visual diversity of the landscape [TOF06]. Most studies on preferences for visual aspect of landscapes are focused on linear elements as being important landscape features [VVKV14]. Only recently, point elements were profoundly included into analyses and found to be even more important to individuals [HZvZ+18].

Meanwhile, pictures can describe the alternatives and their appearance, but do not control for relevant attributes: Respondents might base responses upon elements in the visual illustration, but not those, which the researcher uses as attributes [HZvZ+18].

Another problem arises if one is willing to integrate visual aspects of landscapes into WTP estimates of the underlying ES: Results might suffer from endogeneity. The dynamic interactions of different landscape features naturally leads individuals to value the same feature for different or even multiple reasons [Ste08]. This can be illustrated using two examples. First, consider visual preferences of forest elements: Presence of dead wood is partly known to contribute to biodiversity in forests. Visually, many people might be opposed to a high presence of dead wood [GCŻA15]. But it is questionable, if visual preferences already include personal preferences for biodiversity protection [EA19]. Second, the same could be true for an agricultural landscape with yellow rape fields. As before, people might be attracted by the colorful setting. Meanwhile, rape fields are often cultivated in mono-cultural farming. Respondents risk therefore to implicitly integrate

agricultural mode or implications for biodiversity into their judgment about visual attractiveness [HZvZ+18]. Interestingly, both examples draw on empirical findings: Visual preferences for crop diversity [HZvZ+18]and presence of dead wood [BR15b] have been found to depend on education and prior knowledge. Many studies try to avoid this problem by explicitly asking people to decide on the visual appearance of the landscape, but it is questionable whether this helps to guarantee content validity ([TBLH16], [JBA+17]).

A possible solution to this dilemma is to carry out distinct studies that only focus on either visual aspects of landscapes, or on WTP estimates of underlying ES. The latter would require a comprehensive bundle representation so that individuals could state informed preferences. Meanwhile, considering the interaction of services and effects on intermediary services would harm the recommended practice to only value final ES so that double counting can be avoided [JR11]. To illustrate and integrate this complexity within a stated preference valuation is difficult to achieve and therefore rejected by others (e.g. [PYCL+17]).

The determination of the best way to create, combine and present these elements of a choice task is called experimental design, which will be detailed in the following section.

3.2.3.4. Our study

Our study tries to correspond to most of the recommendations described above [4]. A careful literature review using the Charter of the Cévennes National Park lead to a modeling of the ecological and biophysical interdependencies within the landscapes coupled with cultural values and representations (see figure 2.1). Together with focus groups regrouping inhabitants and stakeholders, main challenges for landscape management linked with natural reforestation have been identified and bundled in several attributes. The resulting questionnaire contains information about the potential ES supply within the region and assessed the demand for the attributes. The representation of landscape patterns as attributes reduces the cognitive burden for participants to state their demand preferences. Meanwhile, bundling remains possible because attributes are not treated as single ES but as bundle of different ES and other benefits.

Relationships between these (as important part of a bundling framework) were assessed by the follow-up questions that were used for a factorial analysis and clustering. The presence of motivations and transcendental values ([KJW+16]; see also section 4.2.1) can therefore be tested and used in a discourse analysis that amplifies their influence within a deliberative framework (section 4.5.4). Drivers of ES bundles demand originating from socio-cultural and economic conditions are identified and complete the analysis. As variations in ES occurrence within bundles appear in temporal and spatial dimensions, we integrate the latter by comparing ES demand of local inhabitants with preferences from the urban area of Montpellier. Our approach can therefore be a possible solution to combine the popular DCE valuation method with the requirements of ES bundles assessments.

4. In the ligth of the preceding literature, I remind here the points already mentioned in the Introduction of Part II of this PhD thesis.

Regarding the visuality-complexity trade-off our two step approach of a traditional DCE application and a further investigation on what actually motivated participants' preferences within each attribute, allows to resolve possible content validity problems of whether specific patterns were preferred for different reasons (and represent therefore different values). Furthermore, it allows to reduce the complexity of the choice task with the help of simplified graphical representations, while controlling for more complex interactions and value dimensions in the follow-up questions. We can therefore determine what people are actually valuing within each attribute and which motivations or rationales are included instead of addressing a value solely to the attribute itself.

This part of our study has not the ambition to develop a new framework for ES bundles valuation, but tries to combine methods in order to address the lack of representations of landscape values and related bundles in economics. It gives a suitable path for economists to assess economic values within a broader, transdisciplinary approach of landscape valuation, conservation and management, necessary for pluridisciplinary boundary objects such as landscapes and ES bundles.

3.3. Results of our experiment

3.3.1. General remarks

In this section of the chapter, I analyze the data obtained from our choice experiment regarding the values of landscape patterns and the ES bundles associated to them. The impact of deliberation will be examined in chapter 4. The analysis is structured as follows: First, a detailed analysis of the logit models is provided, which includes the presentation of several model specifications and the choice of the model to be considered for a detailed interpretation. Both samples (Cévennes and Montpellier) as well as the multinomial and mixed logit model will each be handled separately. The focus is put on the way we decided on the best model approach for the ease of transparency and reproducibility [5]. The multinomial model will be first analyzed, as it serves as approximation for the more general and complex mixed logit approach.

Second, all the models are summarized and compared to each other, while giving first interpretations of the data. The goal here is to determine common patterns and relationships across different models that show a certain robustness [6].

Third, a detailed factor analysis is provided. As with the logit models before, this consists of showing how we discriminated among available model configurations.

Finally, a summary of the factor analysis is given and main patterns are reported. These will then be discussed in section 3.4.

5. As this chapter is dedicated for publication, this part of the results section corresponds to further explanations given in supplementary material furnished for many online versions of published articles.

6. This part of the section in my thesis corresponds to a classical results section in published articles.

3.3.2. Analysis of the choice experiment data by multinomial logit

Two models will be used to analyze the choice data: multinomial logit (MNL) and mixed logit (MXL). I will always present the most basic specification of each model, and then test non-linear effects (by effect coding, the inclusion of interactions with socio-demographic variables or both). Thereby, robustness of signs and size of parameters as well as important differences among groups of participants can be determined with the help of stepwise elimination of non-significant model parameters such as in [VVKV14] and [HZvZ+18]. This procedure will lead to the determination of a final multinomial model to be assessed in detail in section 3.4 and that serves as important indication for possible specification forms for our mixed logit that is analyzed afterwards (similar approach in [dAHM15], [TBLH16], [CEHOC19]). Other important indicators for the performance of our model are the parsimony and goodness of fit indicators such as the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC) and the pseudo-R^2, widely used in case studies of landscape preference by DCEs (e.g. [ACW+18]; [HZvZ+18]; [SM20]). Furthermore, I will begin with the Cévennes samples and then come to the Montpellier sample.

Multinomial logit is the most specific and simple model I want to use. As described in section 2.5.2, all coefficients are fixed and choices in our questionnaire are supposed to follow the IIA property. After determining our best multinomial logit model, we will test these properties in order to justify whether a mixed logit approach has to be used beyond the aim to account for heterogeneity.

3.3.2.1. Cévennes

Effect coding

As first step, we created our baseline model for the Cévennes region. Including the findings of the literature review for the determination of priors for the experimental design, we decided to already include possible non-linearities from the beginning. As outlined in section 2.4.3.1, the tourism attribute and the cultural heritage attribute could possibly be affected by a "saturation effect" which means that the higher attribute levels do not provide (much) additional utility to respondents above a certain threshold level. Departing from the willingness to account for even unforeseen effects, I tested an effect coding scheme for all non-payment attributes having three possible levels (FC - forest cover; TOU - tourism infrastructure; CH - cultural heritage) (see table B.1 in the appendix on page 273).

For the forest cover attribute, the coefficient is negative (indicating a preference for less forest cover and therefore conservation of pastures) and a higher level of reforestation has a coefficient that is approximately the double absolute value of the coefficient for natural (medium) reforestation This indicates a nearly linear negative relationship between utility and forest cover. Accordingly, I do not further apply an effect coding scheme for forest cover.

The coefficients for tourism infrastructure are both positive, but with a lower coefficient for a high level as for a medium level. Hence, in this baseline model a nonlinear effect can be

supposed, but needs to be confirmed throughout further investigations of other multinomial logit specifications. For instance, we try to capture this non-linear effect by effect coding.

Positive values are observed for the higher levels of the cultural heritage attribute, with the medium level coefficient more than half of the high level coefficient. This could represent a weak nonlinear effect. For the reason of prudency, I will also keep the effect coding here, but it is possibly removed later on, if no indications of a clear non-linear effect are found.

Two other things are noteworthy about the introduction of effect coding in our model: First, although we did not used labeled alternatives in our choice experiment, the baseline model contains ASC for the second alternative and for the status quo (SQ) option in order to capture alternative-specific but not attribute-specific heterogeneity [7]. Interestingly, our ASC for the status quo is first significant at the 1%-level (value: 0.3824.), but including effect coding into our multinomial model makes the significance disappear. Possibly, some of our participants have a strong preference for medium levels of our attributes. As we explained the status quo (or business as usual, see section 2.7) as being the natural development often composed of the medium levels, some participants may have chosen this alternative for its implicit notion of naturalness. The open questions in our survey as well as remarks in the discussions of the workshops support this hypothesis. The fact that the attribute levels are not balanced over choice sets (meaning that not every level appears equally often), because medium levels appear on every choice set at least once in the SQ option, may cause that the ASC becomes significant. The effect coding allows to assign a specific coefficient to these medium levels and could therefore account for this source of heterogeneity.

Second, indicators for model fit show higher predictive power of the model when using effect coding: McFaddens pseudo-R^2 rises from 0.0878 to approximately 0.1162 and AIC and BIC change from 1957 and 1991 to 1900 and 1944, respectively (see also the figure 3.2). Effect coding therefore achieves a better explanation of respondents' choices, without introducing too much complexity into the model.

Consequently, we keep the effect coding for the tourism and cultural heritage attributes of our model (see table 3.1).

Main effect interactions

Following our feedback from the focus group discussions, we tested several interactions between main effects (in other words among attributes), keeping in mind that there was no indication that they could be relevant during our pilot test. Nevertheless, the small sample size of that pilot study makes further investigation with our real sample necessary. The early findings are confirmed, as no main effect interaction is significant and no clear changes is size or direction of the other coefficients are observed. Even contrary, the ASC for the status quo option reaches a higher

7. For labeled alternatives, significant ASC coefficients can indicate whether respondents were guided partly by the names of the alternatives of a choice set and not the attributes they are composed of.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.041		(0.090)	0.455
ASC Alt. SQ	-0.425	***	(0.158)	-2.691
Forest Cover	-0.741	***	(0.073)	-10.091
Tree Species - equilibrated	0.772	***	(0.107)	7.193
Tourism Infrastructure - medium	0.867	***	(0.167)	5.180
Tourism Infrastructure - high	0.413	***	(0.108)	3.810
Cultural Heritage - medium	1.346	***	(0.181)	7.451
Cultural Heritage - high	1.807	***	(0.171)	10.548
Payment, Donation	−0.011	***	(0.002)	5.999
Observations			970	
AIC			1900.09	
BIC			1943.99	
Log-likelihood			-941.05	
McFadden's pseudo-R^2			0.1162	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.1. – Results from baseline MNL model for Cévennes sample.

p-value. This means that no significant part of heterogeneity that was not attribute-dependent, is captured by main effects interaction. Slightly growing values for the information criteria do also suggest that the model specification should not include any of these interactions into the model.

Interactions with socio-demographic characteristics

Interesting insights about how preferences change over different parts of the population can be gained by using interactions with socio-demographic variables from participants. Additionally, from a purely statistical point of view, these interactions do provide further possibilities to explain choice outcomes by exogenous variables.

As displayed in figure 3.2, some of these interactions are significant, most are not, as it could be expected. Especially the variable that indicates if the individual lives or lived for at least five years in Montpellier (variable "5yMtp") seems to give some extra information by considerably improving goodness of fit measures: McFaddens pseudo R^2 rises to more than 0.15, the AIC drops under 1830 and the BIC under 1880.

For some interactions (especially if modalities of some categorical variables are rarely taken), the number of observations is too small to keep the effect coded variables. As a trial, in order to investigate the effect of these interactions, we omitted the effect coding. Interestingly, if it is removed for the tourism attribute, so that the latter can be interacted, the status quo ASC variable is often non-significant. As cultural heritage is still effect coded, this means that parts of

Model		ASC_2	ASC_sq	FC	TSD	TOU	CH	payment	interaction	Statistics			
Interaction	model n°									LL	R2	AIC	BIC
effect coding	no	no	yes	yes	yes	yes	yes	yes		-971,27	0,0878	1956,55	1990,69
	yes (all)	no	10%	yes	yes	yes	yes	yes		-941,02	0,1162	1902,04	1950,82
	yes (not FC)	no	yes	yes	yes	yes	yes	yes		-941,05	0,1162	1900,09	1943,99
FC:TSD	2	no	yes	yes	yes	yes	yes	yes	no	-941,04	0,1162	1902,07	1950,85
TOU:FC	3	no	yes	yes	yes	yes	yes	yes	no	-940,92	0,1163	1901,84	1950,61
TOU:TSD	4	no	yes	yes	yes	yes	yes	yes	no	-940,82	0,1164	1901,65	1950,42
CH	5	no	yes	yes	yes	yes	yes	yes	no	-940,92	0,1163	1901,85	1950,62
	6	no	yes	yes	yes	yes	yes	yes	no	-940,27	0,1169	1900,54	1949,31
	7	no	yes	yes	yes	yes	yes	yes	no	-940,92	0,1163	1901,85	1950,62
payment	8	no	yes	yes	yes	yes	yes	yes	no	-940,48	0,1167	1900,97	1949,74
	9	no	yes	yes	yes	yes	yes	yes	no	-941,04	0,1162	1902,08	1950,85
	10	no	yes	yes	yes	yes	yes	yes	no	-940,72	0,1165	1901,43	1950,21
	11	no	yes	yes	yes	yes	yes	yes	no	-940,79	0,1164	1901,58	1950,35
Age	12	no	yes	yes	yes	yes	yes	yes	yes	-937,81	0,1192	1895,62	1944,40
	13	no	yes	yes	10%	yes	yes	yes	no	-939,89	0,1173	1899,78	1948,55
	14	no	yes	yes	yes	not all	yes	yes	10%	-939,34	0,1178	1898,69	1947,46
	15	no	yes	yes	yes	yes	yes	yes	yes	-939,02	0,1181	1898,03	1946,80
Gender	16	no	yes	yes	yes	yes	yes	yes	yes	-935,90	0,1210	1891,81	1940,58
	17	no	yes	yes	yes	yes	yes	yes	yes	-937,64	0,1194	1895,28	1944,05
	18	no	no	yes	yes	yes	yes	yes	no	-949,16	0,1086	1916,32	1960,21
	19	no	yes	yes	yes	yes	yes	yes	yes	-944,33	0,1131	1906,67	1950,56
Household Composition	20	no	yes	yes	yes	yes	yes	yes	partially	-938,89	0,1182	1903,78	1967,18
	21	no	yes	yes	yes	yes	yes	yes	no	-939,54	0,1176	1905,07	1968,48
	22	no	no	yes	yes	yes	yes	yes	partially	-947,16	0,1105	1918,31	1976,84
	23	no	yes	yes	yes	yes	yes	yes	no	-946,63	0,1110	1917,25	1975,78
Activities in Cevennes	24	no	no	yes	yes	yes	yes	yes	yes	-936,22	0,1207	1892,44	1941,12
	25	no	no	yes	yes	yes	yes	yes	10%	-948,37	0,1093	1916,74	1965,51
	26												
Ownership in Cevennes	27	no	yes	yes	yes	yes	yes	yes	10%	-944,86	0,1126	1907,71	1951,61
	28	no	yes	yes	yes	yes	yes	yes	no	-946,79	0,1108	1911,59	1955,48
	29	no	yes	yes	yes	yes	yes	yes	no	-940,83	0,1164	1901,66	1950,44
	30	no	yes	yes	yes	yes	yes	yes	no	-939,90	0,1173	1899,80	1948,57
	31	no	yes	yes	yes	yes	yes	yes	no	-947,00	0,1106	1912,00	1955,90
	32	no	yes	yes	yes	yes	yes	yes	no	-940,67	0,1165	1901,35	1950,12
	33	no	yes	yes	yes	yes	yes	yes	no	-941,04	0,1162	1902,08	1950,85
Membership Environmental Protection	34	no	yes	yes	yes	yes	yes	yes	no	-932,01	0,1247	1884,02	1932,70
	35	no	yes	yes	yes	yes	yes	yes	yes	-930,85	0,1258	1881,71	1930,39
	36	no	no	yes	yes	yes	yes	yes	yes	-940,02	0,1172	1898,04	1941,85
	37	no	yes	yes	yes	yes	yes	yes	no	-938,80	0,1183	1895,60	1939,41
lived 5 years in Cevennes	38	no	yes	yes	yes	yes	yes	yes	no	-930,32	0,1263	1880,64	1929,33
	39	no	yes	yes	yes	yes	yes	yes	no	-930,54	0,1261	1881,08	1929,77
	40	no	yes	yes	yes	no	yes	yes	no	-940,38	0,1168	1898,75	1942,57
	41	no	yes	yes	yes	yes	yes	yes	yes	-936,17	0,1208	1890,34	1934,16
lived 5 years in Montpellier	42	no	yes	yes	yes	yes	yes	yes	no	-901,66	0,1532	1823,31	1871,71
	43	no	yes	yes	yes	yes	yes	yes	yes	-898,52	0,1561	1817,04	1865,44
	44	no	no	yes	yes	yes	yes	yes	no	-909,33	0,1460	1836,66	1880,22
	45	no	yes	yes	yes	yes	yes	yes	no	-908,54	0,1467	1835,07	1878,63

Figure 3.2. – Significance of main effects and interactions of main effect with socio-demographic characteristics for the Cévennes sample.

the information incorporated in the significant ASC for the SQ can be accounted to the tourism attribute which supports our hypothesis of a "saturation" effect which is superposing the status quo alternative. In some cases, the effect of having a high tourism level makes the associated coefficient becoming even insignificant with respect to the low tourism level.

Meanwhile, goodness-to-fit measures are considerably lower if effect coding is abandoned. We therefore continue our analysis using the 5yMtp variable and all other significant interactions that did not require changes in the effect coding. The model at this stage contains eight interactions [8]. I include all these interactions simultaneously in order to test their robustness with regard to the inclusion of the other remaining interactions. A stepwise elimination is then applied for the identification of the final multinomial logit specification.

Backward elimination

In this step we removed the less significant (or better the most insignificant) variable from our regression to test the evolution and robustness of the remaining variables. In this order the interactions of 5yMtp with forest cover and having lived 5 years in the Cévennes (5yCev) with cultural heritage were removed. The second step shifted the age - cultural heritage interaction fairly over the mark of significance. This clearly indicates that individual characteristics are important for this attribute and should be considered in subsequent models. Meanwhile I was surprised to find a significance of gender with the attributes forest cover and tree species (at 10% level): Women prefer significantly less forest cover and a higher proportion of deciduous forests than men in our sample. Interestingly, these interactions correspond to the levels provided with the status quo alternative (natural afforestation, equal proportion of deciduous and broad-leaf forest) whose ASC has still been significant. Therefore, I interacted the gender variable with the SQ-ASC to see whether women's choices regarding this alternative have been significantly different from men (see table B.3 in the appendix on page 275). The result was surprising: The interaction is actually significant and positive, but strengthened the significance of the original ASC dummy (negative) even more. Meanwhile, the interaction of gender with tree species got insignificant. The interpretation for that result is that, as inferred, woman might not significantly prefer more deciduous forest, but they possibly do prefer the status quo option compared to men (which also implies a higher proportion of deciduous forests). It could be that participants considered the status quo alternative as being the most natural evolution and that women particularly appreciated this kind of evolution. But still some heterogeneity is captured in the SQ option that is not yet explained by the model. The last change (model 51) concerned the removal of the ASC for alternative 2, which gave us the final MNL model for the Cévennes sample (table 3.2).

Generally, the goodness of fit measures all indicate that the backward elimination of non-significant variables improved our model fit stepwise: The AIC fell from 1801 to 1787 whereas the BIC decreased from 1884 to 1855. McFadden's pseudo-R^2 reached values over 0.17. It is noteworthy that the pseudo-R^2 is very context sensitive, but that values around 0.2 to 0.4 represent excellent model fit [VZ96].

8. FC:age from model 12 marked red in figure 3.2, FC:Gender from model 16, FC:5yMtp from model 42, TSD:Gender from model 17, TSD:5yMtp from model 43, TSD:ecolo from model 35, CH:5yCev from model 41 and CH:age from model 15; see table B.2 in the appendix on page 274 for the output

Variable	Estimate		Std. Error	z-value
ASC Alt. SQ	-0.768	***	(0.186)	-4.121
Forest Cover	-1.146	***	(0.255)	-4.499
Tree Species - equilibrated	0.798	***	(0.122)	6.543
Tourism Infrastructure - medium	0.832	***	(0.166)	5.014
Tourism Infrastructure - high	0.392	***	(0.112)	3.500
Cultural Heritage - medium	2.021	***	(0.297)	6.797
Cultural Heritage - high	2.995	***	(0.477)	6.277
Payment, Donation	−0.011	***	(0.002)	5.923
Forest Cover : Age	0.011	***	(0.004)	2.623
Forest Cover : Gender - female	-0.352	***	(0.134)	-2.615
Tree Species : Env. Protection	0.450	**	(0.179)	2.516
Tree Species : 5y Montpellier	-0.499	***	(0.179)	-2.791
Cultural Heritage : Age	-0.010	**	(0.004)	-2.470
ASC Alt. SQ : Gender - female	0.560	***	(0.154)	3.643
Observations			934	
AIC			1786.82	
BIC			1854.57	
Log-likelihood			-879.41	
McFadden's pseudo-R^2			0.1741	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.2. – Results from final MNL model for Cévennes sample.

	Interactions									Statistics			
Model	FC:age	FC:Gender	FC:5yMtp	TSD:Gender	TSD:5yMtp	TSD:ecolo	CH:5yCev	CH:age	ASC_SQ:Gender	LL	R2	AIC	BIC
46										-883,62	0,1701	1801,24	1883,51
47										-883,65	0,1701	1799,30	1876,73
48										-884,19	0,1696	1798,39	1870,98
49										-879,10	0,1744	1790,19	1867,63
50										-879,22	0,1743	1788,44	1861,03
51										-879,41	0,1741	1786,82	1854,57

Figure 3.3. – Stepwise determination of the final MNL model for the Cévennes sample. Green cells stand for significant interactions, red cells indicate non significant interactions, black cells are for interaction not or not yet included in the model.

As can be seen in table 3.2, the remaining significant interactions for our final interacted MNL model (figure 3.3) are the following:

— Forest cover - age (positive): the forest cover coefficient is negative, whereas the interaction with age is positive. This means that older people tend to have weaker preferences for the conservation of grassland. This is surprising, as we would have guessed that it would be older persons who - having witnessed the natural reforestation - are more likely to conserve the cultural landscape they know from their youth. At the same time, young persons could be more concerned about climate change and are therefore attaching higher importance to higher forest cover and associated carbon sequestering. Both hypotheses are not confirmed by the data at this point. An investigation of the factor analysis of the associations to the forest cover attribute could reveal reasons for this unexpected result.

— Forest Cover - gender (negative): Women (gender variable takes value of one) have a higher preference for less forest cover than men. In other words, women are more likely to support pasture conservation than men.

— Tree Species - membership in pro-environmental association (positive): Being in an environmental protection group is associated with a higher probability of choosing alternatives with a higher proportion of broad-leaved forest, *ceteris paribus*. A possible rationale for this finding could be that this group of participants gives more importance than the average to biodiversity which is higher in broad-leaved forests. The factor analysis could confirm this finding if the membership is a supplementary variable which is closely related to persons who are preferring biodiversity within the tree species attribute.

— Tree species - 5 years Montpellier (negative): Here the sign goes to the opposite direction. People in our Cévennes sample who lived in Montpellier for at least five years tend to have lower preferences for broad-leaved forests than the average. An investigation on the ES implicitly included in the tree species attribute within the factor analysis could be conclusive on the nature of this finding.

— Cultural heritage - age (negative): The negative interactions witnesses that younger habitants attribute higher importance to cultural heritage in the landscape than older ones. Meanwhile, this effect could also be due to the saturation effect: Older people are not per se unwilling to preserve cultural heritage (even for higher aged persons, the overall preference

for cultural heritage would be largely positive), but they could have a higher preference to conserve this heritage to a certain "threshold degree" (meaning a medium level in our DCE) and not invest further to have a good level of cultural heritage sites/elements in the landscape. This saturation effect could be captured by an appropriate distribution supposed for the cultural heritage coefficient in the mixed logit model.

3.3.2.2. Montpellier

As with the Cévennes sample, the investigation of the Montpellier sample starts with an analysis whether effect coding should be incorporated for some variables. Then, single interactions between main effects and with socio-economic data are included in the model. The significant ones are then all included before testing their robustness by removing the least significant ones stepwise from the model.

Effect coding

For the simplest model, without any effect coding schemes, all but the tree species variable are significant, including the ASC for the status quo (see table B.4 in the appendix on page 276). When the effect coding scheme is applied to the tourism and cultural heritage attribute, the ASC for SQ is longer significant, contrary to the tree species variable. Consequently, the effect coding permits to identify some information within the ASC (such as for the Cévennes sample before) as being perhaps originating from saturation effects that covered preferences for tree species. This superposition might have led to some parts of variability being relegated to the ASC variable.

Regarding the impact on effect coded variables themselves, the most interesting effect is probably the non-significant coefficient for a high tourism level. This would mean that a change from medium to a high level of tourism infrastructure can be associated with a loss of utility for the respondents in Montpellier, an even stronger saturation effect than for the Cévennes sample. For the cultural heritage attribute, no substantial gain in utility can be expected from a high level of cultural heritage compared to a medium level. The only slightly higher value for the coefficient indicates this threshold effect, comparable to that one found for the Cévennes inhabitants.

Generally, the effect coding causes an improvement for the quality indicators: For the model with effect coding on cultural heritage and tourism, the AIC and BIC reach values of 1882 and 1925, which is the best among all combination of effect coding schemes and considerably better than for the simple model without any effect coding. When effect coding is applied to all attributes having three levels, (so including forest cover), the coefficient of forest cover behaves similar to cultural heritage (only slightly higher coefficient for "high" level) but without improving the information criteria (AIC 1883, BIC 1931; see figure 3.4). Meanwhile, computing only tourism as effect coded, gives even worse indicators. Consequently, we adopt the same effect

coding scheme as baseline model as for the Cévennes sample, with the variables tourism and cultural heritage being effect coded (table 3.3).

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.142		(0.097)	1.472
ASC Alt. SQ	-0.188		(0.161)	-1.163
Forest Cover	-0.435	***	(0.072)	-6.052
Tree Species - equilibrated	0.218	**	(0.109)	2.000
Tourism Infrastructure - medium	0.588	***	(0.175)	3.365
Tourism Infrastructure - high	0.146		(0.113)	1.294
Cultural Heritage - medium	1.591	***	(0.205)	7.777
Cultural Heritage - high	2.248	***	(0.197)	11.441
Payment, Donation	−0.013	***	(0.002)	6.934
Observations			955	
AIC			1880.57	
BIC			1925.32	
Log-likelihood			-931.78	
McFadden's pseudo-R^2			0.0958	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.3. – Baseline MNL model for Montpellier sample.

Interactions

Generally, main effects are robust and have the expected sign, but to a different degree: First, payment (negative), cultural heritage (positive) and forest cover (negative) are nearly always significant. Only for interaction of 5yMtp with FC, the latter becomes not significant whereas the interaction itself is negative, meaning that people living longer in Montpellier have stronger preferences for grassland conservation, perhaps because they are more familiar with the cultural landscape. If forest cover is interacted with age, the coefficient for the main effect is significant and positive (value: 0.378, see table B.5 in the appendix on page 276), the interaction term itself is negative (value: -0.015, see table B.5). Given that all participants are adults and that adding both coefficients give a negative value for individuals above 25 years ($25 * (-0.015) + 0.378 \sim 0$), the overall effect of forest cover can still be assumed to be negative.

Second, the first tourism level (medium) is sometimes getting not significant or only at 10% level when tourism is interacted. However, the high level is often non-significant, suggesting the same saturation effect as already visible in the Cévennes sample arises.

Third, the tree species attribute is often not significant when it is interacted. This suggests that some parts of the heterogeneity associated to it might stem from other effects. It also suggests that the preferences for this attribute are not as strong as for the other attributes.

The interactions among main effects (including forest cover - tree species, forest cover - cultural heritage, cultural heritage - tourism) are neither significant, nor do they improve the parsimony indicators. I note here that the ASC for the second alternative (ASC Alt. 2) is close to get significant at the 10% level in several model specifications. This could indicate that some heterogeneity in the model can still not be contributed to the other variables. Further investigation such as with the mixed logit might therefore be useful.

Although some categories of household composition are significant, the associated observations within the sample are relatively low, so that a deeper analysis does not appear very robust or promising. Furthermore, parsimony indicators suggest that these interactions do not generate much additional information compared to the complexity they would introduce into the model. Nevertheless, they could be included as supplementary variables into the factor analysis in order to see whether preferences differ among household composition categories. Only for the age variable, there are considerable improvements, notably a change of McFadden's pseudo-R^2 from approximately 0.10 to 0.13 with the interaction.

I therefore concentrate on interactions that were clearly significant (at least at the 10% level) or generated particular good results for the goodness of fit and parsimony indicators. These are (see figure 3.4):

— interactions with age for all main effects
— interactions of gender with tree species and tourism
— interactions of ownership of a parcel in the Cévennes with tree species (for instance, I have no clear indication what underlying effect could relate this variables, its robustness remains to be assessed...)
— interactions of having lived five years in Cévennes with forest cover and with tourism
— interactions of lived five years in Montpellier with forest cover and cultural heritage

In some cases, the modality of the interacted socio-demographic variable is not taken sufficiently often to allow for effect coding simultaneously. As I am particularly interested in the difference of preferences among parts of the samples, I prefer to remove the effect coding if necessary. Nevertheless, if the modality is rarely taken, this does also mean that the interaction effect might not be strong for the whole population.

Backward elimination

As with the Cévennes sample, I proceed with a stepwise elimination of less significant interactions (table B.6 in the appendix on page 277) to determine the final MNL model for the Montpellier group (see figure 3.5).

Initially, the forest cover attribute (main effect) drops to significance at 10% level when all previously significant interactions are introduced, although most of them are not significant. But it subsequently reestablishes significance as these interactions are removed. As expected, model parsimony significantly improved, if the AIC criterion is assessed, whereas the BIC value still

Model		ASC_2	ASC_sq	FC	TSD	TOU	CH	payment	interaction	Statistics			
Interaction	model n°									LL	R2	AIC	BIC
effect coding	no	no	yes	yes	no	yes	yes	yes		-951,06	0,0771	1916,11	1950,15
	yes (no fc)	no	no	yes	yes	yes (medium)	yes	yes		-931,78	0,0958	1881,57	1925,32
	yes (all)	no	yes	yes	no	yes	yes	yes		-931,42	0,0961	1882,83	1931,45
FC:TSD	2	no	no	yes	no	yes (medium)	yes	yes	no	-931,28	0,0963	1882,56	1931,18
TOU:FC	3	no	no	yes	yes	yes	yes	yes	no	-931,10	0,0965	1888,20	1930,82
TOU:TSD	4	no	no	yes	yes	yes	yes	yes	no	-931,51	0,0961	1883,01	1931,63
CH	5	no	no	yes	yes	yes (medium)	yes	yes	no	-931,59	0,0960	1883,18	1931,79
	6	no	no	yes	no	yes (medium)	yes	yes	no	-931,70	0,0959	1883,39	1932,01
	7	no	no	yes	yes	yes (medium)	yes	yes	no	-931,62	0,0959	1883,25	1931,87
payment	8	no	no	yes	yes	yes (medium)	yes	yes	no	-931,00	0,0966	1881,99	1930,61
	9	no	10%	yes	no	yes (medium)	yes	yes	no	-930,61	0,0969	1881,23	1929,85
	10	no	no	yes	yes	yes (medium)	yes	yes	no	-931,48	0,0961	1882,96	1931,58
	11	no	no	yes	yes	yes (medium)	yes	yes	no	-931,73	0,0958	1883,47	1932,08
Age	12	no	no	10%	10%	yes (medium)	yes	yes	yes	-886,74	0,1395	1793,48	1841,82
	13	no	no	yes	yes	yes (medium)	yes	yes	yes	-889,54	0,1368	1799,09	1847,43
	14	no	no	yes	yes	yes (medium)	yes	yes	yes	-894,98	0,1315	1809,95	1858,30
	15	no	no	yes	10%	yes (medium)	yes	yes	no	-897,41	0,1291	1814,82	1863,16
Gender	16	no	no	yes	yes	yes (medium)	yes	yes	no	-923,43	0,1039	1866,85	1915,38
	17	no	no	yes	yes	yes (medium)	yes	yes	10%	-921,60	0,1057	1863,20	1911,74
	18	no	no	yes	yes	yes (medium)	yes	yes	yes	-924,36	0,1030	1866,71	1910,39
	19	yes	no	yes	no	yes (medium)	yes	yes	no	-929,18	0,0983	1876,36	1920,04
Household Composition	20	no	no	yes	yes	yes (medium)	yes	yes	some	-927,54	0,0999	1881,08	1944,28
	21	no	no	yes	no	yes (medium)	yes	yes	some	-927,24	0,1002	1880,49	1943,69
	22	no	no	yes	no	yes (medium)	yes	yes	some	-928,97	0,0985	1881,94	1940,28
	23	yes	no	yes	no	yes (medium)	yes	yes	some	-929,18	0,0983	1882,36	1940,70
Activities in Cevennes	24	no	no	yes	yes	yes (medium)	yes	yes	no	-903,68	0,1231	1827,37	1875,70
	25	no	no	yes	yes	no	yes	yes	no	-895,93	0,1306	1811,85	1860,08
	26	no	no	yes	yes	10%	yes	yes	no	-922,22	0,1051	1864,44	1912,97
Ownership in Cevennes	27	yes	no	yes	10%	yes (medium)	yes	yes	no	-936,91	0,0908	1891,83	1935,58
	28	yes	no	yes	no	yes (medium)	yes	yes	no	-937,63	0,0901	1893,26	1937,01
	29	no	no	yes	yes	yes (medium)	yes	yes	no	-931,57	0,0960	1883,14	1931,76
	30	no	no	yes	yes	yes (medium)	yes	yes	yes	-928,76	0,0987	1877,51	1926,13
	31	yes	no	yes	no	yes (medium)	yes	yes	no	-937,48	0,0903	1892,95	1936,71
	32												
	33												
Membership Environmental Protection	34	no	no	yes	yes	yes	yes	yes	no	-905,80	0,1210	1831,60	1879,93
	35	no	no	yes	10%	yes (medium)	yes	yes	no	-906,85	0,1200	1833,71	1882,04
	36	no	no	yes	yes	yes (medium)	yes	yes	no	-911,46	0,1155	1840,91	1884,41
	37	yes	no	yes	yes	yes (medium)	yes	yes	no	-911,59	0,1154	1841,17	1884,67
lived 5 years in Cevennes	38	no	no	yes	yes	yes (medium)	yes	yes	yes	-916,95	0,1102	1853,70	1902,42
	39	no	no	yes	yes	yes (medium)	yes	yes	no	-922,83	0,1045	1865,65	1914,17
	40	no	no	yes	yes	yes (medium)	yes	yes	10%	-926,10	0,1013	1870,20	1913,87
	41	yes	no	yes	yes	yes (medium)	yes	yes	no	-928,42	0,0991	1874,84	1918,51
lived 5 years in Montpellier	42	no	no	no	yes	yes (medium)	yes	yes	10%	-921,49	0,1058	1862,97	1911,50
	43	no	no	yes	no	yes (medium)	yes	yes	no	-922,83	0,1045	1865,65	1914,17
	44	no	no	yes	yes	no	yes	yes	no	-927,38	0,1001	1872,75	1916,42
	45	yes	no	yes	no	yes (medium)	yes	yes	yes	-921,67	0,1056	1861,34	1905,01

Figure 3.4. – Significance of main effects and interactions of main effect with socio-demographic characteristics for the Montpellier sample.

determines the best model as being with individual interactions. The R^2 measure evolves to a value above 0.15.

The difference in these criteria is due to the fact that the BIC has a higher penalty for additional variables in the models and therefore accounts negatively for the five interactions that are not significant when starting the backward elimination. Meanwhile, six interactions are significant, but only at the 10% level. When starting the procedure, no interaction changes its

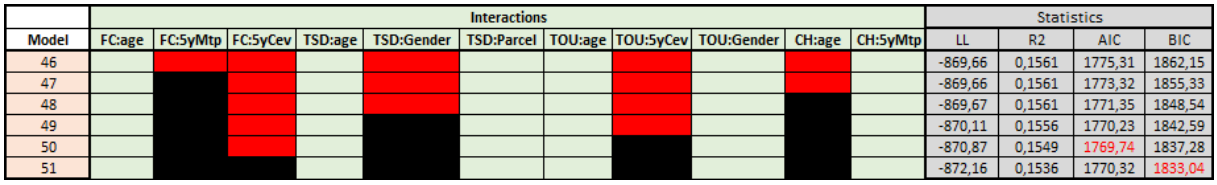


Figure 3.5. – Stepwise determination of the final MNL model for the Montpellier sample.

significance: Five of them are dropped subsequently from the model and six interactions together with the main effects remain. It is noteworthy that the last elimination of the interaction of 5yCev with forest cover is only slightly not significant at the 10% level. This is illustrated by the different optimal values of the BIC and AIC criterion: Whereas the less strict AIC suggests keeping this interaction in the model, the more severe penalty of the BIC criterion recommends to delete it from the model. I remove this interaction with its effect described above, to obtain the final MNL model for the Montpellier sample (table 3.4). Nevertheless, its effect needs to be kept in mind for the mixed logit model.

Variable	Estimate	Std. Error	z-value
ASC Alt. 2	0.102	(0.097)	1.054
ASC Alt. SQ	0.500	(0.116)	4.322
Forest Cover	0.473	(0.184)	2.569
Tree Species - equilibrated	-0.890	(0.239)	-3.723
Tourism Infrastructure	0.804	(0.187)	4.297
Cultural Heritage	1.388	(0.168)	8.284
Payment, Donation	−0.012	(0.002)	5.890
Forest Cover : Age	-0.018	(0.004)	-4.697
Tree Species : Age	0.022	(0.005)	4.891
Tree Species : Owner of parcel	1.983	(0.796)	2.492
Tourism Infrastructure : Age	-0.010	(0.003)	-2.989
Tourism Infrastructure : Gender - female	-0.391	(0.119)	-3.280
Cultural Heritage : 5y Montpellier	-0.598	(0.178)	-3.364
Observations		920	
AIC		1770.32	
BIC		1833.04	
Log-likelihood		-872.16	
McFadden's pseudo-R^2		0.1536	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.4. – Final MNL model with interactions for the Montpellier sample.

3.3.2.3. Pertinence of the multinomial logit model

The IIA condition of the conditional logit model is relatively strict (see section 2.5.2.2). A Hausman test on violation of the property rejects both baseline and final model for both samples. Consequently, the condition has to be relaxed by allowing for other forms of heterogeneity in the model. The mixed logit model in the next section is a convenient way to achieve that. Nevertheless, the findings for the conditional model can furnish useful insights for the robustness of the effects and the interpretation of interactions. Additionally, the interactions found for the conditional logit model are those that will also be tested for the mixed logit model.

3.3.3. Analysis of the choice experiment data by mixed logit

As described in section 2.5.4, the mixed logit model releases the IIA hypothesis. This allows for correlation among error terms in the model which in turn allows for non-systematic heterogeneity among individuals and attributes. Nevertheless, the researcher is constrained to propose or state a distribution which the error terms follows. In most applications of DCEs for landscape valuation (and even most other domains of DCEs such as marketing and transport) the assumed distributions are the same (e.g. [HZvZ$^+$18]). All random coefficients for the attributes follow a normal distribution except the restricting attribute with negative associated utility (the monetary attribute) which is often computed lognormal. A lognormal distribution is strictly positive and guarantees that (together with a negative coefficient of the monetary attribute) the restriction is in line with welfare theory: Additional money to be paid *ceteris paribus* results in a loss in well-being. Alternative distributions also used in applications (but less frequently) are uniform and triangular distributions. They are especially used when preferences for an attribute are wide-ranging so that coefficients are less concentrated around their mean value. In this context, forest cover and tourism are attributes that may be better captured by these forms of distributions because people might more or less prefer having more of them for different reasons.

The significance of the standard deviation of the main effects verifies whether the hypothesis of the randomness of the coefficient cannot be rejected. Hence, the mixed logit specification is able to account for a significant part of heterogeneity in the preferences. As before, the discrimination among several forms of parameter distributions can be done with the help of the information criteria [9]. In order to determine a baseline model without interactions, the form of the parameter distribution will already be assessed. Then, as for the multinomial logit, interactions are introduced in the model individually. The final model for the mixed logit specification is then determined by introducing the interactions simultaneously and removing them stepwise if they are not significant or do not provide sufficient information as indicated by the AIC.

9. The mlogit package does not provide a suitable format for the number of observations that allows for an automatic generation of the BIC. For further analysis of the finding of this section, I will calculate the criterion myself. For instance, only the (less strict) AIC is used, which does not limit our analysis because it follows our intention to recommend models with more included terms that could indicate sources of preference diversity in the data.

3.3.3.1. Cévennes

Baseline model

The first specification of the mixed logit model with "standard distributions" confirms the pertinence of the model: All main effects are significant and have the same expected sign as in the multinomial specification (see table 3.5). Furthermore, all standard deviations are significant, indicating significant heterogeneity of preferences for all attributes. Finally, the information criteria improve considerably compared to the multinomial baseline model (AIC of 1850 compared to 1950, R^2 of 0.1390 compared to 0.1162).

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	-0.036		(0.111)	-0.328
ASC Alt. SQ	0.259	*	(0.140)	1.853
Forest Cover	-0.802	***	(0.098)	-8.209
Tree Species - equilibrated	0.827	***	(0.133)	6.236
Tourism Infrastructure	0.415	***	(0.079)	5.273
Cultural Heritage	0.795	***	(0.098)	8.100
Payment, Donation	-5.387	***	(0.407)	-13.221
SD Forest Cover	0.807	***	(0.143)	5.659
SD Tree Species	1.185	***	(0.155)	7.639
SD Tourism Infrastructure	0.806	***	(0.122)	6.626
SD Cultural Heritage	0.406	**	(0.186)	2.232
SD Payment	2.248	***	(0.268)	8.386
Observations			970	
AIC			17711.4	
Log-likelihood			-873.57	
McFadden's pseudo-R^2			0.1796	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.5. – Baseline MXL model for the Cévennes sample without correlation.

Given the panel structure of the data (several individuals making repeated choices), coefficients can be assumed to be correlated for subsequent choices of one individual. The application of correlation tests (Lagrange-Multiplier test, Score test, Wald test) all reject the hypothesis of uncorrelated random parameters.

Including correlation into the model results in outputs that display the Cholesky factors for each of the main effect combinations. An example is shown in the appendix (table B.7), while the coefficients for main effects are reported in table 3.6. The Cholesky factors are used to establish the variance-covariance matrix (see [Tra09] p. 208ff). As shown in table B.7, many of them are significant. The resulting matrix is illustrated in table 3.7. No strong correlation patterns can be identified, except the positive correlation between forest cover and tree species ($\rho = 0.913$). This

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.052		(0.077)	0.675
ASC Alt. SQ	0.660	***	(0.091)	7.260
Forest Cover	-0.644	***	(0.047)	-13.777
Tree Species - equilibrated	0.931	***	(0.100)	9.300
Tourism Infrastructure	0.326	***	(0.068)	4.759
Cultural Heritage	0.874	***	(0.076)	11.512
Payment, Donation	-5.080	***	(0.208)	-24.427
Observations			934	
AIC			1908.85	
Log-likelihood			-932.43	
McFadden's pseudo-R^2			0.1243	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.6. – Estimated coefficients of the baseline model for the Cévennes sample with account for correlation.

finding is interesting because it supports our intuition for the main effect interaction between the two attributes: Forest cover is more supported, if the forest contains a higher proportion of broad-leaved forests.

	fc	tsd	tou	ch	pay
fc	1	0.913	0.150	0.168	0.257
tsd	0.913	1	0.211	-0.018	0.0002
tou	0.150	0.211	1	0.181	0.273
ch	0.168	-0.018	0.181	1	0.332
pay	0.257	0.0002	0.273	0.332	1

Table 3.7. – Correlation matrix of the baseline MXL model for the Cévennes sample.

Accounting for correlation does not change coefficients drastically, they seem to be robust. Nevertheless, for reasons of simplicity and readability, the analysis of interactions as well as the stepwise removal procedure will not account for correlation at the beginning. This procedure is supported by the AIC criterion that sharply rises (although being less strict then the BIC) from 1858 to 1909 and therefore indicates that the higher complexity of specifications with correlations are not compensated by the information gain. However, correlation patterns will be tested for the final model. This allows also to check the robustness of our findings for the baseline model.

Forms of Random parameter distributions

All distributions tested for the random parameters share the property of providing significant standard deviations. The comparison among distributions started from the standard supposition described above (all normal, except lognormal monetary attribute), giving a value for the AIC of 1858 and for McFaddens pseudo-R^2 of 0.1390 (see second and fifth column of the model output summary in figure 3.6). In a second step, for each variable the common uniform and triangular distributions have been tested, while keeping all other variables normal.

Variable\Distribution	AIC			pseudo-R2		
	normal	triangular	uniform	normal	triangular	uniform
Forest cover	1857,62	1923,17	1905,00	0,1390	0,1082	0,1167
Tree species	1857,62	1924,83	1907,03	0,1390	0,1074	0,1158
Tourism	1857,62	1904,85	1880,93	0,1390	0,1168	0,1280
Cultural heritage	1857,62	1863,03	1860,20	0,1390	0,1364	0,1377

Figure 3.6. – Comparison of different random parameter distributions for the main effects.

As can be seen, for all attributes, the normal distribution fits best, before a narrower uniform and the triangular distribution [10]. This results indicates that heterogeneity in preferences exist, but they are still clustered around a "median tendency". The only exception is cultural heritage, where all forms or random parameter distributions provide only small differences in the AIC value [11]. Nevertheless, our baseline mixed logit model is therefore similar to the standard specification of most mixed logit application in DCEs: All non-monetary attributes are supposed normal, and the monetary attribute is lognormal.

Figure 3.7 shows the estimated part of negative random coefficients per attribute given the normal distributions considered for the main effects in our baseline model. This indicates whether the general direction of an effect is homogenous within the Cévennes sample or whether a relatively important part has diverging preferences. For our baseline model, the forest cover (upper left plot) attribute is mainly perceived negatively (73% of the sample), whereas the other attributes are perceived positively, as indicated by the signs of the mean coefficients (table 3.5). Nevertheless, only for the cultural heritage attribute, this general direction is relatively unanimous. The other three variables are estimated to have between 27% and 36% of individuals within the sample that have a diverging direction of their preferences. The inclusion of interactions may highlight some sources of this diversion by showing how preferences are affected by socio-demographic

10. By "narrow" I want to indicate that the interval over which the parameter distribution is most efficient, is smaller for the uniform distribution than for the triangular distribution. For example, for the forest cover attribute, the estimated optimal interval frontiers given a uniform distribution are -3.83 and 2.41, whereas they are -6.62 and 5.20 for the triangular distribution. For the other attributes, this tendency is confirmed.

11. For the ease of prudence, I still tried a uniform distribution of cultural heritage and a uniform distribution for tourism simultaneously. Not only are these the two attributes where the quality difference between uniform and normal distribution is the least, but tourism is also the attribute which has the highest correlation with cultural heritage (see table 3.7). Given the correlation finding above, a simultaneous uniform specification seemed promising as well. Finally, it performed worse than the initial model.

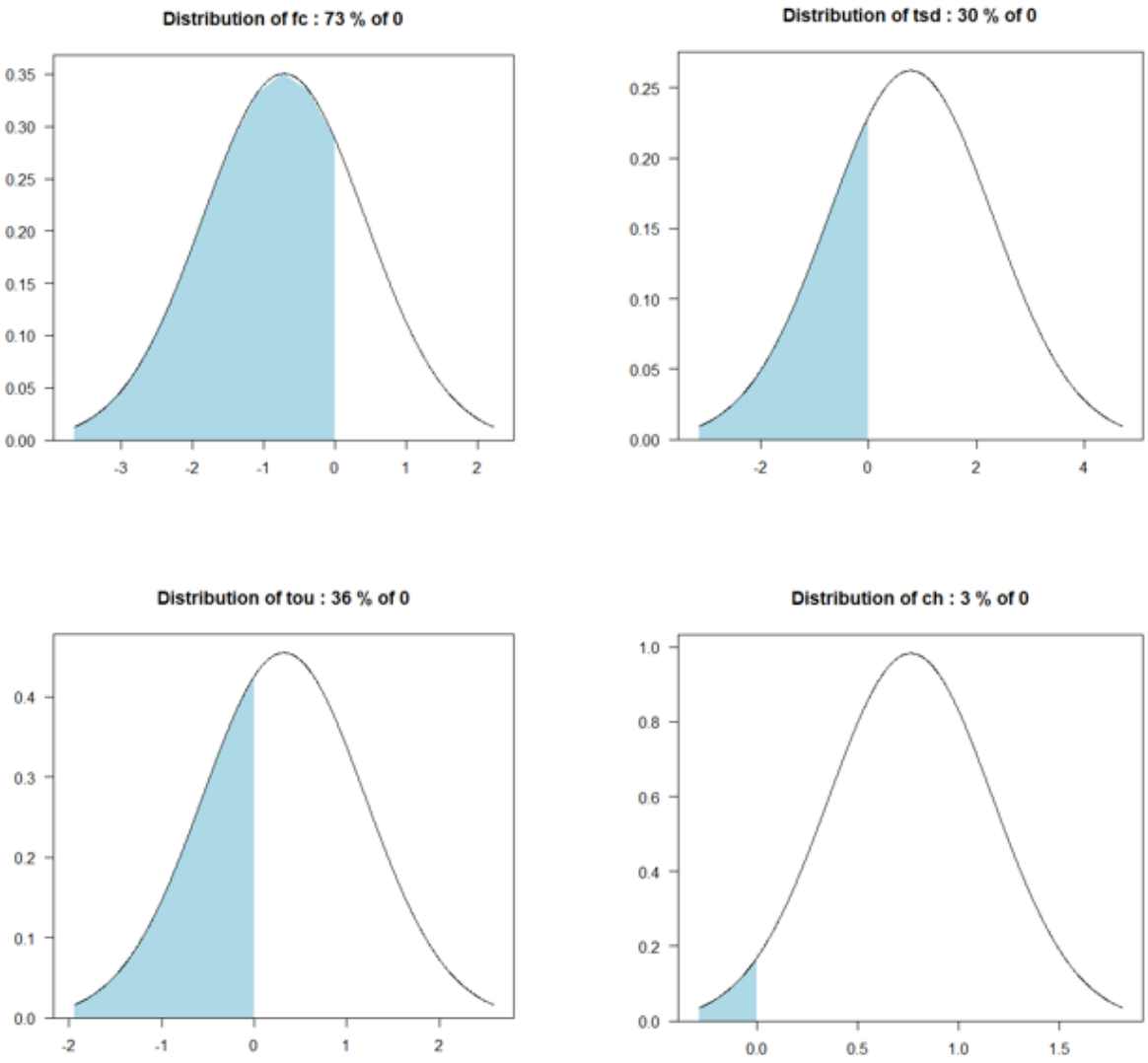


Figure 3.7. – Distribution of random parameters of individuals for the Cévennes baseline model.

characteristics. In the final model (with these interactions) I will assess the same type of plots in order to determine whether preferences for main effects are more homogeneous.

Interactions

As in the MNL model, we now introduce the effect of socio-demographic variables into our model. Therefore, the same interactions that have been found to be significant in section 3.3.2.1 are considered for the mixed logit model. Their individual introduction into the mixed logit model reveals that they are all significant. Meanwhile, performance criteria do not improve considerably for most of them (AIC around 1850, R^2 around 0.14; see figure 3.8).

Model	Interactions from multinomial logit	Estimation parameters				
		Interaction significant	AIC	Main effect significant	pseudo-R^2	LL
11	FC:age	yes	1857,26	yes	0,1401	-915,63
12	CH:age	yes	1857,26	yes	0,1401	-915,63
13	Gender:FC	yes	1857,26	yes	0,1401	-915,63
14	ecolo:tsd	yes	1840,66	yes	0,1479	-907,33
15	5M:tsd	yes	1787,71	yes	0,1727	-880,86
16	asc_sq:Gender	yes	1856,71	no	0,1403	-915,35
Interactions of main effects:						
17	FC:tsd	no	1860,26	yes	0,1387	-917,13
18	tou:CH	yes	1851,80	yes	0,1426	-912,90
19	FC:CH	no	1859,69	yes	0,1389	-916,84

Figure 3.8. – Significance of interactions for the MXL model for the Cévennes sample.

Although this finding supports the robustness of these effect, they do not seem to contribute as much as the randomness of parameter coefficients to determine the source of variability. The mixed logit model is therefore preferred for further analysis of the estimates within this chapter such as the WTP. Accordingly, as interactions are important to have further insights into diverging preferences among the population, but are less important than the random parameters. No further interactions than those already included are tested for determining the final mixed logit model. The only interactions that seem to have a major importance are those of the tree species attribute with the fact of belonging to an environmental protection group and also of the tree species attribute with the fact of having lived for at least five years in Montpellier. The interaction of the ASC for the SQ with the female dummy makes the original ASC non-significant. This supports our hypothesis that preferences to choose the SQ are significantly different among men and women.

Main effect interactions

As we are especially interested into main effect interactions, these are also tested for the mixed logit model. In contrast to the MNL model, one interaction is significant: that one for cultural heritage and tourism. Although its impact on performance indicators is rather weak (AIC: 1851; R^2: 0.1426), it supports our procedure regarding the random parameter distributions which was applied due to the correlation detected for these two attributes. The interaction is therefore kept in the model for the stepwise removal. A somewhat surprising result is that the interaction between forest cover and tree species is not significant although their correlation was rather strong.

Stepwise backward elimination

As previously, a robustness check consists in removing interactions from the model that become not significant when put together while observing the change in values for the other model parameters 3.9. Possible candidates for elimination are also terms that were not clearly improving parsimony indicators.

Interaction	FC:age	FC:Gender	TSD:ecolo	TSD:5M	Tou:CH	CH:age	asc_sq:Gender	LL	pseudo-R^2	AIC
20								-869,01	0,1838	1776,02
21								-869,99	0,1829	1775,99
22								-871,54	0,1815	1779,08
23								-871,93	0,1811	1777,85
24								-870,88	0,1821	1775,77
25								-873,33	0,1798	1778,66
Fixed price coefficient								-855,06	0,1970	1742,12
Integration of correlation								-883,98	0,1698	1821,97

Figure 3.9. – Subsequent elimination of non significant interactions for the MXL model of the Cévennes sample. Green cells represent significant interactions, black cells show interactions that were discarded from the model.

The interactions seem to be relatively robust, which could be due to the mixed logit specification that achieves to associate parts of variability to the random parameters that were possibly overlaying the interaction effects before. In order to pursue the robustness check, I concentrate on the AIC value (1776.02) for interactions that contain socio-demographic variables that are still included in other interactions (e.g. age:ch; fc:gender). If these are robust, deletion of some of the interactions (although being significant) should not change other values.

Deleting the age:ch interaction improves the AIC value slightly (1775.99) and the significance of the main effect interaction of cultural heritage and tourism (ch:tou). Additionally, this step supports an easier interpretation of the effects (no reversed sign). For prudency, the main effect was removed instead of the age:ch interaction but this step worsened the AIC value (1779.08). Consequently, the removal of the socio-demographic interaction is preferred.

The second candidate for elimination, the $fc : gender$ interaction, does not improve model parsimony indicators. Instead, the elimination of other interactions with age and gender were tested ($fc : age$; $ASC - SQ : gender$), but with the same result: no improvement of quality indicators. Consequently, the selection of variables and their interaction was finished at his point.

Nevertheless, two last tests were performed to determine the final mixed logit model for the Cévennes sample. First, the randomness of the payment attribute was tested [12]. As specifications with random coefficients raises the complexity of the model, the AIC value follows significantly (value: 1742; model with fixed price coefficient). However, specification tests (likelihood-ratio test, Wald test) reject the null hypothesis of non-randomness of the coefficients. Consequently, the higher complexity is the "necessary" price to account for the violation of the IIA and the

12. For instance, the violation of the IIA property with the MNL model led to the mixed logit model with random coefficients for the attributes. While this development of the model has been tested above for all non-monetary attributes, the log-normal specification has not yet been tested.

payment attribute is also considered as random. That leads us to consider model 24 as our final mixed logit model specification (see table 3.8).

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.024		(0.114)	0.213
ASC Alt. SQ	-0.059		(0.178)	-0.332
Forest Cover	-0.492	***	(0.130)	-3.772
Tree Species - deciduous	0.882	***	(0.150)	5.890
Tourism Infrastructure	0.665	***	(0.166)	4.003
Cultural Heritage	0.983	***	(0.146)	6.754
Payment, Donation	-5.291	***	(0.450)	-11.748
Forest Cover : Gender - female	-0.636	***	(0.175)	-3.635
Tree Species : Env. Protection	0.740	***	(0.241)	3.075
Tree Species : 5y Montpellier	-0.656	***	(0.225)	-2.908
ASC Alt. SQ : Gender - female	0.590	***	(0.196)	3.011
Tourism : Cultural Heritage	-0.202	*	(0.054)	-1.919
SD Forest Cover	0.784	***	(0.153)	5.122
SD Tree Species	1.000	***	(0.159)	6.290
SD Tourism Infrastructure	0.793	***	(0.125)	6.370
SD Cultural Heritage	0.342		(0.219)	1.561
SD Payment	2.560	***	(0.375)	6.823
Observations			934	
AIC			1705.45	
Log-likelihood			-835.72	
McFadden's pseudo-R^2			0.2151	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.8. – Estimation of final mixed logit model without correlation for Cévennes area.

Finally, as for the baseline model, correlation patterns are introduced into the model to additionally test its robustness. As before, parsimony indicators worsen with inclusion of correlation. Meanwhile, the coefficients are robust in signs and become even stronger (in absolute values) which supports their pertinence for further analysis (table B.8 in the appendix). Figure 3.10 displays the main effects coefficients' parameter distribution. As described above, all main effects have been found to be best captured by normal distributions. In the graph, the proportion of negative coefficients is shaded in blue.

Compared to the density functions of random parameter coefficients in the baseline model, the interaction with socio-demographic variables has considerably raised the homogeneity of preferences for the main effects. Notably the interaction of the tree species attribute with the fact of being member of an environmental friendly group and of having lived in Montpellier for five years has shifted the part of negative coefficients from 30% to 1%. This would mean that a negative preference for that attribute (meaning a positive preference for deciduous tree

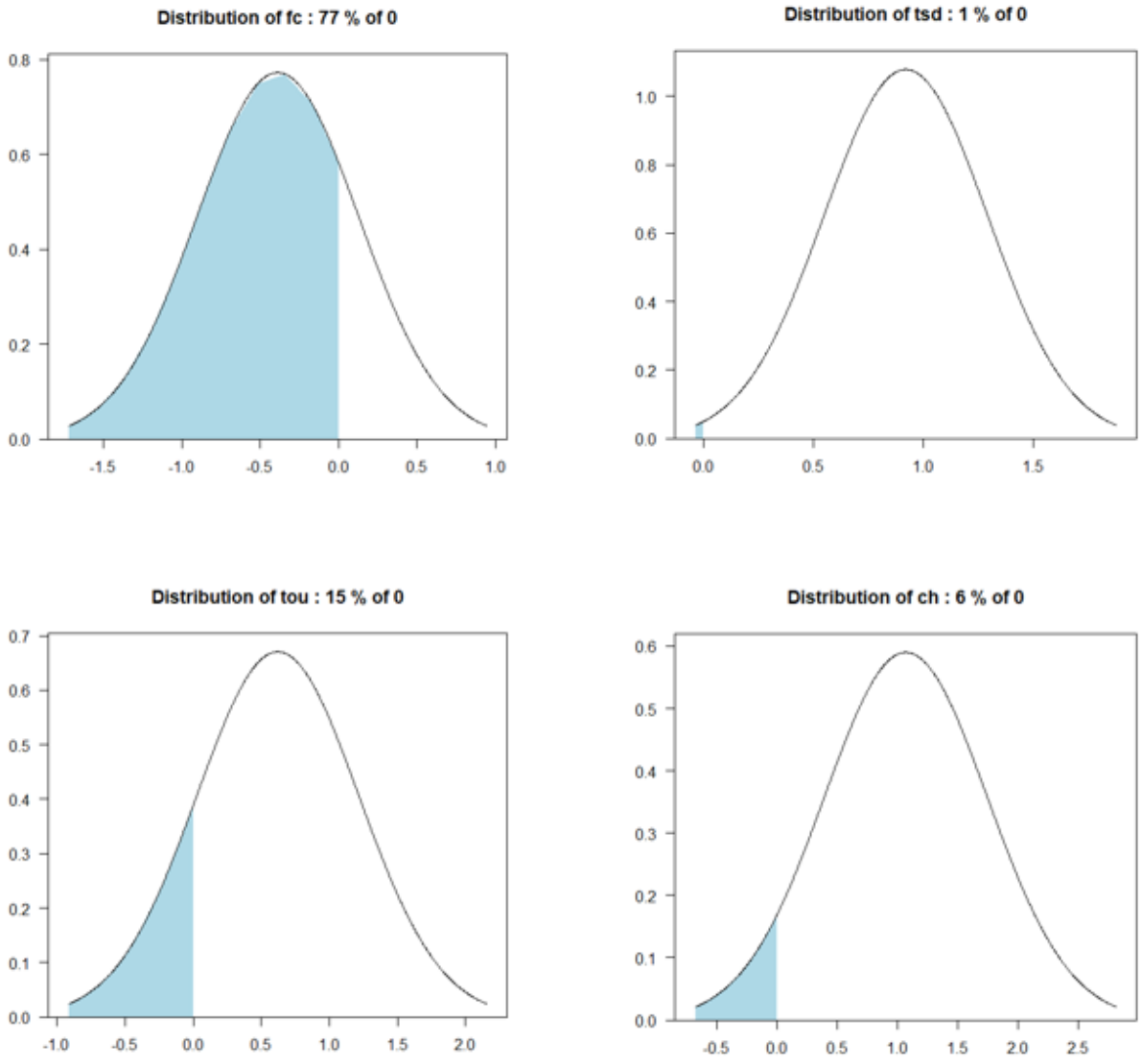


Figure 3.10. – Distribution of random parameters of individuals for the final MXL model of the Cévennes sample.

species) occurs within these categories. Also the minority part of the forest cover attribute and the tourism attribute decreased and the proportion of persons having negative preferences for cultural heritage stays small with 6%.

3.3.3.2. Montpellier

With the procedure being similar to that one applied on the Cévennes sample, I will be shorter in explaining how the models for further analysis have been determined.

Baseline model

The random parameter distributions tested for the baseline model are the traditional assumptions of normal distributions for the non-payment attribute and a lognormal distribution for the payment. Trying other distributions than normal distributions for the first four attributes did not improve model parsimony (see figure B.1 in the appendix on page 279). Consequently, this specification is used as baseline mixed logit model (table 3.9).

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.122		(0.121)	1.010
ASC Alt. SQ	0.246	***	(0.143)	1.720
Forest Cover	−0.464	***	(0.097)	−4.798
Tree Species - equilibrated	0.265	*	(0.139)	1.910
Tourism Infrastructure	0.167	**	(0.080)	2.106
Cultural Heritage	1.171	***	(0.119)	9.850
Payment, Donation	-4.423	***	(0.249)	-17.771
SD Forest Cover	0.697	***	(0.151)	4.626
SD Tree Species	1.127	***	(0.180)	6.245
SD Tourism Infrastructure	0.871	***	(0.123)	7.077
SD Cultural Heritage	0.844	***	(0.166)	5.096
SD Payment	2.195	***	(0.226)	9.717
Observations			950	
AIC			1728.19	
Log-likelihood			-852.095	
McFadden's pseudo-R^2			0.1731	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.9. – Estimation of baseline mixed logit model for the Montpellier sample.

Similarly to the MNL model, mixed logit coefficients for the Montpellier sample are different than those found for the Cévennes sample. The tree species attribute is not significant, whereas the SQ-ASC is. Forest cover seems to be seen positively, indicated by a positive coefficient. The same can be observed for the tourism and cultural heritage attribute.

Accounting for the correlation among individual's choices lifts the tree species attribute over the threshold of significance, whereas the tourism attribute is furthermore significant at the 5% level. As for the Cévennes sample, inclusion of correlation worsens the AIC, but increases the size of the main effects (table 3.10. Similarly, all specification tests reject the null hypothesis of absence of correlation.

As before, the complete output including the coefficients of the Cholesky-factors are displayed in the appendix (table B.9 on page 280). This permits to determine the correlation matrix (table 3.11):

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.092		(0.082)	1.120
ASC Alt. SQ	0.487	***	(0.083)	5.869
Forest Cover	0.441	***	(0.046)	9.580
Tree Species - equilibrated	0.266	***	(0.092)	2.899
Tourism Infrastructure	0.142	**	(0.056)	2.527
Cultural Heritage	1.143	***	(0.050)	22.678
Payment, Donation	-4.196	***	(0.094)	-44.588
Observations			933	
AIC			1884.37	
Log-likelihood			-920.19	
McFadden's pseudo-R^2			0.1070	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.10. – Estimated coefficients of baseline model with account for correlation, Montpellier.

	fc	tsd	tou	ch	pay
fc	1	0.145	-0.323	0.429	0.177
tsd	0.145	1	0.605	0.793	0.041
tou	-0.323	0.605	1	0.696	0.164
ch	0.429	0.793	0.696	1	0.244
pay	0.177	0.041	0.164	0.244	1

Table 3.11. – Correlation matrix of the Montpellier sample baseline MXL model.

Compared to the Cévennes sample, much more correlation on a higher level is observed, especially if the cultural heritage attribute is concerned.

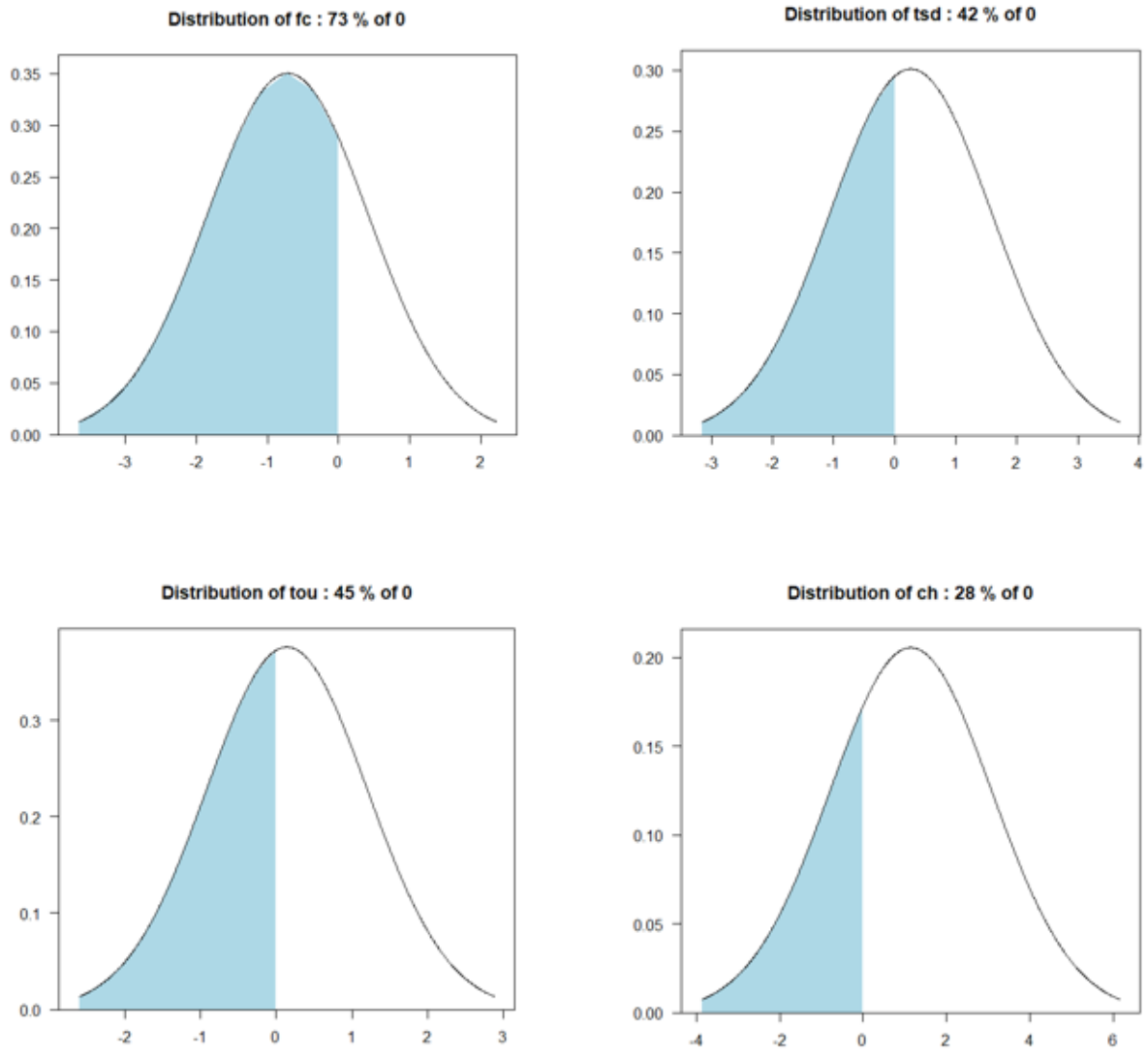


Figure 3.11. – Distribution of random parameters of individuals for the baseline MXL model of the Montpellier sample

The distribution of random coefficients within the Montpellier sample is relatively similar to that one of the Cévennes (figure 3.11). Forest cover is majoritarily perceived negatively, whereas tree species, tourism and cultural heritage have a positive contribution to individual's utility. Nevertheless, for the general direction of these effects, there is much more controversy among the Montpellier sample with nearly the half of coefficients being negative for the tourism and the tree species variable. With 28%, the proportion of negative coefficients for cultural heritage is much larger than for the baseline model of the Cévennes sample (3%).

Interactions and backward elimination

Including the significant interactions from the MNL (section 3.3.2.2) improves the parsimony indicators significantly (AIC: 1669, R^2: 0.2029; see figure 3.12). Main effect interactions are still not becoming significant. Meanwhile, some attribute coefficients get even insignificant several times which indicates no strong robustness of the effects. This concerns the tree species attribute and the tourism variable, which have also been found to be highly correlated, as indicated in table 3.11 .

Model	Interactions considered from MNL	Estimation parameters				
		Interaction significant	AIC	Main effect significant	pseudo-R2	LL
10	FC:age	yes	1668,89	tsd and tou not	0,2029	-821,44
11	tsd:age	yes	1684,73	tsd and tou not	0,1952	-829,36
12	tsd:own.parcel	at 5% level	1733,43	tsd slightly not	0,1715	-853,72
13	tou:age	slightly not	1685,82	tsd not	0,1947	-829,91
14	Gender:tou	yes	1720,86	yes	0,1776	-847,43
15	5M:ch	yes	1710,76	tsd not, tou slightly not	0,1825	-842,38
Interaction of main effects:						
16	FC:tsd	no	1735,56	tsd not	0,1705	-854,78
17	tou:CH	no	1735,51	tou slightly not	0,1705	-854,75
18	FC:CH	no	1736,28	yes	0,1702	-855,13

Figure 3.12. – Significance of interactions for the MXL model, Montpellier.

Continuing with the stepwise elimination results in removing first those interactions that are not significant (the tourism:age interaction, see figure 3.13).

Model	FC:age	TSD:age	TSD:parcel	TOU:age	TOU:Gender	CH:5yMtp	LL	R2	AIC
all interactions - 19							-804,12	0,2197	1644,24
test - 20							-805,47	0,2184	1644,94
Fixed price coefficient							-831,98	0,1926	1697,96
Integration of correlation							-788,43	0,2349	1632,87

Figure 3.13. – Subsequent elimination of non significant interactions for the MXL model of the Montpellier sample.

Trying to remove the interaction (model 20) worsens the AIC slightly. I therefore prefer to keep all interactions in the final model. This results in our final models where all attribute coefficients are significant at 5% level and the ASC for the SQ at 10%. Additionally, all standard deviation terms are significant (see table 3.12), which supports the choice for a mixed logit model with heterogeneity on the level of each attribute.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.086		(0.123)	0.695
ASC Alt. SQ	0.249	*	(0.148)	1.685
Forest Cover	0.638	**	(0.258)	2.472
Tree Species - equilibrated	-0.626	**	(0.333)	-1.880
Tourism Infrastructure	1.084	***	(0.271)	3.997
Cultural Heritage	1.815	***	(0.253)	7.172
Payment, Donation	-4.348	***	(0.248)	-17.547
Forest Cover : Age	-0.023	***	(0.005)	-4.436
Tree Species : Age	0.018	***	(0.006)	2.885
Tree Species : Owner of parcel	2.220	**	(1.104)	2.011
Tourism Infrastructure : Age	-0.012	***	(0.004)	-2.751
Tourism Infrastructure : Gender - female	-0.605	***	(0.167)	-3.619
Cultural Heritage : 5y Montpellier	-0.807	***	(0.254)	-3.176
SD Forest Cover	0.632	***	(0.168)	3.772
SD Tree Species	0.943	***	(0.182)	5.171
SD Tourism Infrastructure	0.800	***	(0.127)	6.284
SD Cultural Heritage	0.685	***	(0.163)	4.207
SD Payment	2.194	***	(0.245)	8.966
Observations			920	
AIC			1639.90	
Log-likelihood			-801.95	
McFadden's pseudo-R^2			0.2218	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table 3.12. – Estimation of the final mixed logit model for the Montpellier sample without correlation.

Compared to the baseline model, the z-values were slightly decreasing for each of the standard deviations so that it can be inferred that interactions are accounting for parts of the heterogeneity found in the baseline model.

When testing for a fixed payment parameter, the same as for the Cévennes sample is found, R^2 and AIC rise to values of 0.1926 and 1697 (see table 3.13). Nevertheless, a likelihood-ratio test rejects the hypothesis of a non-random parameter. Accordingly, a log-normal distribution for the donation attribute is kept in the model assumptions.

The same tendency is observed during the integration of correlation into the model: Information and model fit criteria indicate a worse performance of the model, but specification tests are suggesting presence of correlation. The results for this correlated model are displayed in table B.10 in the appendix on page 281.

The effect of including interactions causes the majority of coefficients for the tree species to become negative (figure 3.14), what supports doubts on the robustness of the effects of this attribute. Notably the age variable seems to have an important effect. The general direction of the effects on utility for the other attributes are confirmed, showing a higher degree of homogeneity, as for the Cévennes sample.

3.3.4. Factor and cluster analysis

As indicated in 2.7.3, participants in the deliberative workshops were invited to state for each attribute of the precedent choice tasks how they accounted for different benefits represented by indicator statements. They had to choose whether they "considered" the issue raised in the statements, whether they found it not important, whether they were not aware of it or if they totally disagree with it. As already explained, this classification aimed to distinguish if a person did not consider an issue due to a lack of information ("not aware") or voluntarily as expression of her preference ("not important"). Other elicitation schemes such as Q-methodology or Likert scales could not have raised this particular information. Especially the assessment of the influence of deliberation made this classification necessary and will be addressed in the fourth chapter.

The information provided by these statements was processed within a multiple correspondence analysis (MCA, methodological overview in section 2.6.3) in order to determine synthetic similarities in the preferences among the ES incorporated in each attribute. The resulting components were then the input data on which a cluster analysis was applied to gather individuals with common preferences for the attributes and gain further insight about the heterogeneity of preferences within the sample regrouping both regions (section 3.3.4.2, with the underlying theory provided in 2.6.4). Further discussion and interpretation of the data is given in section 3.4.2.

It should be noted that the focus groups, on which the indicator statements were based, were particularly reactive with regard to the forest cover attribute. As a result, more statements were presented for this attribute (12 statements) than for each of the other attributes (4 or 5 statements). As a consequence, it causes more variation in the model and components are relatively biased towards forest cover. In other words, the absolute variation among attributes is

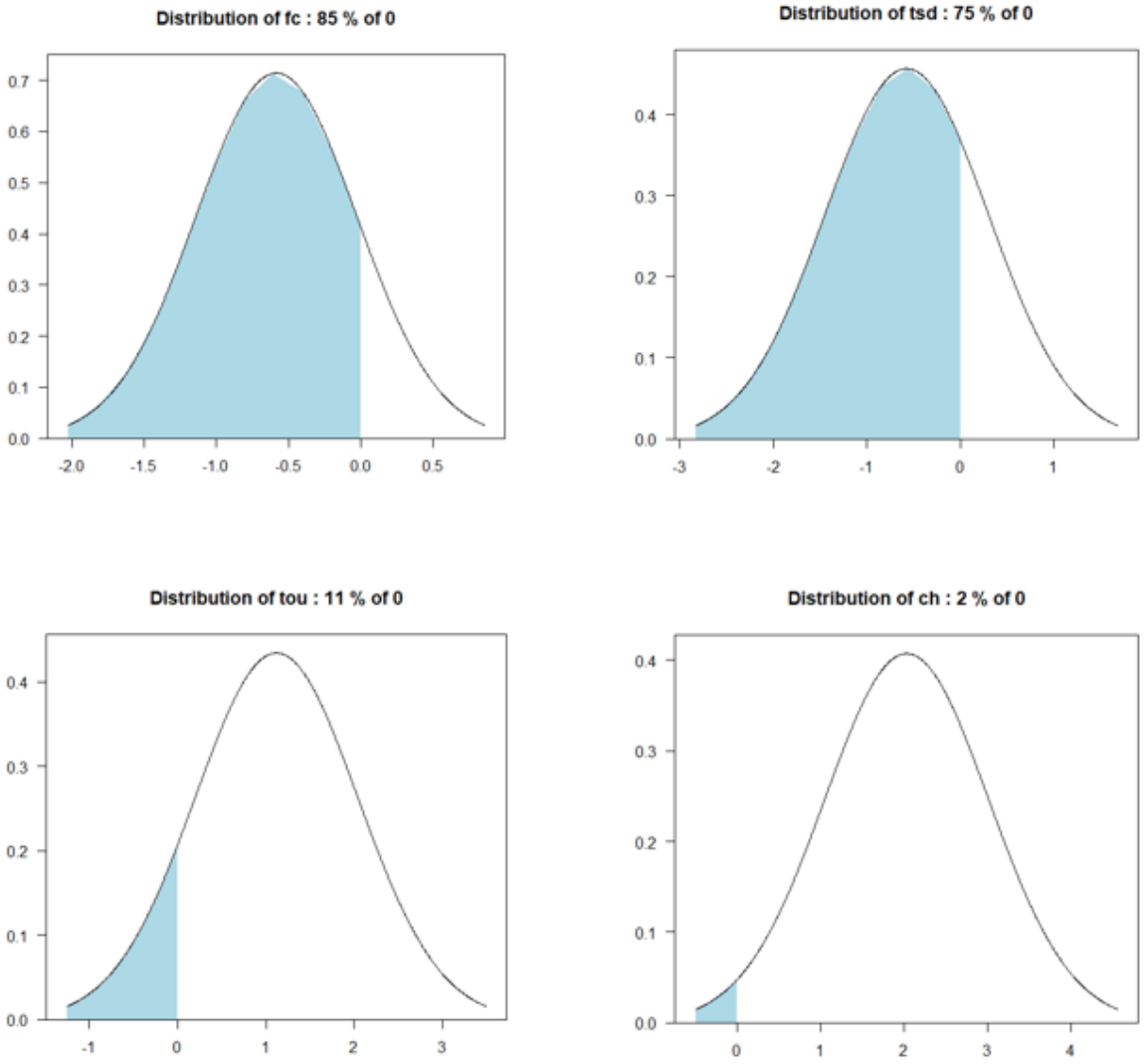


Figure 3.14. – Distribution of random parameters of individuals for the final MXL model of the Montpellier sample.

only compared at the level of each benefit or ES and not across attributes as a whole. Therefore, the cluster analysis cannot provide information on whether one attribute was more important than another. Nevertheless, this unbalanced statement distribution simply reflects the importance accorded to the forest cover by our focus groups.

3.3.4.1. Factor analysis

Non-imputed data set

A first MCA on the data set where missing data was marked as such was run. Figure 3.15 displays the most important categories in the space opened by the first two dimensions of the

total inertia. The most influential correlation is determined by multiple NA-categories that represent missing data. Hence, the most common correlation among individuals in answering to the indicator statements is on whether they responded to the question or not. It retraces the fact that people having not answered to a specific statement are probably not responding to similar statements as well. Although this relation has a certain interest, it also hides interrelation in the structural part of our data and would therefore harm our analysis about the rationale of people having answered to the questions [JCLH12].

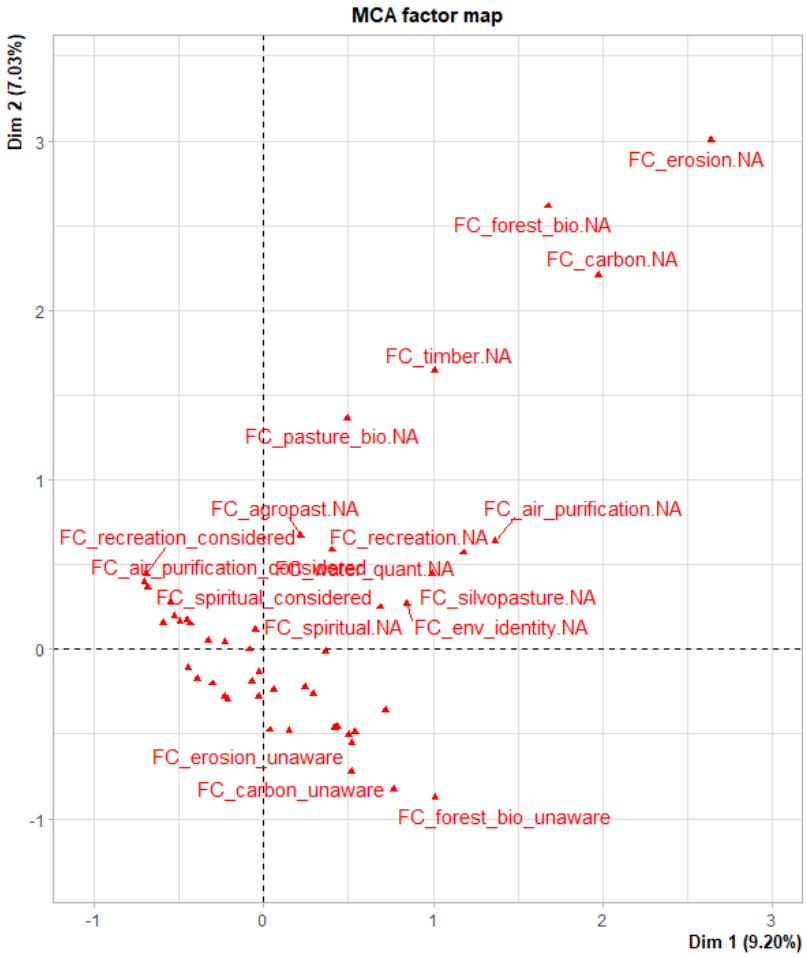


Figure 3.15. – Representation of categories in dimension 1-2 of the non-imputed dataset (both region are combined for the factor analysis).

Instead of removing observations containing those missing values, a procedure of imputation is applied, that replaces missing values with means of the variable categories such that the replacing values do not bias relations of the remaining "real" data. The dataset is then processed with a MCA that measures whether the inertia for the first dimension can be further optimized by replacing the precedent means with those resulting from the categories constructed in the first dimensions in the MCA. This procedure is repeated several times until convergence to stable

imputed values is reached. Even if it does not impact the relation in the structural data, it biases the estimation of the relative importance of principal components. Hence, the partial contribution of the first two dimensions to the entire inertia is overestimated [JCLH12]. The imputation procedure was applied, using the miss.MDA package in R [JH+16].

Imputed data set

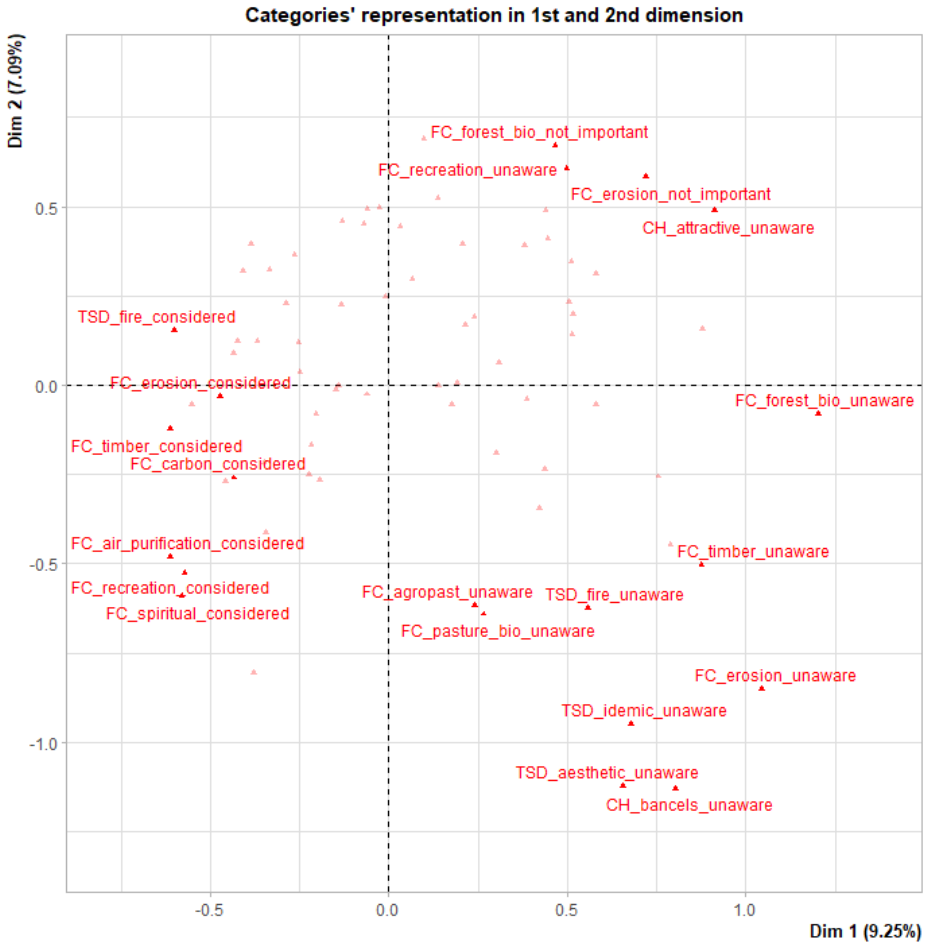
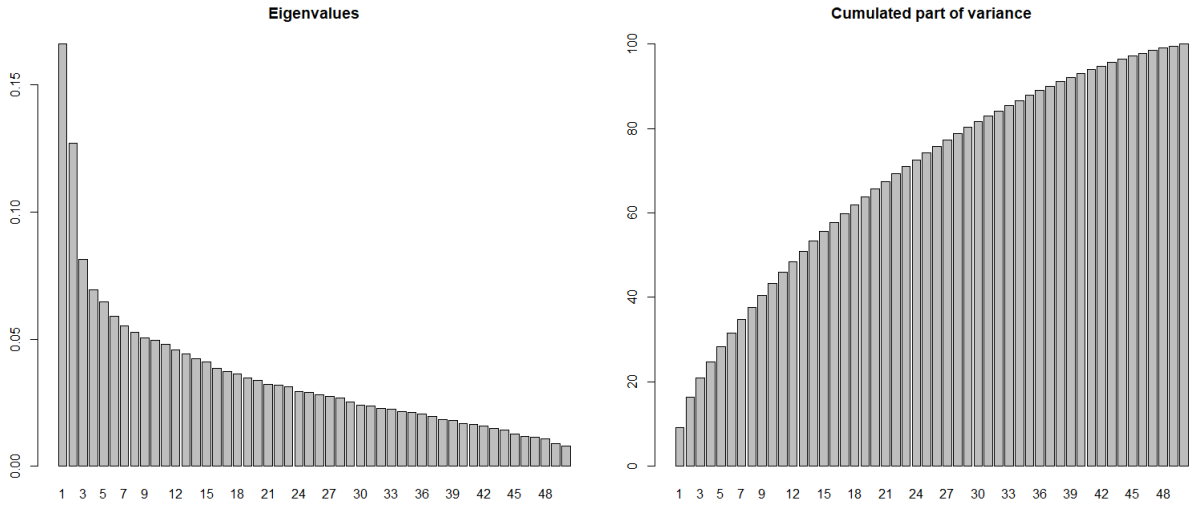


Figure 3.16. – Representation of categories in dimension 1-2 of the imputed dataset.

Generating the same graph as before with the imputed data sets reveals that the importance of the first two dimensions increased (see figure 3.16). This can be partly due to the overestimation of their importance as consequence of the imputation of values (as described above) and the fact that by removing the noising effect of the missing values, the main structural effects in the data set are now accounted for more clearly distinguishable and more inertia is attributed to the



(a) Eigenvalue per component.

(b) Cumulated part variance per component.

Figure 3.17. – Graphical representation of the evolution of eigenvalues and the cumulated proportion of included variance for subsequent dimensions.

first principal components. Clearly, the variables positively correlated to the first dimension [13] are forest related (e.g. erosion control, timber provision and forest biodiversity). The second dimension seems to accentuate complementary benefits of forests within the Cévennes (fire protection, aesthetic and endemic tree species). Before deepening the identification of common characteristics within the principal components, a clarification of how many dimensions should be part of the analysis is necessary.

In order to decide on the pertinence of dimension and their further consideration, an observation of the eigenvalues of each dimension as well as the cumulative variation included within the dimension is necessary. Figure 3.17 present this information. Generally, the least eigenvalue of a dimension in a MCA involving K variables is $1/K$. All dimensions below and even around this value can be considered as noise [HJ14]. With the 25 variables in our data set, the threshold value of $1/16 = 0.04$ is reached at the 16th dimension, which - together with the 15 dimensions before - would account for 57.7% of the variation within the dataset. Whereas this represents a possible limit for the dimensions to consider, the difference of eigenvalues between dimension also reveals possible patterns in the dataset: If the eigenvalue of the nth dimension is considerably higher than those of the dimension $n+1$, a common behaviour in the dataset is included in dimension n and the probability of dimension $n+1$ to represent a large amount of noise increases. Investigating the evolution of the eigenvalues see table 3.13 reveals considerable jumps [14] after the third dimension (eigenvalue 0.081 with total cumulative variance of 20.9%) and the sixth

13. The prefix of each variable displayed in the following figures denote the attribute of the choice, the rest of the variable identifies the service. When the concrete categories are shown, a suffix will identify the nature of consideration (considered, not important, unaware)

14. At least considerably higher than for subsequent (and sometimes even precedent) dimensions.

Statistic	Eigenvalue	% of Variance	Cum. % of Variance
Dimension 1	0.166	9.252	9.252
Dimension 2	0.127	7.085	16.337
Dimension 3	0.081	4.528	20.866
Dimension 4	0.070	3.875	24.740
Dimension 5	0.065	3.602	28.342
Dimension 6	0.059	3.289	31.631
Dimension 7	0.055	3.074	34.705
Dimension 8	0.053	2.944	37.649
Dimension 9	0.051	2.818	40.467
Dimension 10	0.050	2.767	43.234
Dimension 15	0.041	2.287	55.571
Dimension 16	0.039	2.146	57.718

Table 3.13. – Eigenvalues and proportion of total variance per dimension of principal components.

dimension (EV: 0.059; 31.6% of total variation) that should as well be taken into consideration as the threshold value at the 16th dimension. A profound analysis of the dimensions will help to determine the adequate "cut" for the cluster analysis.

Dimensions 1-2

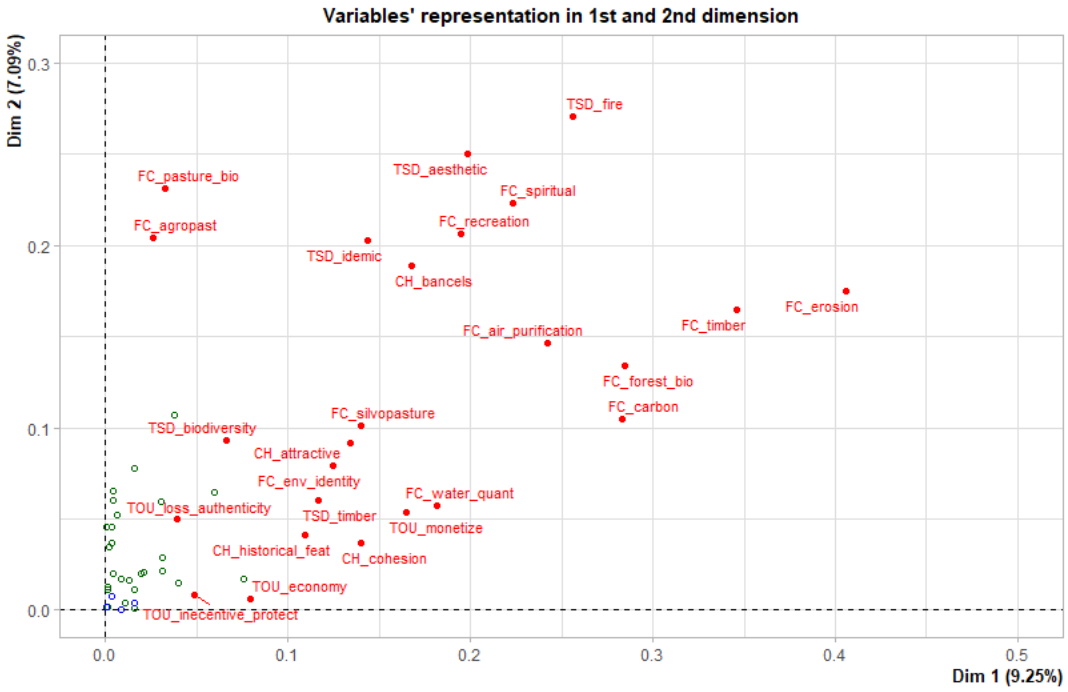


Figure 3.18. – Representation of variables in dimension 1-2.

Figure 3.18 represents the correlation of the active variables in the 1-2 dimension. Table 3.14 indicates the corresponding correlation values (measured by the R^2) for those variables that exceed a value of 0.2.

Dimension 1	R^2	Dimension 2	R^2
FC erosion control	0.38	TSD fire risk	0.25
FC timber provision	0.30	TSD aesthetic value	0.25
FC forest biodiversity	0.29	FC pasture biodiversity	0.22
FC carbon sequestration	0.27	FC recreation	0.21
TSD fire risk	0.23	FC spiritual values	0.21
FC air purification	0.21	TSD endemic species	0.20

Table 3.14. – Correlations per variable in the 1-2 dimension.

For the first dimension, a dominance of forest-related ES and benefits can be observed. The seond dimension still refers to the forest cover and tree species attribute, but relates to rather cultural values and the presence of agropastoral landscapes.

Dimension 1 (9.3% of total variance)

As already mentioned above, forest related benefits and services are clearly most important for this first principal component (see table 3.15). When biophysical impacts of forests are considered by the individual, a clear negative correlation is observed. Consequently, not considering these issues (either as not important or as unaware), causes positive correlation with the component. This means that the first component separates individuals into those that considered forest benefits and those that did not. Nevertheless, this does not automatically mean that individuals preferred forests over pastures.

Dimension 1	Contribution	Estimate
FC forest biodiversity - unaware	3.7061	0.4016
FC timber - unaware	5.0818	0.3288
FC carbon sequestration - unaware	2.9625	0.2917
FC erosion control - unaware	3.4968	0.2786
FC erosion control - not important	2.8296	0.1466
FC spiritual - considered	3.0536	-0.2447
TSD fire risk - considered	3.3450	-0.2538
FC timber - considered	3.2264	-0.2584
FC air purification - considered	3.4112	-0.2718
FC erosion control - considered	3.449	-0.3273

Table 3.15. – Contributions per category in the first dimension.

Dimension 2	Contribution	Estimate
FC pasture biodiversity - considered	3.4750	0.2331
TSD fire risk - not important	3.7277	0.2188
FC recreation - unaware	3.4703	0.1955
FC agropastoral landscape - unaware	3.6082	-0.1437
FC pasture biodiversity - unaware	3.5476	-0.1806
TSD endemic - unaware	5.1918	-0.2553
FC spiritual - considered	4.1274	-0.2579
TSD fire risk - unaware	4.5067	-0.2638
CH bancels conservation - unaware	5.0012	-0.3351
TSD aesthetic value - unaware	6.2389	-0.342

Table 3.16. – Contributions per category in the second dimension.

Dimension 2 (7.1% of total variance)

For this dimension, the focus is less on forest services themselves, but on benefits from different types of land use. Considering forest benefits is rather neutral within this component (around 0), being unaware of most agro-pastoral values (pasture biodiversity and agro-pastoral landscape) and less tangible cultural benefits is negatively correlated, judging them as not important is positively correlated.

As illustrated in table 3.16, most of the categories that are important for the construction of this axis are negating, which means that being unaware of the benefits of open landscapes and the associated cultural values, separates individuals. With reference to the previous dimension, this further distinguishes if the appreciation of forests goes automatically with a depreciation of pastures. It could be that people are more attached to traditions of pastoralism while being aware of the benefits that forests provide.

Dimensions 3-4

Figure B.2 about the variables' representation (in the appendix, page 282) and table 3.17 for the correlation of variables present the same information as it has been done before for the 1-2 dimension.

Dimension 3	R^2	Dimension 4	R^2
FC agropastoralism	0.28	CH historical features	0.35
TOU incentive for protection	0.24	TOU incentive for protection	0.22
TOU economic benefits	0.20	TOU economic benefits	0.21

Table 3.17. – Correlations per variable in the 3-4 dimension.

The most important variables relate to the agropastoral landscape and benefits from tourism (the incitation that nature protection could be enforced to attract tourists and the economic benefits) for the third dimension and additionally to the conservation of historical features for the fourth dimension.

Dimension 3	Contribution	Estimate
CH bancel conservation - not important	5.8853	0.2101
TOU economic benefits - not important	7.4801	0.1900
TOU incentive protection - not important	7.2616	0.1734
FC air purification - unaware	2.9284	0.1560
CH historical features - not important	3.2826	0.1507
FC pasture biodiversity - considered	3.2393	-0.1479
TOU incentive protection - considered	3.7214	-0.1511
FC erosion control - unaware	3.9353	-0.1642
FC forest biodiversity - unaware	4.9021	-0.1978
FC agropastoralism - considered	6.5522	-0.2313

Table 3.18. – Contributions per category in the third dimension.

Dimension 4	Contribution	Estimate
TOU economic benefits -unaware	11.2404	0.581
CH historical features - unaware	17.5827	0.4162
TOU incentive protection - unaware	11.5124	0.3679
CH social cohesion - unaware	4.5100	0.1323
CH attractivity - unaware	2.0605	0.1293
FC environment identity - unaware	1.8917	0.1149
TSD aesthetic values - not important	2.7161	0.1051
FC timber - unaware	1.9704	-0.1199
FC carbon - unaware	4.6950	-0.1452
CH social cohesion - considered	2.5424	-0.146

Table 3.19. – Contributions per category in the fourth dimension.

Dimension 3 (4.5% of total variance)

The most contributions to this dimension (table 3.18) originated from categories that witness that no importance is given to authentic image to foreigners (bancels conservation, several tourism attributes) and a positive image of pasture landscape is correlated with the negative scale. In general, this dimension is less characterised by statements concerning the forest cover and the tree species attribute.

Dimension 4 (3.9% of total variance)

By far the most contributions (those with a value above 11) stand for the unawareness of benefits from tourism and historical features (table 3.19). Other more general conclusions are not apparent.

Obviously, it gets difficult to give a meaningful interpretation to the 4th dimension. Therefore, the analysis of principal components does not go beyond. For proceeding with the clustering of individuals, the question about the number of principal components to be retained arises. Observation of eigenvalues revealed possible cuts after 3, 6 or 16 dimensions. Given that the 4th dimension was still (although difficult) interpretable, taking only 3 dimensions with 20.9% of variation accounted is possibly neglecting some less visible relations. Contrary, including 16 dimension with 57.7% seems to be overly careful and risk to include large amounts of noise. Consequently, I prefer to include the 6 first dimensions of the MCA into the clustering process.

3.3.4.2. Clustering

As motivated in the previous section, the clustering algorithm was launched using the first six dimension of the MCA. The separation into three clusters is proposed. Figure 3.19 displays at the upper right a bar plot that shows the subsequent gain of inertia when the sample is further divided into clusters. Moving from 1 to 2 distinct groups (first bar) and from 2 to 3 clusters, considerably improves inertia whereas moving further to 4 groups does not yield a sufficiently high gain in inertia. Hence, the repartition into three clusters is chosen.

In figure 3.20, individuals are colored in function of their membership in a cluster. Already the space representing the first two dimensions separates the clusters relatively well. This means that individuals share sufficiently different views on the consideration of forest services (first dimension) and on complementary agro-pastoral and transcendental values (second dimension) to identify distinct groups among them. Here, cluster 1 is more homogenous (less wide-spread in the 1-2 dimension) than cluster 3 which is more dispersed. The representation of clusters on the third and fourth dimension does not furnish a similarly clear image as figure 3.20. The same is true for other combinations of dimensions (1-3, 2-3, 1-4, etc). The 3 clusters have different sizes, cluster 1 contains $n_1 = 108$ individuals (47.0%), cluster 2 has $n_2 = 79$ (34.3%) and cluster 3 $n_3 = 43$ (18.7%) individuals.

	Mean in cluster	Mean in sample	p.value	v.test
		Cluster 1		
Dimension 1	-0.3334	0	0.00	-11.65
Dimension 2	-0.0635	0	0.01	-2.53
		Cluster 2		
Dimension 1	0.2223	0	0.00	5.97
Dimension 2	0.3297	0	0.00	10.12
		Cluster 3		
Dimension 1	0.4291	0	0.00	7.64
Dimension 2	-0.4463	0	0.00	-9.08
Dimension 6	-0.0732	0	0.03	-2.19

Table 3.20. – Description of clusters by MCA dimensions.

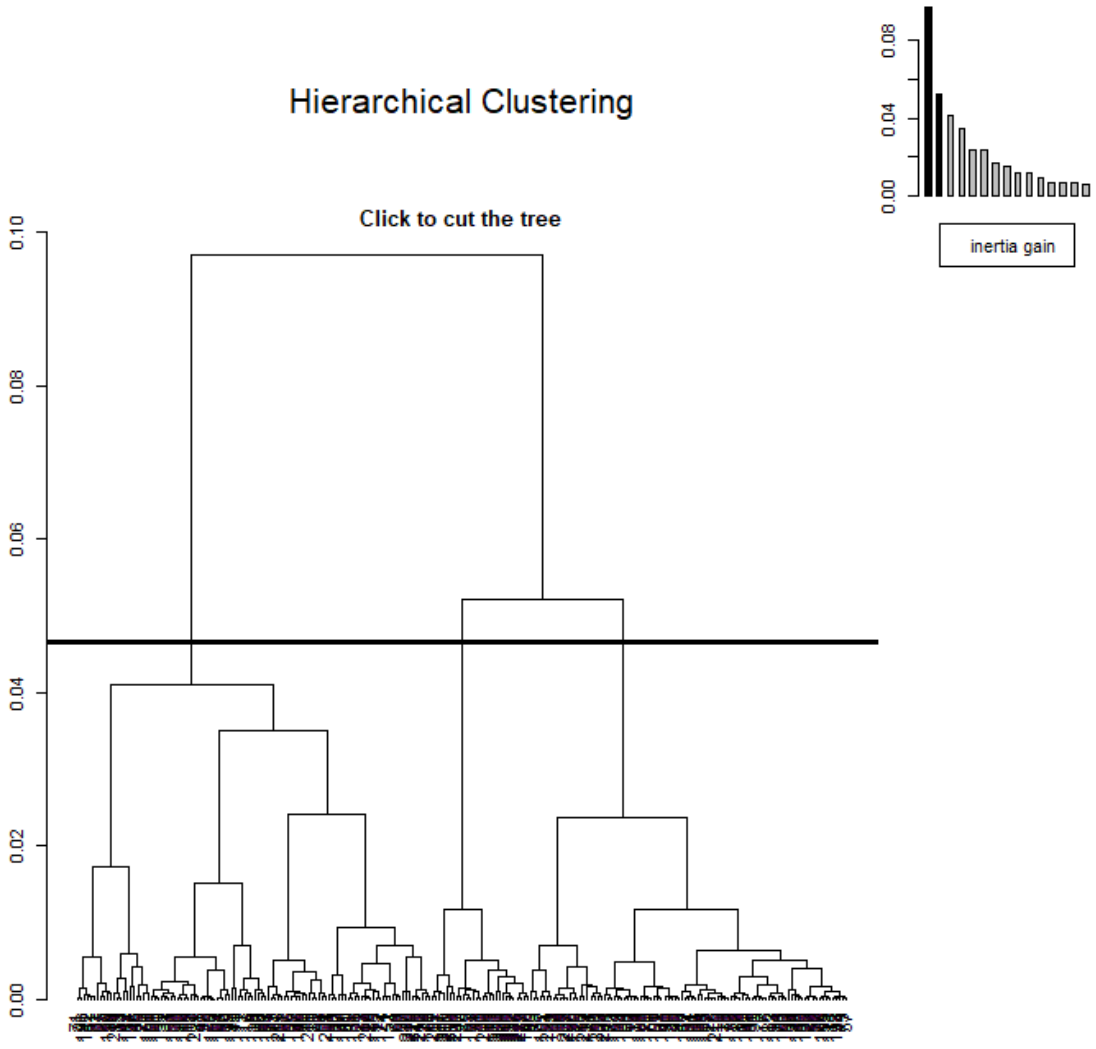


Figure 3.19. – Hierarchical tree supposing a cut into three clusters.

As visualized in table 3.20, the membership in a cluster is mainly determined by the first two dimensions, confirming the visual impression from figure 3.20. As these dimensions were mainly adressing the question of the consideration of forest services as well as cultural values associated to the landscape - and the pastoral landscapes in specific -, it can be expected that modalities on these variables vary over clusters.

In the following, each cluster is investigated in order to distinguish the preferences among clusters.

Figure 3.20. – Representation of the three cluster in the 1-2 dimensional space.

Some remarks

Table 3.21 on page 180 indicates how different modalities are represented within the first cluster: It displays those that are most characteristic for the cluster, meaning that they are particularly over- or underrepresented in this group of individuals compared to the general sample. The first column gives the name of the category, whereas the second one gives the proportion of the class within the modality, in other words how many individuals that took this modality are simultaneously in cluster 1. For example, for the first category (individual s that considered the benefit of erosion control within their choices about the forest cover attribute), 65.3% of the individuals belonging to this category are in cluster 1. The third column gives the inverse relation: How many individuals in the class take the given modality. Particular attention should then be drawn to the fourth column, the share of individuals taking the modality in the whole sample. Investigating again the first category reveals that although "only" 62.6% of the sample considered erosion control, this share increases to 87.0% for cluster 1. Hence, people valuing (or at least considering) erosion control are overrepresented in this first class. The last two columns

show the p-value associated to the Chi-squared independence test on which the table is based as well as the value for the test-statistic [15].

I remind here that the principal components from the MCA on which this clustering is based are only determined by the answers to our indicator statement and not on the socio-demographic variables. Nevertheless, some of these variables might influence the attitude expressed in our association stage and are therefore also correlated with the different clusters and a typology of individuals composing each cluster can be deduced.

In order to keep the table readable, not all significant categories for the cluster are shown, but only those that have a particular interest for its categorization and description. Accordingly, the most important over-and underrepresented categories are displayed, separated by vertical dots from those categories less (but still) significant that give some complementary information. The complete table for each cluster is presented in the appendix [16].

Cluster 1 (47.0%)

The most overrepresented categories in cluster 1 all refer to the consideration of ES and benefits related to forests (e.g. erosion control, carbon sequestration, forest biodiversity, etc.) Consequently, modalities standing for a non-consideration of these - especially biophysical features - are underrepresented. Interestingly, most of the forest-related ES that are underrepresented fall into the "not important" category and not into the "unaware" category. This might be pointing on people deliberately deciding to not consider forest related services and other traditions ("not important" category for historical features, conservation of bancèls, carbon sequestration and erosion control). People with these motivations are not in cluster 1 (or at least underrepresented).

Non-material issues such as (i) aesthetic values, (ii) the social cohesion generated from cultural heritage and (iii) spiritual values (as well as their contribution to the identity of the region and their inhabitants) attributed to forests are also particularly recognized in this first cluster. Accordingly, other benefits also referring to non-material benefits (historical features, endemic tree species) are underrepresented compared to the whole sample. Interestingly, individuals of the youngest age class are underrepresented, explaining in parts the positive correlation of age with this cluster (mean in cluster: 52,1; mean in sample: 49,4) whereas no other socio-demographic characteristics seem to be correlated.

An additional remark concerns the presentation of this "cleared" table compared to the complete table in the appendix (table B.11 on page 284): As the categories "not important" and "unaware" are often related, although not meaning the same, I deleted the category of both that was the least over - or underrepresented in order to increase readability [17]:

15. As the age variable is the only quantitative variable included in the cluster analysis (as supplementary variable) its interpretation is slightly different. Given are the mean in the cluster, the mean in the sample and, as for the qualitative variables, the p-value and the test-statistic.

16. Table B.11 on page 284; table B.12 on page 285 and table B.13 on page 287

17. If for example individuals judging a benefit as "not important" are more under- or overrepresented than people that are "unaware" of the same benefit, only the "not important" category is displayed and vice versa.

In conclusion, this cluster seems to incorporate individuals that appreciated ES and benefits from forests together with traditional practices and places (bancèls, historical features, pastoralism transferred to forests). Nevertheless, no specific tendency is observed regarding open landscapes and agropastoralism.

	Cla/Mod	Mod/Cla	Global	p.value	v.test
FC_erosionconsidered	65.28	87.04	62.61	0.00	7.38
FC_carbonconsidered	67.97	80.56	55.65	0.00	7.26
FC_forestbioconsidered	63.27	86.11	63.91	0.00	6.73
FC_timberconsidered	75.00	52.78	33.04	0.00	6.02
FC_recreationconsidered	75.00	50.00	31.30	0.00	5.78
TSD_fireconsidered	73.68	51.85	33.04	0.00	5.72
FC_air_purificationconsidered	71.95	54.63	35.65	0.00	5.67
CH_bancelsconsidered	59.12	87.04	69.13	0.00	5.63
TSD_aestheticconsidered	61.42	72.22	55.22	0.00	4.89
FC_spiritualconsidered	67.53	48.15	33.48	0.00	4.42
CH_cohesionconsidered	57.24	76.85	63.04	0.00	4.09
TOU_monetizeconsidered	70.59	33.33	22.17	0.00	3.82
⋮					
deliberationTRUE	55.17	59.26	50.43	0.01	2.50
FC_silvopastureconsidered	58.67	40.74	32.61	0.01	2.45
age	-	52.13	49.39	0.02	2.31
FC_envidentity_considered	59.32	32.41	25.65	0.03	2.18
⋮					
FC_silvopastureunaware	37.80	28.70	35.65	0.04	-2.06
FC_pasturebioconsidered	38.46	32.41	39.57	0.04	-2.07
CH_historicalfeatnotimportant	32.61	13.89	20.00	0.03	-2.17
TOU_economynotimportant	30.95	12.04	18.26	0.02	-2.29
deliberationFALSE	38.60	40.74	49.57	0.01	-2.50
age_class-18-29	25.00	9.26	17.39	0.00	-3.07
FC_waterquant-unaware	33.72	26.85	37.39	0.00	-3.10
TSD_idemic-unaware	23.08	8.33	16.96	0.00	-3.30
CH_bancels-not-important	20.00	6.48	15.22	0.00	-3.51
CH_cohesion-unaware	16.13	4.63	13.48	0.00	-3.78
⋮					
FC_recreation-unaware	22.41	12.04	25.22	0.00	-4.38
TOU_monetize-unaware	30.77	29.63	45.22	0.00	-4.47
FC_erosion-unaware	10.00	2.78	13.04	0.00	-4.53
CH_attractive-unaware	7.41	1.85	11.74	0.00	-4.61
FC_carbon-not-important	19.64	10.19	24.35	0.00	-4.79
FC_erosion-not-important	15.69	7.41	22.17	0.00	-5.21
FC_forestbio-not-important	14.00	6.48	21.74	0.00	-5.45
FC_timber-unaware	16.95	9.26	25.65	0.00	-5.48

Table 3.21. – Categories describing the first cluster. At the top are categories displayed that are significantly overrepresented in this cluster. The categories at the bottom are significantly underrepresented.

Cluster 2 (34.3%)

The second cluster of individuals seems to be - not surprising - opposed to the first cluster (table 3.22. People, who did not consider forest services and traditional practices are overrepresented, such as individuals that considered agro-pastoral landscapes and biodiversity associated to pastures. Meanwhile, other benefits partly related to open landscapes such as bancèls and silvopastoralism are not particularly present in this cluster. Furthermore, contributions to this cluster are attitudes that neglect the importance of traditions and cultural values (attractiveness for tourists, cohesion, loss of authenticity, historical features, bancels). This might be an indication that the preference for agropastoralism is not primarily motivated by cultural values or economic opportunities from local production, but by ecological considerations.

Probably due to its smaller size, this cluster already shows some significant correlations with socio-demographic characteristics. It is the only cluster with regional differences: slight underrepresentation of inhabitants from Montpellier and slight underrepresentation of people haven't lived during a long time in the Cévennes. As before, people are older than the average sample. Women are highly underrepresented.

The impression that the characteristics of this cluster give, is that open landscapes are especially supported in this group, mainly driven by ecological values. The fact that variables that indicate a specific tendency towards preferences from the Cévennes region (less Montpellier habitants, more people having lived or living in Cévennes area for a longer period), does - for me, a bit surprisingly - not translate into a higher integration of variables that are related to traditions and cultural heritage. Here, I want to stress that clusters are products of similarities among people. It could therefore be possible that both, people valuing cultural heritage and those who do not, are captured in this cluster because their similarity of valuing open landscapes is a more determinant factor with regard to the other clusters.

	Cla/Mod	Mod/Cla	Global	p.value	v.test
FC_forestbio-not-important	68.00	43.04	21.74	0.00	5.49
FC_carbon-not-important	64.29	45.57	24.35	0.00	5.27
FC_erosion-not-important	64.71	41.77	22.17	0.00	5.01
FC_recreation-unaware	62.07	45.57	25.22	0.00	5.00
TSD_fire-not-important	65.31	40.51	21.30	0.00	4.98
CH_bancels-not-important	68.57	30.38	15.22	0.00	4.44
FC_pasturebio-considered	51.65	59.49	39.57	0.00	4.42
FC_timber-not-important	53.16	53.16	34.35	0.00	4.27
CH_attractive-unaware	66.67	22.78	11.74	0.00	3.59
CH_historicalfeat-not-important	56.52	32.91	20.00	0.00	3.42
TSD_aesthetic-not-important	53.57	37.97	24.35	0.00	3.39
⋮					
FC_agropast-considered	46.51	50.63	37.39	0.00	2.96
FC_silvopasture-not-important	50.98	32.91	22.17	0.01	2.76
TOU_lossauthenticity-not-important	47.76	40.51	29.13	0.01	2.69
CH_cohesion-not-important	48.94	29.11	20.43	0.02	2.30
TOU_monetize-unaware	42.31	55.70	45.22	0.02	2.29
age	-	52.43	49.39	0.05	1.97
⋮					
region=Montpellier	27.68	39.24	48.70	0.04	-2.06
TOU_economy-considered	30.68	68.35	76.52	0.04	-2.06
X5Cev=FALSE	26.67	35.44	45.65	0.03	-2.24
CH_bancels-considered	29.56	59.49	69.13	0.02	-2.25
age_class=45-54	17.65	7.59	14.78	0.02	-2.26
FC_pasturebio-unaware	20.37	13.92	23.48	0.01	-2.50
CH_historicalfeat-considered	28.93	58.23	69.13	0.01	-2.54
FC_agropast-unaware	19.64	13.92	24.35	0.01	-2.70
TSD_idemic-unaware	15.38	7.59	16.96	0.00	-2.81
TOU_monetize-considered	17.65	11.39	22.17	0.00	-2.91
FC_envidentity-considered	18.64	13.92	25.65	0.00	-3.00
TSD_aesthetic-unaware	11.76	5.06	14.78	0.00	-3.13
⋮					
Gender=Female	24.17	36.71	52.17	0.00	-3.38
TOU_lossauthenticity-considered	18.92	17.72	32.17	0.00	-3.45
FC_timber-considered	18.42	17.72	33.04	0.00	-3.63
FC_erosion-considered	24.31	44.30	62.61	0.00	-4.09
CH_attractive-considered	22.22	35.44	54.78	0.00	-4.24
FC_spiritual-considered	10.39	10.13	33.48	0.00	-5.68
FC_forestbio-considered	20.41	37.97	63.91	0.00	-5.85
FC_recreation-considered	8.33	7.59	31.30	0.00	-5.94
FC_airpurification-considered	9.76	10.13	35.65	0.00	-6.12
FC_carbon-considered	14.06	22.78	55.65	0.00	-7.31

Table 3.22. – Categories describing the second cluster. At the top are categories displayed that are significantly overrepresented in this cluster. The categories at the bottom are significantly underrepresented.

Cluster 3 (18.7%)

For cluster 3, a positive correlation with being unaware of most forest cover and tree species attribute can be observed. This is underlined by the fact that on the other end, mainly the tree species attribute seems to be particularly less considered than in the other clusters. Especially the last three categories (consideration of the risk of forest fires, the aesthetics and the importance of endemic species) are most underrepresented in this cluster. These categories would be main drivers for preferences for deciduous forests, which leads to the conclusion that cluster 3 has less aversion against coniferous forests than the other groups.

Personal characteristics associated to having more experience with the landscapes in the Cévennes are underrepresented (not owner in Cévennes, no farming or gardening, having not lived for a long time in the Cévennes, not having a residence in the Cévennes). Nevertheless, no region, neither the Cévennes, nor Montpellier is significantly over- or underrepresented.

Young people are overrepresented (44.2% of the cluster compared to 17.4% in the sample) and inversely, elderly people are nearly not represented. Retired persons are 2.3% in the cluster but 23.9% in the sample. Accordingly, the age variable has a significant negative correlation with group membership in cluster 3.

Interestingly, not deliberated people are overrepresented.

In conclusion, cluster 3 seems to select associations to the attributes that are result of less formed preferences and knowledge. Contrary to previous clusters, the specificity of this group is not the position with regard to reforestation or not (open agropastoral landscapes or closed forested landscape) but that they are less positioned against coniferous forests.

In general, the distinction between "unaware", "not important" and "considered" refers to different degrees of considerations of a benefit, but are not really comparable among them. When it comes to clustering, a more meaningful, single-dimensional measurement of the intensity of consideration should be preferred (Q-methodology, rating, Likert-Scale) together with an opt-out to filter out "unsure" responses. Our method is suitable to assess the motivation of participants but hides this intensity to a certain extent.

Another possibility is to perform the MCA and the cluster analysis per region. This could eventually complement our analysis with relations that do not fit into the open landscapes vs closed landscapes dichotomy. But in our case, the region was hardly correlated to any of the clusters. Additionally, it could hide certain common characteristics across regions. Finally, clustering across regions to identify bundles is the standard (e.g. [MLIAGL+12], [LLF+19], [SCE+19]).

	Cla/Mod	Mod/Cla	Global	p.value	v.test
TSD_fire-unaware	46.67	81.40	32.61	0.00	7.32
FC_timber-unaware	52.54	72.09	25.65	0.00	7.20
TSD_idemic-unaware	61.54	55.81	16.96	0.00	6.69
TSD_aesthetic-unaware	61.76	48.84	14.78	0.00	6.14
CH_bancels-unaware	62.96	39.53	11.74	0.00	5.45
FC_erosion-unaware	56.67	39.53	13.04	0.00	5.03
age_class=18-29	47.50	44.19	17.39	0.00	4.64
CH_cohesion-unaware	48.39	34.88	13.48	0.00	4.06
TSD_timber-unaware	32.18	65.12	37.83	0.00	3.98
FC_silvopasture-unaware	31.71	60.47	35.65	0.00	3.65
⋮					
FC_pasturebio-unaware	35.19	44.19	23.48	0.00	3.33
FC_waterquant-unaware	29.07	58.14	37.39	0.00	3.03
Owner_not-TRUE	25.40	74.42	54.78	0.00	2.88
TOU_monetize-unaware	26.92	65.12	45.22	0.00	2.87
Farming-Not at all	28.09	58.14	38.70	0.00	2.83
X5Cev-FALSE	26.67	65.12	45.65	0.01	2.81
FC_forestbio-unaware	41.67	23.26	10.43	0.01	2.74
Owner_residence-FALSE	24.09	76.74	59.57	0.01	2.57
CH_historicalfeat-unaware	40.00	18.60	8.70	0.02	2.30
deliberation-FALSE	24.56	65.12	49.57	0.03	2.24
CSP-Executive Employees	30.95	30.23	18.26	0.03	2.13
FC_agropast-unaware	28.57	37.21	24.35	0.04	2.08
⋮					
Owner_residence-TRUE	10.45	16.28	29.13	0.04	-2.09
deliberation-TRUE	12.93	34.88	50.43	0.03	-2.24
Sport-In Cevennes area	13.39	39.53	55.22	0.02	-2.26
Owner_not-FALSE	10.26	18.60	33.91	0.02	-2.39
X5Cev-TRUE	11.22	25.58	42.61	0.01	-2.51
FC_pasturebio-considered	9.89	20.93	39.57	0.00	-2.81
age_class=65+	5.45	6.98	23.91	0.00	-3.07
CH_cohesion-considered	12.41	41.86	63.04	0.00	-3.10
age_class=55-64	0.00	0.00	15.22	0.00	-3.56
⋮					
FC_agropast-considered	6.98	13.95	37.39	0.00	-3.65
FC_silvopasture-not-important	1.96	2.33	22.17	0.00	-3.89
FC_erosion-considered	10.42	34.88	62.61	0.00	-4.05
FC_timber-not-important	5.06	9.30	34.35	0.00	-4.07
CH_bancels-considered	11.32	41.86	69.13	0.00	-4.10
CSP-Retired Persons	1.82	2.33	23.91	0.00	-4.13
TSD_fire-not-important	0.00	0.00	21.30	0.00	-4.42
TSD_fire-considered	1.32	2.33	33.04	0.00	-5.32
age	-	36.91	49.39	0.00	-5.36
TSD_aesthetic-considered	5.51	16.28	55.22	0.00	-5.75
TSD_idemic-considered	4.65	13.95	56.09	0.00	-6.25

Table 3.23. – Categories describing the third cluster. At the top are categories displayed that are significantly overrepresented in this cluster. The categories at the bottom are significantly underrepresented.

3.4. Discussion

The goal of this section is to summarize, compare and interpret the results from the logit model estimations and the cluster analysis, as well as to perform a WTP simulation and a bundles representation by exploiting the complementarity the approaches. The differences between preferences of inhabitants from Montpellier and the Cévennes will be analyzed. Finally, I judge the pertinence of our approach.

3.4.1. Results of the DCE approach

The results from our choice experiment are summarized in the table on page 189 for the Cévennes and in the table on page 190 for Montpellier. Following similar studies in the literature [CEHOC19], the estimated parameters for the MNL models (with and without interactions) the MXL models (with and without interactions) as well as the final MXL model accounting for correlation are presented.

For the MNL and the MXL models, the increasing complexity of the specifications allows to integrate more relations within the data, as indicated by the AIC criterion as well as McFadden's pseudo-R^2. For the Cévennes data, the AIC decreases from 1900 to 1700 and the R^2 rises from 0.1162 to 0.2268, which represents a good model fit. Similarly, the AIC decreases from 1882 to 1633 and the R^2 from 0.0956 to 0.2349 for the Montpellier sample. In both cases, the MXL models with interactions and accounting for individual-level autocorrelation perform best.

The decreasing significance of the status quo alternative specific constant also shows that effects that could not be attributed to a specific variable or a combination of variables, are better modeled in the more complex approaches. That these ASC are possibly significant - even with non-labeled alternatives - is also observed in other studies (e.g. [TBLH16]) and can be partly due to the non-balanced attributes over choice sets in our experimental design, a necessity to specify the nature of our status quo alternative. Especially for the Cévennes data, the interaction with the gender variable shows that women have a tendency to systematically prefer this status quo alternative.

Negative, significant coefficients for the payment attributes for both samples imply a positive marginal utility of income, consistent with neoclassical welfare theory underlying DCEs. When addressing the results for each region individually, some remarks and interpretations are possible.

For the Cévennes, the variable that most refers to the issue of natural reforestation in the Cévennes, the forest cover attribute, is constantly negative. Hence, a preference for the conservation of the existing pastoral landscape can be suggested. The latter is especially true for women, as indicated by the according interaction. A weaker preference against increasing reforestation with age is possible but not consistent in our models (see model 2)).

When forests themselves are concerned, the protection and development of deciduous forest compared to coniferous forest is clearly appreciated, as the positive sign of the tree species attribute shows. The interactions show that this is especially true for members of environmental

NGOs. Contrary to that, people in the Cévennes who have lived more than five years in Montpellier have weaker preferences for these endemic species.

The positive contributions of the tourism infrastructure and cultural heritage attribute were also as expected by us and our focus groups. A reservation to that has to be made regarding the non-linear effects highlighted in the MNL models: For the tourism attribute, a "high" quality of it is associated to less well-being than a "medium" value, so that the latter is preferred over the former. For cultural heritage, increasing the value from "medium" to "high" has a weaker effect than from "low" to "medium", as seen in other studies presented in our discussion of prior values for our experimental design.

During the preparation of the experimental design, three different main effect interactions were considered: between forest cover and tree species, between forest cover and cultural heritage and between tourism infrastructure and cultural heritage. For the Cévennes sample, only the latter is significant for the most complex model and that with the opposite sign than expected: negative. The initial intuition was that additional investment in cultural heritage sites would be necessary to attract tourists that would benefit from the higher quality of infrastructure. The results could indicate that this synergy was already internalized by participants: As more tourists would be attracted by the infrastructure, more financial resources would be available for the conservation of cultural heritage. Comments within our discussions included this rationale.

The mixed logit models revealed significant standard deviations for all main effects except cultural heritage. In other words, for all but this attribute the preferences can be supposed to be relatively homogenous. The absolute value for the standard deviations are smaller for main effects where interactions have been found to be significant. Consequently, parts of the heterogeneity could possibly have been captured by the interactions.

Coming to the Montpellier sample (page 190), many similarities with the Cévennes sample are to be noted.

First, the preferences for forest cover are comparable to those of the Cévennes. Pastoral landscapes instead of increasing forest cover is globally preferred, but with a higher impact of age: Older people have stronger preferences for the former. The associated significant interaction in models (4) and (5) (cf. table on page 190) leads even to a positive coefficient for the overall main effects. Nevertheless, calculation shows that in average, people over 25 to 30 tend to have a negative preference for this attribute [18]. One explanation could be that young people in Montpellier are particularly concerned about climate change, leading to higher appreciation of carbon sequestration services of forests and a less pronounced preference for pasture landscapes.

This finding about forest cover follows results from other studies about tourists [19] preferences about extensive pasture economy: When responses of a CV questionnaire were clustered into three groups, the majority preferred pastoral landscapes over reforested landscapes [MSR19].

18. For example, in the final mixed logit model without correlation, 85% of the estimated individual-level coefficient for forest cover are negative (figure 3.14).

19. If Montpellier inhabitants are considered as particularly interested into visiting the Cévennes for holidays.

Second, preferences for tree species are also in favor of deciduous forests, but - comparable to the forest cover attribute - weaker in absolute size. As before, an influence of age can be detected with older people having stronger preferences for forests with a lower proportion of coniferous species. An averaged positive effect is reached for age thresholds from 25 (model 5)) to 40 (model 2)). Accordingly, 75% of the individuals have negative coefficients for the tree species attributes, which is less than for the forest cover attribute (see figure 3.14). Therefore, the influence of the age gradient makes that the "threshold age" for a parameter value of 0 is slightly higher for this attribute. Consequently, the direction of the overall effect is less strong than for forest cover, as also indicated in section 3.3.3.2.

In another study [CEHOC19], a positive WTP to replace artificially planted pine and eucalyptus trees by native broad-leaved tree species is observed for the Basque Country, a region in Northern Spain, as these species are part of the cultural identity. This resembles our findings for both samples applied to chestnut trees, a broad-leaved species considered to contribute to the environmental identity of the Cévennes.

Third, tourism infrastructure and cultural heritage attributes show the same form of preferences, even in their forms of non-linearity: A reversed tendency for a "high" value of the tourism attribute and a weaker increase for a "high" level of cultural heritage. Interestingly, the absolute values for the tourism attribute are higher than for the Cévennes sample, indicating a higher general appreciation of tourism infrastructure. Possibly, this reflects a higher direct use or option value for inhabitants of Montpellier.

Again, a comparison to [CEHOC19] can be applied. In their study (contrary to us), an attribute associated with tourism is the least important in absolute values, explained by a possible negative association to the phenomenon of "over-tourism". Similar thoughts have been pronounced in our discussions, especially in groups in the Cévennes. Nevertheless, the attribute has higher absolute values in our results. Accordingly, discussions of participants especially mentioned the economic opportunities of the tourism sector, which should be viewed in the context of the lowest GDP per capita values of the areas in metropolitan France. Contrary to that, the Basque Country region has GDP per capita values well above the Spanish average for 2019 (see source (8) of the websources), making efforts for economic development perhaps less prioritized for the local population.

Finally, all standard deviation (SD) values of the main effects are significant and comparable in size as the values for the local sample. The latter is partly surprising because the main effects are relatively smaller for the Montpellier sample, but lead to a comparable level of heterogeneity.

Comparing the results between Montpellier and the Cévennes area show that preferences are consistent among both regions, but weaker for Montpellier. Here, a relatively strong age gradient can be stated, shown by significant interaction on three of the four main effects.

Generally, the impact of socio-demographic characteristics on preferences for landscape appearance and management is context-dependent. Bieling et al [BPPV14] find that preferences for landscape patterns at different locations in Germany and Austria change more with respect

to the role as beneficiary (farmer, resident, visitor, etc.) as with regard to other characteristics such as age or gender. A review by van Zanten et al [VVKV14] also highlights the role of residential status compared to that of gender. In a study about landscape aesthetics in the region of Märkische Schweiz, Germany, Häfner et al (2018) observe that the opposite is true and Bottero et al [BCF17] observe significance of several socio-demographic characteristics in a DCE about characteristics of the Corona Verde landscapes in the region of Turin (Italy).

In our case, gender and age are often included in significant interactions. Meanwhile, clear conclusions for the role as beneficiary or for residential status are not possible, because our focus on statistical representativeness combined with lower sample sizes due to the willingness to incorporate deliberative elements are causing that only too few participants of our study fall into these specific categories to provoke significant effects.

When comparing preferences for landscape features of local residents to those of visitors, the former are more often found to support agricultural landscapes, whereas the latter are appreciating forested landscape with a high degree of naturalness. Especially around urban areas, the preferences of the urban tourists and of individuals living in suburban areas often lead to a dominance of the support for a higher proportion of forested areas, except if agricultural land is rare [VVKV14]. Our study indicates a similar situation: Open pastoral landscapes that provide synergies with agricultural activities in the valleys is more supported in the rural area of the Cévennes than in Montpellier. The aim for naturalness for the Cévennes is reflected in the higher significance of the status quo ASC that has (without being labeled as such) been interpreted as the "natural" evolution of the landscape.

The willingness to support and conserve this authenticity is often followed by a negative preference for the accessibility to the site [BCF17].

The appreciations of cultural heritage monuments are particularly appreciated in our study, confirming the general results by van Zanten et al [VVKV14]. Nevertheless, no impact of familiarity on the intensity of preferences is observed. It is often argued that coefficients for historical features are higher if they are valued by people that are visiting these sights for cognitive activities ([VVKV14], [RRO$^+$18]).

	Dependent variable:				
	Choice				
	(1)	(2)	(3)	(4)	(5)
ASC Alt. 2	0.041		−0.036	0.024	0.012
	(0.090)		(0.111)	(0.114)	(0.118)
ASC Alt. SQ	−0.425***	−0.768***	0.259*	−0.059	−0.094
	(0.158)	(0.186)	(0.140)	(0.178)	(0.186)
Forest Cover	−0.741***	−1.146***	−0.802***	−0.492***	−0.513***
	(0.073)	(0.255)	(0.098)	(0.130)	(0.137)
Tree Species - deciduous	0.772***	0.798***	0.827***	0.882***	0.962***
	(0.107)	(0.122)	(0.133)	(0.150)	(0.157)
Tourism Infrastructure - medium	0.867***	0.832***			
	(0.167)	(0.166)			
Tourism Infrastructure - high	0.413***	0.392***			
	(0.108)	(0.112)			
Cultural Heritage - medium	1.346***	2.021***			
	(0.181)	(0.297)			
Cultural Heritage - high	1.807***	2.995***			
	(0.171)	(0.477)			
Tourism Infrastructure			0.415***	0.665***	0.752***
			(0.079)	(0.166)	(0.178)
Cultural Heritage			0.795***	0.983***	1.063***
			(0.098)	(0.146)	(0.162)
Payment, Donation	−0.011***	−0.011***	−5.387***	−5.291***	−5.372***
	(0.002)	(0.002)	(0.407)	(0.450)	(0.436)
Forest Cover : Age		0.011***			
		(0.004)			
Age : Cultural Heritage		−0.010**			
		(0.004)			
Forest Cover : Gender - female		−0.352***		−0.636***	−0.603***
		(0.134)		(0.175)	(0.178)
Tree Species : Env. Protection		0.450**		0.740***	0.630**
		(0.179)		(0.241)	(0.246)
Tree Species : 5y Montpellier		−0.499***		−0.656***	−0.791***
		(0.179)		(0.225)	(0.232)
ASC Alt. SQ : Gender - female		0.560***		0.590***	0.620***
		(0.154)		(0.196)	(0.201)
Tourism : Cultural Heritage				−0.202*	−0.246**
				(0.054)	(0.057)
SD Forest Cover			0.807***	0.784***	
			(0.143)	(0.153)	
SD Tree Species			1.185***	1.000***	
			(0.155)	(0.159)	
SD Tourism Infrastructure			0.806***	0.793***	
			(0.122)	(0.125)	
SD Cultural Heritage			0.416**	0.342	
			(0.186)	(0.219)	
SD Payment			2.248***	2.560***	
			(0.268)	(0.375)	
Observations	970	934	970	934	934
Log Likelihood	−941.05	−879.41	−873.568	−835.723	−823.233
AIC	1900.09	1786.82	1771.14	1705.45	1700.47
McFadden's pseudo-R^2	0.1162	0.1741	0.1796	0.2151	0.2268

Note: Standard errors in parenthesess *p<0.1; **p<0.05; ***p<0.01

Models: (1) MNL baseline model, - (2) MNL final model, - (3) MXL baseline model, - (4) MXL final model, - (5) MXL final model accounting for correlation.

Table 3.24. – Summary of DCE results for the Cévennes sample.

	Dependent variable:				
	Choice				
	(1)	(2)	(3)	(4)	(5)
ASC Alt. 2	0.142	0.102	0.122	0.086	0.097
	(0.097)	(0.097)	(0.121)	(0.123)	(0.124)
ASC Alt. SQ	−0.188	0.500***	0.246*	0.249*	0.261*
	(0.161)	(0.116)	(0.143)	(0.148)	(0.151)
Forest Cover	−0.435***	0.473**	−0.464***	0.638**	0.581**
	(0.072)	(0.184)	(0.097)	(0.258)	(0.261)
Tree Species - deciduous	0.218**	−0.890***	0.265*	−0.626*	−0.578*
	(0.109)	(0.239)	(0.139)	(0.333)	(0.334)
Tourism Infrastructure - medium	0.588***				
	(0.175)				
Tourism Infrastructure - high	0.146				
	(0.113)				
Cultural Heritage - medium	1.591***				
	(0.205)				
Cultural Heritage - high	2.248***				
	(0.197)				
Tourism Infrastructure		0.804***	0.167**	1.084***	1.054***
		(0.187)	(0.080)	(0.271)	(0.275)
Cultural Heritage		1.388***	1.171***	1.815***	1.970***
		(0.168)	(0.119)	(0.253)	(0.279)
Payment, Donation	−0.013***	−0.012***	−4.423***	−4.348***	−4.069***
	(0.002)	(0.002)	(0.249)	(0.248)	(0.227)
Forest Cover : Age		−0.018***		−0.023***	−0.023***
		(0.004)		(0.005)	(0.005)
Tree Species - deciduous : Age		0.022***		0.018***	0.017***
		(0.005)		(0.006)	(0.006)
Tourism : Age		−0.010***		−0.012***	−0.009**
		(0.003)		(0.004)	(0.004)
Tourism : Gender - female		−0.391***		−0.605***	−0.646***
		(0.119)		(0.167)	(0.170)
Tree Species - deciduous : Owner - parcel		1.983**		2.220**	1.985*
		(0.796)		(1.104)	(1.048)
Cultural Heritage : 5y Montpellier		−0.598***		−0.807***	−0.808***
		(0.178)		(0.254)	(0.264)
SD Forest Cover			0.697***	0.632***	
			(0.151)	(0.168)	
SD Tree Species			1.127***	0.942***	
			(0.180)	(0.182)	
SD Tourism Infrastructure			0.871***	0.799***	
			(0.123)	(0.127)	
SD Cultural Heritage			0.844***	0.685***	
			(0.166)	(0.163)	
SD Payment			2.195***	2.193***	
			(0.226)	(0.245)	
Observations	955	920	955	920	920
Log Likelihood	−931.78	−872.16	−852.10	−801.95	−788.39
AIC	1881.57	1770.32	1728.19	1639.90	1632.78
McFadden's pseudo-R^2	0.0958	0.1536	0.1731	0.2218	0.2349

Note: Standard errors in parenthesess *p<0.1; **p<0.05; ***p<0.01

Models: (1) MNL baseline model, - (2) MNL final model, - (3) MXL baseline model, - (4) MXL final model, - (5) MXL final model accounting for correlation.

Table 3.25. – Summary of DCE results for the Montpellier sample.

3.4.2. What kind of landscape is supported and why - insights from the cluster analysis

The different land uses of Cévennes landscapes gave the region a strong anthropogenic character. For this reason, an analysis that is more profound than the question of the conservation of pastoral landscapes at the expense of natural reforestation as provided from the results from our choice experiment is helpful.The results of our combination of factor analysis and cluster analysis on the responses given to our indicator statement can provide these insights.

Our factor analysis in the form of a multi-correspondence analysis (MCA) identified some gradients in our data. For the first dimension (9.3%), a separation between people according to their degree of consideration of biophysical forest attributes occur. This information is complemented on the second dimension (7.1%) concerning the appreciation of benefits from open landscapes. Up to this point, cultural benefits are still underrepresented. These come into play in the third dimension (4.5%), where especially the expression that the Cévennes region gives to foreigners is accounted for. For the fourth dimension (3.9%), a meaningful interpretation gets already difficult.

The factor analysis was the basis for the cluster analysis, which allowed further conclusions on the motivation and rationales behind the preferences for the choices in the DCE. This allows further comparisons with states of the landscape in history. Correlations of socio-demographic characteristics with cluster membership allow to draw a more precise picture on the types of individuals sharing similar preferences for the Cévennes landscapes.

In cluster 1 (47.0%), traditional habits such as bancels and biophysical benefits and ES of forests are highlighted. No particular interest in agropastoralism is observed. This gives the image of a landscape where forests are managed and terracing agriculture is present. Both guarantee erosion control. Reflecting on the witnesses in our discussion, this composition mostly refers to the landscapes in the 50's when the landscape was less forested, because a significant parts of the land was used for agricultural production by terraces. Forests were also highly contributing to the supply of provisioning services, especially chestnut. The conservation of historical features, including bancèls for the provision of local agricultural products, are part of the current landscape planning policy of the national park and local initiatives and therefore correspond to the vision expressed by this first group. Nevertheless, the concern about biodiversity protection and agropastoral landscape are not primarily shared.

The second cluster (34.3%) is concerned about agropastoralism and ecological values, especially those associated to open landscapes. Cultural values and provisioning services generated by forests are less important. The vision of this cluster seems to be even more equivalent to that of the national park. Interestingly, sociodemographic data as well as a slight overrepresentation of inhabitants of the Cévennes indicates that the motivations of this group are particularly shared by an important part of local residents. The fact that still 39% of that cluster are from Montpellier, confirms the findings from Plieninger et al [PDORB13]: In their study about CES hotspots in an Eastern German landscape, they identify two different kinds of demands. Local residents are

more often relating to cultural capital, whereas visitors have a particular demand for natural capital when visiting a rural area. In this case, the majority of local residents in this cluster would suggest an overrepresentation of statements concerning the cultural values. It should be underlined that clusters are not necessarily representing a typical viewpoint but resemble heterogeneous viewpoint that commonly appear together. This means that the relation to natural capital between Montpellier tourists and Cévennes habitants appreciating agropastoralism is stronger than their possible differences in the valuation of cultural capital. Here, a separation of the samples and factor and cluster analysis per region could provide further insights. Generally, cluster 2 supports findings from our logit models that people from the Cévennes have stronger preferences for open landscapes. Their appreciation of the ecological values associated with land use is also a source of the positive interaction of the tree species attribute and membership in an environmental NGO.

Cluster three (18.7%) is characterized by individuals that are either less informed or feel less personally affected than the other clusters. It is the only cluster that shows an underrepresentation of people that consider benefits generated by deciduous forests. They can therefore be expected to be less averse against coniferous forests. They are also the only group that appears to be neutral with regard the dichotomy open vs closed landscapes. Meanwhile, statement that relate to the management of forest have particular importance within this group. These two finding is another confirmation that our initial hypothesis of a relation between the question of land cover (forested or pastoral landscapes) and the question of tree species (coniferous vs deciduous forests) would be linked. As for the results for the DCE, no findings support our claim. An important aspect concerns the strong age gradient: Younger people are overrepresented in this group. Possibly, they appreciated carbon sequestration services without being concerned about the actual management of tree species.

3.4.3. Analysis of the willingness to pay

The analysis of the willingness to pay (WTP) is a common tool to compare the economic efficiency of alternatives in cost-benefit analyses. It can provide guidance for decisions in public policy and management. WTP values are generated by dividing the non-monetary attributes from DCEs by the payment attribute. It can be interpreted as the propensity to achieve a higher level (or quantity) of a good (in our case a higher level of a component of the scenario presented in a given choice set) in exchange to a loss of utility provoked by the payment associated to the same choice set. Estimations for the WTP space enlarge this approach by accounting for the specific parameter distributions of the coefficients.

Table 3.26 gives the WTP in the Cévennes for each attribute and their interactions as obtained by the baseline mixed logit model without interactions as well as the final mixed logit models with interactions, both accounting for correlation.

The table 3.26 for the WTP estimates of the Cévennes shows the impact of choosing the status quo or business as usual option independent from the attributes values being worth 41 euros in

Variable	Baseline model	Final model
ASC Alt. 2	−7.27	−3.40
ASC Alt. SQ	41.26	7.11
Forest Cover	−79.20	−44.95
Tree Species	74.11	79.97
Tourism	35.14	55.21
Cultural Heritage	75.78	89.48
Forest Cover : Gender - female		−51.61
Tree Species : Env. Protection		41.36
Tree Species : 5y Montpellier		−57.43
ASC Alt. SQ : Gender - female		57.44
Tourism : Cultural Heritage		−17.11

Table 3.26. – WTP estimates per attribute for the Cévennes.

average to participants. In the final model this WTP is further explained by women who tend to particularly appreciate this alternative. As described before, higher forest cover lowers the WTP, again with a higher effect for women in the final model (-45 euros for men, -97 euros for women). Having a higher share of deciduous species within forest causes an average WTP of 74 euros. When accounting for interactions, this value rises to 80 Euros, with inhabitants having lived in Montpellier for 5 years stating an average WTP which is 57 euros below, whereas people engaged in an environmental NGO are disposed to pay additional 41 euros supplementary for this attribute.

Tourism infrastructure and cultural heritage conservation represent a gain in well-being stated by respondents of 35 and 76 euros in the baseline model and of 55 and 89 euros in the final model, respectively. In the latter, an increase of the quality of one attribute causes the WTP of the other attribute to decrease by 17 euros, as indicated by the respective interaction.

The WTP estimates of Montpellier are similar to those in the Cévennes (see table 3.27). Generally, socio-demographic characteristics have a bigger impact on WTP in Montpellier, which causes the values for some of the attributes to change the sign in the final model. As explained in section 3.3.2.1, including the interactions into calculation changes signs to the same directions as in the Cévennes sample. As an example, the forest cover attribute gets already negative for 18 years old women. In the same logic, higher age corresponds to higher WTP for deciduous tree species. The high impact of socio-demographic variables on WTP in this final model indicates that preferences could be more heterogeneous across inhabitants in Montpellier than in the Cévennes. As indicated in section 3.4.1, the absolute values for the standard deviations of the mixed logit models were of comparable size with those from inhabitants in the Cévennes, although the main effect coefficients had lower absolute values.

Variable	Baseline model	Final model
ASC Alt. 2	5.66	4.03
ASC Alt. SQ	40.63	37.87
Forest Cover	−33.55	49.80
Tree Species	9.38	−98.10
Tourism	10.58	78.12
Cultural Heritage	74.32	109.23
Forest Cover : Age		−1.72
Tree Species - deciduous : Age		2.30
Tree Species - deciduous : Owner - parcel		118.74
Tourism : Age		−1.00
Tourism : Gender - female		−35.95
Cultural Heritage : 5y Montpellier		−48.77

Table 3.27. – WTP estimates per attribute for Montpellier.

This provides an additional indication for higher heterogeneity. Nevertheless, the general tendency of lower absolute values is also causes also the average WTP values per attributes to be lower, as a comparison of the values of the baseline models shows.

A common point of both models to be addressed are the negative values for the forest cover, as they could be interpreted as a willingness to accept (WTA) a compensation instead of a willingness to pay. Although not really different in theory, they imply important empirical biases. Individuals have been found to report WTA values that were significantly higher than WTP values for the same object. Most often this is referred to as a change of attitude of individuals: In the case of WTA, the good to be valued is in possession of the individual and the question refers to the value at which she is indifferent to give the good up. In the case of WTP, the individual is not yet owner of the good, but asked for which amount she is indifferent to achieve it. Consequently, the former case is possibly involving loss aversion for goods already part of the own property.

The "risk" of obtaining a negative coefficient for this attribute was already expected when creating the experimental design. As we have not discarded the possibility of a positive influence of forest cover on well-being, we did not want to frame our design by our coding scheme. Accordingly, the lowest level of forest cover was coded as 0 with higher levels obtaining codes of 1 and 2. Consequently, the coefficient of these model parameters became negative.

Nevertheless, it is not to be expected that the negative WTP value for the forest cover attribute led participants to interpret choice tasks as asking for WTA. As the examples of this section will show, the overall willingness to pay for the alternatives of our choice sets is still largely positive. Hence, the negative value for forest cover does not imply the construction of a willingness to accept, but decreases the overall WTP of the alternative.

In the following, the WTP for three scenarios is investigated: First, a business as usual scenario ("Business a.u."), indicating the impact of the current evolution in the medium term. It is equivalent to the status quo scenario presented in the DCE. The associated levels of the attributes are i) a natural reforestation; ii) based on that, a further growing proportion of coniferous forests within the forested part of the landscapes; iii) a medium level of tourism infrastructure and iv) a medium level of cultural heritage conservation.

Second, a scenario that supports the (short-term) economic opportunities from forestry and tourism ("Economy"), attracted by a high level of infrastructure and cultural heritage. Consequently, the attribute levels are: i) artificial reforestation; ii) a further growing proportion of coniferous forests within the forested part of the landscapes; iii) a high level of tourism infrastructure and iv) a high level of cultural heritage conservation.

Finally, a "Conservation" scenario, trying to achieve progress towards a landscape characteristic as already observed in the past: i) a conservation and partial reactivation of pastoral landscape; ii) conservation of a majority of broad-leaved species within the forested part of the landscapes; iii) a low level of tourism infrastructure and iv) a high level of cultural heritage conservation. In order to show the variation of WTP with socio-demographic characteristics a calculation for several individuals using the final mixed logit models with correlation is applied for each scenario. An average value per region is also derived from the respective baseline model that is not integrating any interactions with socio-demographic characteristics.

Different values for these characteristics are obtained by taking the representative and specific individuals for each cluster. Representative individuals are those that have the lowest distance to the barycenter of their respective cluster. Their attitudes towards the indicator statements are therefore "representative". Specific individuals are those within their cluster that have the highest distance to the closest barycenter of the other clusters. They are "specific" because their attitudes are the least to fit in another cluster. Each individual is assigned to his or her respective region. These individuals allow to have a relatively representative scenario testing with regard to gender (four men, two women), age (different age classes), the region (three times Cévennes and Montpellier) and indicates WTP estimates per cluster. As other socio-demographic characteristics (membership in environmental NGO, etc.) are not often observed in the overall sample, they will not be introduced in the WTP simulation.

Cluster	Type	Age	Gender	Business a. u.	Economy	Conservation
1	representative	72	female	88.47	27.83	258.93
2	representative	59	male	82.63	131.05	258.93
3	specific	32	male	82.63	131.05	258.93
Sample ∅				31.72	63.44	225.68

Table 3.28. – WTP estimates in euro for test individuals in the Cévennes for different scenarios.

Cluster	Type	Age	Gender	Business a. u.	Economy	Conservation
3	representative	24	male	171.86	343.72	175.55
2	specific	46	female	76.06	152.12	226.15
1	specific	57	male	82.09	164.17	251.45
Sample ∅				51.35	102.70	158.02

Table 3.29. – WTP estimates in euro for test individuals in Montpellier for different scenarios.

Tables 3.28 (and 3.29) illustrate the estimated willingness to pay of the chosen individuals for the Cévennes (and for Montpellier). Before addressing and interpreting the concrete WTP values per scenario, a short remark about the representativeness is necessary. The purpose of the choice of individuals is to furnish a variation in socio-demographic characteristics as observed in the WTP tables for the final models. As the degree of representativness of individuals with regard to their cluster is based on the consideration of indicator statements, they are not representative in terms of socio-demographic characteristics.

Hence, as the latter are also correlated within one cluster, a generalization of the WTP value to the whole cluster is not recommended. For specific individuals this link is even less reliable. Nevertheless, the WTP values for the whole sample by using the baseline WTP values give a relatively good impression of the preferences within the respective region.

Beginning with the WTP simulations for the Cévennes sample, the variation among the different amounts is relatively weak, because socio-demographic characteristics had a less important role for this sample. All individuals prefer the conservation scenario over the other two. For the first individual for the Cévennes, the business as usual scenario is advantageous compared to the scenario that focusses on (short-term) economic opportunities with values of 88 euros and 28 euros. For the individuals two and six, the second scenario makes them better-off than the first, generating 131 instead of 83 euros according to their stated preferences. The reasons for this differences lie in the higher values for tourism in the second scenario, whereas the appreciation of less forested landscapes by the only woman within this table (gender effect) and the fact that the age effect accrues would make her prefer scenario 1. For the overall sample, a similar order applies: the conservation scenario largely exceeds the other two scenarios with a WTP of 226 euros compared to 32 and 63 euros. The combination of pasture conservation, protection of deciduous trees and a high degree of cultural heritage conservation contribute to this positioning.

The WTP table for scenarios using the sample of Montpellier shows a more diverse picture, as a consequence of the importance of socio-demographic differences among individuals and the role these differences play in the underlying mixed logit models. In general, values are closer than for the Cévennes and for individual 3, the representative individual of cluster 3, the second scenario is the most advantageous. Here the positive influence of having more forest cover and tourism in combination with an equilibrated proportion of tree species causes a high WTP. For the other individuals, the same succession of scenarios applies: The conservation scenario is higher valued

than the economic opportunities scenario and the business as usual scenario. For the whole Montpellier sample, the conservation scenario achieves a WTP of 158 euros, the second scenario has a WTP of 103 euros and the business as usual scenario of 51 euros.

Overall, these results suggest that a land management policy that favors conservation of cultural heritage, deciduous forests and pasture landscape entails high social welfare gains for a majority of people from the Cévennes and Montpellier. Additionally, a policy that supports tourism in a controlled manner that coincides with conservation efforts, would generate additional short-term economic benefits in line with the preferences observed in our models.

3.4.4. Bundles representation

In this section, the identification of clusters of individuals having preferences for common ES is translated into bundles of ES. When applying the MCA, the focus was on finding correlations among the considerations of the ES represented by the statements in our questionnaire. The clustering transferred these correlations to the level of individuals so that several groups of people can be assumed to have different demands or perceptions ([BMRVF14], [RVMS17]). Representing ES in a bundle form switches the focus back to a representation of the level of ES demand. This relative demand is determined for each of the clusters. As described above, a single-dimensional metric is better for this approach. That is why, I will assume that the notions "unaware" and "not important" can be regrouped into "not considered". This allows to represent the demand for ES as being higher, if a bigger share of the cluster has stated to have "considered" the service. A higher demand is indicating a higher recognition of the service and informs public decision makers on how landscape management could improve human well-being.

Figure 3.21 displays the rate of consideration ("absolute consideration") for each ES per cluster. In the upper right of each circle, provisioning services are placed, followed by regulating services at the lower right. Cultural services are presented at the left half of the circle. As already mentioned in section 3.3.4.2, the first cluster has high rates of consideration for cultural services and for regulating services. The values for provisioning services are lower, but still relatively high compared to the sample mean.

The second cluster has drastically lower rates of consideration for regulating and provisioning services, except for the appreciation of agropastoral landscapes [20]. The previous analysis of the cluster revealed that ecological values of agropastoral landscapes are also highly appreciated in this group. The non-material benefits are also considered but less than in cluster 1.

The bundles representing the third cluster confirms that those individuals have stated to consider less benefits than the other clusters, perhaps due to a lack of experience and knowledge. Meanwhile, relational values such as recreation, spiritual values and the contribution to an environmental identity are lower than in cluster 1 but relatively present. Carbon sequestration

20. In many open questions, participants stated that they referred often to local products when considering agropastoralism, especially the regional goat cheese - "Pelardon". For this reason, the indicator statement about agropastoral landscape was related to provisioning services.

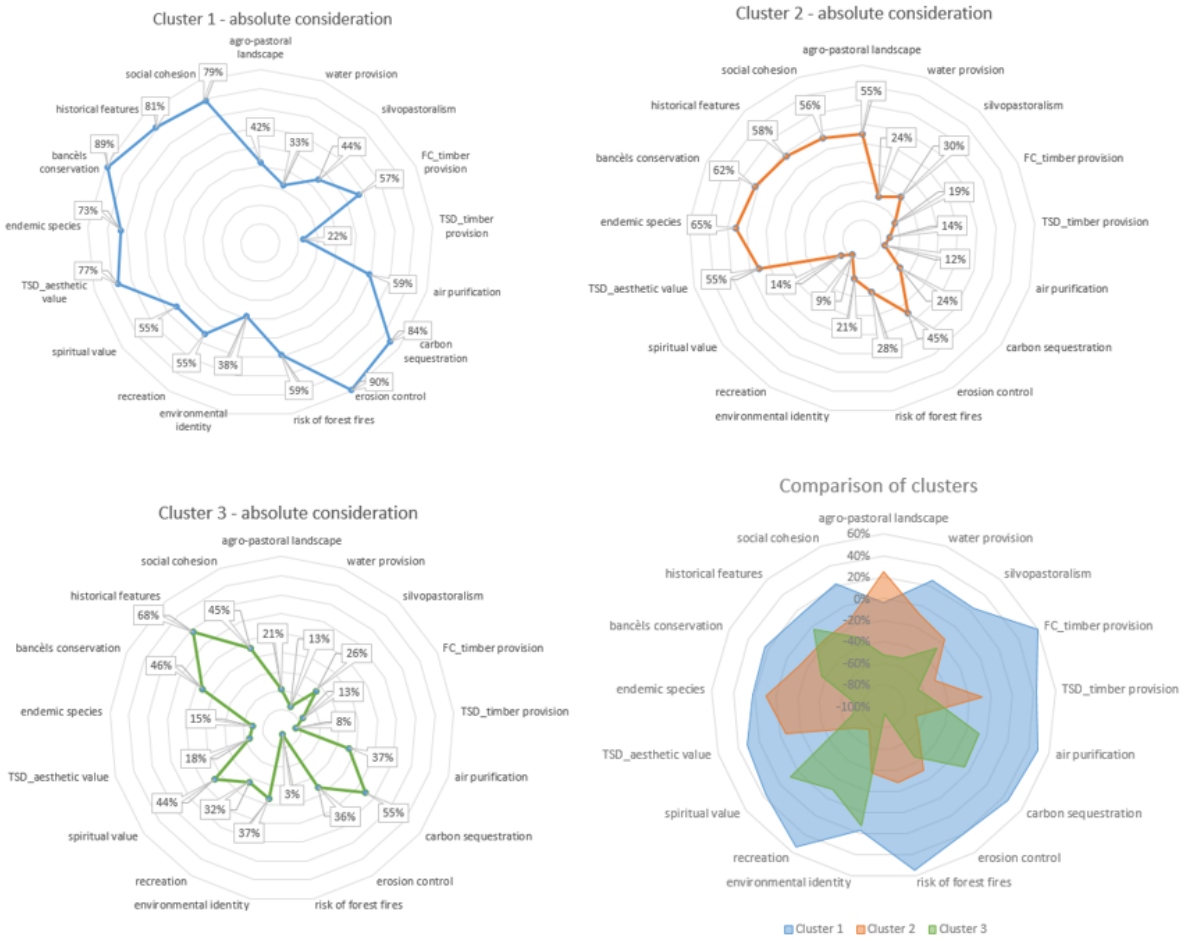


Figure 3.21. – Bundles representation of the ES considered by the different clusters.

and air purification services are mentioned, which supports our hypothesis that this group is concerned about climate change and supports forest, but independent from tree species considerations.

The last graph compares each cluster with the whole sample by showing the difference of the rate of consideration with the sample mean. The perhaps most obvious remark is the dominance of cluster 1: For nearly all services their rate of consideration is at least 20% of the rate of the whole sample. Only the consideration of agropastoralism is higher in cluster 2. Furthermore, the complementarity especially of cluster 2 and 3 has not yet been as visible as with the help of this bundle representation: The rate of consideration of cluster 3 is high where cluster 2 has low values.

In conclusion, this bundles representation revealed that the numerically biggest cluster, regrouping nearly half of the respondents is also the cluster that acknowledges the highest rate of consideration of services. Bundles are therefore visualizing the interactions that might exist between ES generated by landscape patterns and their perceptions by humans [BG09]. Non-

linearities and temporally-lagged effects underlying these interactions are effectively assessed [LLS+17].

They point on differences of potential and actual use due to a lack of recognition in the population and are therefore helpful to guide practitioners in awareness rising among the population [AK17]. Such socio-cultural assessments of preferences for bundles of ES help to model human-nature relationships but are still scarce in the literature ([HBVC19], [MLIAGL+12]). Additionally, an involvement of stakeholders together with a bundling approach would help to create a mutual understanding of relevant drivers and incite collaborations, especially when applied in small-group deliberations ([BTL+18], [CBB+17]).

The representation of ES bundles therefore allows to complement the analysis of the DCE with information about the interrelation of different landscape patterns, as perceived by individuals, and increase its salience for decision makers.

3.5. Conclusion

Throughout this chapter, the impact of landscape patterns and interactions among ES in Cévennes landscapes on the preferences of local and regional inhabitants has been assessed. In the literature, valuations of ES generated by and bundled within landscapes have been found to reveal important links between biophysical supply and socially desired demand.

In our case, the valuations in the Cévennes and Montpellier in the DCE indicate similar preferences for the future evolution of cévenol landscapes. Generally, conservation of pasture landscapes together with forest majoritarily composed by deciduous tree species is supported, but to a lesser extent in Montpellier than in the Cévennes. Tourism development is widely supported, but with a clear aversion towards a considerable increase in affluence. Conservation of cultural heritage is perceived as important.

A cluster analysis on issues considered within the choices in the DCE and its translation into demand bundles of ES revealed an important cluster (47.0% of individuals) that considers and appreciates a wide range of ES, especially those related to non-material benefits and to regulating services provided by forests. A second cluster (34.3%) has a high interest into the ecological values provided by pastoral landscapes. The third cluster (18.7%) has the least rate of consideration of most services, except carbon sequestration and air purification. Although showing socio-cultural characteristics that suggest lower experience and knowledge about the ES in cévenol landscapes, relational values have also been found to be important in this group. In line with the results of the DCE, the residential status (Cévennes or Montpellier) has only minor importance for differentiating preferences for landscape patterns in the Cévennes. The WTP for inhabitants in Montpellier is lower than in the Cévennes, in accordance with other studies that compared values for residents with those of tourists [BCF17].

Furthermore, preferences seem to be more heterogeneous across generations than across regions. For land and national park management this has important implications for awareness rising:

Media supported communication strategies could combine the type of ES appreciated per age category with the type of media particularly used in that specific peer group instead of focusing communication entirely on the distinction of residents and tourists. A general support for conservation policy in the Cévennes is supported by a large majority of participants. The expressed perceptions can be judged representative for the concerned populations in the Cévennes and Montpellier.

Regarding the methodological applications of our questionnaire, the categorization of the consideration of benefits within the attributes due to requirements of our deliberation analysis, could be improved by using Likert-scales or q-methodology to measure the intensity by which ES were included into the responses to the DCE. Aside from that, cluster analysis and DCE could further be complemented by assessing the WTP on cluster level. This could be done by applying a nested logit model where clusters represent a nest with different correlation patterns than in other nests in order to account for the more homogeneous distribution of preferences within that cluster (e.g. [SM20]). Assessing this perception of individuals could facilitate the use of local knowledge in implementation [AK17] and would benefit decision making in landscape planning ([CMT$^+$15], [LLF$^+$19]). Bundles could be used as simplified indicators and in higher-scaled applications, such as supra-regional landscape management, aiming to compensate spatially or temporarily occurring disparities in the supply and demand of ES ([PDORB13], [SCE$^+$19]).

In conclusion, our approach allows to complement DCEs with factorial and cluster analysis in order to achieve a representation of ES bundled within attributes of the choice sets. This allows to benefit from the already widely applied DCE approach to further foster ES bundles valuations. Furthermore, it confirms that people are able to account for different bundles generated by landscape characteristics.

4. The impact of deliberation on valuation

4.1. Introduction

Traditional monetary valuation techniques based on stated preference elicitation have been criticized for not allowing participants to fully understand some of the complex interrelations of environmental goods they are evaluating, marginalizing social and cultural values, framing the value dimensions into economic logic or neglecting the process of preference construction of individuals ([LS13], [KBC+16]). Deliberative approaches have been proposed as an alternative that could complement current valuation methods. They integrate participative and interactive elements into the valuation process or constitute alternative "value articulating institutions" [Vat05] that determine a value by consensus seeking. Nevertheless, deliberative valuation studies suffer from low sample sizes [LBH15] and are actually not providing practical guidance on how results might be up-scaled to other contexts than local or regional ones [Mei19].

Especially, non-material ES are appealed, when the integration of a wider range of values is claimed [CSG12b]. Here, deliberative valuations are seen as a way to assess these benefits by allowing participants to express deeper-held values that relate to the environmental good in question [Ken15].

Our experimental study took place in the form of a deliberative workshop and achieved a relatively high sample size compared to similar studies. Consequently, we want to provide evidence on methodological and logistic questions currently open due to a lack of robust empirical data. This concerns notably the following:

— Given the high cultural identity and non-material ES associated to the Cévennes, does deliberation enhance the expression of these value and their inclusion in the preferences stated in our survey?

— Are there generally other values included when deliberation is introduced or are the same values included differently? Are preferences shaped by changes in moral priorities or solely by a different state of information? Do the answers to these questions relate to the region of the evaluated environmental good?

In order to answer these question in this chapter, a detailed review of deliberative approaches, their theoretical foundations and empiric findings in the literature are presented in the third section.

Before this, a refinement and complementation of the value concept beyond economics is given in section 4.2, because these notions are addressed by different authors, in order to criticize or advocate deliberative approaches.

The fourth section summarizes how deliberative elements and the integration of non-material ES can be applied in valuations.

Subsequently, the data obtained from our experiment is analyzed with regard to the impact of deliberation on the results (section 4.5. Notably the DCE, the cluster analysis, the indicator statements and the way participants perceived the deliberative setting are investigated. These results are to be complemented by a qualitative and quantitative analysis of the transcripts retrieved from the discussions among participants in the deliberative workshops.

A discussion in sectio 4.6 will summarize and interpret these results, notably by combining the information obtained from our different assessment methods, and relate these findings to the literature.

Finally, the conclusion summarizes the chapter and proposes further research directions and complementary analyses for the experimental study as well as for deliberative valuation more generally.

4.2. Non-material ES

As non-material ES have a prominent role throughout this chapter, the underlying concepts will be presented in detail. Before coming to a clear definition of this service category, a broader vision of what other kinds of values exist along with economic interpretation (see the general introduction of this thesis), will be presented.

They are referred to by different authors when arguing for or against the adaption of a specific definition of non-material services and the values they entail.

4.2.1. Complementary value approaches

In order to justify definitions and classifications of values, different notions exist how values have been addressed [1]: dimensions, domains and types of values.

Beginning with the latter, proposed in Arias-Arevalo et al (2018), types of values are differentiated by the disciplines in which values are elaborated (table 1 in the respective publication): intrinsic values (philosophy and ethics), principles guiding value judgements (social psychology), monetary values (neoclassical economics), shared values (sociology), ecological values (ecology) and the way of concern on ES (philosophy).

The different value types have varying interest within each discipline according to the relation between nature and at the value at stake [AAGBMLPR18]: If only ecological systems are considered without any judgement by humans, ecological values are addressed. If values are perceived in a socio-cultural system but independent from human interest, they are intrinsic.

Fundamental values concern the underlying life-supporting system, whereas eudaimonistic values are those that are pursued for a "happy" life is desired and go beyond the fulfillment of

1. Unfortunately, these overarching notions are relatively easy to confound, causing a constant discussion on the salience of different value categorizations.

basic needs and economic interest [2]. The remaining instrumental values are those created by human use of natural resources (see also [OK19]).

Finally, "dimensions of value" are characteristics that describe the context in which values are assessed: 1) by the underlying concept, 2) by the value provider, 3) by the elicitation process, 4) by the scale (individual or group), 5) by the purpose of valuation [Ken15].

Given these different criteria under which values are classified and defined, it is not surprising that a multitude of definitions, each addressing various aspects of values, exists. The most important ones for understanding non-material ES are presented below, some of them have already been mentioned in the previous paragraph.

First, "instrumental" values are those whose use is dedicated to other ends than from the good itself , so that it needs to be "instrumented" by human activity [OK19]. Contrary to them, "intrinsic" values are valued "without reference to the evaluative agent" ([OK19]; p. 1262).

"Relational" values describe a reciprocal interaction between an individual and nature generating human happiness, including values beyond utilitarian considerations [KK08]. It is argued that relational values are complementary to both intrinsic and instrumental values, because on the one hand, they are still based on human-nature relationships, therefore excluding intrinsic values that humanity holds about purely non-anthropogenic processes [HM18]. On the other hand, they are context-dependent, therefore different to cases of context-independent use of a natural resource in the case of many instrumental values .

Proposed to be not complementary, but contrary to relational values, "positional" values are those where an interaction is characterized as an "equivalent exchange" with the aim of efficiency ([KK08]; p. 812).

Having stressed the dependency on context of relational values, this same characteristic is what defines "contextual values", meaning that they are appealed, revealed or changed only in specific situations [KJW$^+$16]. Nearly equivalent, "inalienable values" are unable to be separated from their social and especially local context [dBSB$^+$19].

More stable and built over longer temporal scales than contextual values are "transcendental values" [KRF16]. These are "guiding principles and life goals that transcend [only [3]] specific situations" and are often shaped by "common cultural understandings and experiences" ([KJW$^+$16], p. 271).

4.2.2. Non-material ES - or cultural ES...?

The fact that the presentation of various value concepts is necessary to give a detailed definition and description of non-material ecosystem services, which are targeting those various values, illustrates the problems the concept creates in the literature quite well. Alternatively called

2. Due to the specific meaning of eudaimonistic values, no vulgarized definition apart from direct translation exists. Their characteristic is to follow the ideas originating from the Greek philosophers about what is necessary to perceive "happiness" in life [Vla85]. The description given above is therefore meant as non-formal explanation, not as strict definition.

3. Parenthesis by the author to highlight the difference to contextual values

cultural ecosystem services (CES), they are considered as a residual category within the ES approach that still demands a consistent framework [FCW16]. The same authors summarize the dilemma: "The litany of 'nons' that have often pervaded this category in is of note: non-market; non-instrumental; non-use; non-material; non-monetary; non-economic, non-secular." ([FCW16], p. 215)

The initial categorization underlining the cultural dimension of these services associated to provide non-material benefits in the Millenium Ecosystem Assessment resulted in a situation without clear definition, but a rather widely accepted notion to be intangible and providing no-market benefits [SGC+13]. Furthermore, the cultural dimension precisely excludes an economic character of the benefits but not to be material [FCW16].

For others, CES are non-material ES (e.g. [SMD17]). A conceptual framework provided by Fish et al (2016) describes CES as a result of the interplay between environmental spaces and cultural practices. Consequently, ecosystems represent the biophysical and non-human dimensions of that interplay such that values are constructed in a process and cannot objectively be observed and are therefore necessarily interpretative [FCW16]. Therefore, they are idiosyncratic, meaning that their interpretation depends on the context [Ken15].

The CICES framework now defines the services originally categorized as CES as non-material ES [HYP18], as suggested by some authors. By taking different notions of "culture", it is argued that none of them fits to all services appealed to define while being limited to them [Kir19]. Furthermore, the appearance of the term "ecosystem" would appeal a "natural-scientists' entity" although the relational values included in CES are attached to an "aesthetic-symbolic" entity ([Kir19]; p. 221).

This also refers to the notion of reciprocity in Kumar and Kumar (2008). On the other side it is argued that the concept of CES would be broader and more inclusive than its pure name suggests [Sch19]. Additionally, abandoning the concepts of CES completely would endanger the achieved progress in policy agenda setting [Sch19].

As outlined in the introduction, I will follow the definition of the CICES and prefer the use of the term non-material ES. Nevertheless, to avoid numerous repetitions, the term cultural ES is used as a synonym.

4.2.3. Approaches to assess and value non-material ES

First categorized in the MEA in 2005, a rapid increase in publications about the assessment and valuation of CES has been observed since 2012 [CVLU19]. Meanwhile, the diversity of non-material ES is not reflected within the studies, being majoritarily restricted to one CES class within the CICES framework and only 12% of the studies integrating 5 or more categories [CVLU19] [4].

4. However, the referenced authors discarded articles that did not follow the CICES categorization or could not be associated the these categories. This could systematically bias the results to the expense of services that are not easy to categorize (see, for example [dBSB+19]).

In another review involving a cluster analysis, Milcu et al (2013) divide articles into conceptual (giving recommendations and proposing frameworks), descriptive (showing trade-offs and drivers), concentrated on localized outcomes (often case studies within a protected area), quantifications of perceptions (to assess social aspects) and economic valuations. Nevertheless, in broader economic assessments of ES, non-material ES remain a residual category missing a coherent framework ([MHAF13]; [SGC+13]).

Indicators used to assess CES are elaborated on individual and group levels, but are not focused on the bundle properties of most ES [MHAF13].

In general, the methods used for assessments can be broadly separated into quantitative/monetary and qualitative/non-monetary techniques [HMPB13], with an increasing focus on the latter in recent years ([MHAF13]; [CVLU19]). Whereas half of the publications uses one method in their assessments, the other half combines several methods with combinations of non-monetary techniques applied more often than a combination of monetary with non-monetary techniques. Nearly no combination of monetary procedures is reported [CVLU19].

Monetary methods use market data and CV to assess non-material CES, with valuations of ecotourism and recreational services being highly overrepresented ([HMPB13]; [MHAF13]). Nevertheless, monetary valuations have for instance integrated more categories of CES than non-monetary procedures, but the latter have a higher tendency to consider less tangible ES [CVLU19].

Consequently, a significant variety of non-monetary techniques exists: For revealed preferences approaches, simple observations, document analysis and social media analyses are most applied [CVLU19]. Stated preference assessments rely on the use of interviews or questionnaires [HMPB13] which are coupled with either (i) different kinds of publics or depths of investigation (narrative approaches including storytelling, expert-based approaches, focus groups or Q-methodology) or (ii) with spatial data (participatory mapping, public GIS-surveys, scenario simulations, etc.) [CVLU19].

The participatory character of most methods is the origin of a complementary categorization of CES assessments: a) survey-based methods aiming to gain insights into the attitudes of participants, b) deliberative approaches where the interactions among participants such as collective reflections, debates and negotiations are central and c) analytic-deliberative approaches, where deliberative elements are a preliminary step taken before the main assessment method (e.g. participatory mapping, deliberative monetary valuation, focus groups) [SMD17].

Notable participation mapping is used to identify hotspots and coldspots of CES demand and supply ([PDORB13]; [RRO+18]). Other questionnaire- or interview-based surveys asked participants about local ES and other non-material benefits of urban river systems [dBSB+19] or assessed the link between non-material ES and human well-being in a combination of deliberative workshops and a cluster analysis of online surveys [BJC18].

Storytelling and psychometric analysis have been applied in deliberative monetary valuation (DMV, see next section) to assess non-material ES [KJW+16].

The use of social-media analyses (especially pictures) is also suitable to identify hotspots of CES by assessing the spatial correlation of content or applying a MCA, but are biased towards aesthetic values ([ORMLF+17]; [CCA+19]). Nevertheless, they achieved clear recommendations for planning measures to disperse tourists and redistribute economic benefits towards specific locations in Southern Portugal [CCA+19].

Other approaches have been proposed such as an accounting approach that asseses the proportion of scenic enjoyment and physical activity during outdoor recreation and compares this to the overall invested leisure on the household level to derive a value of the enjoyed non-material ES [MM18]. Other technical approaches are ecological production functions [CSG12b] or the perception of CES by using a psycho-cultural perspective [KK08].

4.2.4. Empirical findings in assessments of non-material ES

The publications about empiric assessments of non-material ES are generally biased towards ecotourism and recreation, whereas spiritual values, educational values, cultural diversity and inspirational values are less reported ([HMPB13]; [CVLU19]). Hence, a tendency to an under-representation of less tangible benefits can be observed ([PDORB13]; [SMD17]). Possibly, the availability of benefit estimators for tourism activities facilitates the assessment of tangible values [HMPB13].

Perceptions of non-material ES by individuals seems to follow this distinction: In a study in an Eastern German landscape heterogeneous preferences are observed causing a trade-off between recreational and specifically non-material benefits [PDORB13]. It is argued that many benefits assessed have material and non-material characteristics, making a distinct classification of non-material benefits difficult [BJC18]. Especially fishing activities are mentioned to underline the close interrelations and high overlaps between provisioning and non-material ES in particular and with the other ES categories in general ([CSG12b]; [BJC18]; [dBSB+19]).

CES have been found to be spatially correlated with habitat quality, representing an opportunity to use assessments of non-material ES in perception surveys as powerful argumentation for local protection measure for biodiversity [RRO+18].

In section, 3.2.2.4 the close relation between non-material ES, ES bundles and landscape patterns has been highlighted. The identification of CES hotspots by spatial autocorrelation revealed a determinant character of landscape composition: Grasslands and settlements, water bodies and forests are related to higher provision of CES whereas the opposite was observed for cropland ([PDORB13]; [RRO+18]). Anthropocentric landscapes were beneficial to spiritual, social and cultural heritage values [ORMLF+17].

Another important factor besides landscape composition for the supply of non-material benefits is accessibility, especially close to settlement areas [RRO+18]. In Southern Portugal, the distance of hotspots has been found to be an important variable for CES enjoyment [CCA+19].

When the results are analyzed with regard to different publics, the perception of non-material ES varies among stakeholders [ORMLF+17]. Furthermore, the perception is negatively influenced

by the state of moral values: If a person is disappointed by the general state of the location (degradation, abandonment, property, etc.), she significantly often states to perceive no non-material ES at all [dBSB$^+$19]. This could be a possible explanation for lexicographic preferences with regard to CES: The willingness to state unsatisfaction makes individuals unwilling to state any possible trade-offs in stated preference surveys.

In line with that, the focus within non-material ES assessments is often not on the actual delivery of ES, but on possible changes [SMD17].

4.2.5. Role of non-material ES for decision making

The need to address the salience of the ES concept as well as ES valuations for decision making and implementation has been demonstrated in chapter 1. The impact of ES to illustrate the interconnectedness between the benefits received from nature and human activity is particularly relevant for non-material ES, as their close relations to other service categories in the previous paragraph have shown [BJC18].

Meanwhile, the lack of spatial fit between management and ecosystem scales is accentuated for non-material ES [SMD17]. Local specificities can represent caveats for management. Therefore, assessing inalienable values associated to CES has particular importance [dBSB$^+$19].

The cultural context, practices and commitments are influencing the support of ecosystem management measures. As a consequence, the account for the cultural dimension within the assessment of ES is beneficial for the implementation of the resulting policy ([CSG12b]; [FCW16]).

4.3. Deliberative approaches to the valuation of ES

It is generally argued that deliberative approaches are needed to achieve a better valuation of non-material ES by individuals in stated preference elicitations. In this section, theoretical foundations of deliberative approaches as well as models, methods and results from the literature are presented.

4.3.1. Definition and theoretical foundations of deliberations

Deliberative approaches are applied when "participants can speak and listen to others' opinions, can ask questions to clarify difficult issues and can (get time to) reflect upon the issue for themselves" ([SBL18]; p. 275). The theory describing this process can be seen as being situated between neoclassical social welfare economics and deliberative democracy [BL18].

This implies a combination of partially different assumptions with the former adopting the hypothesis of individuals with i) fixed preferences, ii) rationality and iii) social welfare functions as aggregation of individual utilities, whereas the latter presumes i) dynamic preference formation by social interaction, ii) communicative rationality and iii) social welfare functions as result of consensus or agreement ([BL18]; see Fig. 1, p. 98).

Just mentioned, another theoretical element to describe a process of deliberation is found in the concept of Habermas' communicative rationality: Arguments for or against particular values are not only sensed to be logically for the individual itself, but the latter is also willing or capable to communicate and advocate them ([OWKBC16]; [BL18]).

An economists' perspective to base deliberative assessments on theory is found in works of Amartya Sen [5] [BL18]. Notably a distinction between rationality and reasonableness in his works adopts neoclassical concepts to the assumption of communicative rationality [BL18].

Furthermore, in Sen's sense, individuals are provided with first-order and second-order preferences, the former applying under the current set of "everyday" constraints, whereas the latter is appealed in a more or less hypothetical alternative set of constraints [6][BL18].

When deciding on the point of an individual being deliberated, Sen's impartial spectator is referred to [BL18]. Here, individuals are constantly confronted with different scenarios by a neutral person or asked to interact and discuss other's views in order to construct their own positions.

The question of the right "amount" of deliberation is also the source of interrogations about the aim of deliberation and how the role of the analyst to assess this point are defined [CM20]. Parting from their formal framework of deliberative judgements [CM20], the authors define the state of being deliberated as situation where individuals have a set of propositions composed of arguments that cannot be trumped by others [CM20]. Meanwhile, this deliberative judgement is "anti-paternalistic" (p.5) which means a result of an endogenous process of the individual. Being capable to define a "sufficiently" deliberated individual then raises the question how to assess whether this state is actually reached.

For this "role of the analyst" issue, operational validity has to be ensured, which requires a) justifiable instability (changing importance of arguments is due to a new, updated set of available arguments chosen by the individual), b) being closed under restatement (new arguments are created by incorporating counter arguments to possible objections to the current set of arguments) and c) a bounded length of what the authors define as "sometimes trump" relation among attributes [CM20]. The proposition of counter-arguments to various positions (either individually or as consequence of interrogations within the debate) is therefore the role of the analyst [CM20]. The initiative of topic- and agenda-setting (from researchers, the discussing group or from both) is therefore depending on the purpose of the deliberation [SBL18].

Depending on the positioning towards the two different sets of hypotheses mentioned above (fixed preferences vs dynamic preferences, etc.), two different types of deliberative valuations are distinguished. On the one hand, "value juries" primarily follow the principles of deliber-

5. Within their analysis, the referenced authors related to the following works: [SK74], [Sen76], [Sen77], [Sen00], [Sen01], [Sen10].

6. An example of an environmental policy of carbon emission reduction can illustrate the issue. First-order preferences are appealed when the behavior of an individual after introduction of a carbon tax is investigated: A new constraint is added to the already existing economic ones. If instead an obligatory maximum carbon budget per individual is introduced, this affects second-order preferences, because the budget represents a (new) set of ecological constraints that at least partly replaces the former set.

ative democracy and try to agree on a "social WTP" by in-depth discussions and qualitative measurements ([Ken15]; [SBL18]). Here, the goal of an institutional process of social learning and adoption of a citizen view is emphasized instead of the articulation of value itself ([LS13]; [OWKBC16]). It is a "democratization of the valuation process" ([SBL18], p. 275) where individuals are supposed to understand but not necessarily agree with opposing arguments [LS13].

On the other hand, analytical-deliberative approaches such as DMV and Multi-Criteria Assessments within "valuation workshops" are more formal processes aiming to derive quantitative measurements ([Ken15]; [SBL18]). They are closer to neoclassical theory by aiming to derive more informed individual preferences ([OWKBC16]; [SBL18]). This is achieved by an extensive information provision as well as the possibility for individuals to have more time to think, ask questions and discuss within a group ([MPHAF02]; [MHL06]; [AAC$^+$15]). Our experiment follows the guidelines of such an analytical-deliberative approach.

The kind of process also determines the statistical properties required for each approach [RKP$^+$14]. For analytical-deliberative approaches, where the aim is to derive quantitative measures, statistical representativeness of the outcome is of importance. For the qualitative assessment and integration of different point of views in purely deliberative "value juries", political representativeness, the integration of sufficiently diverse points of views, is often sufficient ([KBC$^+$16]; [VL16]).

A distinction is also made regarding the impact on preference of individuals. Preference economization depicts the aim to decrease the cognitive burden for participants to trade off values by providing them with more information and the possibility to decide, whereas preference democratization describes the representativeness of possible concerns raised in deliberations [LS13]. Finally, preference moralization focusses on social learning and the legitimacy of points of views and is of particular importance for transcendental values and non-economic considerations ([LS13]; [Ken15]).

The comparison of democratic-deliberative valuations with standard techniques of stated preference valuation further underlines conceptual differences: The rationality assumption appeals the economic man for individuals' preferences and the social man for democratic-deliberative approaches ([Vat05]; [RKP$^+$14]). The elicitation process in value juries does not include the possibility to aggregate results, because these already include social aspects within their citizen view and would therefore lead to double-counting problems. Accordingly, deliberative-democratic approaches incite to use social WTP measures ([LS13]; [RKP$^+$14]).

Another difference is seen in the involvement of decision makers, with standard valuation addressing them as end-users in the role of receiving information from valuations, whereas they are seen as framers or even participants in value juries [RKP$^+$14].

As a consequence, recommendations to "combine the best of both worlds" ([Spa07]; p. 691) have been made in combining traditional instrumental valuations with deliberative valuations. It is argued that instrumental-deliberative approaches focus on traditional approaches where standard

goods are evaluated and surveys for big data bases are appealed complemented by deliberative elements in order to judge trade-offs and incommensurate values. Deliberative-instrumental approaches apply participative valuations when democratic legitimation for instrumental assessments are needed [RKP+14].

4.3.2. Complementary approaches and requirements for study design

Beyond the general question whether deliberation should take place within valuation and on which conceptual theory it is based, a more practical question is how deliberation could be combined with valuation. The main focus then is put on (i) how deeper-held values as identified by the complementary value concepts (see section 4.2.1) are revealed, (ii) how deliberative elements are combined with other quantitative methods and (iii) how the concept of deliberative monetary valuation [Spa07] is implemented.

An important framework on how values are constructed within deliberative settings has been proposed by Kenter et al (2016b). Their Deliberative Value Formation model (DVF) combines a) the Value-Belief-Norm, where transcendental values reflect environmental world views which are shaped by personal norms, with b) the Theory of Planned Behavior, which explains personal intentions by attitudes, external control and subjective judgement, and c) the Value Change Model, that explains changes in preferences with the relative importance of transcendental values [KRF16].

In order to construct, express and account for diverse values in valuation, DVF proposes to first explain the institutional setting in which the valuation takes place and to project possible impacts it could have on the public decision making. Then, a deliberation on transcendental values is followed by an assessment of participants' opinion on the current situation, leading to an option-impact-matrix [KRF16]. The latter is compared with the result of the deliberation on transcendental values and the norms and values affected by the different possible outcomes are assessed. Finally, the value indication (as WTP, rating or within a citizen jury) is given [KRF16].

Especially the exercise on transcendental values can be complemented by a value compass, where participants state individual values, then social values and finally social values in a group setting [KRF16].

For the integration of other quantitative methods within deliberative valuations, the Rapid ES Participatory Appraisal has been proposed [RVMS17]. Here, within a group setting, ES are assessed and rated, allowing a further investigation of possible motivations and rationales behind ES perceptions. This allows the consideration of a wider range of ES and associated benefits or to pre-select services subject to a possible monetary valuation afterwards [RVMS17]. The use of Q-methodology within such a framework is another possibility to construct a ranking of services ([PKM+99]; [SRVS+18]).

Other, less complex assessment methods are the Rapid (Participatory) Rural Appraisal [PQPV05] or interactive Multi-Criteria Decision Analysis [KMSR13]. If the study design does not allow a deliberation on a group preference level, the prediction of deliberative group outcomes

by aggregation of deliberated individual preferences is possible, as has been shown for different aggregation rules [MMM+17]. The standard deviation is a possible indicator of group disagreement or the diverging consideration of different ES within the discussion can be assessed qualitatively via transcripts ([MMM+17]; [VL16]).

The combination of deliberation and monetary valuation in Deliberative Monetary Valuation (DMV) is possible in even relatively simple protocols. A setting composed of information provision, the possibility for individuals to ask question and a discussion session is followed by a traditional stated preference elicitation method such as DCE is proposed [AAC+15]. Our protocol is similar to that approach but with much smaller group sizes [7].

More complex protocols are possible. For example, a DMV can also be composed of an online survey to assess individual WTP and subjective well-being indicators, which is followed by deliberative workshops to again assess individual WTP and social WTP from former online participants. These indicators are again assessed after an additional round of deliberation on transcendental values so that the impact of different rounds of deliberation can be determined [KJW+16]. Other complementary elements to the different rounds of deliberations in workshops can be storytelling, SWOT analyses or collective visits of the study area [OWKBC16].

The choice of an adequate study protocol is based on the study context, financial or logistic constraints and the kind of advantages of deliberative valuation emphasized in the literature that one aims to exploit. An overview of these advantages is given in the next subsection.

4.3.3. Expected advantages of deliberative approaches

The different set of conceptual hypotheses motivated authors to accentuate possible advantages of deliberative valuation over standard stated preference valuation methods.

In general, deliberative valuation and especially DMV is seen as positive combination of democratic legitimation with money as a single metric ([Spa07]; [BRL15]) and would therefore lead to better valuations ([WH02]; Lo and [Spa07]). Deliberation is considered as a possibility to enlarge traditional instrumental methods to broader socio-cultural assessments [AAGBMLPR18].

Consequently, the main reasons mentioned in empirical works to use deliberation has been i) a willingness to enlarge neoclassical assumptions, ii) a better integration of needs of respondents into assessments, iii) allow an easier trade-off of values by giving opportunity to think and ask questions and as a result iv) to achieve a higher understanding of the issue by participants [BRL15].

If theoretical papers are investigated, most often emphasized justifications to call for more deliberative applications have been i) also a depart from neoclassical assumptions, ii) the willingness to assess group preferences instead of individual preferences and iii) to achieve an integration of a broader set of values, all leading to avoid shortcomings of traditional stated

7. Aanesen et al report group sizes of up to 23 individuals which seems questionably high if everyone is supposed to have the possibility to express themselves, listen to others and interact, and to avoid fractioning within the discussion (see also the best practice recommendations for focus groups in Krueger and Casey (2014) presented in section 2.3.1.

preference valuation expressed in the literature ([BRL15]; [WH02]; [Spa07]). Deliberation is also seen as a way to understand interests, rationales and motivations behind choices stated in traditional valuations ([LBH15]; [CM20]).

As described in the previous subsection, the way to enrich the information included and revealed from preference is another field of particular interest, when it comes to deliberation. It is argued that the latter is needed to include not yet pre-formed preferences into valuation, that have still to be constructed, especially by allowing and supporting social learning ([Ken15]; [Spa07]; [Die13]). This situation is relevant for the valuation of unfamiliar goods [AAC+15].

For this process to happen, the integration of complementary values and information than elicited in standard approaches, is investigated in the literature. Deliberations can encourage the recognition of opposing political views and therefore increase the diversity of arguments accounted for in individual preferences and to express formerly implicit values [KRF16].

This allows the assessment of values that are difficult to categorize within specific ES categories [KMSR13]. Furthermore, local and indigenous knowledge can easier be accounted for in valuation [OWKBC16]. Particular importance has this in valuations that take place in developing countries: As important parts of the populations are strongly constrained by income, an approach solely based on individual WTP tends to marginalize their preferences, which are simultaneously influenced by collective approaches of land management ([KHCF11]; [LBH15]). Here, as in general, WTP is an important cardinal scale to rank possible alternatives that can be enriched by qualitative information from deliberative elements [BL18].

The usefulness of deliberative approaches has been emphasized for solution to conflicting values, differences in interpretations of the issue, uncertainty, a high diversity of stakeholders or contests ([Ste05]; [KRF16]). Especially for environmental goods, their consumption is often coupled with citizenship, as numerous product boycotts and contests for environmental reasons show [Vat05]. The need for deliberation is argued to increase with the lack of comparability of values [CSG12b].

4.3.4. Occurring biases and other inconveniences

As it can be expected, the advantages presented in the previous paragraph often come at a cost. Financial resources needed to conduct deliberative workshops are significantly higher, especially if experts are invited for information provision, or if the deliberation is applied over several meetings ([RW06]; [LBH15]). This is also a reason that statistical representativeness cannot be achieved for deliberative settings, but is either approached by stratified sampling or completely replaced by political representativeness ([RKP+14]; [LBH15]; [SBL18]).

Another problem is a possible marginalization of preferences of parts of the (future) population such as future generations and low-income people ([Ste05]; [SGC+13]; [BRL15]). Furthermore, endowment effects such as the capacity to deliberate and to express one's own viewpoint to others may be accentuated by deliberative approaches ([Pel99]; [SGC+13]; [KJW+16]). This

often leads to a self-selection bias to the expense of critical people, people unwilling to share their views or only partially interested in the topic ([VL16]; [AAC+15]).

Communication skills are not only necessary to explain the own opinion but to account for other viewpoints as well, creating knowledge asymmetries within the group ([Vat05]; [SBL18]). Consequently, social statuses are made apparent and power relations within the group might influence the discussion ([PKM+99]; [Ste05]; [BRL15]), such that a bias towards elites arises [LS13] [8].

The social interaction within a group is therefore affecting the results: Peer pressure, especially within consensus-based approaches might incite individuals to accept other viewpoints ([KOH+15]; [OWKBC16]; [SBL18]). Sympathy and eloquence of participants can be a courtesy bias [AAC+15]. Some participants may dominate the discussion and the outcome, but this influence is reduced by giving attention to the seating arrangement ([Pel99]; [BRL15]; [SBL18]; see also section 2.3.1). On the other end, is has also been reported that participants deliberately provided false information to influence the discussion [SBL18].

The process design of the deliberative valuations by the researchers itself is a possible source of biases because results might be framed (unconsciously) ([Spa07]; [SGC+13]; [BRL15]). One example is the duration or frequency of deliberation as well as the daytime that might be constraining for some types of respondents and affect the group composition ([Pel99]; [KBC+16]; [KJW+16]). The institutional context is another confounding factor; such research projects are distrusted and any kind of information provision is seen as political interference ([Die13]; [KJW+16]). Consultation of expert or focus groups represents a possible solution as well as employing a professional facilitator [SBL18].

Unfortunately, this role as facilitator or moderator are other sources of biases that need to be avoided and controlled for ([VL16]; [SBL18]). Most of these framing biases are to be avoided by an appropriate implementation of best-practice guidance [KRF16].

The final and perhaps most important point when it comes to the use of the results from deliberations, is the question how the contextual and often local character of the values included in the valuation can be up-scaled to higher levels and whether they are applicable at all to other contexts ([Die13]; [Mei19]).

4.3.5. Empirical findings

Beyond methodological papers, empirical studies using deliberative techniques to evaluate ES are the main purpose of publications. They often focus on single ES; rarely interactions among multiple services or bundles of ES are assessed [BRL15]. Due to small sample sizes, generalization of results to the general public are questionable [BRL15]. Especially when transcendental, relational and personal attitudes are discussed, individuals emphasize the importance of altruistic,

8. This is what we also observed in our study: an overrepresentation of people showing characteristics of higher education and income.

intrinsic and ecological values to the expense of egoistic ones ([KJW+16]; [OK19]). Intangible benefits are more appreciated [BJC18].

Introducing elements proposed in section 4.3.2, helps to reveal important local knowledge, avoids misunderstandings and include diverse arguments into participants' judgements ([VL16]; [BJC18]). Accordingly, preferences from others are increasingly recognized so that individual values stand back behind social ones, motivated by a consensus seeking process [OWKBC16]. Indicators for that are lower standard deviations within groups as well as higher stated choice certainties ([KJW+16]; [VL16]; [MMM+17]).

As could have been expected from the previous subsection, difficulties and problems arising within the deliberations are also reported and are helping to further improve the process design of deliberative valuation. Vocal protesters expressing their mistrust before the actual discussions or dominant participants that are, despite efforts to facilitate, impacting the discourse and the outcome of valuations by marginalizing points of views of other individuals ([KJW+16]; [OWKBC16]). Even if participants have been found to be unwilling to significantly change their position, a tendency to accept less "extremist" positions can be detected [PKM+99].

Regarding the biases occurring from self-selection, an underrepresentation of young people and blue collar workers is observed [AAC+15], which corresponds to the biases in our empirical study. Meanwhile, high degrees of satisfaction of participants with the overall setting as well as the feeling to be accounted for has also been observed ([PKM+99]; [MMM+17]).

Additionally, deliberating on transcendental values and personal attitudes using storytelling allowed to integrate deeper-held, hidden or subtle values such that monetary estimates and indicators for subjective well-being converged [KJW+16]. The dynamic of group settings for achieving consensus is also possible to simulate, when they are internalized within individual WTP: Using inter-group heterogeneity measures and aggregation rules on deliberated individual preferences achieve a high predictive quality for group outcomes [MMM+17]. Finally, it is observed that deliberation motivates individuals to consider budget constraints more seriously in their choices, such that it represents a possible solution in order to avoid exaggerated WTP estimates due to hypothetical or other biases ([KJW+16]; [VL16]).

4.3.6. Importance for decision making

The scientific literature provides some clarification on how the use of deliberative valuation could impact and enhance public decision making. It is argued that public decisions based on deliberative approaches possess a higher degree of legitimation and are less controversial, especially with regard to possible objections by stakeholders ([KMSR13]; [KRF16]). They allow higher recognition of diverse points of views among participants and are therefore a useful tool for awareness-rising campaigns ([LBH15]; [RVMS17]). Deliberation can enhance trust-building into the process and therefore achieve commitment of stakeholders for the implementation stage, especially in interdisciplinary and transdisciplinary applications ([Pel99]; [Ste05]).

The inclusion of a variety of stakeholders and the assessments on often complementary, local spatial scales are increasingly important for decision makers, but not feasible for higher than regional scales ([LBH15]; [RVMS17]; [SBL18]). However, a general concern is the conflict between the need for structured, comparable outcomes of decision makers with the need for individual, context-dependent adaptation of protocols in order to satisfy conditions in terms of process, agenda setting and non-framing of the point of views of participants [OWKBC16].

4.4. Implications for valuation

4.4.1. Synergies from deliberations and account for non-material ES

It is acknowledged that the use of deliberative approaches is beneficial to the consideration of non-material ES in valuations ([SGC+13]; [KRF16]) and a good compromise between the indication of less tangible and monetary values [CVLU19].

For both domains, place-based, local approaches in a limited area and with common cultural contexts are highlighted ([CSG12b]; [SGC+13]; [SMD17]). Instead, value transfers from higher scales would be inappropriate for local use [CSG12b]. For national scales, instead of having deliberations, a focus on socio-demographic characteristics as in traditional valuation approaches is demanded in order to classify ES beneficiaries for a detailed analysis and adapted policy [SMD17].

Finally, a combination of different methodological elements is recommended for increased understanding for participants and gaining insight into their motivation ([BL18]; [BJC18]). This also concerns the stage of the assessments with deliberations well suited for information purposes whereas monetary approaches are facilitating trade-offs [CVLU19].

An important interrogation is not only whether, but how deliberation may enhance integration on non-material ES. First, how should values be addressed by the protocol of the study? In order to avoid that participants express lexicographic preferences (refusing to trade-off between different sets of values), the overall set of values considered in the study should not be constrained [LS13]. Furthermore, framing towards values related to the environment from the beginning of the deliberation may prevent participants from discovering links between their deeper-held values and ecological values or ES during the discussion [BJC18]. Especially for relational values, it is recommended to assess the personal incorporation of participants into that relation, the so-called "embeddedness" ([HM18]; p. 2).

Second, the role of local institutions and stakeholders within the valuation process is of importance. Their logistic, administrative and consultative support are a decisive factor for a successful setting [Pel99]. The identification of and attention to beneficiaries allows to determine the values at stage [SMD17]. Furthermore, they are needed to interpret transcendental values which might not be evident for researchers in every local, cultural context [ORMLF+17].

4.4.2. Account for non-material ES in valuation

Despite the synergies described above, some recommendations in the literature are more specific to one issue, non-material ES or deliberative approaches - without being opposed to the other. Beginning with suggestions related to the former, it is argued that non-material benefits are not following the disposition of exchange values and should therefore not be evaluated monetarily [dBSB+19]. Satz et al (2013) present a defense against common arguments calling for a general abandonment of valuation of CES: First, interconnected benefits among ES and especially with non-material ES may lead to double-counting, but is to be avoided by a clear description and a focus on final services.

Second, the issue of incommensurability can be avoided if researchers are willing to accept incomplete or implicit comparisons, by (i) distinguishing commitments initiated in social norms from preferences formed in an endogenous process by individuals, and by (ii) applying only partial ordering of alternatives, for example componentwise or separately for several value dimensions [SGC+13]. Third, the plurality of value dimensions can be accounted for if individuals are asked to trade-off in a group setting such that they are forced to acknowledge to account for various other value judgement. Fourth, if the adequate scale for the analysis is unclear, an integration of stakeholders may lead to the determination of reasonable and scale-fitting indicators that account for local knowledge.

And finally, the fact , that only residual interest is given to non-material ES in many assessments and valuations, is marginalizing poor and indigenous people in developing countries who often assign high importance to transcendental values in combination with nature [SGC+13].

Non-material ES often relate to social values that appeal to the adoption of a citizen view or to be in a setting that represents the type of group in which common cultural values are shared ([FCW16]; [SMD17]; [Kir19]).

4.4.3. Implementing deliberative settings in valuations

For implementation of deliberative approaches, the purpose of the valuation has to be considered. Often, valuations represent an information tool for public policy, for which individual WTP values are sufficient and do not include problems such as double counting or moral disagreement forced by social WTP measures [BL18]. Other recommendations have been proposed by Stern (2005): (i) a high participation to include a wide range of possible viewpoints including those from decision makers, (ii) the implementation of valuation as advised by scientific standards, (iii) a transparent process in order to achieve credibility and trust-building among participants and (iv) a clear determination of rules when deliberation ends or if preferences are to be reassessed and when.

This is complemented by clear determination of the values at charge and possible value judgements made throughout the process, especially to distinguish and account for first-order and

second-order preferences such that lexicographic preferences, commitments and protest responses are limited and revealed ([Ste05]; [BL18]).

Other elements of deliberations are subject to the individual context of the valuation. The question whether participants should have a personal interest in the outcome of the valuations implies to weight the risks of having high systematic and hypothetical biases versus the aim to gain insights into the motivation of affected individuals and in particular stakeholders ([Pel99]; [LS13]). Deliberation provides most complementary information in the context of complex and contested goods, but causes high costs in terms of financial and organizational resources [KBC+16].

Several areas of research needs have been identified, especially experimental approaches to test different settings and combinations of techniques [Ste05]. Kenter et al (2016d) propose 35 research questions that are concerned about the ways protocols frame outcomes, how deliberation is facilitated and how power relations in discussions can be controlled for by moderation (see also [KJW+16]; [OWKBC16]). Assessing the perception of ES by participants has to be improved in terms of the integration of indirect and non-use values [RVMS17].

4.4.4. Positioning of our study

When it comes to our study, only a limited part of (sometimes even contradicting) recommendations is adequate to own purposes and contexts. Our experimental study clearly represents an analytical-deliberative approach. When it comes to our DCE, we followed the recommendations of our focus groups (see section 2.3.2) instead of being overly focused on the coherence of the attributes with ES-categories. As an example, the tourism attribute is meaningful for participants and decision makers but not directly related to specific ES. As our list of indicator statements shows, we also integrated other benefits not representing any ES, but mentioned and therefore judged as important within focus group discussions.

The aim was to limit the degree of framing by our pre-selection of attributes and related follow-up questions. In that same direction points the way we organized our discussion: Three questions concerned the attributes of the choice experiment, but they were preceded by a discussion on values, perceptions and impressions that were not yet mentioned in the informative part (or in the case of control groups, who completed the DCE choice sets before the discussion taking place) within the questionnaire. This order appealed to include values and viewpoints into the discussion independent from our views as researchers and organizers and that may also influence the values associated with the attributes.

Our expectation was that our approach was considered as extensive and meaningful by participants, motivating them to freely deliberate, therefore revealing rationales and motivations including deeper-held values. Using our transcripts in a next step will allow us to combine monetary estimates with a qualitative analysis of the discussions. Chapter 3 with the ES bundles assessment has shown that such a combination is beneficial for a holistic analysis. We hope that

the experimental design allows to achieve empirical evidence on the assessment of non-material ES (among others) by deliberative valuation.

4.5. Analysis

This section presents the outcomes of our experiment with regard to the impact of deliberation. First, the econometric estimation of the effect of deliberation is presented using two different approaches. Then the cluster analysis of chapter 3 is investigated and the influence of the fact of being deliberated on cluster composition is described. In order to have more information on the way the different ES and related benefits have been accounted for in deliberated groups and in non-deliberated groups, the distribution of categories of indicator statements is assessed. An important part of the analysis that complements the current results is a content analysis of the transcribed discussions. Approaches and ideas for this next step in the analysis are presented. Finally, as trust-building and satisfaction of participants with the methods are important indicators for decision-makers and practitioners, a final part of this section presents statistics about these issues.

An in-depth discussion including the interrelations of the results obtained from different approaches, as well as comparisons to findings in the literature are provided in the subsequent section 4.6.

4.5.1. Econometric effects of deliberation

As explained in the introduction to part II of this thesis, the mostly used way to assess the impact of deliberation is to compare ex ante deliberation with ex post estimates of the same individuals. In our case, this approach was not feasible within the timing requirements of the deliberate workshops. Furthermore, the indicator statements to be completed before the deliberation would have provided participants with supplementary information from our discussion. An ex ante-ex post comparison would not have made possible to distinguish this pure information effect from effects of the deliberation.

This is why our solution is to compare deliberated groups with control groups. In the literature, this procedure is often characterized by simply showing the estimation results and commenting on differences in coefficients, without referring to whether the effect is actually significant. Statistically, this is debatable.

To prove a significant difference among groups, different ways of capturing the effect of deliberation in econometric models are possible. A first approach estimates coefficients separately in deliberated and non-deliberated groups and compares confidence intervals of estimated coefficients [9]. Here, a problem of scale heterogeneity arises: A difference in coefficients could be caused either by a difference in the parameters of the model (the effect initially to be detected) or by different scale parameters among estimations. For the moment - to my knowledge -

9. I will denote this approach as "separated approach"

no estimation procedure to control this scale effect for a treatment-control approach in logit models has been proposed [KHB12]. However, the scale coefficients are determined by the unobserved part of utility of participants. As our treatments were randomly assigned to groups (the communication was the same for each group and groups were informed only after having finished the questionnaire about the experimental character of the study) we suppose that the unobserved characteristics reflected in the scale parameters are equally distributed. Consequently, this method to compare the confidence intervals may provide useful insights.

A second approach is to estimate the effect of deliberation by including simultaneously deliberated and non-deliberated groups, while distinguishing the effects by interactions [10]. Nevertheless, the calculation of interactions in non-linear models of standard software "does not provide a useful measure of any interesting quality" ([Gre10], p. 292; see also [AN03]) [11]. We therefore rely on the method mentioned in the previous paragraph and use the integrative approach only for illustrative reasons in order to look for the robustness of the effects detected.

Finally, some authors use WTP estimates to test significant differences. In order to be useful, this method requires very tight confidence intervals with large sample sizes to be meaningful and precise. Even for our relatively big sample size compared to other deliberative applications, this approach is still more than questionable.

4.5.1.1. Cévennes

Beginning with the Cévennes, the impact of deliberation for the separated model is presented, followed by the integrated model. Both logit models, the multinomial and the mixed logit model are analyzed subsequently, in order to observe the consistency of the effects. Given the higher quality indicated by parsimony indicators and goodness-of-fit measures in 3, the results from the mixed logit are of particular interest.

MNL model for the Cévennes sample

Figure 4.1 shows the 90% confidence intervals between deliberated groups (red) and not deliberated groups (blue). For most coefficients, overlaps are observed, indicating no significant difference among groups for the 10% significance level. Only the high tourism attribute is significantly higher for non-deliberated groups compared to deliberated ones. Nevertheless, the medium level of the same attribute and the cultural heritage attribute show only small overlaps that could indicate differences that are not significant due to an insufficient sample size.

The summary of model outputs illustrated in figure 4.2 represents the significant interactions between a deliberative dummy and the main effects in MNL models. They were specified as follows: The final models from sections 3.3.2 and 3.3.3 were taken (in this case the final MNL

10. I will denote this approach as "integrated approach"
11. This is also why we assessed the pertinence of interaction terms not only based on their significance, but based on the robustness of significance among several models.

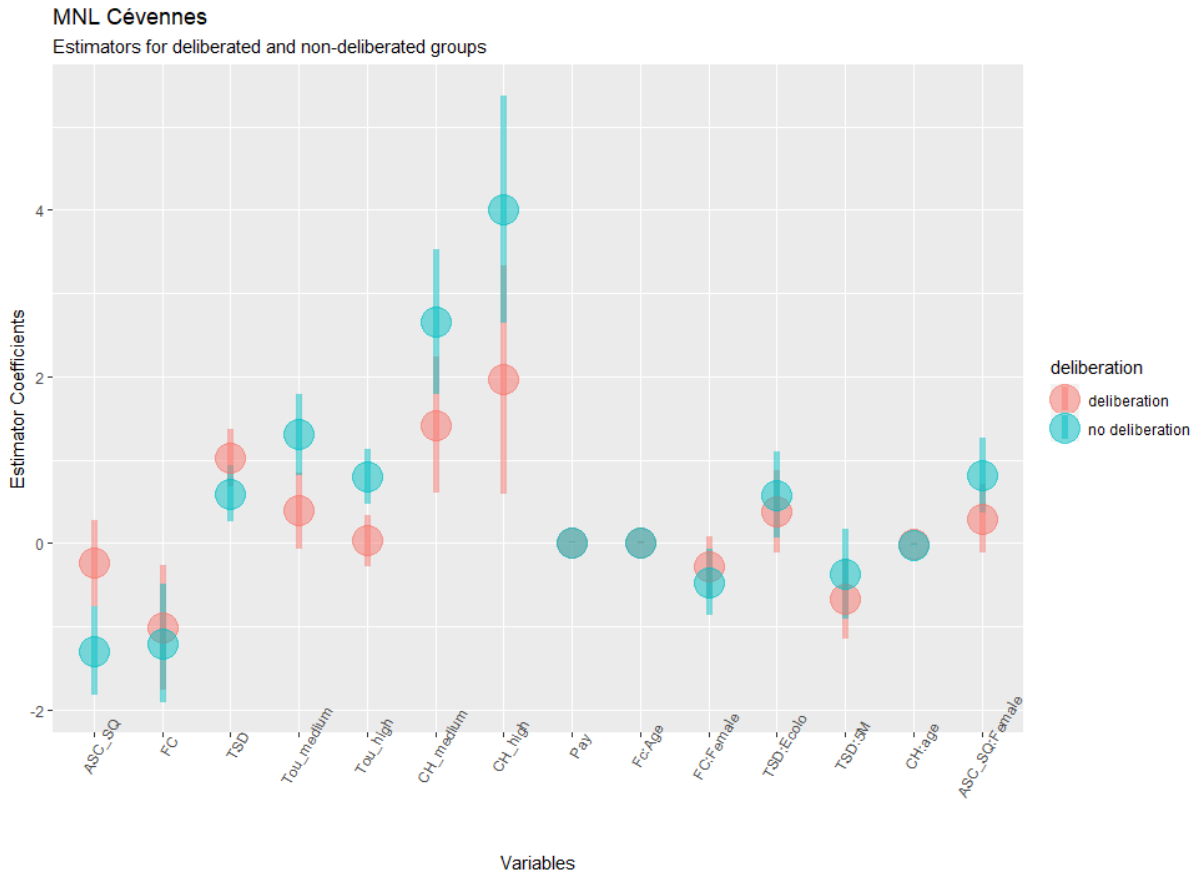


Figure 4.1. – 90% confidence intervals for deliberated and non-deliberated groups for the MNL model of the Cévennes sample.

Cevennes	main effect	Forest Cover	Tree_species	Tourism	cultural heritage	SQ	LL	R2	AIC
	#								
	1	no	closely not	yes	no	no	-903,42	0,1515	1844,8
	2		no	yes			-905,02	0,1500	1840,0
	3			yes			-905,29	0,1498	1838,6

Figure 4.2. – Summary of models to assess the impact of deliberation within one sample for the MNL of the Cévennes. The green cells give information about the significance of the according interactions, red cells illustrate interaction that are discarded and black cells show interactions that have been discarded in previous models.

model for the Cévennes sample, see page 145) and interactions for each main effect as well as the SQ ASC with a dummy that represented the deliberative status were introduced (green cells). If no significance was observed, these interactions were subsequently discarded from the

model (red cells) [12]. As figure 4.2 indicates, the cultural heritage attribute, the SQ ASC and the forest cover attributes were far from significant and were discarded from the model. The tourism main effect is significant at 5% and the tree species only closely not significant and therefore left in the model to observe the effect from the deletion of the other interactions. Nevertheless, it became not significant (not even closer to significance) and was also removed (see table C.1 in the appendix on page 289). Finally, this is a confirmation for the separated model: Only for the tourism attribute a clear difference between deliberated and non-deliberated participants is to be detected. Deliberated participants had weaker preferences for the tourism infrastructure evolution.

MXL model for the Cévennes sample

As described in section 3.3.3, the MXL model did not include effect coding. Even without accounting for non-linearities, the tourism attribute has a significantly lower coefficient for deliberated groups which confirms the findings from the MNL model. As before, no other main effect shows significantly different confidence intervals at the 10% level. Nevertheless, three details are remarkable: (i) Contrary to what could have been expected from the MNL model, the cultural heritage attribute has a nearly perfect overlap of the mean estimation of the coefficient. Then, (ii) the tree species attribute has only a slight overlap of confidence intervals between deliberated and non-deliberated groups. A difference of coefficients for this attribute did not seem to be present in the separated estimation of the MNL model, but possible in the integrated model. Figure 4.3 tends more to the latter case, with a difference which is possibly not (yet) significant due to a low sample size. (iii) The estimator of the mean of coefficients for non-deliberated groups seems to be more precise (smaller confidence intervals) than for deliberated groups. The same is true for the estimators of standard deviations. A possible cause could be a heterogenization of preferences in deliberated groups (against what could have been expected). However, standard deviations for non-deliberated groups are not consistently smaller, which does not support this hypothesis.

As indicated in figure 4.4 for the integrated model (output in table C.2 on page 290 in the appendix), only the interaction terms involving the cultural heritage attribute and forest cover attribute were not significant with deliberation, whereas tree species, tourism and the SQ ASC were significantly different from deliberated groups (with the same signs as to be expected from figure 4.3 with the confidence intervals). For the tourism and the SQ ASC coefficients, this seems to confirm the results for the MNL model. A significant difference for the tree species attribute might indicate an effect of deliberation on that attribute. Possibly, the account for heterogeneity among participants in the MXL model helped to clarify the originate effect of deliberation on the main effect "tree species".

12. Here, the low informative value arising from interactions in logit models has to be repeated, which also lead to the decision to not account for non-linear effects. Furthermore, this reminds of the statistical problems arising from low sample sizes already mentioned in the literature review in section 4.3.4.

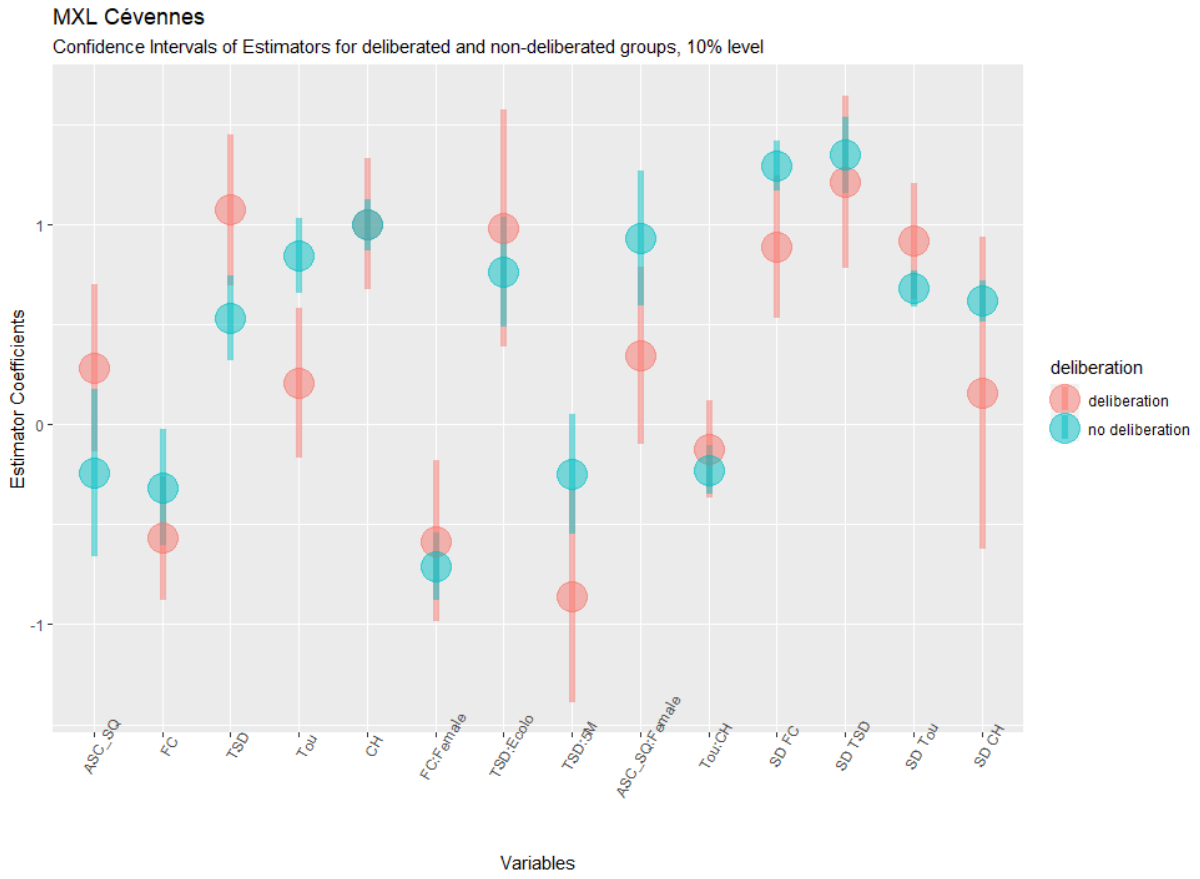


Figure 4.3. – 90% confidence intervals for deliberated and non-deliberated groups for the MXL model of the Cévennes sample.

Cevennes	main effect	Forest Cover	Tree_species	Tourism	cultural heritage	SQ	LL	R2	AIC
	#								
	1	no	yes	yes	no	yes	-865,8	0,1869	1775,6
	2	no	yes	yes		yes	-865,67	0,1870	1773,3
	3		yes	yes		yes	-865,17	0,1875	1770,4

Figure 4.4. – Summary of models to assess the impact of deliberation within one sample for the MXL of the Cévennes.

In the Cévennes groups, a significant effect on the tourism attribute is found: Deliberation seems to decrease the appreciation of tourism infrastructure. As already described for previous models (chapter 3), this could be due to a strong decrease of preferences for the "high" attribute. Notably, this non-linear effect even affects overall the overall linear effect of the parameter modeled in the mixed logit model.

For instance, no effect of deliberation on cultural heritage can be determined, maybe due to non-linear effects, that will further be investigated using dummy-coded schemes. Also for the

forest cover and tree species attributes, no effect of deliberation is found for the Cévennes sample. These findings are further analyzed in section 4.6 .

4.5.1.2. Montpellier

Having identified a consistent effect of deliberation on preferences for the tourism infrastructure attribute for the Cévennes sample, the analysis is now applied on the Montpellier sample.

MNL model for the Montpellier sample

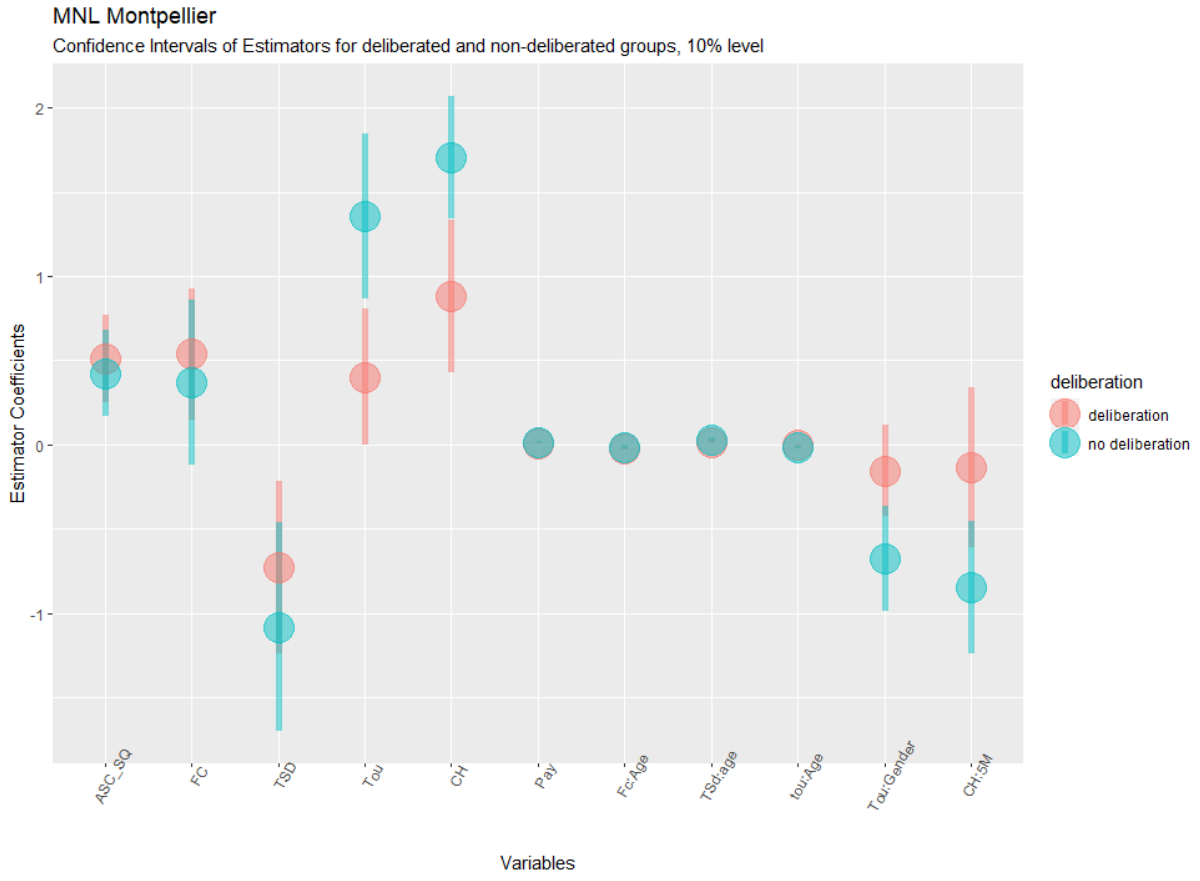


Figure 4.5. – 90% confidence intervals for deliberated and non-deliberated groups for the MNL model of the Montpellier sample.

In the separated model, the deliberated groups show significantly smaller coefficients for tourism (even at the 5% level) and cultural heritage (see figure 4.5). The former would be similar to the Cévennes sample. With regard to the size of the confidence interval range, no effect can be observed.

For the integrated model the tourism and cultural heritage attribute as well as the alternative-specific constant for the status quo alternative are not significantly different among the groups

Montpellier		main effect	Forest Cover	Tree_species	Tourism	cultural heritage	SQ	LL	R2	AIC
		#								
		1	10%	closely not	no	no	no	-867,01	0,1586	1770,0
		2	10%	10%	no	no		-867,01	0,1586	1768,0
		3	10%	5%	no			-867,41	0,1583	1766,8
		4	10%	5%				-867,89	0,1578	1765,8

Figure 4.6. – Summary of models to assess the impact of deliberation within one sample for the MNL of Montpellier.

(see figure 4.6, for the output table C.3 on page 291. They are subsequently removed from the model, which makes the tree species attribute become significant at a level of 5%. It has not been discarded from the model previously, being slightly not significant at 10% level before. Only the forest cover attribute is constantly significant at the level 10%. The results for the two models are divergent. Given the poor theoretical foundation of the integrated model, this cannot be seen as an empiric contradiction to the outcomes of the separated model.

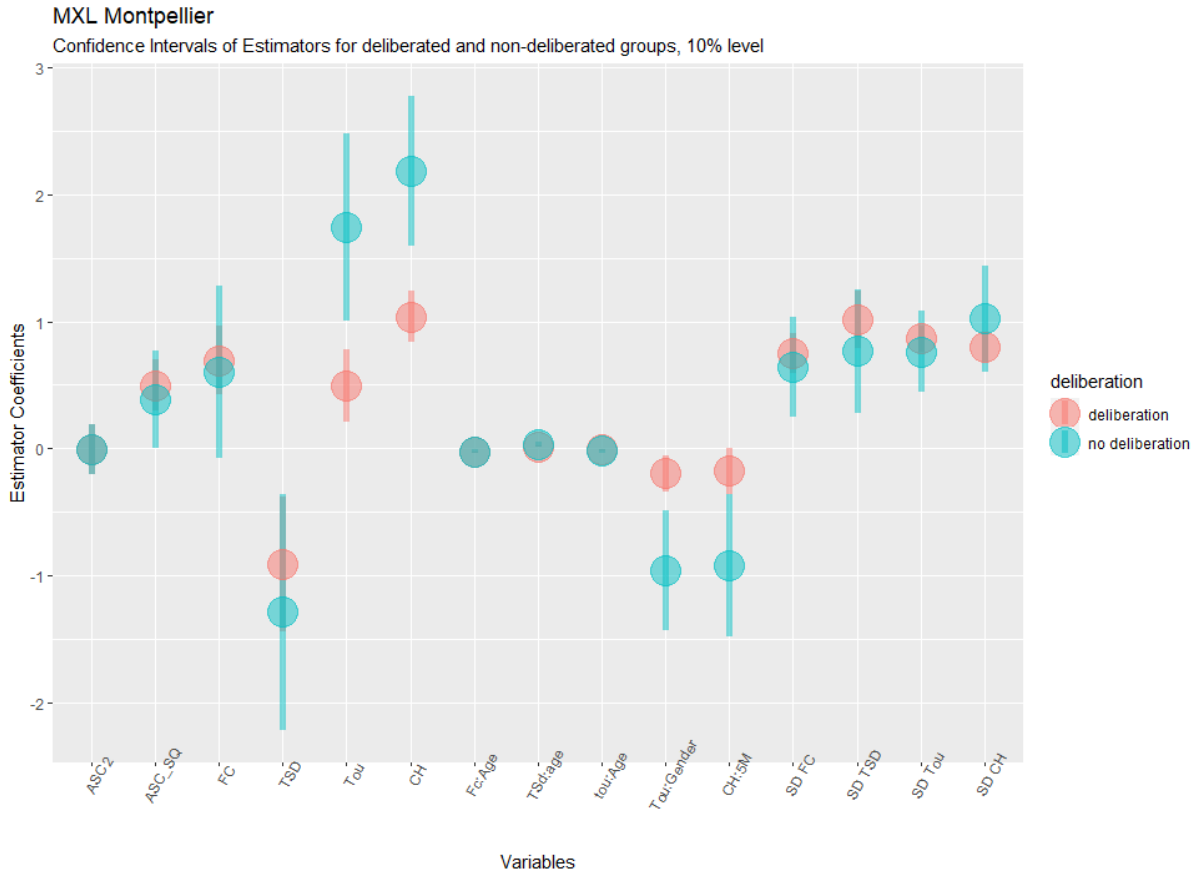


Figure 4.7. – 90% confidence intervals for deliberated and non-deliberated groups for the MXL model of the Montpellier sample.

MXL model for Montpellier As before, the separated model for the mixed logit estimation confirms the findings of the multinomial logit (figure 4.7): Tourism and cultural heritage coefficients are significantly smaller (even at the 5% level). The range of the confidence intervals is higher for non-deliberated groups and the same is true for the range of estimates for standard deviations. Possibly, the results indicate a preference homogenization for the Montpellier sample.

Montpellier	main effect	Forest Cover	Tree_species	Tourism	cultural heritage	SQ	LL	R2	AIC
	#								
	1	no	10%	no	no	no	-801,29	0,2224	1648,6
	2	no	10%	no	no		-801,47	0,2222	1646,9
	3	slightly not	slightly not	no			-801,71	0,2220	1645,4
	4	slightly not	10%				-802,21	0,2215	1644,4
	5		10%				-803,09	0,2207	1644,2

Figure 4.8. – Summary of models to assess the impact of deliberation within one sample for the MXL of Montpellier.

Similar to the separated model, the integrated approach for the mixed logit confirms its outcomes from the multinomial logit model (figure 4.8, output in table C.4 on page 292 in the appendix). The tree species attribute is now only significant at the 10% level, whereas the forest cover gets slightly not significant. Even if the results are similar to the MNL model, they do not appear to be robust.

As announced in the introduction, the separated approach of overlapping intervals is more statistically valid, the approach that uses interactions is only a supplementary element to observe the outcomes' robustness. Accordingly, our analysis indicates a decreasing effect of deliberation on the coefficients for tourism and cultural heritage for the Montpellier sample. The impact on tourism is similar to the findings for deliberated and non-deliberated groups in the Cévennes. Investigating the impact of deliberation on the outcomes of the cluster analysis as well as on the consideration of indicator statements may reveal the reasons for this shift of preferences. Additionally, it provides information on the values integrated into the choice task.

4.5.2. Cluster analysis

The factor analysis as well as the clustering have been applied without taking into account the fact of being deliberated as active variable.

In the first cluster, individuals from deliberated groups have been overrepresented, whereas the opposite is true for the third cluster. Nevertheless, deliberation is not highly correlated with cluster membership such that clusters are not sharply distinguishable by deliberation. Notably, the first cluster disposed generally high values of ES consideration. This could be an indication that deliberation might contribute to higher consideration of a diversity of ES. The same logic would apply for the third cluster. It is a combination of low consideration of ES and an underrepresentation of deliberated individuals. Hence, deliberation seems to be correlated with variables that represent a certain form of expertise.

Although the investigation of the clusters identified in the previous chapter implies a certain influence of deliberation on the consideration of services, a deeper analysis of the indicator statements is necessary. In the subsequent subsection they are compared between deliberated and non-deliberated groups.

4.5.3. Impact of deliberation on consideration of indicator statements

		Cevennes						Montpellier					
		not deliberated			*deliberated*			*not deliberated*			*deliberated*		
Benefit	Service category	Considered	not important	unaware	c.	n. i.	u.	c.	n. i.	u.	c.	n. i.	u.
All		**43,8**	**24,3**	**21,7**	**44,3**	**22,2**	**22,0**	**42,0**	**22,5**	**24,6**	**48,5**	**24,4**	**18,0**
Attribute: Forest Cover		36,7	24,1	26,6	35,7	25,6	26,6	40,3	23,3	25,6	44,7	25,9	18,4
preference for agropastoralism	Provisionning	49	19	27	37	22	31	22	28	24	39	28	16
air purification	Regulating	24	20	39	29	34	31	46	26	20	46	21	26
carbon sequestration	Regulating	49	31	17	46	20	27	63	24	9	67	23	7
erosion control	Regulating	63	20	15	66	22	9	57	20	20	65	25	9
forest biodiversity	Other benefit	51	27	20	59	31	9	72	13	9	75	14	4
pasture biodiversity	Other benefit	48	25	15	39	22	25	35	22	33	35	26	21
environmental identity	Cultural	15	32	25	25	25	20	33	28	22	30	32	25
recreation	Cultural	19	27	37	25	32	31	39	35	15	44	30	16
spiritual value	Cultural	20	19	36	36	17	37	41	19	24	39	30	18
timber provision	Provisionning	39	32	25	20	46	24	37	22	35	37	35	19
water quantity	Provisionning	20	20	32	20	14	31	13	20	56	25	19	33
support for silvopasture	Provisionning	44	17	29	25	22	46	24	22	39	37	28	28
Attribute: Tree Species		42,4	24,6	19,5	42,0	18,6	24,2	29,2	20,9	36,6	40,4	23,7	23,2
aesthetic value	Cultural	48	39	9	68	17	10	46	20	28	58	21	14
risk of forest fires	Regulating	42	14	25	31	19	36	28	22	37	32	30	33
idemic tree species	Cultural	66	24	9	61	20	14	35	24	33	60	16	14
timber provision	Provisionning	14	22	36	9	19	37	7	17	48	12	28	32
Attribute: tourism		47,5	23,3	19,9	48,3	19,9	19,5	43,5	25,0	19,9	50,4	25,9	17,6
loss of authenticity	Other benefit	27	31	22	29	24	29	37	30	15	37	33	21
economic benefits	Other benefit	80	15	3	81	17	0	69	24	2	75	18	5
incentive for conservation	Other benefit	68	20	7	53	31	9	48	35	9	67	21	5
danger of monetization	Other benefit	15	27	48	31	9	41	20	11	54	23	32	39
Attribute: Cultural heritage		62,7	25,4	11,0	68,7	18,2	8,9	58,3	19,5	14,4	66,3	19,3	11,9
conservation of bancèls	Cultural	71	17	10	83	12	2	54	15	20	67	18	16
historical features	Cultural	71	22	7	71	15	10	69	19	9	67	23	9
attractiveness for visitors	Other benefit	42	41	17	56	25	12	54	24	13	68	18	5
social cohesion	Cultural	66	22	10	64	20	12	57	20	15	63	19	18
Provisionning		33,2	22,4	29,2	22,9	27,1	34,3	22,7	22,2	36,6	31,1	29,9	23,7
Regulating		44,5	21,2	24,2	42,8	23,7	25,4	48,6	23,2	21,8	52,2	24,6	18,9
Cultural		44,3	25,4	19,1	53,3	19,8	17,4	48,4	22,2	19,1	52,4	24,6	16,3
Other		47,2	26,6	18,9	49,6	22,5	17,7	47,9	22,8	19,3	54,4	23,0	14,3
Cheap Talk		*49,8*	*25,7*	*23,9*	*46,3*	*26,8*	*26,8*	*49,7*	*25,4*	*25,0*	*49,2*	*27,4*	*23,3*
		No cheap talk			cheap talk			No cheap talk			cheap talk		

Figure 4.9. – Degree of consideration of each indicator statements as reported by individuals.

In order to show the effect of deliberation, figure 4.9 displays the proportions of "considered", "not important" and "unaware" answers for the indicator statements, distinguished between Montpellier and Cévennes and whether the individual has been within a deliberated or a non-deliberated group. Missing values were included (causing values not to some up to 100% in several cases), but are not visualized in order to keep the graphic simple. The grey shaped line gives the mean for all indicator statements, whereas the different colors represent the statements for different attributes of the DCE.

Average effect

Regarding the average effect on all attributes, no impact of deliberation on the Cévennes sample seems to occur, the respective proportions of answer categories is nearly stable. Contrary to

that, in the Montpellier sample, the deliberation has caused an increase in "considered" and "not important" categories (from 42.0% to 48.5% and from 22.5% to 24.4%) to the expense of the "unaware" category (from 24.6% to 18.0%). Deliberation might increase individuals' capacity to judge and express their own preferences in the second sample.

Attributes

Distinguishing the considerations by attributes suggests a refinement of the findings of the previous paragraph. For the Cévennes groups, only few changes are observed for the tree species attribute: The "not important" category decreases (24.6% to 18.6%) whereas the "unaware" category increases (19.5% to 24.2%), against our expectation. However, the responses to statements associated to the cultural heritage attribute shift mainly from "not important" (25.4% to 18.2%) to "considered" (62.7% to 68.7%). Here, a small change in the preference seems to occur. Given its significant impact in the econometric model, an investigation of the tourism attribute is of particular interest. Although no clear changes in values for the average attribute levels can be stated, some changes take place for distinct indicator statements: The danger of monetization of benefits is higher and the possibility that tourism increases the efforts dedicated to protection of nature are less supported in deliberated groups. Within deliberations, the concern that too much tourism would be in conflict with protection of biodiversity was raised, especially by giving the example of littering. Effectively, this could explain lower coefficients for tourism (in particular for the "high" level) in the DCE.

For participants from Montpellier, the information effect seems to be robust for all attributes with decreasing proportions of "unaware" responses from deliberated individuals. This effect is strongest for the forest cover (25.6% to 18.4%) and tree species attribute (36.6% to 23.2%), which may represent that the discussions mainly dealt with topics related to these two attributes.

Service categories

In the grey lines in the lower part of the figure, responses are distinguished with regard to service categories. For the Cévennes sample, it reveals that deliberation resulted in a decrease of the consideration of provisioning services and an increase for non-material services. This underlines our hypothesis that stated preferences may have changed due to an awareness of deeper held values at stake that are often related to non-material ES. Furthermore, less tangible benefits are more often considered, such as environmental identity and spiritual values for the forest cover attribute. For Montpellier, it is provisioning services that are more considered after deliberation, especially those related to pasture landscape. The information effect identified above may have resulted in a higher recognition of the anthropogenic character of the landscape in the Cévennes.

Cheap talk

We introduced a cheap talk in the questionnaire in order to test the presence of a hypothetical bias for the indicator statements. In the table, the percentage values in the last line therefore refer only to the fact of having had a cheap talk, and not on having been in a deliberated group

or not. Hardly any influence is detected, except minor changes for the Cévennes, but without a major influence. Using indicator statements to assess the consideration of different types of value seems to be a relatively robust method.

4.5.4. Analysis of transcribed discussions

The transcribing and subsequent analysis of discussions has been proposed as tool to complement quantitative outcomes in DMV with qualitative data about motivations and eventually conflicting points of views ([BL18], [SBL18]). In our experimental study, 22 discussions (10 in the Cévennes, 12 in Montpellier) representing 20 hours of audio files and involving 208 participants have been recorded and transcribed on more than 350 pages, but have not yet been analyzed. A short example is presented in the appendix in section C.2.

Analyses of transcripts are extensively used for focus groups or semi-structured interviews in the context of assessments and methodological innovations for ES. Examples are discussions among researchers to mainstream the ES concept ([YWS+14]; [CWC+18]), the determination of the willingness or reluctance of stakeholders to adopt the ES concept in the forestry sector [Rau18], the assessment of relation of Cévennes inhabitants to their environing landscapes [Deu05], the associations of inhabitants to cultural values and ES provided by urban river systems (du Bray e al, 2019) or the representation of the diversity of arguments treated in order to debate future land use scenarii [VL16].

Widely used to analyze transcripts is the open coding method, where text fragments are related to specific topics and re- or sub-grouped to combine information from different statements and different contexts (e.g. [CWC+18]). A more structured and software-based approach is a use of codebooks whose compositions with meta-themes and subtopics is steadily revised until convergence ([YWS+14]; [VL16]; [dBSB+19]).

Interesting indicators besides the coding schemes of the precedent paragraph are on the one hand a Gini coefficient that measures the distribution of either the speaking time or the number of interventions within the discussion. This could then be related to the degree of diversity of values using the coding schemes or related to intergroup heterogeneity of the DCE by integrating dummy variables for above- and below-average groups in terms of the Gini coefficients (Alexandre Sauquet, 2019, personal communication). On the other hand, the interrogations on ES and related values can be categorized by their way of being expressed: Are they rational, using scientific knowledge or experiences, or do they include emotional justifications (storytelling, anecdotes, witnesses, etc.) (Rey-Valette, 2019, personal communication)?

Therefore, the analysis of transcripts is an important element to extend and complement the current results.

4.5.5. Impact of deliberation on the quality of valuation

In this subsection, the impact of deliberation on the general quality of valuation is assessed. 'General quality' refers in this context to the ability, willingness and capacity of participants to provide the information on their preferences.

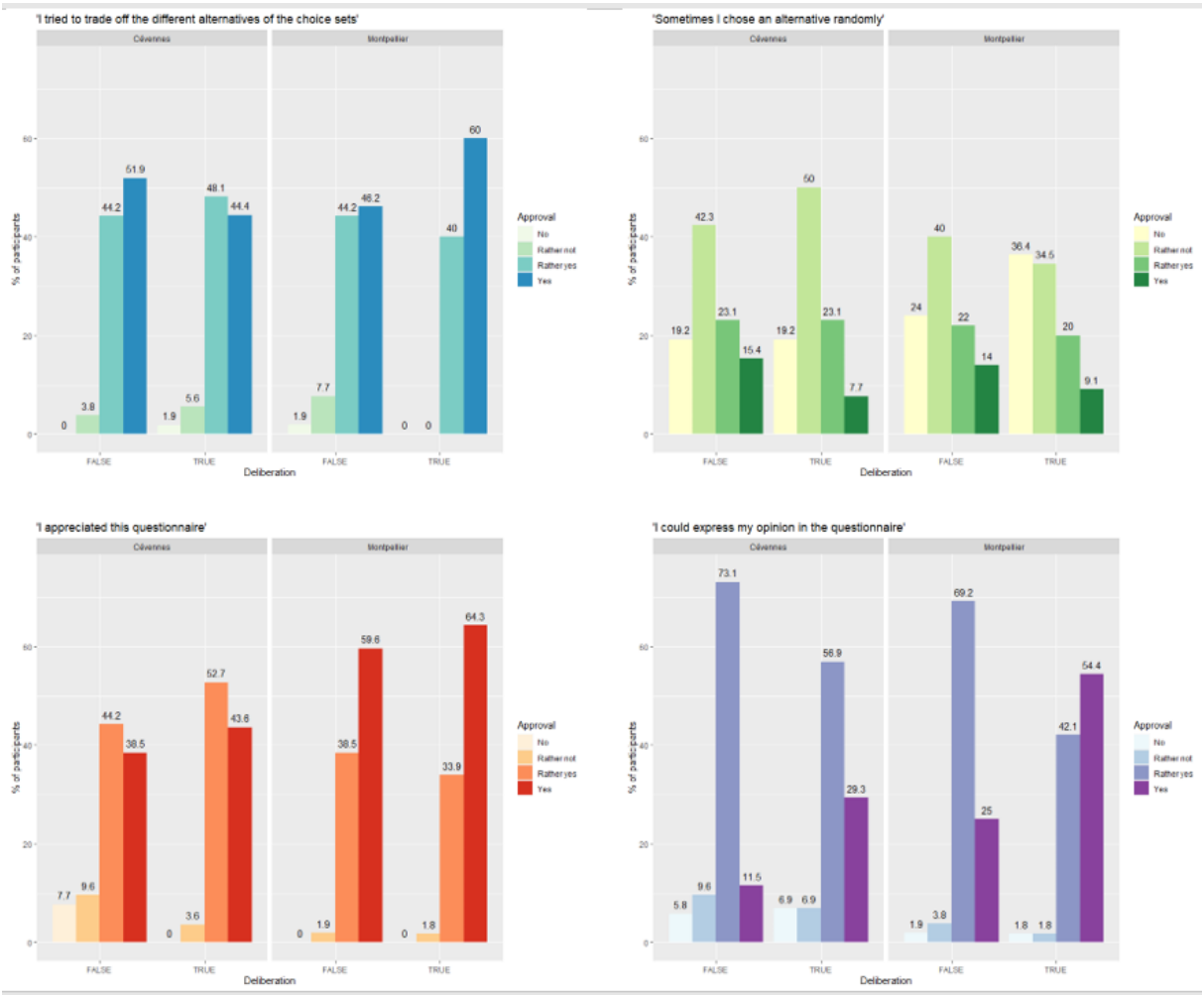


Figure 4.10. – Approval to statements that assess valuation quality. The statements are in the titles of the respective graphs.

Figure 4.10 shows the responses to the four questions at the end of the questionnaire (for non-deliberated groups, the discussion started directly after these questions). Both upper graphs are concerned about the quality of the responses given within the DCE: At the left, participants told whether they have tried to trade-off between the different alternatives, whereas at the right, they stated if they had sometimes chosen an alternative randomly.

The first graph suggests that deliberation motivates inhabitants of Montpellier to trade-off the different alternatives, whereas the opposite is true for the Cévennes. For all cases, the proportion of "rather yes" and "yes" answers together is above 90%. When it comes to deliberated groups,

the proportion even rises to 100% for Montpellier whereas it decreases from 96.2% to 92.5% for the Cévennes. Additionally, an even sharper decrease is visible for the "yes" answer (from 51.9% to 44.4%).

The second graph (upper right) displays whether participants chose some alternatives randomly. Here, for both samples a decrease of this behaviour can be observed. For the Cévennes, especially the proportion of the "yes" answers decrease (15.4% to 7.7%) to the benefit of "rather not" answers (42.3% to 50.0%). Again, the effect is more evident for Montpellier with a strong increase of "no" responses (24.0% to 36.4%) and a slight decrease of "rather yes" or "yes" (22.0% to 20.0% and 14.0% to 9.1%, respectively).

In the graphs below, participants reported whether they generally appreciated the questionnaire (lower left). Here, a positive effect can be stated, even stronger for the Cévennes sample than for inhabitants in Montpellier. For the former group, the proportion of "no" and "rather not" replies fell from 17.3% to 3.6%. For the latter group, the only evident change is a shift from "rather yes" to "yes" responses.

Finally, participants were asked whether they think that the questionnaire allowed them to express their point of view (lower right). Although the part of respondents that answered "no" or "rather not" is nearly stable, a clear change from "rather yes" to "yes" responses is observed (from 73.1% and 11.5% to 56.9% and 29.3% for the Cévennes and from 69.2% and 25.0% to 42.1% and 54.4% for Montpellier).

In general, deliberation achieves in most cases an improvement of the quality of valuation, as measured within this subsection. The choices stated in the DCE tend to be less arbitrary and more thought. The questionnaire is more appreciated and participants feel more often that their point of view is heard and included into the assessment. Nevertheless, the questions about the questionnaire could also have been understood as positioning towards the study in general (including the discussion itself). Consequently, the positive evolution of responses for deliberated individuals in the two lower graphs are possibly biased.

Another tendency is apparent: For most questions, the Cévennes sample shows less positive attitudes than the Montpellier sample. This confirms our impression that participants in the Cévennes groups were more often asking or pointing on a missing representation of human activity within our questionnaire.

4.6. Discussion

4.6.1. Summary

Within this chapter, our analysis showed that within the DCE, the coefficient of the tourism infrastructure attribute significantly decreased for both samples. Additionally, the appreciation of cultural heritage was significant lower in the MNL and MXL model for inhabitants in Montpellier when they were part of a group that discussed before doing the choice tasks. Other robust effects caused by deliberation were not detected in terms of coefficients in the DCE. It has to

be noted that in some cases the level of significance was only detected at 10% confidence level. Therefore, the consistency of these effects among both, multinomial logit and mixed logit models was important. Meanwhile, the latter model visualized a slight increase in confidence interval range for the Cévennes groups with deliberation, whereas it decreased for the sample of the Montpellier area.

Analyzing the results of the clustering from chapter 3 revealed that the cluster composition is not primarily to be explained by deliberation, but that the latter is correlated with characteristics that represent a certain expertise.

In order to clarify how the consideration of ES and other benefits was shaped by the discussions in the workshops, the distinction of answers to indicator statements with regard to the status of the group as being deliberated or not was applied. For the Cévennes sample, no average effect was detected, but a shift of consideration from provisioning to non-material ES was observed. However, an effect over all attributes was visible for groups from Montpellier: The proportion of "unaware" responses decreased, while "not important" and "considered" answers increased, suggesting that deliberation enabled participants to include a higher range of possible arguments into their trade-offs.

4.6.2. Deliberation and the effect of expertise

The information effect for the indicator statements in the Montpellier sample as well as the correlated characteristics in the cluster analysis show that deliberation generates a certain form of expertise among participants. It can therefore be assumed that the low but significant correlation of deliberative status with membership in cluster 1 is mainly caused by deliberated inhabitants from Montpellier, who achieved a sufficient knowledge to consider the wide range of services identified for this cluster. The data suggest that deliberation enables participants to consider more ES in their choices.

4.6.3. Significant differences and sample size problems

A consistent finding from the logit models is the lower preference of deliberated groups for the tourism attribute. As has been shown with the indicator statements and with non-linear model specifications, this mainly refers to concerns of the way how higher tourism affluence can be achieved. An increasing monetization and doubts about the capacity to mutually develop nature conservation and the necessary infrastructure for visitors are claimed.

Importantly, most findings are consistent, but not at high levels of significance, pointing on the problem of deliberative approaches as to their low sample sizes. In order to deliver valid recommendations for the process design and about contextual impact, a high number of experimental approaches have to be applied [SBL18] or particular efforts have to be taken to include more participants into the study. As established in chapter 3, where the regional samples were not divided, the salience of methodological innovations can be assessed. But the testing of

supplementary aspects, as in this chapter, risks to suffer from insufficient statistical power. This is a serious disadvantage over traditional approaches, where methodological questions are more easily investigated for given significance levels thanks to bigger samples.

4.6.4. Non-material ES and deliberations

Especially for the Cévennes sample, an increase in the consideration of non-material benefits has been observed, whereas the information effect of deliberation for the Montpellier sample was stronger for the forest cover and tree species attribute in general. Nevertheless, both attributes also included non-material benefits and especially the increase observed for the tree species attribute was driven by this type of service category (aesthetic values and endemic tree species, see figure 4.10 on page 229). Furthermore, the cultural heritage attribute, representing primarily cultural ES, was significantly smaller for deliberated groups in the DCE, although the degree of consideration increased for the associated indicator statements. It seems that the effect of deliberation for the Montpellier sample accounted for a higher integration of non-material values related to the question of natural forestation and dominated the values presented by non-deliberated groups, such as for cultural heritage. In the Cévennes sample, the deliberation did not reveal further information on the question of natural reforestation but more about deeper-held and transcendental values. Given the intervention and consideration of various non-material services within several attributes further emphasizes the need of a bundle perspective instead of valuation of distinct ES ([HMPB13]; [PDORB13]; [BPPV14]). The valuation of CES as single attribute as with cultural heritage in our study, is not only difficult to achieve but seemed not to be useful neither (see also [CVLU19]).

4.6.5. Preference economization and preference moralization

Closely related to the previous point is the question of how preferences have been shaped through deliberation. Following the categorization of Lo and Spash (2013), preference economization, the decrease of the cognitive burden for participants to trade off different values, was observed for the Montpellier sample. The discussion allowed participants to integrate more information into the construction of their preferences. Additionally, the MXL models revealed a decrease of confidence interval ranges (see figure 4.7 on page 224). This probably indicates a homogenization of preferences: Given that the informative level among participants in Montpellier might be relatively heterogeneous, discussions had an informative character, leading to a homogenization of preferences.

For the Cévennes, preference moralization, the change of preferences due to revelation or affectation of deeper-held values [LS13] may have played a more important role than for the Montpellier sample. The higher accounting for non-material ES, which are more often related to transcendental values, supports the hypothesis of the presence of deeper-held values in deliberations. Furthermore, the confidence interval ranges in MXL models increased for the

deliberated Cévennes groups (see figure 4.3 on page 222), indicating a preference homogenization often observed when moral disagreements arise ([ITK+09]; [MMM+17]). This also suggests the implication of deeper-held values in the preferences of deliberated inhabitants of the Cévennes.

4.6.6. Quality of valuation

In general, several indicators for the quality of the valuation improves with deliberation. This concerns the validity of choices in the DCE (less random choices, higher efforts to trade off) as well as the perception of the questionnaire (appreciation, possibility to express own viewpoint). The effect is stronger for Montpellier, confirming that deliberation might especially be useful for the valuation of complex and unfamiliar goods as it has been the case for many inhabitants for Montpellier ([AAC+15]; [KJW+16]).

Nevertheless, deliberation can also lead to a revelation of lexicographic preferences with participants refusing any trade-off among different value types, as indicated for the Cévennes sample (see figure 4.10 on page 229). At least from a viewpoint of a statistician interested in exchange values, this represents a disadvantage. Again, the fact that this tendency is observed for the local sample strengthens the hypothesis that deeper-held values guided preferences in deliberated groups and the choice tasks. This is another indication for preference moralization in the Cévennes sample, as indicated in the previous point.

4.6.7. What can deliberation bring to the economic valuation of ES?

Throughout all points discussed, the impact of deliberation depends on level of ex-ante expertise: Higher knowledge leads to an inclusion and debate of deeper-held values in discussions, which then leads to preference moralization and, as suggested by our confidence interval range, a heterogenization of preferences. This scenario is more realistic when the issues related to the good are controversial or if personal interests are affected, as one could assume in the case of stakeholder discussions. With lower ex-ante knowledge, the informative effect of discussions is dominant, leading to preference economization. Determining a value by the public then benefits from a better account of non-material ES in valuations such that the preferences as well as the valuations in which they are included are enriched.

These different possible effects induce a framing potential as to "the role of the researcher": A high degree of transparency has to be ensured, including the determination of the optimal point of deliberation and an according choice of the deliberative elements within the study [Mei19]. In conclusion, from the viewpoint of the researcher, deliberative valuation provides potential to address some of the criticism claimed regarding traditional stated preference valuation. A wider range of ES as deeper-held values are included, preferences are therefore enriched and more informed. Unfortunate consequences are lower sample sizes and possible appearance of lexicographic preferences and protest responses. Social interactions within discussions can further be investigated by analysis of transcripts as to be done for our experimental study.

Adopting the viewpoint of a decision maker or practitioner (as claimed in chapter 1), another question arises: Is DMV useful for decision making? As detailed in section 4.3.3, deliberative approaches are beneficial concerning the integration of stakeholders and long-term commitments of participants, the legitimacy and the representation of diverse points of view. When it comes to DMV, the combination of elements from both, traditional economic valuation and deliberative democracy, may not combine the best of both but neglect it. The advantage of traditional valuation is its simple measurement unit (money) that allows easy benefit comparisons or transfers if the context allows it. Applying a DMV diminishes these advantages: The valuation gets context-dependent and no further benefit transfer is possible, because the contextual values incorporated are not adequate for other circumstances. Advantages of approaches following deliberative democracy are its high legitimacy due to consensus seeking and its adaption to local contexts. Again, applying a DMV does not provide advantages neither: The valuation process is less legitimate if individual preferences are used and could be judged as arbitrary because the outcome is determined by technical analyses from researchers instead of having transparent outcomes such as in value juries [LBH15]. Nevertheless, Nienhoop et al (2015) further develop responses in function of the purpose of the valuation: If the environmental good in question is highly economically framed such that not using any valuation would lead to not accounting for it at all (such as possibly in some cost-benefit analyses), DMV allows to evaluate the good by integrating a broader set of especially non-material values. Another example is the need for monetary estimates for penalties in laws, when ES have been illegally damaged or destroyed: Here, a DMV provides a more legitimate value, without taking legitimacy from the judicial authority [LBH15]. In consequence, the relevance of DMV for decision making remains limited, and points on further research needs concerning the aggregation of preferences that account for, without neglecting, the context-dependent nature of the outcomes [Mei19].

4.7. Conclusion

This chapter investigated whether traditional valuation approaches for ES can be enriched by deliberative valuation, especially if non-material ES are more integrated into the assessments. A literature review presented (i) the concept and current interrogations of non-material ES, (ii) the conceptual foundations and practical approaches of deliberation and (iii) consequences for the valuation of ES. After that, the experimental application of a DMV on the Cévennes landscapes was used to derive evidence about the influence of deliberation on the results. Different logit models, the cluster analysis, indicator statements and indicators for the quality of valuation were investigated.

The results have shown that deliberation resulted in a lower appreciation of high levels of tourism infrastructure, mainly due to concerns about its compatibility with nature conservation. As expected, deliberative valuation permitted individuals to better consider non-material ES in their choices. Conceptually, a different impact of the discussion on preference among samples

of different ex-ante expertise has been observed. Deliberation had an informative effect for the Montpellier sample and created a certain degree of expertise, such as predicted for preference economization in the literature [LS13]. For the Cévennes sample, since individuals had higher knowledge about their environing landscapes, the impact resembled a process of preference moralization that reveals and integrates deeper-held values into the discussion. Apart from limitations to generate significant effects due to the sample size, deliberative approaches seem to contribute to a higher quality of the valuation itself, in terms of higher motivation of individuals to trade off alternatives in the DCE as well as in terms of higher participants' satisfaction with the questionnaire.

In general, our combination of different elicitation methods was useful for a broad inclusion of especially non-material ES (see also [MHAF13]; [RKP$^+$14]; [JMLB$^+$18]).

In a researcher's perspective, these findings underline the capacity of deliberative valuation to complement and enrich traditional valuation methods as to the incorporation of transcendental values and the generation of more informed preferences. Considering the needs for decision makers and practitioners, deliberative monetary valuation risks to have limited practical relevance because only partially uses the strengths of methods closer to deliberative democratic approaches such as value juries generating more legitimate, contextual guidance. Meanwhile it loses the strengths of traditional valuation (the comparability), as long as no upscaling mechanism is available.

Consequently, areas of future research are aggregation mechanisms that account for the context-dependent nature of initial valuation (e.g. [MMM$^+$17]), as well as more experimental evidence about the complementarities of deliberative approaches as to traditional monetary valuation. The study presented in this work aimed to contribute especially to the second interrogation, notably when outcomes will be complemented with an analysis of the transcripts. Satisfying the mentioned research needs would allow to determine adequate contexts in which the application of deliberative valuation provides advantages for science, decision making and practice.

Conclusion

The aim of this PhD thesis was to assess the impact of deliberation on the outcomes of valuation of ecosystem services (ES) and how the salience of these outcomes for decision makers and practitioners can be enhanced.

A first interrogation consisted of the way how structural needs of implementing agents of environmental policy could be accounted for in valuations of ES. A literature review identified two main approaches considered in implementation research: top-down and bottom-up approaches. Both have different needs and capabilities to account for local and contextual values as well as the power to force and control progress. Bottom-up approaches try to transfer local issues to higher scales whereas top-down approaches are characterized by decisions taken at higher levels that are then enforced on lower administrative scales. Although both types of implementations result in different processes from decision making to measurable actions, science-policy interfaces (SPI) provide elements that are capable to guide and support effective information transfer among scales for both cases, as the literature review in chapter 1 has shown.

Several case studies provide evidence for the capability of environmental projects to account for the implementation context, but in most cases, the specific decision making and implementation context is not considered. Especially for the various methods to value ES, this information would be useful in order to assess their salience for different implementation context.
As determined in the first chapter, traditional monetary valuation is theoretically more adapted to top-down context, whereas bottom-up approaches are better suited to account for the contextual values assessed in deliberative valuations. Finally, the best way to make the results of valuation relevant for decision making, is to account for the needs for or collaborate with SPIs, because these organizations have the capacities to serve as knowledge broker for diverse decision making and implementation contexts.

The second aim of this thesis was to empirically test the capability of deliberative valuation to enrich traditional monetary valuation approaches of ES. For this reason, a study about the ES perceived from the Cévennes landscapes by local inhabitants and by inhabitants of the metropolitan area of Montpellier was performed, applying a discrete choice experiment (DCE) within deliberative valuation workshops.
The conduction of such an experimental study needs the careful design and preparation following best practice guidelines. As valuation is necessarily context dependent, the clear communication on which guidelines are considered and how they impact the design and implementation of the

study, is the aim of the second chapter.
Focus group discussions gave valuable recommendations about (i) what the valuation should include, (ii) how it should be conducted, (iii) which attributes the DCE should consist of, how they should be presented and (iv) by providing examples of how they perceive several ES and other benefits associated to the attributes (indicator statements) within their discussions. The indicator statements were included in the questionnaire and tested in a pilot survey which delivered prior estimates for calibrating our experimental design of our choice experiment. The study was advertised using flyers and posters, articles in local newspapers, notices on municipalities' web pages, personal invitations to passersby and a radio interview.
Although it was difficult at some locations to reach a sufficient quantity of motivated participants, a final number of 243 individuals attended our deliberative workshops with 122 of them in 11 groups (five as deliberated treatment groups and six as non-deliberated control groups) in the Cévennes and the other 121 individuals in 12 groups (six deliberated, six non-deliberated) in Montpellier. This represents indeed a high sample size for a valuation through deliberative workshops. Descriptive statistics revealed an overrepresentation of women as well as a slight underrepresentation of people having an age between 30 and 55 and of blue-collar workers. These self-selection biases are similar to other deliberative valuation studies in the literature.
In general, the use of focus groups for the preparation of the study was extremely [1] helpful for the implementation stage afterwards. Some experiences gained within focus groups could have been even more considered such as the difficulties to motivate people to participate.
The need to summarize best practice guidelines for the conduction of DCEs for environmental valuation is now recognized, as the publication of Mariel et al (2021) shows. This has to be complemented by reports of empirical works on how these recommendations had to be shaped by specific local contexts in order to further standardize and increase the quality of the valuation of ES.
The composition of the study allows to give a representative view on the main perceptions, concerns and requests with regard to the Cévennes landscapes. The self-selection bias has to be considered, and is notably impacting the relative sizes of the clusters identified in chapter 3.

For instance, assessing the economic value of ES by stated preference elicitation is not accounting for possible interdependencies among services. The use of the concept of ES bundles is proposed as method to enhance the quality of information provided by assessments. Meanwhile, this concept is not yet widely applied in economic valuation.
In our experimental study, it was tested whether attributes of a DCE can already be considered to provide a certain form of bundle representation. A combination of logit model regression for the outcomes of the DCE as well as factor and cluster analysis were used to measure the degree to which participants considered several ES within one attribute, as represented by the indicator statements.
Within our experiment, a general agreement on the conservation of pasture landscape, a tendency

1. Although not scientifically appreciated, the author wants to underline the use of this word here.

to protect and increase the proportion of deciduous forests, preferences for a medium development of tourism infrastructure and a willingness to support cultural heritage protection within the Cévennes landscapes were detected. Differences among the Cévennes and the Montpellier samples were less important than among different age categories.
The combination of the clusters with a bundle representation of ES revealed that the biggest cluster reported a high level of consideration for most services, the second cluster had a high consideration for services related to agropastoralism, whereas the last cluster has low levels of consideration except for transcendental and climate change related values.
The coupling of the quantitative results of the DCE with qualitative methods such as cluster analysis in chapter 3, allowed to associate WTP estimates to different beneficiary groups with varying motivations and rationales. With this information, addressing public policy measures to different user groups would be facilitated.
Our study showed that different ES and ES categories were related to the attributes in the perception of individuals. As these perceptions per attribute varied among clusters, a representation of single ES within DCEs about landscape patterns seems not to be consistent. Rather, DCEs are well suited to deliver economic values for bundles of ES.
Refining methods to assess bundles of ES by stated preference surveys is an area of future research. In our approach, another indicator to assess the intensity of consideration of indicator statements (such as Likert scales) would provide a more coherent information than our categorization into "considered", "not important" and "unaware".

Finally, chapter 4 analyzed the contribution of deliberative approaches to the valuation of ES, and especially of non-material ES. For this reason, model parameters were estimated separately among deliberated and non-deliberated groups. The observation of a superposition or not of the resulting confidence while assuming a similar distribution of unobserved characteristics due to random assignment, allowed to indicate possible effect of deliberation.
Results showed that deliberation lead to weaker preferences for tourism because the awareness of possible negative consequences of high tourist affluences were discussed among participants. Together with an analysis of the indicator statements, a general shift towards non-material values was observed, in particular for the Cévennes sample. For the other ES, the increase of consideration was higher for inhabitants of Montpellier.
The outcomes suggest that this increase is due to a gain in the level of information for the second sample, whereas for inhabitants from the Cévennes the deliberation encouraged to express, defend and include deeper-held values.
Our experimental study on deliberative monetary valuation showed that the combination of different approaches allowed to detect and interpret possible effects of the setting on the preferences of participants expressed within the questionnaire. Although having a relatively large sample size, significant effects were often only recorded for the 10% level, but were consistent among various models and could be explained by data from the cluster analysis and indicator

statements.
It can be suggested that the effect of deliberation depends on the degree of expertise: If the good is complex or unfamiliar, deliberation allows participants to consider a higher amount of information within their choices, making this approach particularly useful for valuation of ES. If, however, individuals can be seen as experts about the good to be valued, the effect of deliberation is not characterized by an information effect, but achieves to account for transcendental values intervening within the discussions. These differences put a responsibility on the researcher to define the deliberative process such that it is not framing the values integrated in the outcomes. Furthermore, a positive effect on the general quality of valuation can be achieved, as several supplementary questions in our questionnaire have revealed. An analysis of the transcribed discussion is another method that will allow to observe how preferences are shaped within discussions and will complement the quantitative results. Therefore, more experimental studies to investigate whether, while accounting for each context, deliberation has consistent effects on valuation across several studies are needed. This would possibly compensate the difficulties of deliberative valuation to measure effects on higher levels of significance due to lower sample sizes.

In conclusion, the outcomes derived within this thesis proposed methods and results to enhance the valuation of ES and its salience for decision makers. Its findings furthermore suggest three main areas of future research on conceptual innovation of the economic valuation of ES and that transcended the different chapters.
First, more case studies need to be conducted that contribute to a growing experience in the design of stated preference methods including deliberative elements. They would allow to have more evidence on the way deliberation may enrich the preferences of participants within discussions. Second, decision makers' and practitioners' needs have to be accounted for by incorporating valuations into transdisciplinary processes. ES bundles appear particularly useful in this context, not only because they facilitate the economic valuation of the embedded interrelations of ES, but also their concept is explicitly interdisciplinary.
Finally, deliberative approaches seem to enrich the preferences of individuals and allow a better recognition of non-material ES in valuations. Consequently, they are capable to compensate some of the shortcomings of traditional monetary valuation approaches and to complement their results. Nevertheless, more research is necessary on how deliberation is conceptually included in valuation and how this frames or impacts the outcomes.
In order to increase the utility of DMV for decision makers and practitioners, a future research field would be how results of DMV could be aggregated without losing the information revealed by contextual values.

Appendix

A. Appendix of chapter 2

In this appendix, supplementary material for the second chapter is presented. This includes the NGene code, an example of a complete questionnaire, the list of municipalities of the Cévennes and some pictures about the implementation of our study.

A.1. Ngene Code

```
Design

? first try for final design
? include SQ option
? efficiency criteria: D-efficiency
? *****attribute level balance?*****
? efficient design with MMNL (repeated random) and pre_pilot priors;
? optimized for random parameter panel (rppanel)

; alts = alt1, alt2, SQ
; rows = 36
; block = 4
; eff = (rppanel, d)
; alg = mfederov
; bdraws = halton(100)

? constraints to include SQ option: fixed levels for SQ and positive payments for other alternatives
; require:
alt1.pay > 0,
alt2.pay > 0,
SQ.FC = 1 and SQ.TSD = 0 and SQ.Tou = 1 and SQ.CH = 1 and SQ.pay = 0

? Descirption of attributes : FC = Forest Cover, TSD = Dominating Tree Species,
? Tou = Toursim Affluence, CH = Conservation of Cultural Heritage, pay = payment attribute

? different order of CH-attributes do have simpler code for priors of effect-coded parameter
; model:
U(alt1)= b1 + b3[(n, -0.6, 0.4)] *FC[0,1,2]
            + b4[1]*TSD[0,1]
            + b34[(u, -0.4, 0.2)] *FC*TSD
            + b5[-0.2] *Tou[0,1,2]
            + b6.effects[1.1|0.7] *CH[2,1,0]
            + b36[(n, -0.35, 0.2)] *FC*CH
            + b7[-0.01]*pay[0,5,10,20,35,50,75] /

U(alt2)= b2 + b3*FC + b4*TSD + b34*FC*TSD + b5*Tou + b6*CH + b36*FC*CH + b7*pay /
U(SQ)= b3*FC + b4*TSD + b34*FC*TSD + b5*Tou + b6*CH +b36*FC*CH + b7*pay
$
```

Figure A.1. – The Ngene code used to design the choice sets of our study. It has been optimized for correlated mixed logit models using the priors derived from the pilot study.

A.2. Final questionnaire

The following pages present the final questionnaire used in the empirical study.

Mesdames, Messieurs, bonjour,

Tout d'abord, nous vous remercions de participer à cette enquête. Notre étude a pour but d'analyser les valeurs écologiques, économiques et culturelles que les résidents et les visiteurs associent à divers aspects des paysages cévenols.

Pour y parvenir, ce questionnaire d'une vingtaine de minutes, issu d'échanges citoyens en Cévennes, nous permettra de recueillir vos regards sur le sujet. Vous pourriez y trouver une vision propre, opposée ou complémentaire à la vôtre. Au besoin, vous pourrez préciser, compléter ou ajouter des notions ou des perceptions qui vous sembleraient manquantes, à la fin du questionnaire. De même vous pourrez engager une discussion avec nous dans un deuxième temps pour enrichir l'enquête de vos arguments.

Le questionnaire débute par une introduction au cadre scientifique de l'étude et aux apports du paysage pour les hommes. Sa présentation par un membre de l'équipe en reprend une synthèse. Sans être indispensable, c'est un référent qui vient en appui à votre compréhension.

Suite à l'introduction, un total de 9 cartes de choix de scénarios est présentée pour recueillir vos préférences.

Ensuite, des questions annexes sur les motivations des répondants permettront d'affiner nos données.

Enfin, la dernière étape comporte des questions, relatives à votre profil, qui contribueront à l'analyse statistique de vos perceptions en répartissant les réponses par catégorie d'âge, de sexe, de ressources ou même d'affinités.

Bien évidemment, les instituts nationaux de recherche étant soumis prioritairement aux règlementations en vigueur, nous garantissons l'anonymat des données exprimées.

Merci pour votre aide et bonne lecture…

Questions préalables – 2 Questions

Avant de commencer avec l'étude, nous souhaitons connaître vos motivations et vos attentes.

Q1 : Quelle est votre motivation pour participer à cette étude ? Mettez les trois raisons qui ont été les plus importantes pour vous de venir à cette réunion d'enquête.

Classement d'importance :	***1er***	***2eme***	***3eme***
Passer un moment convivial avec d'autres personnes du village	☐	☐	☐
Je suis venu car je trouve le sujet particulièrement intéressant.	☐	☐	☐
Je m'intéresse généralement à la science et je suis heureu(se)x de pouvoir y contribuer.	☐	☐	☐
La possibilité d'avoir un petit cadeau à la fin.	☐	☐	☐
Une personne que je connais m'a invité à l'accompagner.	☐	☐	☐
Une personne qui a déjà participé à l'étude m'a conseillé de venir.	☐	☐	☐
Autres, précisez :	☐	☐	☐

Q2 : Pour vous, de quelle nature sont les enjeux principaux concernant les paysages cévenols ? Indiquez les deux types d'enjeux qui sont les plus importants pour vous.

Types d'enjeux importants :	***1er***	***2eme***
Enjeux culturels / traditions	☐	☐
Enjeux économiques	☐	☐
Enjeux écologiques	☐	☐
Enjeux identitaires cévenols	☐	☐
Enjeux de cohésion sociale	☐	☐
Autres, précisez :	☐	☐

Partie I : Introduction

Châtaigner comme arbre emblématique des Cévennes

Consommation d'une partie des précipitations et donc moins d'eau disponible

Les fonctions de la forêt

Opportunités économiques pour filière bois

Protection contre l'érosion

Habitat pour la flore et faune forestière

Espaces pour des promenades ou de la randonnée

Filtration des polluants dans l'air

Stockage de dioxyde de carbone pour lutter contre réchauffement climatique

L'héritage patrimonial

Monuments historiques

- Guerre des camisards
- Terre de refuge
- Esprit de résistance

Empreinte humaine dans le paysage

- Agriculture en terrasses (bancèls)
- Mûriers pour la sériciculture
- Exploitation minière

Architecture

- Constructions en pierre sèche
- Mas isolés

Le rôle du tourisme

Source pour générer des revenus locaux (restauration, hôtellerie, location de gîtes)

Présenter paysage, la culture, les traditions et l'esprit aux visiteurs

Promotion des produits locaux

Perte du caractère sauvage si trop de tourisme ?

L'évolution actuelle

1. Reboisement naturel du paysage

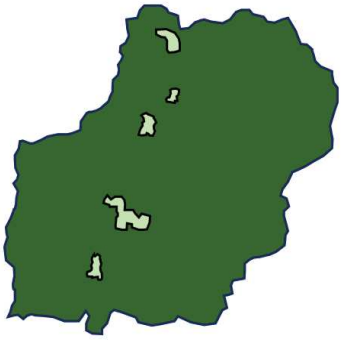
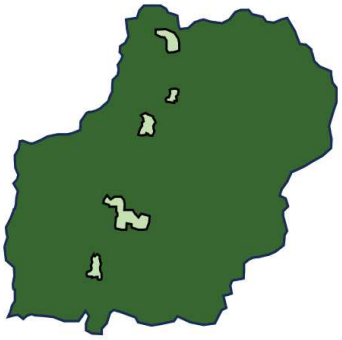
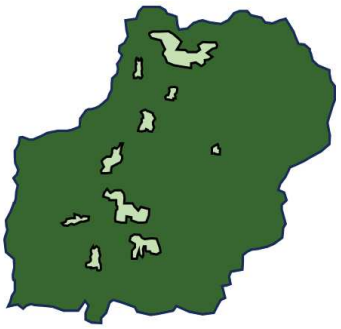
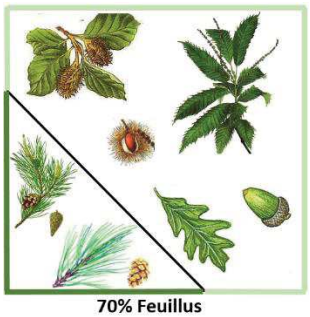
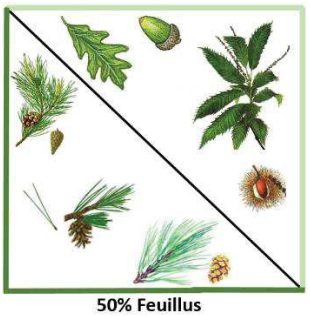
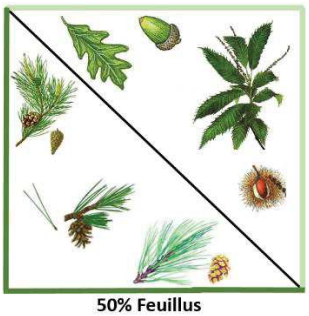
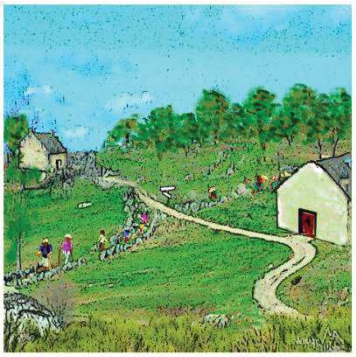
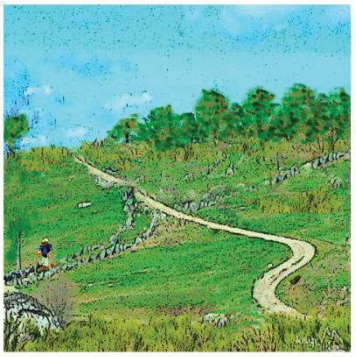
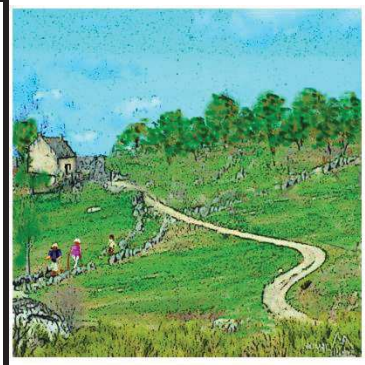
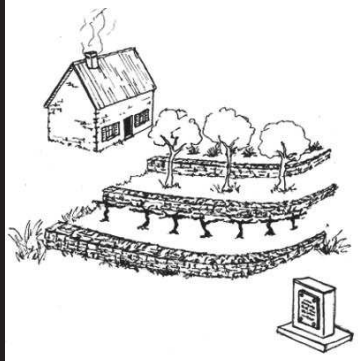
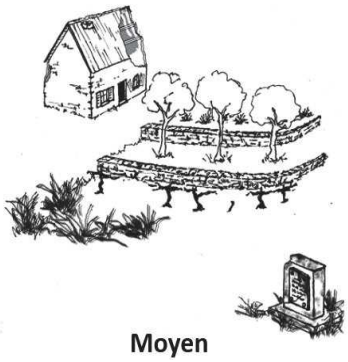
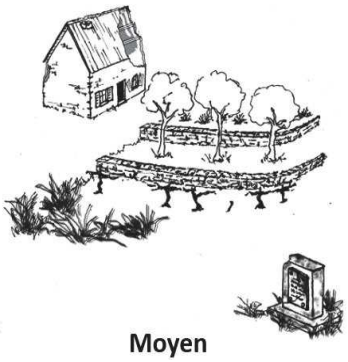
    - Pâturages disparaissent au profit des forêts (surtout résineux)
    - Raison : moindre pression par transhumance et exploitations agricoles

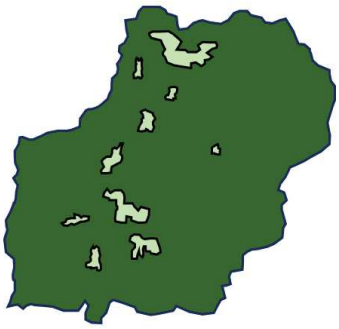
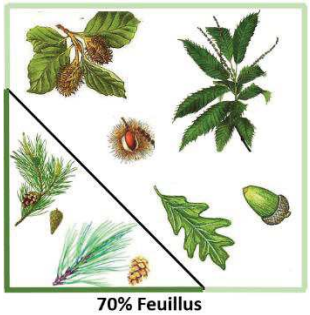
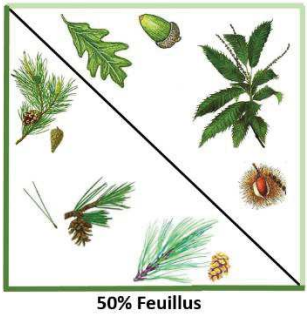
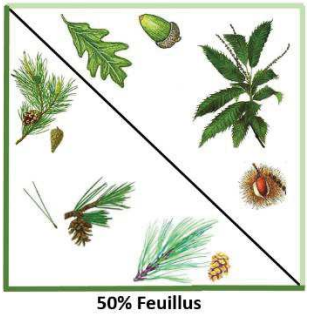
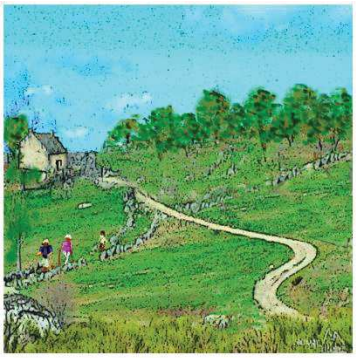
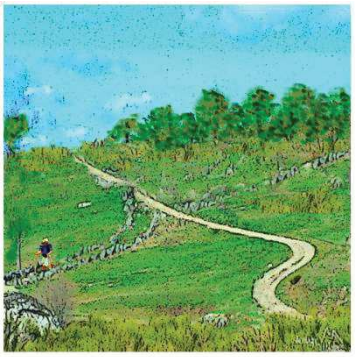
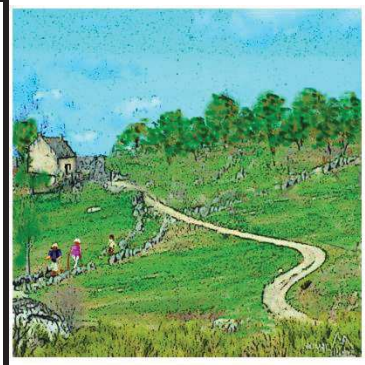
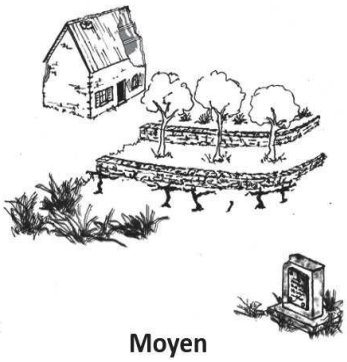
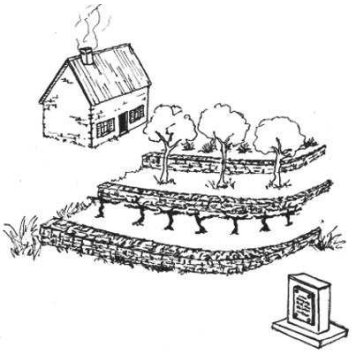
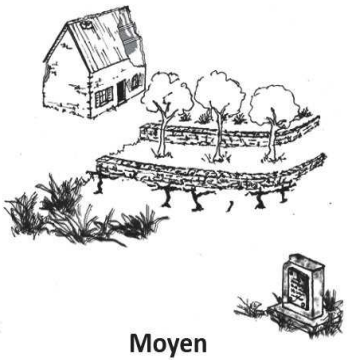
2. Perte de la biodiversité associée aux pâturages

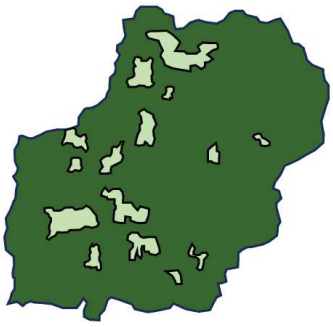
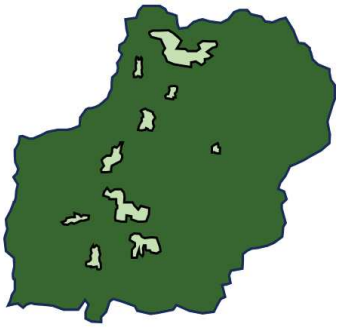
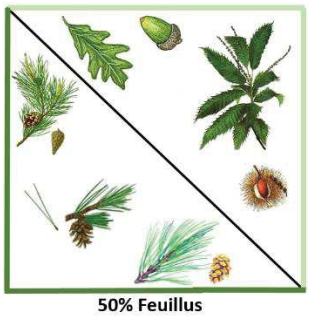
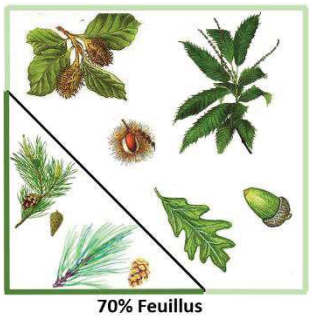
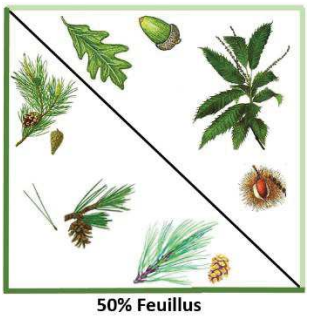
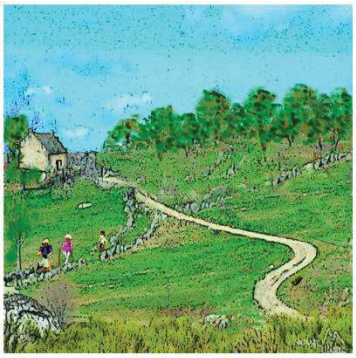
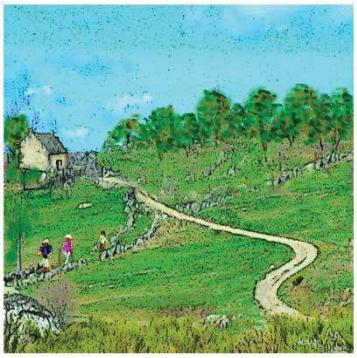
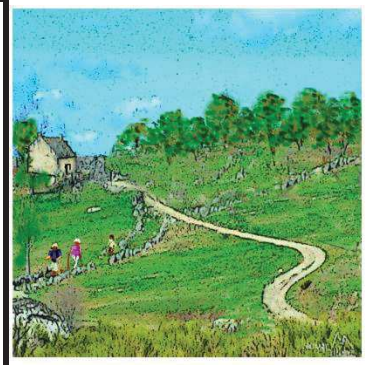
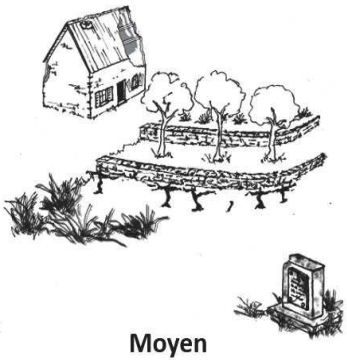
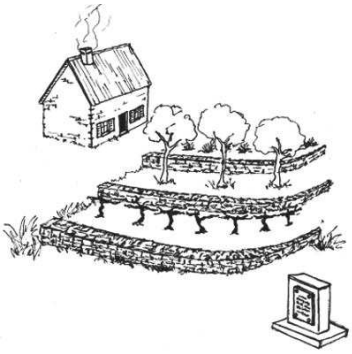
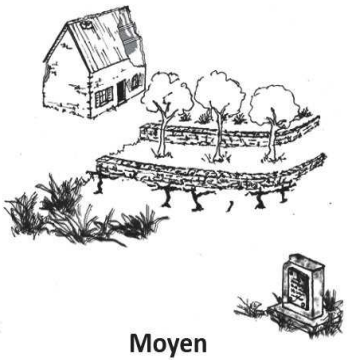
    - Plus rare que flore et faune forestière
    - Papillons, rapaces, orchidées

3. Changement du mode de transhumance

    - Transhumance dans les forêts au lieu des pâturages
    - En cohérence avec besoins de la filière bois (sylvo-pastoralisme)

Scénario / Attribut	Alternative A	Alternative B	Alternative de référence
(1) Couverture par forêt Quelle répartition de la surface entre forêt et pâturages ? 1	 **Reboisement soutenu**	 **Reboisement soutenu**	 **Reboisement naturel**
(2) Essences des forêts Quelle répartition entre forêt de feuillus et forêts de résineux ?	 **70% Feuillus** **30% Résineux**	 **50% Feuillus** **50% Résineux**	 **50% Feuillus** **50% Résineux**
(3) Infrastructure touristique Investissement dans des gîtes, des chemins de randonnée et leur balisage pour accueillir plus de touristes	 **Élevé**	 **Bas**	 **Moyen**
(4) Héritage patrimonial Niveau de conservation des bancèls, mas isolé, plaques et lieux commémorative, bâtiment historiques	 **Bon**	 **Moyen**	 **Moyen**
(5) Paiement (Don aux associations)	10 €	5 €	0 €
Votre choix :	☐	☐	☐

Scénario / Attribut	Alternative A	Alternative B	Alternative de référence
(1) Couverture par forêt Quelle répartition de la surface entre forêt et pâturages ?	 Conservation pâturages	 Conservation pâturages	 Reboisement naturel
(2) Essences des forêts Quelle répartition entre forêt de feuillus et forêts de résineux ?	 70% Feuillus 30% Résineux	 50% Feuillus 50% Résineux	 50% Feuillus 50% Résineux
(3) Infrastructure touristique Investissement dans des gîtes, des chemins de randonnée et leur balisage pour accueillir plus de touristes	 Moyen	 Bas	 Moyen
(4) Héritage patrimonial Niveau de conservation des bancèls, mas isolé, plaques et lieux commémorative, bâtiment historiques	 Moyen	 Bon	 Moyen
(5) Paiement (Don aux associations)	75 €	20 €	0 €
Votre choix :	☐	☐	☐

Scénario / Attribut	Alternative A	Alternative B	Alternative de référence
(1) Couverture par forêt Quelle répartition de la surface entre forêt et pâturages ?	 Conservation pâturages	 Conservation pâturages	 Reboisement naturel
(2) Essences des forêts Quelle répartition entre forêt de feuillus et forêts de résineux ?	 50% Feuillus 50% Résineux	 70% Feuillus 30% Résineux	 50% Feuillus 50% Résineux
(3) Infrastructure touristique Investissement dans des gîtes, des chemins de randonnée et leur balisage pour accueillir plus de touristes	 Moyen	 Moyen	 Moyen
(4) Héritage patrimonial Niveau de conservation des bancèls, mas isolé, plaques et lieux commémorative, bâtiment historiques	 Moyen	 Bon	 Moyen
(5) Paiement (Don aux associations)	10 €	75 €	0 €
Votre choix :	☐	☐	☐

Partie III – Quelques précisions (explications) : 7 questions

Q1 : Si vous avez *toujours* choisi la situation de référence dans les cartes de choix, quelle en était la raison ?

- Les autres alternatives ne m'ont pas apporté l'élément justifiant de dépenser de l'argent.
- J'aurai aimé choisir les autres alternatives, mais mon budget ne permettrait pas d'y contribuer.
- Je paie déjà beaucoup d'impôt. C'est le rôle de l'Etat de s'occuper de l'évolution des paysages.
- Je ne voulais pas trancher entre les alternatives en termes d'argent. C'est pourquoi j'ai toujours choisi l'alternative sans contribution financière
- Donner de l'argent à un fond géré par des associations ne me semble pas fiable. Je refuse d'y contribuer.
- Autres :

Q2 – Lors des cartes de choix chaque scénario incluait un don hypothétique à un fonds géré par des associations locales. Comment souhaitez-vous repartir un tel don entre les associations ? *Si vous aviez 100 €* à donner, combien donneriez-vous à chaque association ? Merci de préciser si vous êtes- adhérents à une d'entre elles ?

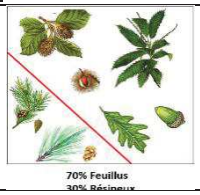
Répartition des 100 Euros	Association	Adhérent à cette association ?
_____ Euro pour	Cévennes Ecotourisme	○ Oui
_____ Euro pour	ASLG de Forêts Cévenoles	○ Oui
_____ Euro pour	Objectif Laine	○ Oui
Somme : 100		

Attention

Sur les prochaines 4 questions vous serez demandé d'indiquer quelles pensées vous avez eu en tête lors des cartes de choix. L'expérience nous montre que beaucoup de participants cochent plus de réponses que réellement considérées afin de faire plaisir aux enquêteurs. Malheureusement, ce comportement biaise les résultats.

Merci de seulement indiquer les arguments que vous avez vraiment considérés !

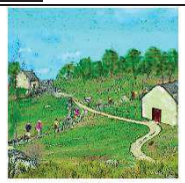
Q3 - Qu'avez-vous considéré lors de votre choix concernant la caractéristique *« Essences des Forêts »* ? *K*

	*Oui, j'ai bien pris en compte cet argument dans mon choix.*	*J'ai considéré cet argument, mais il n'est pas vraiment décisif.*	*Je n'ai pas vraiment considéré cet argument.*	*Non, cet argument n'a aucune importance pour moi ou je ne l'approuve pas.*
Les forêts de feuillus sont identitaires pour les Cévennes.	○	○	○	○
Les résineux représentent de meilleu-res opportunités pour la filière bois.	○	○	○	○
Pour moi, les forêts de résineux ont une plus grande valeur écologique.	○	○	○	○
Les forêts de feuillus sont particulièrement belles.	○	○	○	○
Les forêts de résineux sont plus facilement inflammables.	○	○	○	○
Autres, précisez :	○	○	○	○
Autres, précisez :	○	○	○	○
Autres, précisez :	○	○	○	○

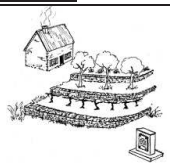
Q4 - Qu'avez-vous considéré lors de votre choix concernant la caractéristique *« Couverture par Forêt »* ?

Reboisement naturel	*Oui, j'ai bien pris en compte cet argument dans mon choix.*	*J'ai considéré cet argument, mais il n'est pas vraiment décisif.*	*Je n'ai pas vraiment considéré cet argument.*	*Non, cet argument n'a aucune importance pour moi ou je ne l'approuve pas.*
L'air dans la forêt est plus pur.	○	○	○	○
La forêt est un habitat important pour la flore et la faune.	○	○	○	○
Une extension de la forêt détruit des habitats pour la flore et la faune des milieux ouverts et des pâturages.	○	○	○	○
Pour moi, l'identité des Cévennes est liée aux forêts, je préfère donc qu'il y en ait plus.	○	○	○	○
La forêt contribue à protéger les sols contre l'érosion et des glissements de terrain.	○	○	○	○
Dans les Cévennes, je préfère augmenter les surfaces agro-pastorales que les surfaces forestières.	○	○	○	○
La forêt est un moyen de stockage de carbone pour lutter contre réchauffement climatique.	○	○	○	○
La forêt fournit des ressources pour l'économie locale (du bois par exemple).	○	○	○ .	○
L'élevage est aussi praticable dans la forêt (sylvo-pastoralisme).	○	○	○	○
Être dans une forêt est une expérience spirituelle positive pour moi.	○	○	○	○
Avec l'extension des surfaces forestières, je crains une baisse de la disponibilité de l'eau.	○	○	○	○
La forêt m'offre de meilleures possibilités pour me promener.	○	○	○	○
Autres :	○	○	○	○
Autres :	○	○	○	○

Q5 - Qu'avez-vous considéré lors de votre choix concernant la caractéristique *« Investissement touristique »* ?

	*Oui, j'ai bien pris en compte cet argument dans mon choix.*	*J'ai considéré cet argument, mais il n'est pas vraiment décisif.*	*Je n'ai pas vraiment considéré cet argument.*	*Non, cet argument n'a aucune importance pour moi ou je ne l'approuve pas.*
Le tourisme ne respecte pas les besoins des habitants, ni la nature. Il menace le caractère de certains sites cévenols.	○	○	○	○
Un aménagement des structures touristiques aide à valoriser et préserver le patrimoine naturel.	○	○	○	○
Les aménagements touristiques sont parfois utilisés de faire payer pour quelque-chose qui n'était pas payant avant.	○	○	○	○
Le tourisme peut être géré en respectant les besoins des habitants et la nature. Il offre des opportunités économiques.	○	○	○	○
Autres, précisez :	○	○	○	○
Autres, précisez :	○	○	○	○
Autres, précisez :	○	○	○	○

Q6 - Qu'avez-vous considéré lors de votre choix concernant la *caractéristique* « *l'héritage patrimonial* » ?

 Bon	*Oui, j'ai bien pris en compte cet argument dans mon choix.*	*J'ai considéré cet argument, mais il n'est pas vraiment décisif.*	*Je n'ai pas vraiment considéré cet argument.*	*Non, cet argument n'a aucune importance pour moi ou je ne l'approuve pas.*
Pour l'identité des Cévennes, les points historiques de mémorisation sont importantes.	○	○	○	○
Les bancèls sont nécessaires pour l'agriculture contemporaine et identitaire pour le paysage.	○	○	○	○
La conservation de l'héritage culturel renforcera également la cohésion sociale	○	○	○	○
L'investissement dans l'héritage permet d'attirer plus de touristes et des personnes qui s'intéressent aux Cévennes	○	○	○	○
Autres, précisez :	○	○	○	○
Autres, précisez :	○	○	○	○

Q7 : Pour vous, de quelle nature sont les enjeux principaux concernant les paysages cévenols ? Indiquez les *deux* types d'enjeux qui sont les plus importants pour vous.

Types d'enjeux importants :	***1er***	***2eme***
Enjeux culturels / traditions	☐	☐
Enjeux économiques	☐	☐
Enjeux écologiques	☐	☐
Enjeux identitaires cévenols	☐	☐
Enjeux de cohésion sociale	☐	☐
Autres, précisez :	☐	☐

Partie IV – Questions personnelles (15 questions)

Ces dernières questions visent à recueillir quelques données personnelles. Vous êtes libres de ne pas répondre aux questions bien qu'on garantisse l'anonymat des réponses.

Q1 : Quel âge avez-vous ?

ans

Q2 : Vous êtes …

- o Un homme
- o Une femme

Q3 : Comment votre foyer est-il composé ? Mettez le nombre des personnes par catégorie.

___ adultes au-dessus de 18 ans

___ adolescents entre 14 et 17 ans

___ enfants ayant 13 ans ou moins

Q4 : Est-ce que vous êtes membre d'une association de protection de l'environnement ?

- o Oui
- o Non

Q5 : Résidez-vous dans les Cévennes depuis 5 ans ou y avez-vous résidé pendant 5 ans dans le passé (résidences secondaires incluses) ?

- o Oui
- o Non

Q6 : Résidez-vous à Montpellier ou son Agglomération/Métropole depuis 5 ans ou y avez-vous résidé pendant 5 ans dans le passé (résidences secondaires incluses) ?

- o Oui
- o Non

Q7 : Quel est votre Code postal ?

Q8 : Pratiquez-vous les activités suivantes ?

Activité :	*Oui, mais ailleurs*	*Oui, en Cévennes*	*Non*
Cyclisme, VTT, Randonnée	☐	☐	☐
Canoë, Pêche	☐	☐	☐
Agriculture, Jardinage, Apiculture	☐	☐	☐
Gestion d'une structure qui accueille des touristes (gîte, hôtel, restaurant, location canoë ou vélo, etc.)	☐	☐	☐
Chasse	☐	☐	☐

Q9 : Etes- vous propriétaire d'un terrain en Cévennes ?

- Non.
- Oui, d'une maison/résidence.
- Oui, d'un terrain à bâtir
- Oui, d'une parcelle agricole.
- Oui, d'un terrain forestier.
- Oui, mais d'une autre forme de propriété. A préciser :

Q10 - Quelle est votre catégorie socioprofessionnelle ?

- Agriculteur exploitant
- Artisan, commerçant ou chef d'entreprise
- Cadres et professions intellectuelles supérieures
- Professions Intermédiaires
- Employés
- Ouvriers
- Retraités
- Autres personnes sans activité professionnelle

Q11 : Quel est le revenu mensuel de votre ménage (salaires nets, retraites, allocations, intérêts), vous inclus ?

- < 1.000 €
- Entre 1.000 € et 2.000 €
- Entre 2.000 € et 3.000 €
- Entre 3.000 € et 4.500 €
- Entre 4.500 € et 6.000 €
- Entre 6.000 € et 8.000 €
- > 8.000 €

Q12 : Quel est le plus haut diplôme que vous ayez obtenu ?

- ○ Bac +5 et plus (Master, Doctorat, Grande école, Ingénieur)
- ○ Bac+3 et Bac+4 (Licence, Master 1)
- ○ Bac+2, BTS, DUT ou équivalent
- ○ Baccalauréat (générale, technologique ou professionnelle) ou équivalent
- ○ CAP, BEP ou diplôme de même niveau
- ○ Certificat d'études primaires, aucun diplôme

Q13 – Les déclarations suivantes, approuvez-vous les ?				
	Oui.	**Plutôt oui.**	**Plutôt non.**	**Non.**
Je considère que le questionnaire m'a bien permis d'exprimer mes opinions personnelles.	○	○	○	○
Dans les cartes de choix (Partie II), j'ai essayé de trancher entre les différents scénarios.	○	○	○	○
Dans les cartes de choix (Partie II), je n'étais pas sûr de quelle alternative choisir. Parfois, j'ai un peu choisi par hasard.	○	○	○	○
J'ai apprécié ce questionnaire.	○	○	○	○

Q14 : Comment vous avez entendu parler de notre réunion ?

- ○ Par un(e) ami(e) (mail, téléphone, en direct, …)
- ○ Par la publicité sur le site web de la mairie
- ○ Par votre affiche à l'endroit : _____
- ○ Par votre site web regards-cevennes.com
- ○ Par les réseaux sociaux : _____
- ○ Contact direct avec un organisateur de l'étude (mail, téléphone, en direct, …)
- ○ Autres :

_____

Q15 – Les déclarations suivantes, approuvez-vous les ?				
	Oui.	**Plutôt oui.**	**Plutôt non.**	**Non.**
Avec mon avis, je me sentais minoritaire dans la discussion.	○	○	○	○
Pensez-vous que vous avez influencé le jugement d'autres participants de la discussion ?	○	○	○	○
Le modérateur a-t-il permis à chaque participant de s'exprimer équitablement ?	○	○	○	○
Avez-vous acceptez les arguments et regards d'autres personnes pendant la discussion ?	○	○	○	○
Vous êtes-vous adapté aux valeurs et arguments exprimés par d'autres personnes dans la discussion ?	○	○	○	○
Un ou plusieurs participants ont été tellement dominant dans la manière de discuter qu'ils ont empêché d'autres personnes à s'exprimer.	○	○	○	○
J'avais bien compris les informations données.	○	○	○	○
J'aurais bien aimé d'avoir plus d'informations.	○	○	○	○
Je me sentais « étouffé » par la quantité d'information.	○	○	○	○
Cette forme d'étude est une bonne façon d'intégrer l'opinion des gens sur le sujet de recherche.	○	○	○	○

Avez-vous des remarques, des précisions ou des critiques concernant notre étude ? Merci de nous en faire part. Cette page vous est réservée, vous pouvez vous y exprimer librement :

Voilà, vous avez terminé notre enquête. Nous vous remercions pour votre aide précieuse !

Si vous voulez être informé sur plus de détails de notre étude, vous pouvez écrire un mail à :

marcus.kieslich@supagro.fr

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Un grand merci à Yann Tropé pour la création des images utilisées sur les cartes de choix.

A.3. Pictures from the implementation of the study

Figure A.2. – Picture taken during a deliberative workshop in a municipality in the Cévennes.

Figure A.3. – Local products given to participants as compensation for their time and effort.

Figure A.4. – Picture taken before a deliberative workshop in the municipality of Cournonterral.

ENQUÊTE SCIENTIFIQUE

LA SCIENCE CHERCHE VOTRE REGARD SUR LES PAYSAGES CÉVENOLS

Le CNRS développe une étude sur l'évaluation environnementale des paysages cévenols par ses habitants.

DON DE SANG MAINTENANT

Figure A.5. – Article in a local newspaper of the Cévennes region.

Figure A.6. – Interview with a local radio.

A.4. Example of a poster distributed around a municipality in the Cévennes

The following page shows a poster that was used to inform inhabitants about our deliberative workshop.

LA SCIENCE CHERCHE VOTRE REGARD SUR LES CEVENNES

INVITATION A UNE ENQUÊTE SCIENTIFIQUE

Le CNRS pilote un projet sur la perception des paysages cévenols par ces habitants, selon des critères culturels, économiques et écologiques. Pour recueillir vos témoignages, nous organisons une enquête et une table de discussion (2 heures) autour d'un buffet, le :

JEUDI 13 SEPTEMBRE 2018

À Sainte Croix De La Vallée Française

19h

Salle PIBOULIO

Un lot de cadeaux sera remis à chaque participant (panel représentatif de 25 personnes maximum !)

Sur inscription uniquement, à regards-cevennes@umontpellier.fr **sur** regards-cevennes.com(rubrique « inscription ») **ou au** 0699.90.6087

cnrs — UNIVERSITÉ MONTPELLIER — INRA SCIENCE & IMPACT — CEE-M CENTER FOR ENVIRONMENTAL ECONOMICS – MONTPELLIER

A.5. List of municipalities that have been part of our study area in the Cévennes

The following document illustrates the municipalities part of our study area in the Cévennes.

Code_INSEE	Municipality (Gard)	Inhabitants
30009	Alzon	158
30010	Anduze	2948
30015	Arphy	169
30016	Arre	245
30017	Arrigas	193
30022	Aujac	156
30024	Aulas	422
30025	Aumessas	192
30026	Avèze	930
30037	Bessèges	2445
30038	Bez-Et-Esparon	295
30044	Bonnevaux	80
30045	Bordezac	329
30051	Branoux-Les-Taillades	1172
30052	Bréau-Et-Salagosse	328
30077	Cendras	1514
30079	Chambon	235
30080	Chamborigaud	780
30087	Colognac	175
30094	Corbès	152
30097	Courry	250
30099	Cros	218
30105	Dourbies	161
30108	Estréchure	154
30120	Gagnières	980
30129	Générargues	593
30130	Génolhac	740
30137	Lamelouze	139
30139	Lanuéjols	315
30140	Lasalle	976
30152	Mages	1732
30154	Mandagout	330
30157	Mars	146
30159	Martinet	679
30167	Meyrannes	688
30168	Mialet	540
30170	Molières-Cavaillac	789
30171	Molières-Sur-Cèze	1229
30172	Monoblet	575
30190	Notre-Dame-De-La-Rouvière	370
30194	Peyremale	250
30195	Peyrolles	21
30198	Plantiers	210
30203	Portes	295
30216	Robiac-Rochessadoule	715
30220	Roquedur	215
30227	Saint-Ambroix	2703
30229	Saint-André-De-Majencoules	506
30231	Saint-André-De-Valborgne	351

Code_INSEE	Municipality (Gard/Lozère)	Inhabitants
30236	Saint-Bonnet-De-Salendrinque	93
30239	Sainte-Cécile-D'andorge	470
30246	Sainte-Croix-De-Caderle	107
30253	Saint-Florent-Sur-Auzonnet	991
30268	Saint-Jean-De-Valériscle	578
30269	Saint-Jean-Du-Gard	2238
30272	Saint-Julien-De-La-Nef	95
30283	Saint-Martial	170
30291	Saint-Paul-La-Coste	225
30296	Saint-Roman-De-Codières	140
30297	Saint-Sauveur-Camprieu	214
30298	Saint-Sébastien-D'aigrefeuille	476
30310	Saumane	245
30316	Sénéchas	212
30322	Soudorgues	250
30329	Thoiras	355
30332	Trèves	125
30339	Valleraugue	886
30345	Vernarède	293
30350	Vigan	3228
48 019	Barre-Des-Cévennes	185
48 020	Bassurels	64
48 028	Bondons	119
48 036	Cassagnas	99
48 050	Bédouès-Cocurès	375
48 051	Collet-De-Dèze	674
48 061	Florac Trois Rivières	1 700
48 065	Fraissinet-De-Fourques	75
48 069	Gatuzières	44
48 075	Ispagnac	718
48 096	Meyrueis	712
48 097	Moissac-Vallée-Française	193
48 098	Molezon	70
48 115	Pompidou	145
48 116	Pont De Montvert - Sud Mont Lozère	528
48 122	Quézac	294
48 130	Rousses	101
48 136	Saint-André-De-Lancize	113
48 144	Sainte-Croix-Vallée-Française	245
48 148	Saint-Étienne-Vallée-Française	458
48 152	Ventalon En Cévennes	180
48 155	Saint-Germain-De-Calberte	414
48 157	Sainte-Hélène	80
48 158	Saint-Hilaire-De-Lavit	102
48 163	Saint-Julien-Des-Points	93
48 166	Cans Et Cévennes	227
48 170	Saint-Martin-De-Boubaux	163
48 171	Saint-Martin-De-Lansuscle	159
48 173	Saint-Michel-De-Dèze	201
48 178	Saint-Privat-De-Vallongue	200
48 193	Vebron	172
48 194	Vialas	395

Liste des communes cévenoles de notre étude

A.6. Choice of representative income statistics for the Cévennes sample

In the following, the choice of adequate income statistics for the Cévennes is detailed.

Cèze-Cévennes (completely considered)

	Municipalities	Habitants
Intermunicipality	23	19219
Municipalities belonging to Cévennes	9	11046
Municipalities with individual income data	2	6006

➔ Cevennes communities are approximately half of the whole intermunicipality (EPCI) and a relatively big part of Cevennes communities at all. I therefore decide to take the whole Intermunicipality by inferring that no significant difference among Cévennes and non-Cévennes municipalities exists. I judge this less biased than only taking the 2 municipalities for which individual statistics exist.

Alès Agglomeration (partly considered)

	Municipalities	Habitants
Intermunicipality	72	128969
Municipalities belonging to Cévennes	26	20524
Municipalities with individual income data	3	7943

➔ For only 3 out of 26 Cévennes municipalities within this Intermunicipality data exists. Nevertheless, taking the whole Alès Agglomeration would hardly be representative due to the limited share the municipalities have within and the urban character of the other communities which differs from the Cévennes region. I therefore decide to use only the data of the 3 municipalities.

Mont Lozere et Goulet (not considered)

Only one municipality (Sainte-Hélène, 101 habitants) is part of our sample and has no individual level data. We therefore excluded this municipality from our population income distribution statistic.

Gorges Causses Cévennes (completely considered)

	Municipalities	Habitants
Intermunicipality	17	7041
Municipalities belonging to Cévennes	12	5502
Municipalities with individual income data	1	2075

➔ The municipalities also being part in our sample constitute the majority of the Gorges Causes Cévennes Intermunicipality in terms of number of Municipalities and habitants. We therefore judge the whole Intermunicipality as representative and integrate it into our analysis of income distribution.

Cévennes gangeoises et suménoises (not considered)

	Municipalities	Habitants
Intermunicipality	13	13170
Municipalities belonging to Cévennes	4	2026
Municipalities with individual income data	0	0

➔ The Cévennes municipalities cover a relatively small part of the Intermunicipality “Cévennes Gangeoises et sumènoises”. Unfortunately, for none of them, individual data exists. Given their little importance at the level of the Intermunicipality and the level of the whole Cévennes region, I do not treat data of the Intermunicipality.

Other EPCI:

These intermunicipalities are nearly entirely constituted by municipalities of our sample and are therefore completely considered in our income statistics.

	Municipalities	Habitants
Cévennes au Mont Lozère	13	13170
Causses Aigoual Cévennes	15	5559
Pays viganais	21	10089

Web sources used for the analysis and population data (Wikipedia):

EPCI Cévennes:

Alès Agglomération (*retrieved 10/08/2020; 13:56*):

https://fr.wikipedia.org/wiki/Al%C3%A8s_Agglom%C3%A9ration

Causses Aigoual Cévennes (*retrieved 10/08/2020; 14:35*):

https://fr.wikipedia.org/wiki/Communaut%C3%A9_de_communes_Causses_Aigoual_C%C3%A9vennes

Cévennes au Mont Lozère (*retrieved 10/08/2020; 16:07*):

https://fr.wikipedia.org/wiki/Communaut%C3%A9_de_communes_Des_C%C3%A9vennes_au_Mont_Loz%C3%A8re

Cévennes gangeoises et suménoises (*retrieved 10/08/2020; 14:54*):

https://fr.wikipedia.org/wiki/Communaut%C3%A9_de_communes_des_C%C3%A9vennes_gangeoises_et_sum%C3%A9noises

Cèze-Cévennes (*retrieved 10/08/2020; 15:30*):

https://fr.wikipedia.org/wiki/Communaut%C3%A9_de_communes_C%C3%A8ze-C%C3%A9vennes

Gorges Causses Cévennes (*retrieved 10/08/2020; 15:11*):

https://fr.wikipedia.org/wiki/Communaut%C3%A9_de_communes_Gorges_Causses_C%C3%A9vennes

Pays viganais (*retrieved 10/08/2020; 14:20*):

https://fr.wikipedia.org/wiki/Communaut%C3%A9_de_communes_du_Pays_viganais

B. Appendix of chapter 3

B.1. Output tables

B.1.1. MNL models Cévennes sample

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.038		(0.090)	0.423
ASC Alt. SQ	-0.389	*	(0.225)	-1.729
Forest Cover - Natural Reforestation	-0.777	***	(0.176)	-4.417
Forest Cover - Supported Reforestation	-1.477	***	(0.148)	-9.950
Tree Species - equilibrated	0.779	***	(0.113)	6.922
Tourism Infrastructure - medium	0.864	***	(0.168)	5.134
Tourism Infrastructure - high	0.412	***	(0.108)	3.806
Cultural Heritage - medium	1.356	***	(0.185)	7.308
Cultural Heritage - high	1.810	***	(0.172)	10.538
Payment, Donation	−0.011	***	(0.002)	5.993
Observations			970	
AIC			1902.04	
BIC			1950.82	
Log-likelihood			-941.02	
McFadden's pseudo-R^2			0.1162	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.1. – MNL baseline model with all attributes being effect coded for the Cévennes sample.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.103		(0.097)	1.064
ASC Alt. SQ	0.501	***	(0.116)	4.318
Forest Cover	0.378	*	(0.213)	1.776
Tree Species - equilibrated	-0.787	***	(0.273)	-2.883
Tourism Infrastructure	0.739	***	(0.192)	3.857
Cultural Heritage	1.415	***	(0.220)	6.418
Payment, Donation	−0.012	***	(0.002)	5.936
Forest Cover : Age	-0.015	***	(0.004)	-3.322
Forest Cover : 5y Cévennes	-0.325		(0.201)	-1.619
Forest Cover : 5y Montpellier	0.009		(0.180)	0.047
Tree Species : Age	0.022	***	(0.005)	4.818
Tree Species : Gender - female	-0.157		(0.168)	-0.933
Tree Species : Owner of parcel	1.948	**	(0.817)	2.383
Tourism Infrastructure : Age	-0.008	**	(0.004)	-2.136
Tourism Infrastructure : Gender - female	-0.388	***	(0.120)	-3.239
Tourism Infrastructure : 5y Cevennes	-0.201		(0.170)	-1.184
Cultural Heritage : Age	-0.001		(0.004)	-0.178
Cultural Heritage : 5y Montpellier	-0.586	***	(0.189)	-3.110
Observations			920	
AIC			1775.31	
BIC			1862.15	
Log-likelihood			-869.66	
McFadden's pseudo-R^2			0.1561	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.2. – MNL model for the Cévennes sample containing all significant interactions before stepwise elimination.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.057		(0.093)	0.617
ASC Alt. SQ	-0.795	***	(0.197)	-4.035
Forest Cover	-1.148	***	(0.255)	-4.505
Tree Species - equilibrated	0.746	***	(0.153)	4.868
Tourism Infrastructure - medium	0.861	***	(0.173)	4.980
Tourism Infrastructure - high	0.389	***	(0.112)	3.473
Cultural Heritage - medium	2.014	***	(0.298)	6.748
Cultural Heritage - high	3.010	***	(0.478)	6.297
Payment, Donation	−0.011	***	(0.002)	5.949
Forest Cover : Age	0.011	***	(0.004)	2.631
Forest Cover : Gender - female	-0.357	***	(0.135)	-2.649
Tree Species : 5y Montpellier	-0.506	***	(0.179)	-2.825
Tree Species : Gender - female	0.096		(0.192)	0.499
Tree Species : Env. Protection	0.439	**	(0.180)	2.445
Cultural Heritage : Age	-0.010	**	(0.004)	-2.493
ASC Alt. SQ : Gender - female	0.618	***	(0.194)	3.186
Observations			934	
AIC			1790.19	
BIC			1867.63	
Log-likelihood			-879.10	
McFadden's pseudo-R^2			0.1744	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.3. – MNL with inclusion of ASC.SQ-Gender interaction for the Cévennes sample (model 49).

B.1.2. MNL models Montpellier sample

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.095		(0.092)	1.041
ASC Alt. SQ	0.459	***	(0.111)	4.141
Forest Cover	-0.326	***	(0.067)	-4.894
Tree Species - equilibrated	0.152		(0.101)	1.500
Tourism Infrastructure	0.112	**	(0.055)	2.054
Cultural Heritage	0.822	***	(0.075)	11.017
Payment, Donation	−0.011	***	(0.002)	5.524
Observations			955	
AIC			1916.11	
BIC			1950.15	
Log-likelihood			-951.06	
McFadden's pseudo-R^2			0.0771	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.4. – MNL baseline estimation for main effects without effect coding, Montpellier sample.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.160		0.100	1.609
ASC Alt. SQ	-0.193		0.165	-1.168
Forest Cover	0.346	*	0.184	1.880
Tree Species - equilibrated	0.219	*	0.112	1.955
Tourism Infrastructure - medium	0.635	***	0.180	3.535
Tourism Infrastructure - high	0.122		0.117	1.042
Cultural Heritage - medium	1.689	***	0.214	7.885
Cultural Heritage - high	2.399	***	0.207	11.603
Payment, Donation	−0.014	***	0.002	7.103
Forest Cover : Age	-0.017	***	0.004	-4.657
Observations			955	
AIC			1793.48	
BIC			1841.82	
Log-likelihood			-886.74	
McFadden's pseudo-R^2			0.1395	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.5. – Results from MNL model with Forest Cover - Age interaction for Montpellier sample.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.103		(0.097)	1.064
ASC Alt. SQ	0.501	***	(0.116)	4.318
Forest Cover	0.378	*	(0.213)	1.776
Tree Species - equilibrated	-0.787	***	(0.273)	-2.883
Tourism Infrastructure	0.739	***	(0.192)	3.857
Cultural Heritage	1.415	***	(0.220)	6.418
Payment, Donation	−0.012	***	(0.002)	5.936
Forest Cover : Age	-0.015	***	(0.004)	-3.322
Forest Cover : 5y Cevennes	-0.325		(0.201)	-1.619
Forest Cover : 5y Montpellier	0.009		(0.180)	0.047
Tree Species : Age	0.022	***	(0.005)	4.818
Tree Species : Gender - female	-0.157		(0.168)	-0.933
Tree Species : Owner of parcel	1.948	**	(0.817)	2.383
Tourism Infrastructure : Age	-0.008	**	(0.004)	-2.136
Tourism Infrastructure : Gender - female	-0.388	***	(0.120)	-3.239
Tourism Infrastructure : 5y Cevennes	-0.201		(0.170)	-1.184
Cultural Heritage : Age	-0.001		(0.004)	-0.178
Cultural Heritage : 5y Montpellier	-0.586	***	(0.189)	-3.110
Observations			920	
AIC			1775.31	
BIC			1862.15	
Log-likelihood			-869.66	
McFadden's pseudo-R^2			0.1561	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.6. – MNL model of Montpellier containing all interactions for stepwise elimination.

B.1.3. MXL models Cévennes sample

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.052		(0.077)	0.675
ASC Alt. SQ	0.660	***	(0.091)	7.260
Forest Cover	-0.644	***	(0.047)	-13.777
Tree Species - equilibrated	0.931	***	(0.100)	9.300
Tourism Infrastructure	0.326	***	(0.068)	4.759
Cultural Heritage	0.874	***	(0.076)	11.512
Payment, Donation	-5.080	***	(0.208)	-24.427
Cholesky-fc:fc	0.548	***	(0.066)	8.332
Cholesky-fc:tsd	0.340	***	(0.097)	3.501
Cholesky-tsd:tsd	0.152		(0.145)	1.049
Cholesky-fc:tou	0.099		(0.067)	1.488
Cholesky-tsd:tou	0.120		(0.104)	1.157
Cholesky-tou:tou	0.645	***	(0.064)	10.087
Cholesky-fc:ch	0.147	**	(0.065)	2.263
Cholesky-tsd:ch	-0.367	***	(0.111)	-3.298
Cholesky-tou:ch	0.208	***	(0.063)	3.328
Cholesky-ch:ch	0.749	***	(0.057)	13.253
Cholesky-fc:pay	2.283	***	(0.126)	18.048
Cholesky-tsd:pay	-5.120	***	(0.209)	-24.516
Cholesky-tou:pay	3.098	***	(0.234)	13.253
Cholesky-ch:pay	-0.381	**	(0.163)	-2.340
Cholesky-pay:pay	6.140	***	(0.160)	38.265
Observations			970	
AIC			1908.85	
Log-likelihood			-932.42	
McFadden's pseudo-R^2			0.1243	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.7. – Estimation of baseline MXL model for the Cévennes sample with account for correlation and with Cholesky factors.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.012		0.118	0.102
ASC Alt. SQ	-0.094		0.186	-0.507
Forest Cover	-0.513	***	0.137	-3.736
Tree Species - equilibrated	0.962	***	0.157	6.108
Tourism Infrastructure	0.752	***	0.178	4.228
Cultural Heritage	1.063	***	0.162	6.565
Payment, Donation	-5.372	***	0.436	-12.323
Forest Cover : Gender - female	-0.603	***	0.178	-3.379
Tree Species : Env. Protection	0.630	***	0.246	2.560
Tree Species : 5y Montpellier	-0.791	***	0.232	-3.407
ASC Alt. SQ : Gender - female	0.620	***	0.201	3.091
Tourism : Cultural Heritage	-0.246	**	0.057	-2.196
Observations			934	
AIC			1700.47	
Log-likelihood			-823.23	
McFadden's pseudo-R^2			0.2268	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.8. – Estimation of final mixed logit model with correlation for Cévennes area

Variable\Distribution	AIC			pseudo-R2		
	normal	triangular	uniform	normal	triangular	uniform
Forest cover	1788,21	1829,80	1812,86	0,1440	0,1238	0,1320
Tree species	1788,21	1813,39	1806,07	0,1440	0,1318	0,1353
Tourism	1788,21	1848,48	1820,98	0,1440	0,1148	1,8719
Cultural heritage	1788,21	1815,45	1803,28	0,1440	0,1308	0,1367

Figure B.1. – Comparison of different random parameter distribution for the main effects, Montpellier sample.

B.1.4. MXL models Montpellier sample

	Estimate	Std. Error	z-value	Pr(>|z|)
ASC Alt. 2	0.092	0.082	1.120	0.263
ASC Alt. SQ	0.487	0.083	5.869	0
Forest Cover	0.441	0.046	9.580	0
Tree Species - equilibrated	0.266	0.092	2.899	0.004
Tourism Infrastructure	0.142	0.056	2.527	0.012
Cultural Heritage	1.143	0.050	22.678	0
Payment, Donation	-4.196	0.094	-44.588	0
Cholesky-fc:fc	-0.089	0.066	-1.358	0.174
Cholesky-fc:tsd	-0.192	0.118	-1.626	0.104
Cholesky-tsd:tsd	1.310	0.115	11.375	0
Cholesky-fc:tou	0.342	0.077	4.469	0.00001
Cholesky-tsd:tou	0.699	0.072	9.714	0
Cholesky-tou:tou	0.721	0.056	12.847	0
Cholesky-fc:ch	-0.833	0.077	-10.848	0
Cholesky-tsd:ch	1.432	0.066	21.796	0
Cholesky-tou:ch	0.995	0.049	20.226	0
Cholesky-ch:ch	0.169	0.071	2.366	0.018
Cholesky-fc:pay	-1.791	0.022	-81.242	0
Cholesky-tsd:pay	0.159	0.019	8.405	0
Cholesky-tou:pay	3.136	0.067	46.706	0
Cholesky-ch:pay	-0.327	0.048	-6.843	0
Cholesky-pay:pay	9.454	0.060	158.048	0
Observations			920	
AIC			1884.37	
Log-likelihood			-920.19	
McFadden's pseudo-R^2			0.1070	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.9. – Estimation of baseline MXL model with account for correlation, Montpellier

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.097		0.124	0.782
ASC Alt. SQ	0.261	*	0.151	1.7244
Forest Cover	0.581	**	0.261	2.226
Tree Species - equilibrated	-0.578	*	0.334	-1.730
Tourism Infrastructure	1.054	***	0.275	3.838
Cultural Heritage	1.970	***	0.279	7.051
Payment, Donation	-4.069	***	0.227	-17.945
Forest Cover : Age	-0.023	***	0.005	-4.268
Tree Species : Age	0.017	***	0.006	2.770
Tree Species : Owner of parcel	1.985	*	1.048	1.893
Tourism Infrastructure : Age	-0.009	**	0.004	-2.115
Tourism Infrastructure : Gender - female	-0.646	***	0.170	-3.795
Cultural Heritage : 5y Montpellier	-0.808	***	0.264	-3.057
Observations			920	
AIC			1632.87	
Log-likelihood			-788.39	
McFadden's pseudo-R^2			0.2349	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table B.10. – Estimation of final mixed logit model with account for correlation, Montpellier.

B.2. Factor analysis and cluster analysis

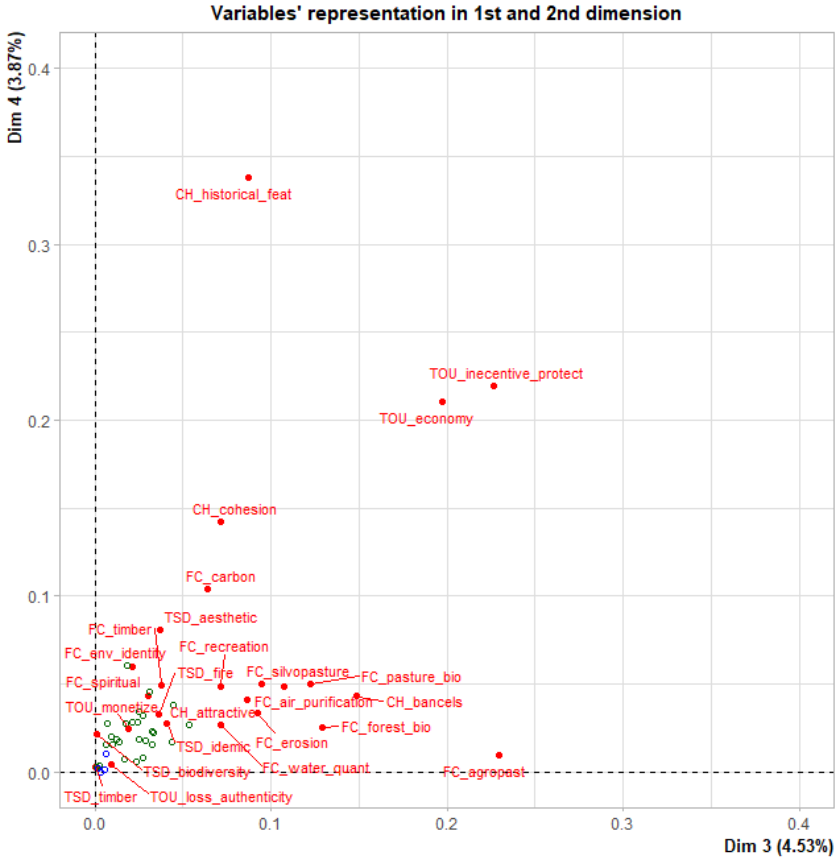

Figure B.2. – Representation of variables in dimension 3-4.

	Cla/Mod	Mod/Cla	Global	p.value	v.test
FC_erosionconsidered	65.28	87.04	62.61	0.00	7.38
FC_carbonconsidered	67.97	80.56	55.65	0.00	7.26
FC_forestbioconsidered	63.27	86.11	63.91	0.00	6.73
FC_timberconsidered	75.00	52.78	33.04	0.00	6.02
FC_recreationconsidered	75.00	50.00	31.30	0.00	5.78
TSD_fireconsidered	73.68	51.85	33.04	0.00	5.72
FC_air_purificationconsidered	71.95	54.63	35.65	0.00	5.67
CH_bancelsconsidered	59.12	87.04	69.13	0.00	5.63
TSD_aestheticconsidered	61.42	72.22	55.22	0.00	4.89
FC_spiritualconsidered	67.53	48.15	33.48	0.00	4.42

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	Cla/Mod	Mod/Cla	Global	p.value	v.test
CH_cohesionconsidered	57.24	76.85	63.04	0.00	4.09
TOU_monetizeconsidered	70.59	33.33	22.17	0.00	3.82
CH_attractive-considered	57.14	66.67	54.78	0.00	3.39
SatisfactionQ-Yes	58.88	58.33	46.52	0.00	3.36
TSD_idemic-considered	55.81	66.67	56.09	0.00	3.03
CH_historicalfeat-considered	53.46	78.70	69.13	0.00	2.95
Expressed-Yes	62.90	36.11	26.96	0.00	2.92
TSD_timber-considered	72.00	16.67	10.87	0.01	2.62
TOU_economy-considered	51.70	84.26	76.52	0.01	2.60
deliberation-TRUE	55.17	59.26	50.43	0.01	2.50
FC_silvopasture-considered	58.67	40.74	32.61	0.01	2.45
age	-	52.13	49.39	0.02	2.31
income_class-3	63.41	24.07	17.83	0.02	2.30
FC_waterquant-not-important	62.79	25.00	18.70	0.02	2.28
Owner_plot-TRUE	87.50	6.48	3.48	0.02	2.26
FC_envidentity-considered	59.32	32.41	25.65	0.03	2.18
TSD_biodiversity-considered	73.33	10.19	6.52	0.04	2.06
CH_historicalfeat-unaware	25.00	4.63	8.70	0.04	-2.04
FC_silvopasture-unaware	37.80	28.70	35.65	0.04	-2.06
FC_pasturebio-considered	38.46	32.41	39.57	0.04	-2.07
CH_historicalfeat-not-important	32.61	13.89	20.00	0.03	-2.17
FC_envidentity-NA	33.33	15.74	22.17	0.03	-2.20
TOU_economy-not-important	30.95	12.04	18.26	0.02	-2.29
deliberation-FALSE	38.60	40.74	49.57	0.01	-2.50
TSD_aesthetic-unaware	26.47	8.33	14.78	0.01	-2.59
FC_spiritual-unaware	32.84	20.37	29.13	0.01	-2.74
age_class-18-29	25.00	9.26	17.39	0.00	-3.07
FC_waterquant-unaware	33.72	26.85	37.39	0.00	-3.10
CH_bancels-unaware	18.52	4.63	11.74	0.00	-3.19
TSD_idemic-unaware	23.08	8.33	16.96	0.00	-3.30
CH_bancels-not-important	20.00	6.48	15.22	0.00	-3.51
FC_airpurification-unaware	28.36	17.59	29.13	0.00	-3.63
TSD_fire-unaware	29.33	20.37	32.61	0.00	-3.73
CH_cohesion-unaware	16.13	4.63	13.48	0.00	-3.78
TSD_aesthetic-not-important	25.00	12.96	24.35	0.00	-3.81
FC_forestbio-unaware	8.33	1.85	10.43	0.00	-4.19
FC_carbon-unaware	14.29	4.63	15.22	0.00	-4.33

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	Cla/Mod	Mod/Cla	Global	p.value	v.test
FC_recreation-unaware	22.41	12.04	25.22	0.00	-4.38
TOU_monetize-unaware	30.77	29.63	45.22	0.00	-4.47
FC_erosion-unaware	10.00	2.78	13.04	0.00	-4.53
CH_attractive-unaware	7.41	1.85	11.74	0.00	-4.61
FC_carbon-not-important	19.64	10.19	24.35	0.00	-4.79
FC_erosion-not-important	15.69	7.41	22.17	0.00	-5.21
FC_forestbio-not-important	14.00	6.48	21.74	0.00	-5.45
FC_timber-unaware	16.95	9.26	25.65	0.00	-5.48

Table B.11. – Categories describing the first cluster - full table (appendix).

	Cla/Mod	Mod/Cla	Global	p.value	v.test
FC_forestbio-not-important	68.00	43.04	21.74	0.00	5.49
FC_carbon-not-important	64.29	45.57	24.35	0.00	5.27
FC_erosion-not-important	64.71	41.77	22.17	0.00	5.01
FC_recreation-unaware	62.07	45.57	25.22	0.00	5.00
TSD_fire-not-important	65.31	40.51	21.30	0.00	4.98
CH_bancels-not-important	68.57	30.38	15.22	0.00	4.44
FC_pasturebio-considered	51.65	59.49	39.57	0.00	4.42
FC_timber-not-important	53.16	53.16	34.35	0.00	4.27
CH_attractive-unaware	66.67	22.78	11.74	0.00	3.59
CH_historicalfeat-not-important	56.52	32.91	20.00	0.00	3.42
TSD_aesthetic-not-important	53.57	37.97	24.35	0.00	3.39
FC_carbon-unaware	57.14	25.32	15.22	0.00	2.97
FC_agropast-considered	46.51	50.63	37.39	0.00	2.96
FC_airpurification-not-important	50.00	36.71	25.22	0.00	2.83
FC_silvopasture-not-important	50.98	32.91	22.17	0.01	2.76
TOU_lossauthenticity-not-important	47.76	40.51	29.13	0.01	2.69
CH_attractive-not-important	46.77	36.71	26.96	0.02	2.36
CH_cohesion-not-important	48.94	29.11	20.43	0.02	2.30
TSD_biodiversity-NA	42.31	55.70	45.22	0.02	2.29
TOU_monetize-unaware	42.31	55.70	45.22	0.02	2.29
age	-	52.43	49.39	0.05	1.97
HsH_comp-Other	18.75	7.59	13.91	0.04	-2.02
region=Montpellier	27.68	39.24	48.70	0.04	-2.06

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	Cla/Mod	Mod/Cla	Global	p.value	v.test
TOU_economy-considered	30.68	68.35	76.52	0.04	-2.06
TSD_fire-considered	25.00	24.05	33.04	0.04	-2.10
Owner_other-FALSE	31.66	79.75	86.52	0.04	-2.10
FC_agropast=NA	18.18	7.59	14.35	0.03	-2.14
X5Cev=FALSE	26.67	35.44	45.65	0.03	-2.24
CH_bancels-considered	29.56	59.49	69.13	0.02	-2.25
age_class=45-54	17.65	7.59	14.78	0.02	-2.26
Sport-Not at all	17.65	7.59	14.78	0.02	-2.26
Express-Yes	22.58	17.72	26.96	0.02	-2.30
Hunt-Not at all	31.09	75.95	83.91	0.02	-2.30
TSD_fire-unaware	24.00	22.78	32.61	0.02	-2.30
FC_pasturebio-unaware	20.37	13.92	23.48	0.01	-2.50
CH_historicalfeat-considered	28.93	58.23	69.13	0.01	-2.54
FC_agropast-unaware	19.64	13.92	24.35	0.01	-2.70
TSD_idemic-unaware	15.38	7.59	16.96	0.00	-2.81
Own_residence-FALSE	27.01	46.84	59.57	0.00	-2.81
TOU_monetize-considered	17.65	11.39	22.17	0.00	-2.91
FC_envidentity-considered	18.64	13.92	25.65	0.00	-3.00
Water-Elsewhere	10.34	3.80	12.61	0.00	-3.05
Owner_not-TRUE	25.40	40.51	54.78	0.00	-3.12
TSD_aesthetic-unaware	11.76	5.06	14.78	0.00	-3.13
TSD_biodiversity-considered	0.00	0.00	6.52	0.00	-3.19
Gender=Female	24.17	36.71	52.17	0.00	-3.38
TOU_lossauthenticity-considered	18.92	17.72	32.17	0.00	-3.45
FC_timber-considered	18.42	17.72	33.04	0.00	-3.63
FC_erosion-considered	24.31	44.30	62.61	0.00	-4.09
CH_attractive-considered	22.22	35.44	54.78	0.00	-4.24
FC_spiritual-considered	10.39	10.13	33.48	0.00	-5.68
FC_forestbio-considered	20.41	37.97	63.91	0.00	-5.85
FC_recreation-considered	8.33	7.59	31.30	0.00	-5.94
FC_airpurification-considered	9.76	10.13	35.65	0.00	-6.12
FC_carbon-considered	14.06	22.78	55.65	0.00	-7.31

Table B.12. – Categories describing the second cluster - full table (appendix).

	Cla/Mod	Mod/Cla	Global	p.value	v.test
TSD_fire-unaware	46.67	81.40	32.61	0.00	7.32
FC_timber-unaware	52.54	72.09	25.65	0.00	7.20
TSD_idemic-unaware	61.54	55.81	16.96	0.00	6.69
TSD_aesthetic-unaware	61.76	48.84	14.78	0.00	6.14
CH_bancels-unaware	62.96	39.53	11.74	0.00	5.45
FC_erosion-unaware	56.67	39.53	13.04	0.00	5.03
age_class=18-29	47.50	44.19	17.39	0.00	4.64
CH_cohesion-unaware	48.39	34.88	13.48	0.00	4.06
TSD_timber-unaware	32.18	65.12	37.83	0.00	3.98
FC_silvopasture-unaware	31.71	60.47	35.65	0.00	3.65
FC_agropast-NA	42.42	32.56	14.35	0.00	3.42
FC_pasturebio-unaware	35.19	44.19	23.48	0.00	3.33
FC_waterquant-unaware	29.07	58.14	37.39	0.00	3.03
Own_not-TRUE	25.40	74.42	54.78	0.00	2.88
TOU_monetize-unaware	26.92	65.12	45.22	0.00	2.87
Farming-Not at all	28.09	58.14	38.70	0.00	2.83
X5Cev-FALSE	26.67	65.12	45.65	0.01	2.81
FC_forestbio-unaware	41.67	23.26	10.43	0.01	2.74
Own_residence-FALSE	24.09	76.74	59.57	0.01	2.57
FC_airpurification-unaware	28.36	44.19	29.13	0.02	2.32
CH_historicalfeat-unaware	40.00	18.60	8.70	0.02	2.30
deliberation-FALSE	24.56	65.12	49.57	0.03	2.24
CSP-Executive Employees	30.95	30.23	18.26	0.03	2.13
Sport-Elsewhere	30.95	30.23	18.26	0.03	2.13
FC_agropast-unaware	28.57	37.21	24.35	0.04	2.08
Owner_residence-TRUE	10.45	16.28	29.13	0.04	-2.09
deliberation-TRUE	12.93	34.88	50.43	0.03	-2.24
Sport-In Cevennes area	13.39	39.53	55.22	0.02	-2.26
FC_waterquant-not-important	6.98	6.98	18.70	0.02	-2.28
Owner_not-FALSE	10.26	18.60	33.91	0.02	-2.39
X5Cev-TRUE	11.22	25.58	42.61	0.01	-2.51
TSD_timber-not-important	6.12	6.98	21.30	0.01	-2.68
FC_pasturebio-considered	9.89	20.93	39.57	0.00	-2.81
TSD_timber-considered	0.00	0.00	10.87	0.00	-2.87
age_class=65+	5.45	6.98	23.91	0.00	-3.07
CH_cohesion-considered	12.41	41.86	63.04	0.00	-3.10
FC_timber-considered	6.58	11.63	33.04	0.00	-3.46

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	Cla/Mod	Mod/Cla	Global	p.value	v.test
age_class=55-64	0.00	0.00	15.22	0.00	-3.56
FC_agropast-considered	6.98	13.95	37.39	0.00	-3.65
FC_silvopasture-not-important	1.96	2.33	22.17	0.00	-3.89
FC_erosion-considered	10.42	34.88	62.61	0.00	-4.05
FC_timber-not-important	5.06	9.30	34.35	0.00	-4.07
CH_bancels-considered	11.32	41.86	69.13	0.00	-4.10
CSP-Retired Persons	1.82	2.33	23.91	0.00	-4.13
TSD_fire-not-important	0.00	0.00	21.30	0.00	-4.42
TSD_fire-considered	1.32	2.33	33.04	0.00	-5.32
age	-	36.91	49.39	0.00	-5.36
TSD_aesthetic-considered	5.51	16.28	55.22	0.00	-5.75
TSD_idemic-considered	4.65	13.95	56.09	0.00	-6.25

Table B.13. – Categories describing the third cluster - full table (appendix).

C. Appendix of chapter 4

C.1. Output tables

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	-0.037		(0.088)	-0.424
ASC Alt. SQ	0.103		(0.142)	0.723
Forest Cover	-0.851	***	(0.241)	-3.538
Tree Species - equilibrated	0.714	***	(0.115)	6.212
Tourism Infrastructure	0.442	***	(0.080)	5.520
Cultural Heritage	1.109	***	(0.219)	5.065
Payment, Donation	0.007	***	(0.002)	3.860
Tourism : Deliberation	-0.378	***	(0.110)	-3.439
Forest Cover : Age	0.009	*	(0.004)	2.359
Forest Cover : Gender - female	-0.436	***	(0.130)	-3.355
Tree Species : Env. Protection	0.451	*	(0.176)	2.560
Tree Species : 5y Montpellier	-0.460	**	(0.177)	-2.595
Cultural Heritage : Age	-0.009	*	(0.004)	-2.263
ASC Alt. SQ : Gender - female	0.535	***	(0.149)	3.592
Observations			920	
AIC			1838.6	
Log-likelihood			-908.29	
McFadden's pseudo-R^2			0.1498	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table C.1. – Integrated model to measure the impact of deliberation: MNL for the Cévennes sample.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	-0.002		(0.081)	-0.027
ASC Alt. SQ	-0.065		(0.145)	-0.451
Forest Cover	-0.406	***	(0.061)	-6.700
Tree Species - broad-leafed	0.662	***	(0.116)	5.706
Tourism Infrastructure	0.759	***	(0.094)	8.071
Cultural Heritage	0.962	***	(0.057)	16.812
Payment, Donation	-5.168	***	(0.159)	-32.402
ASC Alt. SQ : Deliberation	0.388	***	(0.144)	2.705
Tree Species : Deliberation	0.365	***	(0.138)	2.644
Tourism : Deliberation	-0.453	***	(0.082)	-5.490
Tourism : Cultural Heritage	-0.154	***	(0.056)	-2.759
ASC Alt. SQ : Gender - female	0.582	***	(0.141)	4.126
Forest Cover : Gender - female	-0.576	***	(0.074)	-7.766
Tree Species : Env. Protection	0.607	***	(0.125)	4.867
Tree Species : 5y Montpellier	-0.617	***	(0.132)	-4.657
SD Forest Cover	1.132	***	(0.055)	20.729
SD Tree Species	1.453	***	(0.081)	17.896
SD Tourism	0.851	***	(0.044)	19.358
SD Cultural Heritage	0.411	***	(0.055)	7.453
SD Payment	7.365	***	(0.082)	90.229
Observations			934	
AIC			1770.4	
Log-likelihood			865.17	
McFadden's pseudo-R^2			0.1875	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table C.2. – Integrated model to measure the impact of deliberation: MXL for the Cévennes sample.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.101		(0.097)	1.045
ASC Alt. SQ	0.501	***	(0.116)	4.319
Forest Cover	0.602	**	(0.196)	3.072
Tree Species - broad-leafed	-0.723	**	(0.252)	-2.870
Tourism Infrastructure	0.814	***	(0.188)	4.323
Cultural Heritage	1.383	***	(0.167)	8.282
Payment, Donation	0.012	***	(0.002)	5.886
Forest Cover : Deliberation	-0.255	*	(0.133)	-1.922
Tree Species : Deliberation	-0.337	**	(0.162)	-2.083
Forest Cover : Age	-0.018	***	(0.004)	-4.665
Tree Species : Age	0.022	***	(0.005)	4.873
Tree Species : Owner of parcel	2.205	***	(0.805)	2.739
Tourism : Age	-0.010	***	(0.003)	-3.031
Tourism : Gender - female	-0.391	***	(0.120)	-3.269
Cultural Heritage : 5y Montpellier	-0.591	***	(0.177)	-3.332
Observations			955	
AIC			1765.8	
Log-likelihood			-867.89	
McFadden's pseudo-R^2			0.1578	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table C.3. – Integrated model to measure impact of deliberation: MNL for the Montpellier sample.

Variable	Estimate		Std. Error	z-value
ASC Alt. 2	0.085		(0.122)	0.698
ASC Alt. SQ	0.272	*	(0.145)	1.877
Forest Cover	-0.580	**	(0.253)	-2.296
Tree Species - broad-leafed	-0.545		(0.348)	-1.566
Tourism Infrastructure	0.941	***	(0.266)	3.542
Cultural Heritage	1.913	***	(0.265)	7.221
Payment, Donation	-4.602	***	(0.276)	-16.697
Tree Species : Deliberation	-0.398	*	(0.209)	-1.905
Forest Cover : Age	0.022	***	(0.005)	4.369
Tree Species : Age	0.019	***	(0.006)	3.138
Tree Species : Owner of parcel	2.439	**	(1.099)	2.220
Tourism : Age	-0.010	**	(0.004)	-2.172
Tourism : Gender - female	-0.613	***	(0.166)	-3.704
Cultural Heritage : 5y Montpellier	-0.915	***	(0.263)	-3.484
SD Forest Cover	0.497	***	(0.180)	2.755
SD Tree Species	0.843	***	(0.179)	4.706
SD Tourism Infrastructure	0.786	***	(0.124)	6.359
SD Cultural Heritage	0.684	***	(0.174)	3.933
SD Payment	1.911	***	(0.247)	7.734
Observations			920	
AIC			1644.2	
Log-likelihood			-803.09	
McFadden's pseudo-R^2			0.2207	

***p <0.01,**p <0.05,*p <0.1. ML estimations

Table C.4. – Integrated model to measure impact of deliberation: MXL for the Montpellier sample.

C.2. Part of a transcribed discussion

The following pages show a part of a transcript of a discussion in a Cévennes municipality.

Est-ce qu'il vous manque encore des choses qui ne sont pas intégrés dans les trois caractéristiques ou dans le questionnaire que vous avez rempli ?

10 : Moi, j'aimerais bien comprendre la finalité. Comment vous souhaitez exploiter ces données ? Je n'arrive pas à bien cerner, je sais que les tendances sont de rentrer les grandes bases de données et modéliser tout ça. Quelle va être l'utilisation est qu'est-ce que peut en résulter ?

J'aimerais bien répondre à votre question mais afin de ne pas biaiser vos réponses, j'aimerais y répondre à la fin de notre discussion. Donc qu'est-ce que pour vous manque encore dans des questionnaires ?

9 : Vous avez présenté dans le questionnaire une confrontation entre la forêt et les pâturages. Si on a plus d'une, on a moins de l'autre et le contraire. De mon avis, il y a une autre confrontation entre la forêt et un aspect du patrimoine, les traversées et les murs en pierre sèche qui retiennent la terre et qui permettent à quelqu'un de faire une petite d'agriculture, pousser de nourriture, d'être plus autonome ce qui m'a attiré dans ce coin. J'ai vu des traversées écroulées et à la place des arbres poussent et qui ont peut-être cassé les murs de petit à petit. Pour moi c'est un petit confond entre les deux : les forêts et les traversées. Maintenir ou pas maintenir ? C'est ça la question.

Je vous ai entendu silencieusement approuvé… ?

5 : Oui, tout à fait. Effectivement, je m'interroge sur le maintien de ces cultures en terrasse et notamment la maintenance des mures qui pour la plupart sont effondrés ou mal entretenus. Je trouve ça extrêmement dommage. C'est un travail qui a été colossales qui a été réalisée pose par nos ancêtres. Ils ont sué ça en haut pour organiser ces cultures en terrasse et on laisse tout à l'abandon. Ça fait piquer…

6 : Mais il n'y a plus de bras …

11 : Le problème, ce sont des coûts…

5 : Mais « il n'y a pas de bras, il n'y a pas de bras » il n y'a pas de volonté surtout ! On les a, les bras, on n'a pas de volonté surtout.

2 (et plusieurs) : non, non. Je ne suis pas d'accord.

11 : Ce n'est pas ça qu'il fallait dire. Je ne suis pas d'accord non plus. C'est un problème de coût tout simplement. Est-ce que vous avez du terrain ?

5 : Non.

11 : Voilà. Moi, j'ai du terrain et j'ai des mures qui tombent. J'aimerais bien pouvoir toutes les remonter… Physiquement je ne peux pas, après, financièrement c'est très cher.

13 : C'est vrai, c'est très cher.

12 : Et après avoir les remontées, il faut les entretenir. Il faut faire en sorte que les traversées

sont propres.

11 : Parce que ça continue à pousser, la végétation entre les pierres. Ça veut dire, il faut les cultiver. Ce n'est pas seulement remontée des mures, mais il faut entretenir la terre au-dessus.

6 : Vous savez qui c'est qui a remonté les murs ? Ce sont des personnes âgées et des gosses à l'époque.

5 : Au départ s'étaient qui qui les a créées ?

6 : Ce sont des grandes familles, surtout des grands-parents qui ont monté des murs et des enfants de tout âge charriaient les cailloux. C'est fait comme ça.

10 : Mais ça ne fonctionne plus avec le mode de vie actuel. Le constat, il est dommageable, ça c'est certain. On est tous d'accord là-dessus que c'est magnifique.

1 : Je crois qu'il faut bien prendre en compte la densité de la population qui était tout à fait différente à l'époque.

2 et 10 : Tout à fait. / Egalement.

1 : D'abord, les traversées se ne sont pas mis en place mentalement. Ce que vous avez dit du travail familial, ça se faisait dans un travail très très long sur plusieurs siècles. Ensuite il y avait progressivement une densification des Cévennes qui faisait qu'il y a eu beaucoup plus des bras pour travailler. Et que s'était aussi l'agriculture qui était prédominant à cette époque-là, beaucoup plus que l'élevage. Il faisait partie, mais… Donc, la densification de la population permettait d'entretenir le paysage. Chaque personne qui y travaillait où habitait sur place, n'arrêtaient pas de remonter une pierre, de regarder comment ça se passait un tel endroit, d'appeler les voisins, de collaborer dans des activités entre les familles ou entre les quartiers.

5 : Vous avez dit le mot juste : c'est l'entretien. Ce n'est pas le moment où tout s'est effondré où il faut s'y mettre.

Marmonnement et désaccord dans le groupe.

11 : vous avez vécu et combien de temps en Cévennes ?

5 : Peu importe.

11 : Mais si. Ceux qui ont vécu… Moi quand je suis né il n'y avait pas de confort. On n'avait pas d'argent. C'était très pauvre. Donc ça ont été les enfants qui ont travaillé. Moi, dès l'âge et du moment où j'ai pu tenir une cercelette, j'ai cerclé les oignons. Du moment où j'ai pu planter, j'ai planté. Du moment où j'ai pu garder les chèvres, j'ai gardé des chèvres. Mais à l'arrivée, on faisait ce qu'on pouvait. Parce qu'on n'avait pas l'argent pour acheter autre chose. On est allé une fois par semaine au magasin du village en mobylette pour chercher des courses. Une mobylette pour six personnes dans la famille - vous pouvez vous imaginer les courses qu'on faisait !

5 : Oui mais c'est bon. Vous parlez, il y a 40 ans.

11 : Non je parle, il y a 30 ans pas 40 ans.

5 : Mais là, on se positionne aujourd'hui.

11 : Oui, mais aujourd'hui, qui est propriétaire dans les Cévennes ? Des gens qui arrivent qui n'ont pas vécu ici qui arrive pour avoir une résidence secondaire, ils ont plus ou moins de terrain ou pas. Le terrain qui est en friche ce sont des terrains qui appartiennent à des personnes qui sont âgés qui sont peut-être décédées. Il n'y a plus personne pour les entretenir. Et même s'il y a quelqu'un qui peut entretenir s'il a un travail à l'extérieur, il n'a pas le temps pour s'occuper de l'entretien de son terrain, sauf s'il a une parcelle de 200 ou 300 mètres carrés.

4 : Non, personne ne va obtenir des murs pour ne rien faire, c'est impensable. Avant il y avait beaucoup de monde comme vous avez dit. Il fallait vivre. Donc du moindre petit bout de cailloux, ils mettaient des pierres, ils portaient même de la terre pour faire les traversiers. À La-Rouvière il y a des traversiers qui font 1,2 m de large une vigne. Donc à l'époque, c'était fait pour survivre. Maintenant, il faut que ça soit … qui vient. Comment voulez-vous remonter tous ses murs ? C'est impensable. Je pense simplement comme tout le monde certainement, il faut en sauver quelques-uns pour garder le caractère cévenol. *(Accord dans le groupe.)* Puisque les traversiers comme on dit ici, ça caractérise non pas les vallées mais les implantations des hommes, c'est fondamental. Mais on ne peut pas les tous petits remonter. Si je vous montrerais en photo de La-Rouvière de 1960, le village est entouré des traversiers ! Maintenant j'en ai fait une il y a une année : le village disparaît sous les arbres. Il y a trois traversiers qui résiste. Ça s'est foutue, on ne pourra jamais revenir en arrière.

5 : Mais est-ce que tout est privé là ? Est-ce qu'il n'y a pas de terrain qui soit public ?

4 : À La-Rouvière tout est privé, il n'y a pas de terrain communal. Tout est privé. Si vous voulez monter des traversiers, il n'y a pas de problème, moi j'ai un terrain. Je veux le donner à M. Numéro 9 qui lui a remonté des murs et qui en a pris beaucoup de plaisir. Moi, j'ai assez de terrains comme ça et moi et les autres on ne peut pas remonter les murs. Si vous y tenez je vous trouve en terrain, ce n'est pas un problème.

Il faut se rappeler qu'en fera aussi des discussions à Montpellier. S'il y a des volontaires, je leur donnerai votre contact… !

4 : Je doute qu'il y a des gens qui veulent financer à fonds perdu des constructions des mures.

10 : Mais il y a des associations, mais c'est marginal. Je suis à la fête de la draille il y a des bonnes initiatives.

Il y a encore des personnes qui voulaient intervenir. Je donne la parole à numéro 2 et après à numéro 7.

2 : Pour replacer la situation pour numéro 5, je pense que ce n'est pas si vieux que ça. J'ai 75 ans et quand j'étais jeune, on vivait en autarcie pratiquement. Ça veut dire que tout le monde

ici – il y avait beaucoup plus de personnes – et que tout le monde avait un petit élevage, il n'y avait presque pas d'élevage intensif. Un ou deux peut-être. Presque tout le monde avait un petit élevage : des bêtes, des chèvres. Les gens partaient le matin et il partait dans les champs. S'il y avait des murs qui commençaient à s'effondrer ils les refaisaient. Ils allaient amenaient des chèvres dans les châtaigneraies. Les châtaigneraies c'était un plaisir avant. Vous vous régaliez d'aller chercher les champignons. Il n'y avait pas un chêne vert, il n'y avait pas des brousses. Parce-que en ferrant mesure ça soient les bêtes et les chèvres qui les mangeaient soit l'agriculteur qui suivait ces bêtes, il l'entretenait. Donc tout ça si vous voulez, ça représente des heures et des heures, les gens faisaient énormément d'heures. Ils travaillaient beaucoup, il n'y avait pas de télévision. Est encore le soir et ils se rencontraient entre voisins pour le plaisir de passer un moment ensemble. Et ça on ne peut plus faire actuellement. Alors moi, je suis contente s'il y a encore des terrasses qui se relève grâce à l'oignon doux. Parce que c'est quand même une richesse, une épaule ornée pour le pays. Moi j'y tiens totalement. Et il'y a une association qui s'est montés autour des terrasses de l'Aigoual et qui se sont fondées notamment pour garder le patrimoine. Mais on ne peut pas garder tout. Les éleveurs qui font de l'oignon, ils sauvent leurs murs où il y'a des terrains cultivés mais celles qui ne sont pas cultivés, ils ne feront pas. Tout ça pour vous replacer qu'il y a rien que 50 ans ou 60 ans en arrière, on ne vivait pas du tout du tout comme aujourd'hui.

5 : Ah oui oui, surement, oui.

2 : Je me suis mariée, je n'ai jamais eu une douche chez moi. Je veux dire, que ça ne fait pas vieux.

11 : Le plus flagrant c'est peut-être l'évolution qui a … Nous parce qu'il y a beaucoup plus de travail humain à la base que à la bosse, où c'est tout plat, et il n'y a pas des mures où il n'y a rien, à part débroussailler ou labourer le champ. Ce n'est qu'un problème de nettoyer ou de débroussailler ç'est bon, on arrivera à le faire, mais remonter des murs, c'est phénoménal le travail qu'il y a.

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Abstract

The salience of ecosystem services valuations (ESV) is not sufficient to provide meaningful information for decision makers and practitioners. Using deliberative approaches is seen as a way to enrich preferences and to increase the range of values assessed within valuation. This thesis proposes how ESV can account for the informational needs of practitioners, notably by using complementarities between traditional and deliberative monetary valuation. The impact of deliberation on the outcomes of ESV is tested in a case study about the landscapes of the Cévennes. A discrete choice experiment (DCE) within deliberative workshops with samples in the Cévennes and in Montpellier showed that participants preferred landscapes with agropastoral surfaces, broad-leaved trees, a controlled access for tourism and a conserved cultural heritage. These findings were complemented by a cluster analysis that determined groups of beneficiaries with varying bundles of ecosystem services (ES) that were perceived within the attributes of the DCE. One group showed high recognition of many ES, whereas a second group considered particularly agropastoral values and a last group perceived generally less ES than the others. The deliberative setting affected the preferences of both samples, but differently. Whereas the more experienced groups in the Cévennes expressed more moral values within deliberations, the effect for the Montpellier sample was that better informed preferences were formed and incorporated in valuation. Furthermore, a broader range of non-material ES were considered and indicators for the valuation quality improved. It can therefore be concluded that deliberative valuation is a suitable method to enhance valuation of unfamiliar goods such as ES. Concepts such as deliberation or ES bundles assessed by DCEs and coupled with qualitative approaches facilitate the use of valuation of ES within transdisciplinary processes and increase their salience for decision makers and practitioners.

RÃ©sumÃ©

Les Ã©valuations Ã©conomiques des services Ã©cosystÃ©miques (ESE) sont critiquÃ©es au motif qu'elles ne seraient pas rÃ©ellement utilisÃ©es par les dÃ©cideurs publics. Des approches dÃ©libÃ©ratives ont Ã©tÃ© proposÃ©es comme solution possible car elles permettent aux individus de construire et enrichir leurs prÃ©fÃ©rences et ainsi d'intÃ©grer une plus grande base de valeur dans l'Ã©valuation. Dans cette thÃ¨se, il est Ã©tudiÃ© comment les Ã©valuations peuvent intÃ©grer les besoins d'information des responsables pour la mise en œuvre des dÃ©cision publiques. En particulier, une exploitation des complÃ©mentaritÃ©s entre des approches traditionnelles d'Ã©valuation et des approches dÃ©libÃ©ratives est bÃ©nÃ©fique pour des contextes d'implÃ©mentation diverses. L'impact de la dÃ©libÃ©ration sur l'Ã©valuation est dÃ©terminÃ© dans le cadre d'une Ã©tude expÃ©rimentale sur les services Ã©cosystÃ©miques (SE) associÃ©s aux paysages cÃ©venols. Des ateliers dÃ©libÃ©ratifs en CÃ©vennes et Ã Montpellier contenant une expÃ©rience de choix (DCE) ont dÃ©montrÃ© la prÃ©fÃ©rence des 243 participants pour une conservation des espaces agropastoraux. De mÃªme, des forÃªts de feuillus, un dÃ©veloppement touristique modÃ©rÃ©, ainsi que la prÃ©servation du patrimoine culturel ont Ã©tÃ© soutenus. Une analyse de cluster a complÃ©tÃ© ces rÃ©sultats en identifiant trois groupes de participants avec une perception distincte de bouquets des SE associÃ©e aux attributs du DCE. Un cluster considÃ¨re une vaste sÃ©lection des SE dans leur perception, alors que le deuxiÃ¨me retient surtout des valeurs associÃ©es Ã l'agropastoralisme. Le dernier groupe considÃ¨re moins de SE que les autres. Les effets de la dÃ©libÃ©ration sur l'Ã©valuation sont diffÃ©rents entre les deux Ã©chantillons. La dÃ©libÃ©ration amÃ©liore la prise en considÃ©ration des informations dans les prÃ©fÃ©rences des MontpelliÃ©rains, alors qu'elle contribue Ã une meilleure expression et rÃ©vÃ©lation des valeurs morales pour l'Ã©chantillon en CÃ©vennes, ayant plus d'expertise dans le sujet. La dÃ©libÃ©ration permet Ã©galement aux individus de prendre plus de SE non-matÃ©riels en considÃ©ration dans leurs choix et augmente la qualitÃ© gÃ©nÃ©rale de l'Ã©valuation. En conclusion, les approches dÃ©libÃ©ratives sont capables d'amÃ©liorer l'Ã©valuation des biens non familiers, tels que les ES dans des nombreux cas. La combinaison des analyses qualitatives avec des approches dÃ©libÃ©ratives ou avec la dÃ©termination des bouquets des ES Ã l'aide d'un DCE, peut faciliter l'intÃ©gration de l'Ã©valuation des ES dans un processus transdisciplinaire et ainsi augmenter leur utilitÃ© pour les dÃ©cideurs publics ou les personnes responsables de leur mise en œuvre.