THÈSE

En vue de l'obtention du

DOCTORAT DE L'UNIVERSITÉ DE TOULOUSE

Délivré par l'Université Toulouse 2 - Jean Jaurès

Présentée et soutenue par

Aysegul KANAY

Le 13 septembre 2021

Encourager la consommation durable : évaluer l'efficacité des instruments économiques et psychologiques dans le contexte des courses en ligne

---

Ecole doctorale : **CLESCO - Comportement, Langage, Education, Socialisation, Cognition**

Spécialité : **Psychologie**

Unité de recherche :
CLLE - Unité Cognition, Langues, Langage, Ergonomie

Thèse dirigée par
Denis HILTON et Stefan AMBEC

Jury
Mme Isabelle REGNER, Rapporteure
M. Luca PANZONE, Rapporteur
M. Laurent WAROQUIER, Examinateur
Mme Fanny VERKAMPT, Examinatrice
M. Patrice TERRIER, Examinateur
M. Stefan AMBEC, Co-directeur de thèse

Table of Contents

Acknowledgements **15**

Dedications **18**

Abstract **19**

Résumé **21**

General Introduction **23**

Review Chapters **29**

Chapter 1: A Review of Taxation Schemes and Their Effectiveness in Encouraging Sustainable Grocery Consumption **30**

1. Introduction **30**

2. What are Market-Based Instruments (Economic Instruments)? **30**

2.1. Carbon Tax and Its Use in Sustainability Context **31**

2.1.1 Carbon Tax and Its Use in Sustainable Food Consumption 33

2.1.2 Carbon Tax and Its Use in Sustainable Grocery Shopping Context 34

2.2. Bonus-Malus (i.e., Feebate) and Its Use in the Sustainability Context **36**

2.2.1. Bonus-Malus and Its Use in Sustainable Food Consumption 39

2.2.2. Bonus-Malus and Its Use in Sustainable Grocery Shopping Context 41

2.3. Use of Taxation Instruments in Grocery Shopping Context **42**

3.Psychological Aspects of Taxation **43**

3.1. Tax Salience and Its Impact on Consumer Response **45**

3.2. Tax Acceptability **48**

3.3. Injunctive Norms and Normative Side of Taxation Schemes 50

3.3.1. Injunctive Norms and Their Impact on Sustainable Behaviour................................. 50

3.3.2. Normative Aspect of Taxation and Its Impact on Sustainable Behaviour.................. 61

3.4. How Does Combination of Non-Monetary Instruments and Taxation Measures Impact Behaviour?.. 64

3.4.1. Impact of Extrinsic Rewards on Intrinsic Motivation and Motivational Crowding Out 64

3.4.2. Motivational Crowding Effect 70

3.4.3. Implications of Motivational Crowding Theory in Sustainable Consumption........... 73

4. Conclusion 74

Chapter 2: A Review of Carbon Labels and Their Effectiveness in Encouraging Sustainable Grocery Consumption 76

1.Introduction.. 76

2.Information Provision and Labels as Nudges 76

2.1. What is Information Provision and How It Can Impact Behaviour: Economic and Psychological Theories.. 76

2.2. Product Labels as Means of Information Provision: How Can Labels Impact Behaviour... 77

2.2.1 Carbon Footprint Labels as Means of Information Provision: How Do Carbon Labels Impact Behaviour... 80

2.2.2 A Psychological Approach 81

3. How to Increase the Effectiveness of Information Provision Through Carbon Footprint Labels: The Role of Presentation Format 82

3.1. Information Presentation Format 82

3.2. Format of Carbon Footprint Labels 83

3.3. A Cognitive Approach: Numerical Labels vs. Colour-Coded Labels 85

4. Use of Carbon Footprint Labels in Sustainable Consumption 88

4.1. Comparing Numerical and Colour-Coded Labels in Sustainable Consumption 92

4.2 Use of Colour-Coded and Traffic Lights Labels in Sustainable Food Consumption 94

4.3 Application of Traffic Lights Carbon Footprint Labels in a Grocery Store Context 97

5. Conclusion 98

Empirical Chapters 101

Chapter 3: Carbon Labels Have More Effect Than Carbon Taxes and Injunctive Norms on Sustainable Consumption in an Experimental Online Grocery Shop* 102

Abstract 102

1. Introduction 104

2. Literature Review: Incitations Towards Sustainable Grocery Shopping 106

2.1. Carbon Taxes and Grocery Shopping 107

2.2. The Effects of Tax Salience (Signposting) on Shopping 109

2.3. The Effect of Injunctive Norms on Sustainable Consumption 111

3. Our Approach and Hypotheses 112

4. Experiment 1 114

4.1. Method **117**

4.1.1. Participants 117

4.1.2. Materials and Procedure 117

4.1.3. Measures 118

4.1.4. Experimental Conditions: 120

4.2 Results **121**

4.2.1. Descriptive Statistics With Self-Reported Measures 121

4.2.2. Assessing the Impact of Carbon Tax on Carbon Footprint of Shopping Baskets 122

4.2.3. Assessing the Impact of Carbon Tax on Product Carbon Footprint Knowledge 125

4.3. Discussion of Experiment 1 .... **125**

5. Experiment 2 .... **126**

5.1. The Impact of Carbon Footprint Labels in the Form of Traffic Lights on Grocery Shopping Behaviour **126**

5.2. The Use of Non-Monetary Instruments and Carbon Tax (Monetary Instrument) on Sustainable Behaviour **128**

5.3. Our Approach and Hypotheses **129**

5.3.1. Our Approach 129

5.3.2. Hypotheses: 129

5.4. Method **131**

5.4.1. Participants 131

5.4.2. Materials and Procedure 131

5.4.3. Measures 132

5.4.4. Experimental Conditions: 133

5.5 Results **134**

5.5.1 Descriptive Statistics With Self-Reported Measures 134

5.5.2. Assessing the Impact of Carbon Tax, Traffic Lights Carbon Labels, and Injunctive Norm on Carbon Content of Shopping Baskets 135

5.5.3. Assessing the Impact of Carbon Tax, Traffic Lights Carbon Labels, and Injunctive Norm on Product Carbon Footprint Knowledge 138

5.5.4. Mediation Effect of Carbon Footprint Knowledge on the Relation Between Traffic Lights Labels and Basket Carbon Footprint 139

5.6 Discussion of Experiment 2 .... **139**

6. General Discussion **140**

7. General Conclusion **144**

Chapter 4: The Impact of a Bonus-Malus Tax in Online Grocery Shop* **146**

Abstract **146**

1. Introduction **147**

2. Literature Review **149**

2.1. Bonus-Malus Taxation System in the Sustainability Context **149**

2.2. The Use of Bonus-Malus System in Sustainable Food Consumption **153**

2.3. Psychological Aspect of Bonus-Malus **156**

2.3.1. Tax Salience 156

2.3.2. Injunctive Norms 157

2.4. Carbon Footprint Labels in the Sustainability Context **158**

3. Experiment 1 .... **161**

3.1. Hypotheses 163

3.2. Method 164

3.2.1. Participants 164

3.2.2. Materials and Procedure 164

3.2.3. Measures 165

3.2.4. Experimental Conditions 166

3.3 Results 168

3.3.1. Descriptive Statistics With Self-Reported Measures 168

3.3.2. Assessing the Impact of Bonus-Malus on Carbon Footprint of Shopping Baskets .. 169

3.3.3. Assessing the Impact of Bonus-Malus on Product Carbon Footprint Knowledge ... 170

3.4 Discussion of Experiment 1 171

4. Experiment 2 173

4.1. Aim and Hypotheses: 173

4.1.1. Aim 173

4.1.2 Hypotheses: 175

4.2. Method 176

4.2.1. Participants 176

4.2.2. Materials and Procedure 177

4.2.3. Measures 177

4.2.4. Experimental Conditions 178

4.3. Results 180

4.3.1. Descriptive Statistics With Self-Reported Measures 180

4.3.2. Assessing the Impact of Bonus-Malus and TL on Carbon Content of Shopping Baskets 181

4.3.3 Assessing the Impact of Bonus-Malus and TL on Product Carbon Footprint Knowledge 183

4.3.4. Mediation Effect of Product Carbon Footprint Knowledge on the Relation Between Basket Carbon Content and TL 184

4.4. Discussion of Experiment 2 184

5. General Discussion 186

6. General Conclusion 192

Chapter 5: Making the Carbon Basket Count: Goal Setting Promotes Sustainable Consumption in a Simulated Online Supermarket* 193

Abstract 193

1. Introduction 194

1.1. Using Goal Setting Techniques to Promote Sustainable Consumption 195

1.1.1. Do Product Carbon Labels Influence Sustainable Food Consumption in Realistic Supermarket Settings? Contextual Effects in the Construction of Consumer Preferences 197

2. Reducing Task Complexity: The Basket-Level Approach to Giving Carbon Footprint Feedback 207

3. Overview of Our Protocol and Empirical Studies 211

4. Experiment 1 212

4.1. Method 213

4.1.1. Participants 213

4.1.2. Materials and Procedure 215

4.1.3. Measures 215

4.1.4. Experimental Conditions 216

4.2. Results 218

4.2.1. Descriptive Statistics and Preliminary Analyses 219

4.2.2. Assessing the Impact of Goal Setting and Feedback 220

4.3. Discussion 222

5. Experiment 2 224

5.1. Method 225

5.1.1. Participants 225

5.1.2. Materials and Procedure 226

5.2. Results 227

5.2.1. Descriptive Statistics and Correlations With Stated Choice Criteria 227

5.2.2. Assessing the Impact of Goal Setting and Feedback 231

5.2.3. Meta-Analysis of the Effects of the Numerical Goal-Setting and Numerical Product Information Conditions 232

5.3. Discussion 233

6. Experiment 3 234

6.1. Method 235

6.1.1. Participants 235

6.1.2. Procedure 235

6.1.3. Measures 236

6.2. Results 237

6.2.1. Descriptive Statistics and Preliminary Analyses 237

6.2.2. Assessing the Impact of Goal Setting and Number of Visits on Carbon Footprint of Baskets 239

6.2.3. Relations Between Goal Setting, Number of Visits, Carbon Footprint Knowledge, and Basket Carbon Footprint 240

6.2.4. Meta-Analysis of the Effect of the Multi-Coloured Goal Setting Condition 243

6.3. Discussion 243

7. General Discussion and Conclusions 244

8. Limitations and Future Directions 246

General Conclusion 249

References 259

Appendices 294

Résumé Français de la Thèse/ French Summary of the Thesis 331

List of Tables

TABLE 1: Descriptive statistics (Experiment 1)* 123

TABLE 2: Descriptive statistics (Experiment 2)* 137

TABLE 3: Descriptive statistics (Experiment 1)* 169

TABLE 4: Explanation of the levels of bonus-malus variable of the Experiment 2 179

TABLE 5: Descriptive statistics (Experiment 2)* 182

TABLE 6: Summary of studies on the effect of carbon labels on sustainable consumption in realistic settings 200

TABLE 7: Brief explanation of each experimental condition 214

TABLE 8: Experiment 1: Mean carbon emissions per kg of basket and mean of total carbon emission of basket in kg for each experimental condition 222

TABLE 9: Experiment 2: Mean carbon emissions per kg of basket and mean total carbon emission of basket for each experimental condition 229

TABLE 10: Overview of results of the three experiments 230

TABLE V11: Mean percentage of green, orange, and red products in shopping baskets (Experiment 2)* 323

TABLEAU 12: L'explication des conditions expérimentales 360

TABLEAU 13: Les détails de la variable bonus-malus 363

TABLEAU 14: L'explication des conditions expérimentales utilisées dans la première expérience 370

TABLEAU 15: L'explication des conditions expérimentales utilisées dans la deuxième expérience 372

List of Figures

FIGURE 1: Carbon labels used in UK (from Liu et al., 2016, p.73).. 203

FIGURE 2: Black and white and coloured numerical product CO2 labels (Spaargaren et al., 2013, p. 438-439).. 204

FIGURE 3: Colour schemed labels (Vanclay et al., 2011, p. 155)... 204

FIGURE 4: Colour-coded label used in student union restaurant in Sweden (Brunner et al., 2018, p. 660) 205

FIGURE 5: Label selected as the most effective in communicating the eco-friendliness of a product (Vlaeminck et al., 2014, p.182) 209

FIGURE 6: Kilometric environmental label (label on the left), single traffic lights environmental label (label in the middle), multiple traffic lights environmental label (label on the right) (Muller et al., 2019) 209

FIGURE 7: Experiment 3: Mean of carbon emission per kg of shopping basket for each experimental condition.. 241

FIGURE 8: Experiment 3: Mean of total carbon footprint emission of shopping baskets in kg for each experimental condition 242

FIGURE 9: Experiment 3: Carbon footprint knowledge error score for each experimental condition [lower error rates indicates increased learning].. 242

List of Appendices

APPENDIX A: Further information concerning sample description (Experiment 1) 295

APPENDIX B: Control condition 296

APPENDIX C: No norm no display carbon tax condition 297

APPENDIX D: Norm no display carbon tax condition 298

APPENDIX E: Norm carbon tax display condition 300

APPENDIX F: Norm high-CO2 display carbon tax condition 301

APPENDIX G: Details concerning the sample recruited for Experiment 2 303

APPENDIX H: Carbon tax without display 304

APPENDIX I: Carbon tax with display 305

APPENDIX J: Injunctive norm 307

APPENDIX K: Traffic lights carbon footprint labels 309

APPENDIX L: Experiment 1: No norm baseline condition 310

APPENDIX M: Experiment 1: Norm baseline condition 311

APPENDIX N: Norm medium bonus-malus without display condition 312

APPENDIX O: Experiment 1: Norm medium bonus-malus display condition 313

APPENDIX P: Details concerning the sample (Experiment 1) 314

APPENDIX Q: Experiment 2: Baseline condition 315

APPENDIX R: Experiment 2: Medium bonus-malus without display 316

APPENDIX S: Experiment 2: Medium bonus-malus with display 317

APPENDIX T: Experiment 2: Traffic lights condition 319

APPENDIX U: Details regarding the sample in Experiment 2 320

APPENDIX V: Additional analyses regarding Experiment 2 321

APPENDIX W: Control condition.. 324

APPENDIX X: Product numerical footprint condition 325

APPENDIX Y: Numerical product & basket footprint condition 326

APPENDIX Z: Graphical thermometer goal setting condition with example of a basket exceeding sustainable threshold... 327

APPENDIX AA: Colour coded product numerical footprint condition.................................... 328

APPENDIX BB: Multi-coloured thermometer goal setting condition with example of a shopping basket respecting the sustainable level 329

APPENDIX CC: Example of an item in carbon footprint knowledge survey........................... 330

Acknowledgements

I hope this thesis can have a contribution and impact, albeit small, to adopting effective plans for dealing with climate change to attain a better world and future.

I would like to thank my supervisors Professor Denis Hilton, Professor Stefan Ambec, and Dr Laurent Waroquier for their invaluable guidance and great contributions to the completion of my thesis, and their full support and encouragement throughout my doctorate years. My supervisors' in-depth experience in their respective fields equipped me with advanced research knowledge and techniques and further developed me in the research domain. Special thanks to Laurent Waroquier for having accepted to supervise my thesis right after the passing of Dear Denis Hilton and diligently working with me for completing the thesis on time. He kept sharing his insights generously with me all the time.

I owe my sincere thanks and gratitude to many precious people who helped me through four years of my doctoral program without whom this thesis could not have been completed, namely;

To the members of the jury, Professor Isabelle Regner, Professor Luca Panzone, Doctor Fanny Verkampt, and Professor Patrice Terrier for taking their precious time to read my thesis and accepting to be in my thesis jury.

To the CLLE Laboratory and CLESCO Doctoral School for their support and giving me the opportunity to finalize my thesis. I highly appreciate all the opportunities they have provided enabling an impeccable research environment for me to conduct my studies.

To Mme Valérie Tartas, M Franck Amadieu, and Mme Hélène Giraudo for their great support and for helping me diligently with various procedures I had to conduct concerning my PhD, contract, and taking time to respond to all my questions. I am grateful for their encouragement and taking great care of me during the pandemic period and lock down restrictions.

To all the members of the MED (formerly MEJIC) Group, specifically to Dear Fanny Verkampt and Stéphane Perrissol for their continuous support providing me convenient conditions to complete my studies. I am also grateful for having had the opportunity to present my research in the Group during various occasions and having received valuable suggestions and feedbacks throughout my presentations. All the group meetings I joined enriched me personally and academically.

To all the members of the iSUSTCON project, for their valuable suggestions, inputs, and comments during our meetings and my presentations.

To all members of Environmental and Natural Resource Economics Group in Toulouse School of Economics, for giving me opportunity to present my work and for their valuable input and suggestions during my presentations. I am also grateful for the various presentations I had the chance to attend.

To Stephane Cézéra for proving the logistics and contributing to the development of the experimental platforms for my thesis.

To my colleagues in CLESCO Doctoral School for their help with my studies and their valuable comments and suggestions. To Léo Facca for helping me with my experiments, recruitment procedures and with the various questions I had all the time. To Morgane Fage, for her help with the experiments and recruitments. To Sebastian Simon for transforming a messy data to an elegant one so that I could do my analysis.

To Estefanya Vazquez, for her help with my experiments, her contribution to the project as well as for her amazing friendship and making my PhD journey more enjoyable. I am very happy to have you as a friend and a colleague.

To all the participants who took time to participate to the experiments.

To all my friends for their encouragement, with special thanks to Valentine Bouhier and Dangeon family (Corinne, Pascal and Nicolas and Claude) for patiently finetuning my French translations whenever I needed a hand. To my friends in France, Ioanna and Erick who never stopped calling me and provided constant emotional support as well as to Valentine, Marta, Antonis and to Nese for helping me finding my way in Toulouse.

Finally, to my family who always gave me the greatest support anytime I needed. I always felt their unconditional support and love anytime, anywhere, even though the physical distance we had in the last couple of years because of Covid-19 pandemic. This thesis could not have been accomplished without you…

Dedications

I dedicate this thesis to my supervisor Professor Denis Hilton, who unfortunately passed away this year in 2021. It was an honour to meet him and a privilege to work with him. I will always remember him as a great mentor who supported me all the time.

I also dedicate this thesis to my family who always supported me and were there for me all the time.

Abstract

Agriculture is a sector that emits substantial amount of CO_2, which contributes to the greenhouse gas emissions and provokes climate change. Change of diet patterns towards a sustainable way can decrease these emissions. In this thesis, I have investigated the impact of economic instruments and non-monetary measures on sustainable grocery consumption. I tested whether these instruments reduce carbon footprint of shopping baskets and increase CO_2 knowledge in an experimental online grocery shop by running laboratory experiments. In the first empirical chapter, we have conducted two experimental studies to disentangle price and psychological effect of a linear carbon tax. To do that, we analysed the effect of price adjustments, normative messages, and tax salience (through the implementation of tax signposts). In the second experiment, we also tested the impact of traffic lights carbon footprint labels on carbon content and CO_2 knowledge. Additionally, we tested whether tax signposts could improve knowledge. Over two experiments, we found little or no effect of carbon tax on basket CO_2. Similarly, norms did not have a significant impact on consumption. However, carbon labels reduced carbon footprint. Tax display did not have an effect on knowledge, but carbon labels and norms did. Importantly, we demonstrated that CO_2 knowledge was a mediator of the relation between carbon labels and sustainable grocery consumption. In the second empirical chapter, we conducted two experiments to investigate the impact of bonus-malus and carbon labels on basket carbon content and CO_2 knowledge. We aimed to decompose the price effect of bonus-malus and its psychological impact. To achieve this, we investigated the impact of price adjustments, tax justification messages, and tax salience (with tax signposts). In the second experiment, we also tested the impact of traffic lights carbon labels on basket CO_2 and on carbon knowledge. Furthermore, we tested whether tax signposts enhance CO_2 knowledge. Over two experiments, we found no significant impact of bonus-malus on basket carbon content. However, we found evidence for the effectiveness of tax display on knowledge. Furthermore, we showed that carbon labels were effective in changing behaviour and increasing knowledge. In particular, we demonstrated that the impact of carbon labels on basket CO2 was mediated by CO2 knowledge. In the third empirical chapter, we tested whether goal-setting techniques, provision of a goal and feedback would reduce carbon footprint of baskets. We also tested the impact of carbon labels and basket footprint information and compared their effectiveness to that of goal-setting techniques. In the first experiment, we found that goal-setting techniques were effective in reducing basket CO2 whereas providing only basket and product CO2 information was not effective without a goal. In the second experiment, we replicated the significant effect of goal-setting techniques. In the third experiment, we showed that being exposed to goal-setting techniques can ameliorate CO2 knowledge and that this knowledge was enhanced over multiple visits. However, CO2 content did not decrease across visits. Over three experiments, we did not detect any difference in the effectiveness of the different formats (numerical, use of bicolour graph, or multi-colour graph) for presenting the goal and the feedback. Lastly, while we did not detect any impact of colour-coded labels, numerical labels had an effect after combining data of the first two experiments. Our studies may have important implications for policy makers aiming to reduce CO2 generated from groceries.

Keywords: sustainability, carbon footprint labels, injunctive norms, linear carbon tax, bonus-malus, goal-setting

Résumé

Dans cette thèse, j'ai examiné les effets des instruments économiques et non-monétaires sur la consommation durable. Dans une série d'expériences de laboratoire, j'ai testé si ces instruments pouvaient réduire l'empreinte carbone des courses faites dans un supermarché en ligne expérimental et améliorer les connaissances à propos de l'empreinte carbone des produits. Dans le premier chapitre empirique, nous avons mené deux expériences en vue d'évaluer l'impact des taxes carbone, des étiquettes carbone, et des normes injonctives sur l'empreinte carbone et les connaissances. Les résultats de deux expériences montrent que la taxe carbone avait peu ou pas d'impact sur la consommation. Nous n'avons pas trouvé un effet significatif des normes sur l'empreinte carbone des paniers alors que les étiquettes carbone la réduisaient. De plus, les étiquettes carbone et les normes amélioraient les connaissances mais nous n'avons pas détecté un effet significatif de l'affichage du montant de la taxe. Finalement, nous avons démontré que les connaissances sont les médiators entre la relation des étiquettes carbone et l'empreinte carbone des paniers. Dans le deuxième chapitre empirique, nous avons mené deux expériences pour tester l'impact du bonus-malus et des étiquettes carbone sur l'empreinte carbone et les connaissances. Bien que le bonus-malus n'ait pas eu d'effet sur l'empreinte carbone, afficher son montant améliorait les connaissances. Dans la deuxième expérience, nous avons modifié la présentation du bonus-malus. Comme dans l'expérience 1, nous n'avons pas trouvé d'effet significatif du bonus-malus sur la consommation. Toutefois, les étiquettes carbone étaient efficaces pour diminuer l'empreinte carbone et améliorer les connaissances. L'affichage du montant du bonus-malus a également amélioré les connaissances. Finalement, nous avons trouvé que les connaissances étaient des médiators entre la relation des étiquettes carbone et l'empreinte carbone. Dans le troisième chapitre empirique, nous avons testé si les techniques de goal-setting, qui consistent à donner un objectif et des feedbacks, diminuent l’empreinte carbone. Nous avons aussi examiné l’effet des étiquettes carbone et celui d’afficher l’empreinte carbone du panier dans son ensemble, et comparé leurs effets à ceux des techniques de goal-setting. Dans la première expérience, nous avons montré que les techniques de goal-setting étaient efficaces alors qu’afficher l’empreinte carbone des produits et du panier ne l’était pas en l’absence d’objectif. Dans la deuxième expérience, nous avons répliqué l’effet de goal-setting. Dans la troisième expérience, nous avons montré que les techniques de goal-setting amélioraient les connaissances, d’autant plus si elles étaient appliquées de manière répétée. Malgré cela, l’empreinte carbone ne diminuait pas au fil des visites. Les trois expériences n’ont pas mis en évidence de différence dans l’efficacité des différents formats de présentation de l’objectif et du feedback. Enfin, alors que les étiquettes à code couleur n’avaient pas d’effet sur l’empreinte carbone, l’analyse conjointe des expériences 1 et 2 a montré que les étiquettes numériques en avaient un.

Mots-clés : durabilité, label écologique, normes injonctives, taxe carbone, bonus-malus, goal-setting

General Introduction

"To deal with these problems – of world population and hunger, of peace, of energy and mineral resources, of environmental pollution, of poverty – we must broaden and deepen our knowledge of Nature's laws, and we must broaden and deepen our understanding of the laws of human behavior."

Herbert E. Simon (1978)

Total greenhouse gas emissions originated from human activity augmented between 1970 and 2010 where the larger increase happened in the end of this period. Additionally, Earth's surface has become warmer over the last 30 years than it has been since 1850. Greenhouse gas emissions persisting over time will generate further warming and thus will significantly influence climate system. As a result, there will be drastic and irrevocable impacts on humans and eco-systems. To limit the risk of climate change, a considerable and sustained decline of these emissions is needed (IPCC, 2014).

A rough estimation of greenhouse gas emissions generated from global food consumption is about 30% of global emissions.[1] 62% of these emissions are engendered by animal products' consumption (Rogissart et al., 2019). In order to keep the climate change less than 2 degrees Celsius (which is the global climate goal), emissions induced by agriculture, and consumption and production of food should be diminished (Hjorth, 2020). Moreover, Bryngelsson et al. (2016) indicated that even though technological changes can help to reduce greenhouse gas emissions generated from food consumption, they may not be sufficient to achieve the targeted decrease to meet EU Climate targets for 2050. Therefore, diets should be modified to include food with lower emissions. As stated by Poor and Nemeck (2018), by changing their diet (i.e.,

[1] Authors indicated that there was no consensus concerning anthropogenic greenhouse gas emissions generated from food and the share of animal products. The estimation is done through a literature review.

avoiding animal products), consumers can initiate a reduction in greenhouse gas emissions caused by food.

To reduce carbon footprint, different fiscal measures were introduced. One of these measures is carbon taxes which use the principle of carbon pricing, a cost-effective method. This principle suggests implementing a price to carbon emissions, which have to be paid by consumers and producers (OECD, 2013). Another fiscal measure to mitigate the carbon emissions is the bonus-malus tax. This tax was applied in France to decrease emissions generated by vehicles (d'Haultfoeuille et al., 2014). These measures can be effective in reducing CO2 emissions; however, the investigation of their use on sustainable grocery consumption is limited. These measures can reduce CO2 emissions through their price effect, but they may also include non-monetary aspects that can have an influence on consumer behaviour (e.g., d'Haultfoeuille et al., 2014). These aspects are important to take into account in order to create efficient policy measures. This non-monetary impact on consumer behaviour is still to be tested in sustainable grocery consumption context. Regarding the substantial contribution of food consumption to greenhouse gas emissions and lack of studies testing the economical as well as the psychological impact of fiscal measures in this context, it is crucial to conduct studies to investigate the impact of fiscal measures on sustainable grocery consumption in realistic settings.

The aim of the thesis is to investigate the effectiveness of fiscal measures and non-monetary instruments in sustainable grocery consumption context. More specifically, by conducting laboratory experiments, we aimed to test whether these measures can reduce carbon footprint of baskets in an incentive-compatible experimental online grocery store and increase product carbon footprint knowledge.

Concerning the investigation of fiscal measures, we tested the impact of a linear carbon tax and a bonus-malus tax in the sustainable grocery consumption context. Most importantly, our aim was not only to test their economic effect (i.e., price effect) on consumption but also their psychological (i.e., non-monetary) aspect. Moreover, we also tested whether displaying the amount of the tax through tax signposts of products would increase the knowledge of product carbon footprint.

Concerning the investigation of non-monetary instruments, we tested the effectiveness of carbon footprint labels and injunctive norms in reducing carbon footprint of baskets. As carbon labels, we tested the impact of three-coloured traffic lights labels and five-colour coded ones as well as numerical ones in this context. Furthermore, we tested the effectiveness of insights from goal-setting theory (Locke & Latham, 2002), more specifically, effectiveness of setting a goal together with the provision of a simultaneous feedback with respect to the goal on the sustainability of shopping baskets. We, then, compared this technique to more conventional strategies such as the use of product carbon labels. As far as the knowledge is concerned, we tested whether three-coloured traffic lights carbon footprint labels and their interaction with injunctive norms could improve product carbon footprint knowledge. Additionally, we investigated whether insights from goal-setting theory can improve product carbon footprint knowledge as well.

In the first chapter of the thesis, we reviewed different taxation schemes in the sustainable consumption context. First, we explained what market-based instruments are and explained carbon tax and its use in the sustainability domain. Thereafter, we studied bonus-malus scheme and its use in the sustainability domain. In the next section, we explained psychological aspect of taxation by first reviewing the contribution of behavioural economics to our understanding of the functioning of economic mechanisms and then tax salience and tax acceptability and their impact on behaviour. Additionally, to better understand the psychological impact of taxation, we reviewed injunctive norms and motivational crowding-out theory.

In the second chapter, we reviewed carbon footprint labels and their effectiveness on sustainable behaviour. First, we started by explaining what information provision means and how labels can be used as information provision tools. We also explained how labels can have an impact on behaviour and discussed the importance of the label format. Finally, we reviewed research that investigated the effectiveness of carbon footprint labels in experimental studies, surveys, or by using real-life data.

In the third chapter, we investigated the impact of a linear carbon tax on sustainable consumption behaviour in our experimental online grocery shop. We investigated not only the price effect of this instrument but also its psychological impact. Moreover, we tested effectiveness of carbon footprint labels and injunctive norms as well as their interaction and analysed whether they can promote sustainable grocery consumption in this shop setting. Additionally, the second experiment that we conducted for this chapter allowed us to detect whether carbon tax interacted with the non-monetary instruments. Our secondary aim was to analyse whether tax signposts, carbon footprint labels, and their interaction with injunctive norms were effective in increasing participants' product carbon footprint knowledge.

In the fourth chapter, we investigated the effectiveness of a bonus-malus taxation scheme and analysed whether it can decrease basket carbon footprint. As in the third chapter, we did not only investigate its price effect but also its psychological impact on behaviour. Furthermore, we investigated whether traffic lights carbon labels can render participants' shopping baskets more sustainable by decreasing their carbon footprint. Additionally, the design of the second experiment of this chapter allowed us to detect whether bonus-malus and carbon labels interacted. Finally, we further tested whether these instruments increase participants' product carbon footprint knowledge.

In the fifth chapter, we investigated the effectiveness of goal-setting techniques in promoting sustainable grocery consumption. Techniques derived from the goal-setting theory developed by Locke and Latham (2002) were successfully used in the sustainability context such as energy conservation (e.g., Becker, 1978); nevertheless, these techniques were not tested within the sustainable online grocery consumption context in a realistic setting. We analysed whether these techniques could decrease carbon footprint of participants' shopping baskets and compared their effectiveness to that of product and basket carbon footprint label strategies. We used different formats to present sustainable goal and feedback concerning basket footprint, namely, numeric form, bi-coloured graphic format, and multi-coloured graphic format. We also investigated whether colour coding would enhance the impact of numerical carbon labels and numerical basket CO2 information together with numerical feedback. Additionally, we investigated the impact of feedback alone strategies where we presented basket CO2 information and/or product carbon footprint labels (i.e., five-colour coded carbon labels, numerical carbon labels) alone. Finally, we tested whether doing multiple visits to the online shop (when exposed to goal-setting techniques) would improve participants' product carbon footprint knowledge and as well as decrease basket CO2.

The final chapter is dedicated to the conclusion of the thesis. We derived general conclusion from our empirical studies and explained their contribution to the literature and their implications. We also discussed the limitations of our studies and presented perspectives for future studies.

Review Chapters

Chapter 1: A Review of Taxation Schemes and Their Effectiveness in Encouraging Sustainable Grocery Consumption

1. Introduction

In this chapter, we will review different taxation schemes and understand their impact on sustainable consumption and then we will focus on their impact on sustainable grocery consumption. First, we will start by explaining how market-based instruments are used in the environmental context and then focus on carbon tax and bonus-malus taxation schemes by taking an economical approach. Furthermore, we will explain how tax schemes can be used in the sustainable food and grocery consumption context. Secondly, we will explain psychological aspect of these measures. We will explain the extra-monetary impact of these measures on behaviour and then focus on the psychological impact of taxation on sustainable consumption. To better explain psychological impact of these monetary instruments, we will also review injunctive norms and their impact on sustainable behaviour as well as motivational crowding theory in the same context. Finally, we will finish by drawing a general conclusion.

2. What are Market-Based Instruments (Economic Instruments)?

Instruments that are incentive-based function by generating incentives for firms or individuals in order to voluntarily alter their behaviour. Hence, pay-offs that individuals have to face are changed by these instruments (Perman et al., 2003).

Economic instruments are used in order to reach environmental goals, and their use has been increased in OECD economies since 1970s. In 2000, around 7% of the total OECD tax revenues was constituted by revenues gathered from environmentally motivated taxes and their share have been firmly growing since. These instruments are used in different settings such as water quantity management, forestry, fisheries, or oil preservation (Perman et al., 2003).

2.1. Carbon Tax and Its Use in Sustainability Context

Before reviewing different taxation schemes, we explain how price change can influence consumers' decision from a standard economic approach. A simple way to present "standard economic model of decision-making" (Leicester et al., 2012, p. 14) would be to consider an individual who has a set of choices with their prices and a budget to take into account. Among these options, a choice set would contain the options that the individual can afford. Moreover, individual would have preferences against these options, and they would choose the options, which maximise their utility (Leicester et al., 2012). Therefore, a change in prices may have an impact on consumer behaviour.

Environmental challenges such as climate change or water pollution are big problems that governments are facing around the world. Market-based instruments are one of the instruments used in environmental policy addressing these problems (OECD, 2017). The aim of these instruments is to address market failure generated from environmental externalities by integrating consumption or production activities' external cost via charges or taxes on products or on processes (OECD, 2007). In other words, damage generated by pollution is manifested on market prices, an approach related to the internalization of the external cost (OECD, 2017).

Environmental taxes are a subgroup of these market-based instruments (OECD, 2017). Their base should be a physical unit, which is proven to have a negative effect on the environment (OECD, 2005). Climate change, pollution, biodiversity, and consumption of natural resources are four big environmental problems to which environmental taxes can be applied.

These taxes are implemented to reach environmental goals and are important tools to change consumer behaviour in a more sustainable way (Pourquier & Vicard, 2016).

Carbon tax is an example of environmental taxes. As Metcalf and Weisbach (2009) stated, carbon tax could be considered as a tax on greenhouse gases whose aim is to internalize externalities related to climate change caused by human activities. A carbon tax obligates agents to consider the consequences of the activities they conducted which generated carbon emissions according to the idea developed by Pigou (1929).

Externalities occur when a product’s or service’s consumption or production induce a benefit or a cost to other individuals and when these costs or benefits are not manifested in their prices. Pollution is considered as a negative externality (Khemani & Shapiro, 1993).

To reduce greenhouse gas emissions, carbon pricing (such as carbon tax) is considered as an effective tool. It may diminish these emissions through the increase of the prices of the products with high emissions, which in the end reduces the demand towards them. Moreover, due to this tool, products with lower emissions would be cheaper compared to the ones with higher emissions; therefore, the demand towards the former augments (Flues & van Dender, 2020; OECD, 2018).

Carbon tax had been used in different countries. It was introduced in Australia in 2012 after Government’s commitment to decrease carbon emissions by 80% (Meng et al., 2012). The tax reduced carbon emissions after its introduction; however, as a result of the reaction coming from voters and industry, the program was repealed (Plumer & Popovich, 2019). Similarly, in 2008, a carbon tax was used in British Columbia which covered around three quarters of the whole emissions in the province (Murray & Rivers, 2015). In 1990, it was introduced in Finland to be applied on gasoline, light/heavy fuel oil, diesel, natural gas, coal jet fuel and aviation gasoline, and jet fuel; in 1991, in Norway, to be applied on natural gas, petroleum, and mineral fuel; in Denmark, in 1992, to be applied on natural gas, mineral fuels, and petroleum; and as well as in Sweden in 1991 to be applied on all fuel oil (Lin & Li, 2011). Lastly, in France, a carbon tax (whose rate was €7 per ton of CO_2 that increased to €45 per ton) has been applied on consumption of fossil fuel since 2014 (Dussaux, 2020).

2.1.1 Carbon Tax and Its Use in Sustainable Food Consumption

Taxes have been used to change food consumption. To begin with, in the context of nutrition, taxes were applied to foods or drinks to promote healthy diets. For instance, Jensen and Smed (2013), with an econometric analysis, demonstrated that a fat tax introduced in Denmark in 2011, decreased the fat consumption by 10-15%. Moreover, Wang et al. (2012) found evidence for the effectiveness of a tax on sugar-sweetened beverage. Authors estimated a 15% decrease of these beverages among 25-64 years old individuals. A similar type of tax, soft drink tax in United States, was studied by Fletcher et al. (2010). The authors examined how taxation impacted status of obesity and body mass index between 1990 and 2006 and showed that tax had small but significant impact: BMI can be diminished by 0.003 points, overweight by 0.02 percentage points, and obesity by 0.01 with a 1 percentage point of increase in tax. In a laboratory experiment, Epstein et al. (2010) investigated the impact of putting tax on less healthy foods (with higher calorie content) and subsidies on healthier foods (with lower calorie content) by 12.5% and 25%. Participants conducted five grocery tasks in a room where 30 cards of healthy foods, 30 cards of unhealthy foods, four cards of healthy drink items, and four cards of unhealthy drink items were placed together with their nutritional value and price information. It was shown that whilst the largest subsidy led to highest calorie purchase by increasing purchase of both healthier and less healthy foods, taxing decreased less healthy food purchase as well as increased that of healthier food.

Taxation can also be used in the sustainability context. Carbon tax can be used as a tool to reduce greenhouse gas emissions generated by food. By studying taxation scenarios, Edjabou and Smed (2013) and Briggs et al. (2013) found evidence of the effectiveness of carbon tax applied on food in decreasing carbon emissions. Similarly, by presenting a method to measure how food taxes based on greenhouse gas emissions impact at a household level, Kehlbacher et al. (2016) showed evidence for these taxes to be efficient in diminishing food related emissions. Lastly, Wirsenius et al. (2011) stated that taxes on food could be a cost-effective tool to decrease greenhouse gas emissions based on agriculture.

2.1.2 Carbon Tax and Its Use in Sustainable Grocery Shopping Context

The impact of a carbon tax on food was estimated by several studies in the literature. However, there are lack of studies investigating the impact of a carbon tax in the context of grocery shopping. As stated by Upham et al. (2011), studies showed that groceries are involved in around one third of the emissions and environmental effects generated by EU economies. Therefore, investigating whether carbon tax would be effective in reducing these emissions in a realistic setting can be useful for policy makers. One study that investigated the impact of a carbon tax in the grocery-shopping context was conducted by Panzone et al. (2018). In their study, in an experimental online grocery shop, first, participants bought groceries in the control condition without any price modification and in the next week, they ordered their groceries on the same platform where product prices were changed with a carbon tax. In the end, they gained one of the baskets they ordered during these two weeks. The rate of the carbon tax was £70 per ton of CO_2 and each product received a tax according to their CO_2 content. Authors showed that carbon tax was effective in reducing carbon content of shopping baskets.

From these studies, we can conclude that taxation can be an effective tool in the sustainable food purchase context. First, although not related to environmental concerns, Jensen and Smed (2013), Wang et al. (2012), and Fletcher et al. (2010) found evidence to support taxation in the healthier diet context. However, their results were based on econometric studies; therefore, despite their promising results, testing these types of taxes in more realistic contexts, such as in lab or field experiments can provide insights about how these taxes might work in real life. Similarly, despite finding promising results concerning the use of taxes in promoting healthy diets, Epstein et al. (2010) tested the effectiveness of the tax in an experimental room with pictures of different food and drink items (healthy and unhealthy), a setting which is different than a real life environment. Moreover, participants did not make real purchase decisions, which could have an impact on their decision.

Concerning the studies that tested the effectiveness of a carbon tax, Edjabou and Smed (2013), Briggs et al. (2013), and Wirsenius et al. (2011) showed results in favour of the use of the tax to decrease carbon footprint. However, similar to previously mentioned studies, these studies investigated the tax through scenarios or with econometric analyses. Conducting a study in a realistic setting where consumers make real purchase decisions can be more informative to understand the consumer response to a carbon tax. Panzone et al. (2018) conducted a study in such environment where participants made real purchase decisions in a realistic environment and found that carbon tax could be a useful tool to reduce carbon footprint of shopping baskets. However, the use of a within subject-design might have rendered the tax manipulation salient (first, ordering products with their baseline prices and in the consecutive week, with taxed prices). Therefore, results could be overestimated. Further studies can be conducted to understand psychological aspect of carbon tax to understand whether taxation systems have extra-monetary effects other than their price effect. This may help policy makers to efficiently apply carbon tax in such context by considering not only its economical but also psychological effect.

2.2. Bonus-Malus (i.e., Feebate) and Its Use in the Sustainability Context

Another type of environmental taxation is *bonus-malus* system (Pourquier & Vicard, 2016). Bonus-malus is a policy tool to internalize externalities of certain commodities such as cars, through implementing a fee on consumers who choose vehicles with higher emissions and a rebate for those who buy cars with lower emissions (d'Haultfoeuille et al., 2014). In other words, while non-polluting or energy efficient goods receive a subsidy, goods that are greatly polluting or consuming energy are taxed according to their level of harmfulness (Callonnec & Sannié, 2009). Moreover, this system can be revenue-neutral if the revenue collected from malus finance bonus (d’Haultfœuille et al., 2011). Hence, this scheme can, on average, be budget-neutral for consumers.

A feebate system (i.e., bonus-malus system) was applied in France in 2008 on the sales of new cars. Through this policy, individuals purchasing cars with emissions lower than 130 g of CO2 per km profited from a reduction on their invoice, which could reach €1000 contingent on the type of the car (d'Haultfoeuille et al., 2011). In other words, the bonus amount was dependent on the CO2 emissions per km of the vehicle (Callonnec & Sannié, 2009). Rebate could even reach €5000 for electric cars. On the other hand, individuals purchasing cars with emissions more than 160 g of CO2 per km were obliged to pay a tax up to €2600. There was no tax or bonus applied to the cars whose emission level was between 130 and 160 g of CO2 per km (d'Haultfoeuille et al., 2014). With this system, it is possible to generate a balanced budget through the funding of bonus by the revenue generated by malus (i.e., taxes) (Callonnec & Sannié, 2009); therefore, the system could be revenue neutral.

In the initial phase, the system did not turn out to be revenue-neutral since an important shift towards cars with lower emissions had occurred. This shift generated an increase of total sale of the cars and hence a larger decline of emissions did not occur (d'Haultfoeuille et al., 2014). However, throughout the years, different modifications were conducted to help to assure the effectiveness of the system and revenue stream balance. Therefore, it is important to set right thresholds for bonus and malus and adjust them regularly so that the scheme would be efficient (Monschauer & Kotin-Förster, 2018). Finally, bonus-malus system implemented in France in the transportation sector, managed to reduce average emissions generated by vehicles. While the average emissions were 149 g CO_2/km in 2007, they were reduced to 112 g CO_2/km in 2019 (ADEME, n.d.).

Bonus-malus system was also shown to be effective in altering transportation choices in a sustainable way in an experimental setting. Hilton et al. (2014) examined the effectiveness of increasing the price of the less sustainable travel option (airplane) and decreasing that of more sustainable option (train) in a hypothetical choice scenario where participants had to choose between one of these options to travel from Toulouse to Paris. Authors demonstrated that the price change, application of bonus-malus, had a significant impact on travel choice; hence, further evidence was found for the effectiveness of bonus-malus in the sustainable transportation context. On the other hand, another experimental study conducted by Raux et al. (2020) showed that presenting the price change as bonus-malus did not have a significant effect on hypothetical transportation choices. Authors claimed that motivational crowding effects might have occurred. Therefore, further investigation of this scheme on sustainable mobility choices is important.

Bonus-malus system can be applied in other contexts as well. Use of a feebate scheme on household appliances to reduce greenhouse gas emissions and energy consumption in Canada was proposed in the report of Rivers and Peter (2007). This policy proposal includes implementation of a fee on appliances with low efficiency and a rebate on appliances with higher efficiency level. By using an economic model, authors analysed (and forecasted) the environmental impact of different levels of fee and rebate. They demonstrated that emission decline would be approximately linearly related to the policy severity; in other words, emissions decline as the policy become more rigid. In sum, a bonus-malus scheme can be effective in reducing carbon emissions and changing consumption in energy consumption context.

Studies mentioned here demonstrated that bonus-malus taxation scheme could be effective in transportation and energy context. Hilton et al. (2014) found that bonus-malus system can alter transport choices in a sustainable way; however, authors showed this through an experiment where participants made hypothetical choices. Nevertheless, in another experimental study where participants made hypothetical transport choices, bonus-malus did not have an impact. Therefore, use of bonus-malus in sustainable transport choice may need further investigation. Moreover, making real choices and facing their outcome might have a different impact on consumer choices compared to a situation where hypothetical choices are made. Similarly, following the results of the report of Rivers and Peter (2007), use of a feebate system on appliances can be tested in a real life setting. Lastly, bonus-malus scheme applied in France in 2008 was not initially revenue-neutral and did not yield to large CO2 reductions as predicted (d'Haultfoeuille et al., 2014). Further studies could investigate the reasons behind this result, for instance by investigating extra-monetary impact of bonus-malus system to have better insights about the functioning of this scheme.

2.2.1. Bonus-Malus and Its Use in Sustainable Food Consumption

As carbon tax, bonus-malus taxation system can also be used to alter food purchase behaviour. Dogbe and Gil (2018) emphasized the importance of a revenue-neutral policy in decreasing environmental impact of food consumption. They pointed out that taxing all products according to their CO2 emissions would not be realistic since food prices can be increased up to 55%.

Bontems and Réquillart (2009) suggested that bonus-malus system can be efficient to increase fruit and vegetable consumption and decrease that of less healthy foods such as fatty products by subsidizing the former and taxing the latter. For instance, Papoutsi et al. (2015) conducted a real choice experiment study which allowed them to investigate the effectiveness of fiscal policies in impacting parents' food purchase patterns for their children. In a within-subject design study, participants (parents) were first presented with foods with their average market prices. Afterwards, they were presented with a fat tax that was applied to unhealthier food products (25% of increase on initial price) then, with a subsidy on healthier food products (25% of decrease of initial price) and finally, with both tax on unhealthier and subsidy on healthier food products at the same time. The order of these treatments was randomized. Participants were either informed or not about the reason of these price changes. Authors also investigated information provision about policy and children' pester as between-subject factors. Results showed that use of subsidy and tax at the same time was more effective in altering purchasing behaviour in a healthier way compared to implementation of subsidy alone, tax alone, or to market-price condition. Moreover, it was shown that the impact of this fiscal system could be boosted when it was accompanied with a message explaining the aim of the price change. This suggested that normative messages might enhance the impact of fiscal measures.

Another experimental study in the healthy food choice context was conducted by Darmon et al. (2014). Authors tested different price manipulations, one of which was implementing a 30% discount on fruits and vegetables and the other was implementing a discount of 30% on vegetables and increasing prices of unhealthy food products by 30%. Results showed that the purchase of vegetables and fruits augmented in both price treatments, for both low and middle-income groups. Nonetheless, the amount of less healthy food diminished only in the second price manipulation condition. Authors concluded that a simultaneous application of a subsidy on healthier food products and tax on less healthy ones might be an effective policy tool to increase healthier food consumption. Authors also pointed out that the inequalities related to nutrition may occur between different income groups.

Galarraga and Markandya (2006) proposed the use of simultaneously applied subsidy and tax in the context of fair trade of coffee. The production of fair trade and organic coffee occurs under stricter social circumstances compared to regular coffee; therefore, while the production of regular coffee or tea may generate negative externalities, that of fair trade tea or coffee may create social benefit. The policy proposed by the authors subsidizes growers of fair trade coffee and put a tax on regular tea and coffee. They demonstrated that a tax of €0.005 per kg on regular tea and a tax of €0.008 per kg on regular coffee would be sufficient to ensure a subsidy for production of fair trade/organic coffee with an amount of €0.5 per kg which could diminish regular tea and coffee consumption by 0.01% and increase fair trade coffee consumption by 1.4%. Similarly, tax of €0.01 per kg on tea and €0.0145 on fair trade/organic coffee would be sufficient for a subsidy of €1 per kg which may lead to a 2.8% increase in the consumption of fair trade coffee and 0.03% decrease in that of regular coffee and tea and lastly, a tax of €0.02 per kg on regular tea and €0.03 on regular coffee would finance a subsidy of €2 per kg for fair trade production leading a 5.7% of increase in fair trade coffee consumption. In sum, this study showed evidence that a bonus-malus scheme would be efficient in the fair trade coffee context in changing consumption behaviour by being financially viable.

Studies showed that bonus-malus taxation scheme can be an efficient tool in the healthy food consumption context. Papoutsi et al. (2015) showed promising results about the use of simultaneous tax and subsidy on food products and indicated that explaining the reason of the policy scheme may even boost its impact. Although it was relevant in the context of the experiment which was parental choice of food, only three product categories (yoghurt, cheese, and choco milk beverage) were used in the experiment. Moreover, within-subject treatment of control, fat tax, subsidy, and fat tax and subsidy treatments may increase the salience of fiscal measures and may have caused an overestimation of the results. This design may also increase experimenter demand effect. Moreover, Darmon et al. (2014), in their study, used a sample composed of only female participants. Lastly, Galarraga and Markandya (2006) made a proposal for the use of subsidy and tax to promote fair-trade coffee and tea consumption. Regarding their promising results, the test of the proposed scheme in an experimental setting can provide insights about how consumers would react to such scheme.

2.2.2. Bonus-Malus and Its Use in Sustainable Grocery Shopping Context

As mentioned above, considering the CO2 impact generated by groceries, different economic instruments such as bonus-malus taxation scheme can be used to mitigate these emissions. To our knowledge, there is one study that investigated the impact of bonus-malus on the sustainable grocery consumption context in an experimental setting. Panzone et al. (2021)

investigated the impact of bonus-malus in an experimental online grocery store along with other manipulations, which were moral goal priming (display of a message about the moral importance of carbon reduction) and choice architecture (i.e., displaying the products in the store according to their CO_2 emissions). Participants ordered their products (with a budget of £25) on the platform over three consecutive weeks where the first week was the control without any experimental manipulation. They had the opportunity to win one of the three baskets and receive the unspent budget. Results showed that bonus-malus reduced CO_2 emission of shopping baskets both in the second and third week. Moreover, while basket CO_2 was also diminished by choice architecture in the last week, moral priming only reduced emissions in the second week. Additionally, in the last week, choice architecture marginally significantly interacted with bonus-malus and moral goal priming. However, concerning the results related to effect of bonus-malus, the authors indicated that basket CO_2 was decreased with bonus-malus treatment because of the decrease of the budget spent in the shop (in the second week). To conclude, this study provides promising results for the effect of bonus-malus in rendering shopping baskets more sustainable. However, future studies might further investigate bonus-malus by also investigating its psychological aspect to better explain its impact on consumer behaviour.

2.3. Use of Taxation Instruments in Grocery Shopping Context

The use of economic instruments in grocery consumption can be effective on consumption behaviour. In a systematic review, with the inclusion of randomized controlled trial studies, Hartmann-Boyce et al. (2018) showed that economic instruments are effective in promoting healthier product purchase in grocery stores. This intervention may even be more promising than swap interventions, product labelling or consumer education, or conducting changes in the store environment. Therefore, economic interventions can be promising tools in changing grocery product consumption.

However, there is lack of studies investigating the use of fiscal measures such as bonus-malus scheme or a carbon tax in a grocery-shopping environment in order to decrease carbon footprint generated by consumption of groceries. To our knowledge there is only Panzone et al. (2018) and Panzone et al. (2021) studies that have tested a carbon tax and a bonus-malus tax in this context. Considering the substantial greenhouse gas emissions generated by food consumption, it is important to further test the effectiveness of such monetary instruments in this setting. It might be also important to extend these studies by investigating psychological aspect of these taxation measures to have insights about how they can be effectively applied to change behaviour in a sustainable way. As shown in this review, environmental taxation through the monetary instruments can be promising in altering consumption behaviour.

3.Psychological Aspects of Taxation

To discuss about the non-monetary aspect of taxation, we should review the contribution of behavioural economics to our understanding of economic mechanisms. Behavioural economics is a sub-field of economics that relates economics to psychology (Mullainathan & Thaler, 2000).

There are at least three unrealistic characteristics of human behaviour in the standard economic model as argued by Mullainathan and Thaler (2000); these are unbounded selfishness, unbounded willpower, and unbounded rationality. A counter argument to unbounded rationality came from Simon (2000). He elaborated the idea of bounded rationality stating that individuals' abilities such as evoking knowledge, formulating consequences of their acts, managing uncertainty, and deciding between several competing needs are limited. Therefore, individuals' rationality is impacted not only by their inner environment (such as their memory) but also by their outside environment against which they take action. Hence, consumers may not be as rational as defined by the theory of economic rationality where maximization of expected utility according to which behaviour can be predicted without taking into account consumers' decision processes is the focus. In other words, Simon (1955) pointed out that the idea of a rational person defined by traditional economic theory who has vast and clear knowledge about their environment, who has stable preferences, and has computational skills allowing them to do calculations concerning available actions which will lead them to obtain preferences with the highest value should be revised.

Slovic (1972) supported the idea of bounded rationality by stating that because of individuals' limited reasoning capacity, attention, and memory, they implement simplifying cognitive strategies to process information while making judgment and making decisions. These strategies describe decision-processing mechanisms differently than what normative or traditional models assert. Due to their cognitive limitations, economic agents may try to facilitate information integration process while making decisions.

Concerning unbounded willpower, *homo-economicus* is predicted to choose the optimum. However, because of self-control problems, humans may neglect to choose it even though they know what the optimum option is. For example, people may procrastinate (Mullainathan & Thaler, 2000).

Lastly, humans are not unboundedly selfish as classical economic theory predicts according to which self-interest is an underlying motive. However, real life examples and controlled experiments showed that people display unselfish behaviour. For example, they give money to charity, work as volunteer, or contribute to public good in experiments (Mullainathan & Thaler, 2000).

In sum, behavioural economics have shown that assumptions provided by the standard economic models are not accurate representations of how individuals behave or think in real life. Individuals are not always self-interested, their preferences are not always consistent, and they do not always act rationally (Congdon et al., 2009). They are motivated by social norms and fairness; their behaviour is impacted by social status and social approval (Carlsson, & Johansson-Stenman, 2012). These deviations from standard economic model assumptions can be important for policy making. Finally, behavioural economics suggest that violations of these assumptions are identifiable (Congdon et al., 2009).

From an economic point of view, understanding how tax policies can impact welfare and hence constructing a policy that is equitable and efficient is important. In order to do this, models of incidence and deadweight loss are proposed. These models produce results by taking into account how agents would respond to these tax policies. In the standard model, elasticities, which are the expression of consumer response through a parameter, are crucial in detecting tax efficiency. However, behavioural economics pointed out that consumers would not respond to taxation policies as straightforward as standard economic model assumes. Psychological factors could be involved in the way irrational individual responds to taxation (Congdon et al., 2009).

3.1. Tax Salience and Its Impact on Consumer Response

Carbon tax, which can be used to change consumer behaviour, is one of the tools that can be used to control carbon emissions. Behavioural economics may inform policy makers by indicating that the effectiveness of tax may not follow what standard economic model concluded. Considering the imperfect rationality of individuals, they may perceive taxes incorrectly;

therefore, they would react to taxes as they construe them but not as they are applied. Manipulation of tax salience may be a solution to improve welfare outcomes (Congdon et al., 2009).

According to the neoclassical theory, consumer welfare should not be impacted by whether the amount of the tax is posted on the products' price tag or it is levied at the register, because individuals can accurately compute taxes (Goldin & Homonoff, 2013). However, as shown by Chetty et al. (2009), salience effects, described as not perceiving tax accurately (Congdon et al., 2009) exist when taxes are applied to commodities at the register. More specifically, consumers avoid sales taxes. Authors showed that consumers respond differently to taxation when tax inclusive prices (i.e., price containing the sales tax) are posted on price tags compared to the situation where tax exclusive prices (i.e., prices without sales tax amount) are posted on price tags and sales tax amount is included to the final price at the register.

A similar study was conducted by Goldin and Homonoff (2013), where authors investigated consumer response in the cigarette tax context in USA where two taxes are applied to cigarettes: a sales tax applied at the register and an excise tax added to the posted price. Authors demonstrated that individuals both from high and low-income groups reacted to the changes in taxes included in the posted price; however, it was only individuals from lower income group who reacted to the adjustment in the sales tax rate. Therefore, responsiveness to register taxes of cigarettes depends on the income level; in other words, individuals from lower income are more attentive to register taxes of cigarettes compared to those from higher income level.

Another study about tax salience was conducted by Zizzo et al. (2016). Contrary to Chetty et al. (2009) and Goldin and Homonoff (2013), they did not conduct a study about sales tax. They investigated whether changes in price by implementing a tax and whether displaying the amount of this tax, in other words tax signposting, would have an impact on healthy food choices (cereals or soft drinks) in an experimental online supermarket. In their experiment, in the experimental conditions, a tax was applied to the healthier (unhealthier) products by either 20% or 40% and the prices of unhealthier (healthier) were not modified. In the control condition, prices remained at the baseline level. Tax amounts were either signposted or not. Authors found that when tax amounts were displayed, taxing products by 20% or by 40% can decrease their purchase. When the tax amount was not displayed, only the purchase of healthy soft drinks and less healthy cereal diminished with a 20% of tax, and the purchase of both types of soft drinks and less healthy cereals reduced with a 40% of tax. As a conclusion, tax signposts could be effective nudges to boost the taxation effect.

Another study concerning tax salience was conducted by Finkelstein (2009). By conducting two surveys, author investigated the association between tax rate and salience by studying how electronic toll collection system, which was adapted in USA, had an impact on toll rates. These rates may become less salient to the driver when they no longer pay cash but pay electronically. Results showed that toll rates were less salient to drivers who pay electronically and thus they were less aware of the rate compared to drivers who pay cash. Moreover, it was also demonstrated that the toll rates augmented after the installation of electronic toll collection.

Importance of tax salience was also mentioned by Leicester et al. (2012). They claimed that framing tax in a less salient manner may impact how responsive consumers will be towards it. Consumers react to taxation as they perceive it, which is contingent on the visibility of taxes. Salience of tax can be affected by different factors: first, the tax size and how frequently it is collected; secondly, to what extend individuals pay the tax automatically; third, complexity of the taxation scheme; fourth, whether the tax amount is included in the posted price; and lastly, the way the tax is labelled may have an influence on its salience (e.g., which wording is used to describe the taxation scheme).

Overall, these studies provided evidence for the impact of tax salience on consumer response. Goldin and Homonoff (2013) demonstrated that consumers from different income groups respond differently to register tax of cigarettes. Further investigation could be done to test whether this result can be generalized to other commodities and the reason behind the different level of attentiveness of consumers from different income levels to the register taxes. Similarly, while Chetty et al. (2009), in their study, changed the price tags of three product categories (deodorant, hair care accessories, cosmetics) in a grocery store, Finkelstein (2009) investigated electronic toll collection and whether paying toll electronically or cash would impact consumer awareness. Further investigation could test the impact of tax salience in wide range of categories in a grocery store and expand the toll collection study to other contexts in other countries. Similarly, Zizzo et al. (2016) investigated the impact of tax signposts only for two products (cereal and soft drink) in an online experimental grocery setting. Future studies may extend this study by applying tax signposts to all the products in the store and investigating their impact not only in the healthy food consumption context but also in the sustainable one.

3.2. Tax Acceptability

To understand that the taxation may also have non-monetary effects, one can investigate the acceptability of tax. Acceptability can be an important non-monetary, psychological aspect of taxation, which can have an impact on consumer behaviour.

Baranzini and Carattini (2017) showed that the way individuals perceive the effectiveness of tax is important regarding the acceptability of carbon tax. From an economist’s point of view, environmental benefits of a carbon tax are *given*; however, for citizens, its effectiveness may not be internalized which may constitute a barrier to its acceptance.

Baranzini and Carattini (2017) also showed that when earmarked (i.e., indicating that the collected revenue to be used for environmental purposes), acceptability of tax increases dramatically. Lastly, how the tax is *labelled* may also be important for its acceptability. For instance, labelling tax as *climate contribution* or *carbon tax* may have different impact on acceptability.

Moral side of taxation can also impact its acceptance. Kallbekken and Sælen (2011), by conducting a survey, analysed factors influencing fuel tax (i.e., environmental taxation) acceptability. They demonstrated that predictors of taxation support are first beliefs concerning environmental consequences of taxation and second, concerning consequences to others. Therefore, increasing understanding and belief that the taxation would have beneficial outcome towards environment may improve support for taxation. Moreover, support can be improved by mitigating concerns about negative allocation impacts generated by taxation. This can be achieved by transferring revenue to households with lower income or by implementing tax rates, which are differentiated according to the regions. To sum up, believing that the tax has positive impact on the environment and that the revenue distribution would be fair can increase acceptability of tax. This suggests that the moral side of taxation is important for individuals to support it.

Douenne and Fabre (2020) conducted a study concerning acceptability of taxation showing another extra-monetary side of taxation. They demonstrated that to gain support for taxation, one needs to convince individuals about the policy effectiveness and real incidence. Moreover, self-interest is also an important component concerning the support of taxation policy.

For instance, if one believes that they will not lose from the policy, tax acceptance can be enhanced. Furthermore, acceptance can increase when one believes that the tax is environmentally efficient. These results suggest that psychological factors are important in supporting tax policies and may have important implications on consumer behaviour.

3.3. Injunctive Norms and Normative Side of Taxation Schemes

3.3.1. Injunctive Norms and Their Impact on Sustainable Behaviour

Before discussing the normative aspect of taxation, we review injunctive norms and their impact in the sustainable consumption context. First, we will explain what social norms are and then, we will review their impact on sustainable behaviour. Finally, we will discuss their use in the food consumption context.

Norm is a construct, which can be used to define and explain behaviour (Cialdini & Trost, 1998). It may state things that are commonly done and things that are commonly approved (Cialdini et al., 1991).

Human beings do not live in a vacuum, meaning that they are influenced by each other; therefore, their behaviour, emotions, or attitudes cannot be considered in a way that is separated from the social groups they are part of. Family, religious groups, or nations can be some examples to these social groups and each person can be associated with different social groups. To determine the appropriate and normal way of behaving, thinking, and feeling; each of these social groups comprise a set of rules, expectations, and standards, which influence individuals belonging to the group. Social norm is a term, which refers to these expectations, standards, and rules (Stok & Ridder, 2019).

Social norms guide our interactions with other individuals and they can be considered as unwritten rules and informal agreements about what we expect from other individuals and what is expected from us (Young, 2015). Cialdini and Trost (1998) defined social norms as standards and customs comprehended by members of a group, which can restrain or guide social behaviour without the need of law enforcement. Norms can appear through interaction with others and they might be asserted explicitly or not. Concerning the deviations from these norms, sanctions are imposed by social network and not by the legal system.

Social sanctions impose social norms. Sanctions caused by violation of these social norms can generate unpleasant (or in some cases pleasant) mental states to the individuals who violated norms. Behaviour, which is inconsistent with these social norms, may create shame or embarrassment caused by public disapproval. Besides, while norms can be constraining, they can also have a facilitating role in social life since they determine conventions about what actions signify (Sunstein, 1996).

Norms may address to what is done frequently or what is approved. What is commonly done and what is commonly approved can be two distinct sources of human motivation (Cialdini et al., 1991). As stated by Deutsch and Gerard (1955) social influence can be informational referring to the influence of accepting information acquired from others to infer about the reality or social influence can be normative referring to the influence of conformity with the expectations of someone else, a group, or oneself whose fulfilment reinforces or conducts to positive feelings. Therefore, while a descriptive norm is a term specifying what is mostly done, injunctive norms indicate what people ought to do (Cialdini et al., 1991).

In social psychology, Focus Theory of Normative Conduct (Cialdini et al., 1990) is one of the most established theories about social norm and behaviour relation (Farrow et al., 2017). Normative Focus Theory states that at the moment of decision, social norms impact behaviour if they are activated which can be achieved by making norms salient or focusing individuals’ attention to a specific norm (Stok & Ridder, 2019). Kallgren et al. (2000) also highlighted the importance of norm focus on norm-consistent behaviour.

Cialdini et al. (1991) stated that behaviour might be systematically and effectively affected by norms. They also indicated that once activated, injunctive social norms are more likely to generate a socially beneficial behaviour compared to descriptive norms and personal norms.

Social norms have been used in various settings regarding socially beneficial settings. Littering behaviour is one example of these behaviours. For instance, the studies cited above such as Cialdini et al. (1990), Cialdini et al. (1991), and Reno et al. (1993) focused on the decrease of littering with the use of social norms based on the Focus Theory of Social Conduct. Reno et al. conducted three field studies in which they found evidence for the effectiveness of injunctive and descriptive norms. In the studies, to render the descriptive norm salient, a confederate threw a bag to the environment, more precisely 4.5 meters close to the participants, so that they pay attention to the environment's condition which was either littered (norm of prolittering) or clean (norm of antilittering). To render injunctive norm salient, the confederate, when 4.5 meters close to the participant, picked up a trash (a bag). Finally, in the control condition, the confederate only passed by the participants. In their first study, they showed that when injunctive and descriptive anti-littering norms were rendered salient, participants littered less compared to control condition or to the condition where the environment was already littered and pro-littering descriptive norm was made salient. Injunctive norm's focus decreased littering in a clean environment as well as in a littered environment; whereas, when descriptive norm was made salient in a littered environment, participants did not significantly littered less than the control condition. In their second study where the descriptive norm was held constant by providing a clean environment, authors showed that when injunctive norm was rendered salient, participants littered less independent from the place where it was made salient. In other words, whether injunctive norm was made salient in the same environment where participants could litter or made salient in a different environment, it always reduced littering. In the final experiment, the environment was clean in all conditions. To render (antilittering) descriptive norm salient, the confederate who had a trash (a bag) threw it to a bin, which was almost full, when they were 4.5 meters far from the participants. In this experiment, when injunctive and descriptive antilittering norms were rendered salient in the same environment where participants had the chance to litter, littering behaviour was marginally significantly lower than the control condition. Most importantly, they found evidence for the fact that the anti-littering injunctive norm may work whether it was made salient in the same or different environment where participants could litter. However, concerning anti-littering descriptive norms, littering was reduced only when this norm was made salient in the same environment where participants could litter. Overall, Reno et al. found evidence to assist the practical benefit of injunctive norms compared to descriptive norms.

Social norms seem to be effective in promoting a variety of pro-environmental behaviours (Farrow et al., 2017). Evans et al. (2017) indicated in their report that social norms are promising tools to be used in environmental policy.

One of the environmentally friendly behaviours is the towel re-use, a conservation behaviour. Schultz et al. (2008) conducted a field experiment in a hotel to test the impact of injunctive and descriptive normative messages on towel re-use. They conducted three studies in the bathrooms inside hotel rooms where different messages about towel re-use were displayed as a function of the experimental conditions. In the first study, six different messages were tested:

(a) high injunctive normative message about towel reuse, (b) low injunctive normative message, (c) high descriptive normative message, (d) low descriptive normative message, (e) combination of high injunctive and descriptive normative messages, and (f) control. In the second study, in the condominiums, two messages were placed in the bathrooms as a function of conditions: (a) a combination of high injunctive and high descriptive normative messages about towel re-use and (b) control. In the third study, similarly, in condominiums inside the bathrooms, three messages were displayed as a function of experimental conditions: (a) control message, (b) generic normative message (combined high injunctive and descriptive message), and (c) specific normative message (descriptive message referring to the previous behaviour of the guests stayed in the same room together with high injunctive norm message). Overall result from these studies is that normative messages can change behaviour. From the first and second study, it was concluded that the most effective way to reduce towel use is to align high injunctive and descriptive normative messages. Third study showed that generic and specific messages lead to a lower towel use compared to control message, but the impact of these two messages were not different from one another meaning that the referent group did not change the strength of normative message. This study also suggests that social interactions are not necessary for norms to be effective, printed normative messages (in a private environment, as in a hotel room) can work as well.

Another conservation behaviour, energy conservation, was investigated by Schultz et al. (2007). By conducting a field experiment, authors tested the impact of normative messages on household energy conservation. Households participating in the experiment were provided with feedback about their energy consumption in the previous weeks and information about the mean energy consumption of other households in their district (descriptive norm). Households were either in the descriptive message only condition where they received a message containing how much energy they used in the previous weeks, a descriptive normative information about the average energy consumption of the other households in their neighbourhood, and suggestions about energy conservation; or in the descriptive and injunctive information condition where participants received the same information as the previous condition; however, additionally, households consuming less than the mean consumption of the neighbourhood received a happy face emoticon and households consuming more than the mean consumption of the neighbourhood received an additional sad face emoticon. Emoticons communicated injunctive normative message about disapproval or approval concerning the consumed energy. Results showed that when high energy consuming households received descriptive message about the mean home energy consumption of the neighbourhood, they decreased their consumption. On the contrary, households consuming lower energy, after receiving descriptive normative message, increased their energy consumption (a boomerang effect). However, when these low energy-consuming households, together with the descriptive normative message, received an emoticon (i.e., injunctive normative message), they maintained a desirable low energy consumption level. Similarly, for the households with higher than average energy consumption, reception of descriptive norm and an injunctive norm message led to a decrease in energy consumption. Moreover, the impact of the intervention lasted for the following four weeks showing a long-term effect of these social norms. This study showed the importance of injunctive norms in reducing possible destructive impact of descriptive norms on house energy consumption and that social norms may decrease home energy consumption, which can last even after the initial intervention. As Schultz et al. (2008), authors also showed that even without social interaction, normative messages may also have an impact on behaviour.

Another set of field experiments that investigated energy conservation behaviour was conducted by Dolan and Metcalfe (2015). In their first experiment (which lasted around one and a half year), they investigated injunctive and descriptive norms to determine their impact on household energy use and whether their combination with information would have an impact. Therefore, they conducted an experiment with three conditions: (a) a condition where only a basic energy statement (how much energy was used by the household) was given; (b) norms together with the energy statement were presented; and (c) last condition where participants were provided with information (about behavioural changes to reduce energy consumption), energy statement, and norms. Concerning norms, whilst participants under the average energy consumption of neighbourhood received a descriptive normative message, which compared household's consumption to the average neighbourhood energy consumption together with an injunctive normative message; those who were above the average received only descriptive normative message. Results showed that in the norm-only and norm and information treatments, the energy consumption decreased. Secondly, even though effect size of the norm with information treatment was twice as big as to the effect size of norm-only condition, the latter was shown to be effective in changing energy consumption behaviour in the long term. Authors also showed that norms had the largest impact at the time where consumers received the normative message. Moreover, participants whose consumption was above the average tend to modify their behaviour more than those who were consuming below the average. Hence, Dolan and Metcalfe showed the efficacy of social norms in decreasing household energy use.

Last study conducted in the energy efficiency context to investigate the impact of injunctive norms was run by Corrégé et al. (2018). Authors conducted a lab-experiment to test the impact of injunctive norms and compared it to a goal setting method (without the use of norms) on a building renovation simulation where participants could change structure of a building on a simulator by modifying, for example, light bulbs or cooking equipment. In the injunctive norm condition, an injunctive normative message about climate change and improvement of energy was displayed to participants. In the salient injunctive norm condition, in addition to this message, a thermometer displaying an energy target, a box displaying normative message together with building's current energy consumption, and target energy level were presented on the screen. A control condition with a neutral message was also implemented. Results showed that salient injunctive norm had an impact on decision-making and differed from control condition in reducing energy use. Similarly, salient injunctive norm was more effective in reducing energy use of the building than non-salient injunctive norm. Authors also demonstrated that salient goal setting improved performance related to design of energy efficient buildings. In line with Cialdini et al. (1990), this study showed again the effectiveness of injunctive norm salience on environmentally friendly behaviour.

Reducing the use of plastic bags is another example of sustainable behaviour on which the impact of injunctive norms was analysed. By conducting a field study, De Groot et al. (2013) investigated how injunctive and personal norms can have an effect on diminishing the use of free plastic bags in a supermarket. In this study, in a naturalistic setting, participants saw either (a) an injunctive normative message together with supermarket's environmental message, (b) a personal normative message together with supermarket's environmental message, (c) a mix of injunctive normative and personal normative message with supermarket's environmental message, or (d) only supermarket's environmental message. The messages were displayed through signs placed in the supermarket. Authors showed that shoppers who were in the conditions where an injunctive norm, a personal norm, and a combined injunctive and personal norm message were displayed used fewer plastic bags compared to those who were in the condition where only supermarket's environmental message was displayed. Hence, injunctive norms were shown to be effective in a naturalistic setting where the aim was to promote sustainable behaviour. Moreover, as in Reno et al. (1993), authors indicated that even though the descriptive norm was in line with an undesired behaviour (use of free plastic bags), the use of injunctive norms could promote the sustainable behaviour, which was the use of fewer plastic bags. This showed again that the injunctive norms could be promising tools to promote environmentally friendly behaviours.

Paper waste reduction is another pro-environmental behaviour which should be addressed. Hamann et al. (2015), in a field experiment, tested whether injunctive and descriptive norms could increase the attachment of an anti-ad sticker to the mailbox. Authors manipulated the salience of injunctive norm and the reference group by putting a normative message on a leaflet. This message either contained no injunctive normative statement (non-salient message), or an injunctive normative message about anti-ad stickers by taking citizens as the reference group or a normative message by taking neighbours as the reference group. Salience of descriptive norm was manipulated either by putting anti-ad stickers to the other boxes or not. Strength of the descriptive norm was observed by confirming the number of mailboxes with an anti-ad sticker. Results showed that when injunctive norm message was made salient, the number of stickers attached increased compared non-salient injunctive norm condition. No significant difference between messages with different reference groups was found. Similarly, when the strength of the descriptive norm was high, the number of stickers attached was increased; however, the difference between high and low norm strength was marginally significant. Lastly, strongest effect occurred when the injunctive norm was rendered salient and the strength of the descriptive norm was high. Again, the effectiveness of salient injunctive norms was shown in a pro-environmental context, specifically, in the context of paper reduction.

Injunctive norms were also used in the context of food consumption; however, the aim of the investigation of injunctive norms in this context was mostly to increase healthy eating rather than promote pro-environmental behaviour.

Mollen et al. (2013) conducted a field experiment where the impact of injunctive and descriptive normative messages on food choices was investigated. On a food court in a campus, three normative messages were used: a healthy injunctive norm, a healthy descriptive norm, and an unhealthy descriptive norm. Each day, a different norm message (or no message as control condition) was displayed through signs situated in different places in the food court. Results showed that when exposed to healthy injunctive norm, participants chose the healthy option more often compared to the condition where they saw an unhealthy descriptive norm message; however, no difference was found between injunctive norm and control conditions. Moreover, the odds of choosing the healthy option in the healthy descriptive norm condition was higher compared to control and unhealthy descriptive norm conditions.

There are however, studies investigating food related behaviour in the sustainability context. For instance, Stancu et al. (2016) investigated determinants of household food waste behaviour, which can cause important greenhouse emissions. Through a survey, they analysed consumers’ psycho-social factors, households’ routines and their perceived ability in handling these routines, self-reported household food waste behaviour, and intentions on not to waste food. Results of the study showed that injunctive norms were strong predictors of the intention on not to waste food. Therefore, this study gives evidence for the potential impact of the injunctive norms on reducing food waste behaviour (through impacting intention).

Another study regarding food-related behaviour in the sustainability context was conducted by Salmivaara and Lankoski (2019). In a field experiment, the impact of the activation of injunctive norms on the choice of sustainable dish was analysed. The experiment took place in 19 restaurants each of which was assigned to one of the four treatment groups where a message was displayed on a message holder next to the sustainable dish on the buffet as a function of the treatment: (a) a control group where no message was presented, (b) an injunctive message about the protection of Baltic sea, (c) an injunctive message about promoting local food, and (d) a message of combined b and c. Results showed that although the lunch choice was not impacted by injunctive norms, authors indicated a possible effect of these messages on smaller sub-groups as a function of past consumption patterns and demographic characteristics.

One study which investigated whether injunctive norms influence grocery purchase was carried out by Weir (2012). Through interviews and questionnaires, the role of social descriptive and injunctive norms and personal injunctive norms on green grocery shopping (i.e., purchase of locally grown, organic food products which are free of antibiotics and hormones and not genetically modified) were analysed. Results showed that social and personal injunctive norms were predictors of green grocery shopping behaviour, whereas descriptive norms did not have an impact. While the results of this study provide evidence for the effectiveness of injunctive norms in promoting green grocery shopping, these results should be extended to a more realistic setting. Moreover, purchase of products having low carbon footprint were not considered as green purchase behaviour while carbon emissions from food consumption may contribute substantially to the climate change.

Studies mentioned above provide evidence for the effectiveness of injunctive norms in promoting pro-social (e.g., anti-littering) and sustainable behaviour (e.g., energy conservation, reducing paper-waste, towel re-use). Most of the studies mentioned were field experiments, such as study of Schultz et al. (2008), Schultz et al. (2007), Dolan and Metcalfe (2015), Salmivaara and Lankoski (2019), and Hamann et al. (2015) and showed that injunctive norms can be effectively used in the naturalistic settings. They also work effectively in more controlled settings such as in the study of Corrégé et al. (2018). Concerning sustainable food consumption, survey and interviews were conducted to investigate the impact of injunctive norms as in Weir (2012) and Stancu et al. (2016). The promising results concerning norms obtained from these studies could be further replicated in a more realistic experimental setting to determine the causal relationships between injunctive norm and sustainable food consumption. Salmivaara and Lankoski (2019) conducted such a field experiment, in a restaurant setting, where authors found significant impact of injunctive norms; however, the use of self-reported measures as dependent variable (dish choice) could be a limitation and may not be considered as an objective measure. However, concerning the potential of injunctive norms in the sustainability context, future studies should investigate its effectiveness in the sustainable grocery-shopping context.

3.3.2. Normative Aspect of Taxation and Its Impact on Sustainable Behaviour

It is argued that government policies such as financial measures or regulations may be applied to change behaviour. These tools have the potential to modify social and personal norms by way of various mechanisms. For example, fines may be used to change behaviour because they communicate the importance of the issue (to which the fine is applied). Therefore, financial measures can influence behaviour through this mechanism, which alters norms by indicating which behaviours society considers important. Additionally, these measures may also influence personal norms (Kinzig et al., 2013).

Monetary incentives may have an impact on environmentally friendly behaviour above their price effect. Thogersen (2003) investigated through which factors monetary incentives may have an impact on sustainable behaviour. In the context of garbage collection, the author wanted to show how providing performance-contingent garbage fees (to increase recycling and decrease waste) may influence behaviour in a field setting with a survey. This study demonstrated that a price effect existed since consumers who paid a performance-contingent fee for garbage collection recycled more materials and composted more vegetables and fruits as opposed to the situation where a fixed price was implemented for garbage collection. Nevertheless, when the additional psychological factors such as self-efficacy and personal norms are held constant, price effect cannot explain a big proportion of behaviour. In other words, these psychological factors mediate the impact of the monetary incentive on sustainable behaviour. The author concluded that the extra-monetary impact of monetary instruments may enhance their impact on sustainable behaviour above their price effect.

Personal carbon trading schemes can also have a normative aspect, which could impact consumer behaviour. For example, Raux et al. (2015) conducted a stated preference study where they evaluated the impact of the implementation of personal carbon trading (PCT) on choices of transportation with the aim of reducing carbon emissions. Authors suggested that this scheme can be a potentially useful instrument in changing transport choices in a sustainable way. Although they did not test the normative impact of this scheme, they note that it can induce pro-environmental behaviour due to its social normative aspect and that future studies should test this. They argue that consumers would have a feedback about their travel impact. Moreover, an allowance scheme would target a maximum carbon emission level for the society that should be respected. This may act as a social norm that can be considered as a psychological incentive to adopt environmentally friendly behaviour.

Fawcett (2010) conducted a review concerning PCT and explained a possible non-monetary side of the scheme. PCT may have an impact on consumers through its social and psychological aspect as explained in the following: First, due to PCT, carbon cost of the purchase decision would be more visible. Secondly, feedback about behaviour would be given through a carbon account. Moreover, contrary to carbon tax, a shared target by the society would be communicated through the scheme. Lastly, PCT would give new responsibilities to consumers and increase the importance of carbon emission concerns in buying decisions.

Similarly, Parag and Strickland (2009) suggested that personal carbon allowances (a variant of PCT) influence behaviour not only through an economic mechanism but also through psychological and social mechanisms. Psychological and social mechanisms may operate by generating awareness about the carbon emission of activities and of climate change, which can hence strengthen social support of emission reduction. Lastly, with the introduction of personal carbon allowance scheme, it is expected that a new social norm concerning carbon consumption will be established.

Lastly, Lewis and Capstick (2008) conducted a review about PCT scheme and explained the impact of this scheme with a psychological approach. Authors suggested that this scheme can promote norms concerning environmentally friendly behaviour. Under this scheme, individuals are assumed to be responsible of their emissions and they contribute to a collective outcome. These claims can be tested through empirical analyses.

Both personal carbon allowance and carbon taxation scheme may render carbon consumption and climate change issues more visible which can be considered as a psychological factor contributing to behavioural change (Parag et al., 2009).

In conclusion, it is important to assess the psychological aspect of monetary measures/fiscal systems. As indicated by Kinzig et al. (2013), studies investigating how these policy measures impact social norms are limited. Understanding of the psychological mechanism behind how taxation schemes influence behaviour can be important and useful in creating effective policies.

3.4. How Does Combination of Non-Monetary Instruments and Taxation Measures Impact Behaviour?

3.4.1. Impact of Extrinsic Rewards on Intrinsic Motivation and Motivational Crowding-Out

To understand how fiscal measures and non-monetary instruments (e.g., nudges) can interact, one can investigate the interplay between monetary instruments and nudges. Policy makers might think that combining monetary instruments and nudges can be useful in creating an effective environmental policy. However, one should be careful in interpreting the outcome of the combination of these instruments. On one hand, combining a monetary instrument and a nudge may have a lower impact compared to what each instrument could achieve alone. In this case, the policy is not effective; it has backfired. On the other hand, combination of instruments may result in a higher effectiveness compared to what a single instrument could achieve alone or compared to the sum of individual impact of each instrument. In these cases, combined policies may be implemented (Drews et al., 2020).

To understand how non-monetary instruments and fiscal measures interact, whether their combination will be effective or not, and to comprehend the extra-monetary aspect of these fiscal instruments, motivational crowding theory should be considered. Crowding out approach was started to be established with Titmuss' work in which he mentioned that the principle of voluntary was undervalued and discouraged by the commercialization of blood. One's altruism expression and feeling of belonging to a community were suppressed (Wilson, 1972). Hence, Titmuss pointed out that financial payoff for blood donation may crowd out the supply (Mellström, & Johannesson, 2008).

Before Titmuss' work, the interaction between intrinsically motivated behaviour and monetary instruments had already been investigated. The impact of monetary instruments on intrinsic motivation had indeed been systematically analysed by researchers in social psychology (e.g., Deci, 1975; Deci & Ryan, 1985).

Intrinsic motivation is to conduct an activity not for an external reward but for the activity itself. One engages in an activity not because an extrinsic reward will be received but for its own sake. It can be understood that one may derive pleasure from the activity itself and that there is not any apparent reward present. This is the generally accepted definition of intrinsic motivation, which is also used as an operational one. Although this definition is adequate to operationalize intrinsic motivation, it does not further explain its psychological basis. In order to give a more comprehensive definition, the internal consequences generated by intrinsically motivated activities should be taken into account (Deci, 1975).

Deci (1975) reviewed theories explaining human motivation from which he conceptualized intrinsic motivation. He asserted that both reducing and inducing stimulations are accounted for the explanation of intrinsic behaviour and this fact is dealt with the theories whose emphasis was on competence and self-determination (e.g., White, 1959), on optimal incongruity (e.g., Dember & Earl, 1957), and on optimal arousal (e.g., Hebb, 1955).

White (1959), while explaining his approach regarding motivation, used the word competence to define “an organism's capacity to interact effectively with its environment.” (p. 297). He emphasized on the idea that competence had a motivational aspect, which he called effectance motivation. Satisfaction in this approach is described as a feeling of efficacy, which can be used to explain the affective part of effectance. Feeling of efficacy can be achieved by conducting behaviours with exploratory and experimental features and generating changes in the stimulus field. Hence, an individual may be motivated by effectance motivation in order to conduct behaviours, which allow them to deal effectively with the environment and feel competent. Similarly, Angyal (1952) emphasized on self-determination. According to the author, human beings appear to strive in order to affirm and expand their self-determination. He asserted that human beings are active organisms who are autonomous and self-governing. They are autonomous and by interacting with their environment, they construct and modify it. They follow a trend in which they strive from a condition of a low level of self-determination to a condition of a high level of self-determination, which shows a pattern towards raised autonomy.

As White (1959) and Angyal (1952), deCharms (1983) also emphasized the importance of competence and self-determination; he stated that individuals are motivated to generate changes in the environment and be effective in it. They aim for personal causation (i.e., the fact that a person knows themselves as motivated and as a causal agent). He also indicated that individuals feel intrinsically motivated when they happen to be the locus of causality concerning their own behaviour; on the other hand, individuals feel extrinsically motivated when they consider the locus of causality for their behaviour to be external to themselves.

Optimal incongruence is also an important notion for intrinsic motivation (Deci, 1975). Discrepancy between what an individual expects and what is observed (i.e., features of stimulus) is an important subject in Dember and Earl's (1957) approach regarding intrinsically motivated behaviours (i.e., curiosity, explorations). Authors asserted that individuals approach to a stimulus which has an optimal discrepancy.

Concerning optimal arousal theory, Leuba (1955) discussed about optimal stimulation in his paper. He suggested that one learns the reactions that can generate an optimal level of stimulation. In other words, in the case where there is low overall stimulation, one is likely to have some reactions increasing stimulation and in the case of a high overall stimulation, decreasing stimulation.

By taking into account the theories above, Deci (1975) argued that behaviours energized by intrinsic motivation are the behaviours one conducts in order to feel self-determined and competent. There are two types of behaviours, which are intrinsically motivated. First type of behaviour is seeking stimulation (i.e., challenge) when there is none. With no stimulation, one may not feel self-determining and competent. Hence, individuals will look up the opportunities to behave in a manner allowing them to feel self-determined and competent. Second type of behaviour is to overcome the challenging situation or to reduce incongruence in order to feel competent and self-determining. In sum, seeking and overcoming optimal challenges are processes in which individuals engage.

Deci (1975) also explained the impact of monetary rewards (i.e., extrinsic rewards) on intrinsically motivated behaviour. In order to do this, he proposed Cognitive Evaluation Theory and suggested three propositions. According to the first proposition of this theory, as a result of receiving extrinsic rewards for pursuing activities that are intrinsically motivated, people's perceived locus of causality changes from internal to external, which generates a reduction in intrinsic motivation. This proposition indicated that salience or effect of extrinsic rewards is more prominent compared to those of intrinsic rewards. Another implication is that when people perceive that their locus of causality is external, in other words when they perceive that they conduct a behaviour to obtain an extrinsic reward, they engage in this activity if they think it will bring the extrinsic reward. Moreover, the second proposition posits that intrinsic motivation can be impacted by the change in the competence and self-determination feeling. If an individual experiences an increase in their feelings of competence and self-determination, the intrinsic motivation augments; however, if an individual experiences a decrease in their feelings of competence and self-determination, their intrinsic motivation diminishes. Rewards may increase one's intrinsic motivation through the process explained in the second proposition or may decrease it through the process explained in the first and second propositions. Lastly, third proposition states that which process will take place depends on which aspect of rewards (along with feedback) will be more salient: controlling aspect or informative aspect giving information regarding one's competence and self-determination. If the former is salient, individuals feel controlled by the prize; hence, they feel that the locus of causality is external. This may happen when the reward is money. If the second aspect is salient, informational feature of the rewards will trigger the change in the feelings of competence and self-determination.

There are empirical studies testing the impact of external rewards on intrinsic motivation. Deci (1971) conducted two lab-experiments and one field experiment to investigate the impact of external rewards on intrinsic motivation. In the first experiment, participants in the control and experimental condition solved puzzles (an intrinsically motivated activity) during three sessions. Difference between the conditions was that experimental group received a monetary reward for each puzzle they solved within the time limit during the second session. Experimenter left the room in each of the session for 8 minutes during which participants had free time to do whatever they wanted. The motivation was measured as the time spent on the puzzles during this free time. The second study, which was a field experiment, was conducted in a newspaper office. The task of the participants in the control and in the experimental condition was to write headlines for 10-week period (first period consisted of four weeks and the second and third of three weeks). Intrinsic motivation was measured as the time participants spent on writing the headlines. The difference between the two conditions was that participants in the experimental group received a monetary reward (50 cents per headline) during the second period.

From these two experiments, Deci (1971) demonstrated that when money was given to subjects as external reward for engaging in an activity, subjects' intrinsic motivation to conduct that activity decreased. In the third study, positive feedback was used instead of money to determine its impact on intrinsic motivation in a lab-experiment. During three sessions, participants in the control and experimental group solved puzzles (as in the first experiment) and the difference between the groups was that participants in the experimental group received positive feedback about their performance in the second session. Motivation was measured as the time spent on the puzzles on the free time period as in the first lab study. Results of this study showed that the intrinsic motivation of participants who received positive feedback was increased from the first to third session compared to those in control condition. These results are in line with the propositions of Deci (1975).

In line with Deci (1971), Deci (1972) conducted another experiment to investigate the impact of positive feedback and monetary reward on intrinsic motivation. In this experiment, he also tested the impact of combination of reward and feedback. He was also interested in the effect of the time participants received the monetary reward. Participants solved a puzzle in one session of the experiment. Intrinsic motivation was measured through the time spent on puzzle in the free choice period where the experimenter left the room. Participants either did not get any reward, or got their reward before the free choice period, or they got their rewards after the free choice period, or they were exposed to these three conditions which were accompanied by verbal reinforcement. Results demonstrated that monetary rewards reduced intrinsic motivation. So, again, results supported the proposition of Cognitive Evaluation Theory about the impact of extrinsic rewards on intrinsic motivation. Nonetheless, verbal reinforcement increased motivation only for males. And there was no significant difference between control condition and the condition where participants received both rewards.

3.4.2. Motivational Crowding Effect

In economics, crowding-out approach was introduced by Frey (1992, 1993). Frey (1993) argued that while neo-classical economists claim that pricing is an effective tool in affecting behaviour and in generating efficient resource allocation in comparison to its alternatives, there are substantial limitations of pricing that are overlooked. Notably, the crowding effect of motivation is one of the limits of pricing and indicates that pricing might have an impact on intrinsic motivation in a systematic way. Pricing might become an inefficient tool since its implementation may destroy intrinsic motivation (Frey & Oberholzer-Gee, 1997).

Frey (1993) discussed the cognitive conditions, according to which increased monetary rewards may reduce intrinsic motivation to engage in an activity in a principle-agent context. As defined by Jensen and Meckling (1976), in this context, the principle makes the agent conduct some tasks or services on behalf of them under a contract. Frey expressed that firstly, if the agent perceives that monetary reward is given because the principle distrusts their intrinsic motivation, a reduction in intrinsic motivation may occur. Secondly, intrinsic motivation can be enhanced, if a modification in monetary reward is perceived equitable among agents; however, if the modification is perceived unfair, intrinsic motivation will be undermined. Lastly, intrinsic motivation for engaging in a task is enhanced by a monetary reward, if the agent feels that principle acknowledges and appreciates their work. Moreover, it is important for the agent being able to establish for themselves some features of the relationship with their principle. To the contrary, if agents feel that the external pricing occur to have a control on their behaviour, their feeling of self-determination diminishes and hence their intrinsic motivation.

Frey (1993) also explained the conditions under which the crowding-out occurs by discussing the shift in locus of control. According to the author, price can influence intrinsic motivation when perceived locus of control is altered from intrinsic to extrinsic motivation which may happen under the following conditions: First, when the relationship between principle and agent which was more personal becomes violated by the introduction of a monetary reward, locus of control might be attributed from intrinsic motivation to extrinsic one. Secondly, introduction of increased monetary rewards or punishment for an interesting task can diminish one’s self-determination. Third, there is a positive relation between participation possibility to an activity and intrinsic motivation; hence, introduction of monetary punishments or rewards may undermine intrinsic motivation for that activity. Moreover, the properties of external interventions may also have an impact on intrinsic motivation. Perceived locus of control may alter from intrinsic to extrinsic and a crowding-out effect may occur if a reward, which is contingent on task engagement or performance, is introduced. Lastly, intrinsic motivation can increase, if monetary punishments and rewards are being fair by differentiating individuals of low and high intrinsic motivation.

Some similarities can be detected between Frey’s (1993) suggestions related to motivational crowding-out and Cognitive Evaluation Theory of Deci (1975). First, in both theories, the perception of the external reward is important to indicate how it will impact intrinsic motivation. Frey indicated that when the individual has a feeling that the external reward given to them because of principle's mistrust (towards them), their intrinsic motivation can be diminished. On the contrary, in the case where the agents receive the monetary compensation as a result of an appreciation of their work, their intrinsic motivation could be boosted. Similarly, Deci indicated that if the reward has an informative aspect showing an indication about individual's competence, their intrinsic motivation might be enhanced by it. Secondly, Frey indicated that if an agent considers that an increase or decrease in monetary reward is equitable between agents, their intrinsic motivation might be enhanced, which again can be compared to Deci's argument about the importance of how the rewards impact the feeling of competence. A fair change in monetary compensation amongst agents may convey the message that their competence is acknowledged and not underestimated and hence improve intrinsic motivation. Finally, both Deci and Frey concluded that the feeling of self-determination is important for intrinsic motivation.

A difference can also be detected from arguments of Deci (1975) and Frey (1993) about the impact of external rewards on intrinsic motivation. While Deci stated that the intrinsic motivation can be undermined because of a shift in perceived locus of *causality* from internal to external, Frey explained this process as a change in locus of *control*. To understand the difference between these two concepts, one can refer to Deci's book. He explained that an individual who has an internal locus of control could have either an external locus of causality or internal locus of causality. Since someone whose locus of control is external does not assume that the environment would react to their actions, neither intrinsic nor extrinsic reward will motivate them. On the other hand, someone with internal locus of control assumes that they can have an impact on their environment and may display behaviour to increase their self-determination and competence feelings; thus, internal locus of control is important to be intrinsically motivated. Finally, Frey did not give an exhaustive explanation for the concept of locus of control in his paper. Nonetheless, in another paper, Frey (1997) explained that when the locus of control switches from internal to external, individuals would consider that it is the external person who is responsible but not themselves.

There are studies of meta-analysis investigating the impact of financial rewards on performance and find evidence for crowding-out effect. One example to these studies is the study conducted by Stajkovic and Luthans (1997), which examined the impact of organizational behaviour modifications on task performance. Their results showed that monetary rewards when combined with non-financial interventions might reduce the impact of the overall intervention.

Another meta-analysis study was conducted by Deci et al. (1999) to investigate the impact of extrinsic rewards on intrinsic motivation. They showed evidence for motivational crowding-out from experimental studies. Specifically, authors showed that for interesting tasks, rewards that are contingent on the engagement and completion of the task and on the performance undermine intrinsic motivation (in free choice behaviour).

3.4.3. Implications of Motivational Crowding Theory in Sustainable Consumption

There are studies that found evidence concerning motivational crowding in the sustainable consumption domain. Perino et al. (2014) showed evidence for motivational crowding-out in the sustainable grocery-shopping context. In their experiment, they compared effectiveness of a subsidy, a neutral price change, and carbon labels on altering choices towards environmentally friendlier options. While in subsidy treatment participants learnt that government applied a subsidy to environmentally friendlier products, in neutral price change treatment price reduction was attributed to market mechanism. Authors showed that subsidy treatment which was a combined price and information manipulation did not have a significant impact on altering choices and performed the worst compared to other two treatments; therefore, combining information and price change manipulations were less effective than implementing them separately. These results showed evidence for motivational crowding-out with the use subsidy as a policy tool.

Hilton et al. (2014) also found evidence for motivational crowding-out in their experimental study where participants made hypothetical choices and decided between airplane (polluting option) and train (sustainable option) to travel between Toulouse and Paris. Authors applied a bonus-malus tax to the prices of the transport options and manipulated their amount without changing their final prices. Their results showed that larger the amount of bonus and malus applied to prices of train and airplane, the lower the number of participants choosing the environmentally friendly (train) option. This may suggest that increasing financial incentives decreased participants' intrinsic motivation to choose sustainable transport option.

4. Conclusion

In this review, we have studied different fiscal measures such as carbon tax and bonus-malus and their use in the sustainable consumption context. Moreover, we also discussed the psychological impact of taxation by reviewing tax salience, acceptability of taxation, injunctive norms, and theory of motivational crowding-out.

Studies that investigated health-related taxation schemes such as fat taxes or bonus-malus schemes on diet choices have shown that they were effective. Economic instruments can also be used to mitigate carbon emissions by altering consumer behaviour in a sustainable way. Carbon emissions from food consumption are substantial and studies that investigated the impact of taxation on sustainable grocery consumption are limited. Therefore, further studies are needed to test the impact of taxes applied with environmental concerns such as carbon tax on sustainable grocery choice in realistic settings. Panzone et al. (2018) conducted such study by testing the impact of a carbon tax on basket carbon footprint in a realistic online grocery shop environment. Similarly, Panzone et al. (2021) investigated the impact of bonus-malus taxation scheme in the same context. The authors found promising results concerning the impact of these measures. These studies can be extended by investigating the interplay of these taxation schemes with other non-monetary instruments to detect their impact on consumers' behaviour. Moreover, through this review, we have discussed that economic instruments may have psychological aspects as well as their price effect. Therefore, investigation of the extra-monetary impact of environmental taxation schemes is also crucial for future studies. For example, one should take into account possible motivation crowding effect or the normative impact of these taxation schemes. Acceptability of these measures is also important and may contribute to their effectiveness. Insights from these studies can inform policy makers whose aim is to mitigate emissions from grocery shopping to construct and implement policies in an effective way.

Chapter 2: A Review of Carbon Labels and Their Effectiveness in Encouraging Sustainable Grocery Consumption

---

1.Introduction

Carbon footprint labels allow consumers to learn about environmental impact of products and change their behaviour. This behavioural change may result in diminished carbon emissions which would help addressing global warming. In this review, first, we discuss about what information provision means and explain its use from an economic standpoint. We then explain how labels can have an impact on behaviour. Next, we discuss the importance of the format in which the information is provided and how carbon footprint information can be given in the most effective label format. Lastly, we discuss experimental studies, surveys, and studies that used real-life data, which investigated the impact of carbon footprint labels on consumer behaviour. We finish with a general conclusion.

2.Information Provision and Labels as Nudges

2.1. What is Information Provision and How It Can Impact Behaviour: Economic and Psychological Theories

Sellers and buyers are equipped with perfect information according to the traditional microeconomic theory; therefore, buyers can differentiate between products and sellers can assess what consumers' needs are. However, when there are informational market failures such as existence of limited or false information, governments may interfere in order to correct these market failures (Mazis et al., 1981). Information provision about products or services to consumers can be a tool to overcome this problem.

Correcting information market failure (e.g., providing information) may have three benefits. First, economic agents can make better decisions with more complete information they are provided with compared to the state where they have limited knowledge concerning attributes of products. Secondly, product quality might be improved. Since consumers can change their choices according to the new information, sellers can receive this as a signal to modify their products. Lastly, reduction of prices may occur with information provision. With new information, produce comparison will be facilitated and therefore competition between market forces may occur (Mazis et al., 1981).

Information disclosure was started to be recognized as a policy tool to decrease pollution in 1980s; before, it was mostly the market-based approaches or command-and-control systems which were considered as strategies to diminish emissions (Cohen & Viscusi, 2012). Regulators may be interested in information disclosure strategies since they can be politically feasible by being considered as non-coercive and more cost-effective for governments compared to new regulations which have to be drafted and then implemented (Cohen, 2001). Moreover, heightened interest in environmentally friendly products from the consumer side motivated companies to produce commodities containing environmental attributes. For instance, the EU Ecolabel was awarded to 70692 products in 24 different product categories such as furniture, laundry detergent, or graphic paper as per March 2020 (European Commission, 2020).

Provision of information can be important in influencing economic behaviour. As stated by Caswell and Mojduszka (1996), the U.S. government accentuated the importance of the use of programs regarding information provision in order to influence economic behaviour. These programs might be efficient by giving economic agents aids to make better decisions.

2.2. Product Labels as Means of Information Provision: How Can Labels Impact

Behaviour

Labels are considered as proper methods for information provision (Vandenbergh et al., 2011); they have already been used as information provision tools to convey information related to health and environment (Teisl & Roe, 1998).

Teisl and Roe (1998) defined product labelling as any policy tool in which the product information is regulated by a third party or government for consumers. This information may contain information about product use characteristics (e.g., price, nutrition, taste) and/or non-use characteristics (e.g., environmental consequences, ethical factors). Moreover, the authors provided an economic justification for implementing labelling programs. Market inefficiencies caused by hindered or costly information flow can be circumvented by labelling policies that render the information (which was maintained at first by the firm) available to consumers. Hence, consumers can be more informed about the exact product attributes and their choices will be closer to their preferences and there would be less uncertainty regarding attributes of goods.

To understand how product labels convey information about sustainability and how this can help consumers to make better choices, one may examine the differences between search, attribute, and credence goods by following work of Nelson (1970) and Darby and Karni (1973). Search attributes define the attributes, which can be examined before the purchase such as price or size through research and inquiry. Experience attributes define the attributes, which can be evaluated after purchase and credence attributes are those that cannot be detected even after use. To assess their value, one needs costly and additional information. Environmental attributes such as ecosystem protection are considered as credence attributes (Moser et al., 2011). The aim of the product labels is, therefore, to transform credence attributes to search attributes in that agents can make comparisons between products and hence conduct more informed choices (Cohen & Vandenbergh, 2012).

Apart from helping consumers to make better-informed choices, labelling may alter consumer behaviour in a socially beneficial way. To understand this, one can consider the work of Teisl et al. (2002) which explained how labelling may impact consumer behaviour. The authors stated that information search cost would be diminished by labelling and that labels might signal how important environmental information is. Therefore, label policies may have an impact on behaviour through its impact on the number of attributes an agent takes into account during a choice process. Plus, labelling might have an effect on the implicit weights allocated to each attribute. Conveying environmental information through labelling in a way that influences market behaviour may be considered as socially optimal by regulators. By demonstrating through econometric analysis the significant impact of an eco-label, more specifically, of dolphin-safe labelling, authors supported their point about the impact of eco-labels on consumer behaviour.

Governments started using labelling policies to influence agents' consumption choices by associating them with social goals. For instance, food labelling can be used to minimize environmental hazards or to ameliorate health and safety. More specifically, when externalities (circumstances in which one's action influences the utility of another agent in a way that is not reflected in the market) occur, labelling can be administered as a governmental intervention to maximize social benefits if there is not relevant information provision from firms. Mandatory labels can be efficient tools in reaching social objectives since information is potentially powerful in influencing consumer choices. In other words, in the case of externalities generated by private consumption choices, social welfare can be enhanced through labelling (different from the ones developed by firms by taking into account, for example, their profits) (Golan et al., 2001).

2.2.1 Carbon Footprint Labels as Means of Information Provision: How Do Carbon Labels Impact Behaviour

Carbon footprint indicates the greenhouse gas emissions provoked by a person, a product, or an institution (Johnson, 2008) and carbon labelling was created as a tool to instigate reductions of greenhouse gas emissions (Liu et al., 2016), which can provoke climate change and global warming. Vandenbergh et al. (2011) stated that the use of carbon labelling could diminish carbon emissions by having an impact on consumer choices and by motivating firms to detect supply chain efficiencies. Carbon labels, firstly, were displayed on grocery products since greenhouse gas emissions of these products are more easily controlled over their life cycle and more measurable compared to other products. Plus, food products substantially contribute to greenhouse gas emissions (Liu et al., 2016). Therefore, the use of carbon labels on grocery products can be promising in mitigating carbon emissions.

The aim of carbon labels is to supply relevant information to consumers and business, which can help them to make informed choices concerning products (Cohen & Vandenbergh, 2012). Moreover, as stated by Caswell and Mojduszka (1996), in United States, labelling is used to form consumers’ purchase patterns, shape their knowledge and use practices as well as product offerings and marketing methods of manufacturers. Therefore, carbon labelling can be used to alter purchase behaviour of consumers by instigating them to make more informed choices with the aim of reducing carbon footprint of their purchase.

2.2.2 A Psychological Approach

To understand how labels can have an impact on behaviour from a psychological standpoint, we can explain how carbon footprint labels can be considered as translated attributes (cf. Ungemach et al., 2016). Ungemach et al. stated that translated attributes, which are distinct features of one attribute, could function as signposts of decision since individuals' objectives (e.g., environmental goals) can be activated by them. Moreover, these translated attributes can guide individuals to the alternatives that can help them to reach these objectives. Therefore, presentation of translated attributes may have an impact on preferences. Another aspect of translated attributes is that instead of restricting freedom of choice, translated attributes enable individuals to choose the alternatives, which are in line with their objectives. Consequently, carbon footprint labels can be considered as a translated attribute that can act as a decision signpost activating economic agents' environmental objectives and help them to choose options, which are aligned with these objectives.

Moreover, the Theory of Normative Conduct (cf. Cialdini et al., 1991) can also be informative to understand how carbon labels can have an impact on behaviour. Stok and Ridder (2019) explained that according to this theory, norms can change behaviour in a systematic way and that norms should be prominent (i.e., focal) to have an impact. While descriptive norms reveal what individuals commonly do, injunctive norms indicate the behaviour that the society approves. Moreover, injunctive norms have been used in the sustainability context to promote eco-friendly behaviours (e.g., Cialdini, 2003; Hilton et al., 2014). Thus, we can conclude that the mere presence of carbon labels may render environmental concerns and goals salient and implicitly convey an injunctive norm and hence impact behaviour.

3. How to Increase the Effectiveness of Information Provision Through Carbon Footprint Labels: The Role of Presentation Format

3.1. Information Presentation Format

Although information availability is important, it is not sufficient to have an impact on decision (e.g., Russo et al., 1975). For consumers to understand the information and use it in their decision-making, it should be conveyed in an understandable and convenient format. Therefore, the distinction between availability of information and to what extent it is understandable suggests that the same information presented in different formats may have different effects on decisions (Magat et al., 1986). In the next part, we will discuss this distinction in detail and explain the importance of format of information presentation.

Same information presented in different formats may have different impact on behaviour (Magat et al., 1986). For instance, in a field experiment, in a grocery store, Russo et al. (1975) demonstrated that changing the presentation format of unit pricing of products (presenting prices on the shelf tags vs. presenting product prices on a list starting with lowest product price to the highest) had an impact on purchase by leading consumers to purchase lower priced products. Similarly, a laboratory experiment conducted by Magat et al. (1986) provided evidence for the impact of information format on residential energy conservation by comparing four different ways of displaying the same energy analysis information. The control format was a report presented in an existing format adopted by Duke Power Company. In the first modified format, the conservation measures were ordered according to increasing payback years. This means that if one uses payback as benchmark in their investment decisions, this new format can facilitate information processing and hence may help them to choose the most efficient conservation measure. In the second modified format, column showing the cost of installation was switched with the column showing estimated savings. This way, one can know about the advantage of measures before their cost of installation and concentrate more on the advantages and less on the costs. This format can help consumers to choose the measure with higher energy savings. Last modified format was conceived to modify the reference point consumers use to make choices concerning conservation measures. In the original (control) format, consumers use energy savings from first year concerning each measure in order to assess benefits provided by conservation expenditures. Whilst in the control format the reference point was zero energy savings, in the new format, the reference point was considered as the energy cost incurred without investing in energy conservation. Authors showed that these format changes improved conservation decisions.

3.2. Format of Carbon Footprint Labels

Product labels can be used as tools to convey information. Carbon footprint labels are special type of product labels which provide information about carbon content of products. Since the same information given in different format may produce different behavioural responses (Magat et al., 1986), the same carbon footprint information given in different formats may have different impacts on behaviour. Therefore, the format in which this carbon content is communicated is crucial.

In line with the principles of human information processing, Bettman et al. (1986) proposed a framework to design labels to convey risk information, which can give insights about product carbon footprint label design. Given the limitation in information processing capacities, these authors indicated that the number of pieces of information that can be processed from a label is limited. In addition, to help to process the information on labels, one should take into account that consumers may use simplifying strategies during information processing. The assumptions that the agents are thorough in information processing and that the provision of more information is always useful go against these claims. Therefore, while availability of information is valuable, processability referring to the extent to which the information can be understood and used with ease is also important. Information should be easily processed in order to be used.

Information processability is contingent on how the information is presented. Use of well-organized information presentation and formats facilitating information processing may enhance the usage of the information. Moreover, the type of processing to be implemented is also essential. Consumers can adopt different strategies of information processing contingent on the task; additionally, policy makers may prefer to boost specific types of processing, such as making comparisons between product attributes through careful format designs (Bettman et al., 1986).

Bettman et al. (1986) analysed the factors that are important in label design. First, they emphasized the importance of the ease of locating the information on label and then understanding that information. Use of different colours or typing size can make information more salient, hence easier to locate. Once located, information should be easily comprehended. Golan et al. (2001) also highlight the importance of concise and clear information for labelling. Moreover, labels should be simplified to enable comparison of various alternatives; therefore, the label format should be in a comparative format. Bettman et al. suggested that labels in the form of point of purchase display may have an impact on purchase in the circumstances where comparing product information is important. Similarly, Cowburn and Stockley (2005) indicated that providing interpretational aids could promote comparison of products. Lastly, hierarchical design of labels is also important; in other words, information should be ordered in a way that helps consumers to use it (Bettman et al., 1986).

3.3. A Cognitive Approach: Numerical Labels vs. Colour-Coded Labels

There are different types of carbon footprint labels such as colour-coded carbon footprint labels (e.g., Vanclay et al., 2011), numerical labels (e.g., Perino et al., 2014), or kilometric format labels (Muller et al., 2019). One important question is which type of carbon label is the most effective in influencing purchasing behaviour.

As stated by Bettman et al. (1986) and Golan et al. (2001), information conveyed by labels should be clear and understandable. There are studies investigating to what extent consumers understand the information presented on product labels on food. Before reviewing studies analysing the level of comprehension of the information on carbon footprint labels, we will review studies on nutritional labels since they can provide insights about carbon labelling. First, in their review, Grunert and Wills (2007) indicated that Guideline Daily Amount label (a numerical label) was considered as being harder to comprehend compared to a colour-coded one. Similarly, in their review, Cowburn and Stockley (2005) indicated that consumers found numerical information on nutrition labelling confusing. These authors also pointed out that agents make mistakes in evaluating whether a food product consists of small or large amounts of particular nutrient because of difficulty in comparison with a reference value; however, provision of non-numerical or numerical aids may improve accuracy of comparison of produces.

It is also important to assess to what extent the information provided by carbon labels is actually understood. On the basis of focus groups, Upham et al. (2011) showed that although the majority of participants were in favour of carbon labels, the ones containing numerical values might be misunderstood or hard to make sense. For instance, one participant claimed not being able to make sense of information when they see numbers (e.g., 12 kg, 55 kg) or another claimed not knowing the impact of 260 g of carbon. Moreover, authors indicated that participants were in favour of simplified colour-coded systems and concluded that in the absence of a comparator, it was difficult to make sense of carbon value. Another focus group study was conducted by Hartikainen et al. (2014). It demonstrated that most participants preferred a carbon footprint label containing a scale which allows to make comparisons with other products. These authors conducted an online survey where participants who preferred the label with scale indicated that they found this label informational and clear and that it enabled comparisons with other products, hence may facilitate choices of more sustainable products.

In sum, study by Upham et al. (2011) showed that consumers may prefer colour-coded carbon labels and similarly, Grunert and Wills (2007) also demonstrated that consumers may prefer colour-coded nutritional labels. Moreover, by conducting a systematic review and meta-analysis, Cecchini and Warin (2016) compared nutritional labels, namely, Guideline Daily Amount, traffic lights and other labels. Authors found that traffic lights label which is an interpretative label was more effective in constructing healthier diets.

We have seen that a traffic lights label system (as in nutritional labels and carbon labels) seems to be comprehensible and allows doing comparisons across products; therefore, it can be an effective format for product labelling. However, we can also adopt a more cognitive approach to understand whether traffic lights system can be an effective labelling format in changing consumer behaviour in a more sustainable way.

Muller and Prevost (2016) conducted a review to investigate the cognitive mechanisms behind the use of nutritional labels. First, they analysed studies which aimed to detect the regions in the brain activated when doing arithmetic problems or regions recruited for executive functioning. These authors concluded that it might take more energy to process (i.e., to comprehend and manipulate) numerical labels; in other words, it is a cognitively demanding task. Nevertheless, colour perception may demand little effort or time. For example, Ozturk et al. (2013) conducted an eye-tracking study which demonstrated that children who are 8-months-old have the ability to perceive colour in a categorical manner, suggesting that knowledge of colour vocabulary is not necessary for categorical colour perception.

Moreover, Elliot et al. (2007) proposed that danger or failure could be associated to red colour for different reasons. For example, from early age, individuals learn to associate red to not succeeding in contexts related to achievement (where the competence is assessed according to the outcome, which could be positive or negative) since mistakes were shown with red colour. Moreover, this connection could be maintained and amplified through pairing red colour with danger in other circumstances where a possible negative outcome is prominent such as seeing red colour in traffic lights, in danger signs, or in alarm warning of fire. Therefore, authors hypothesised that to perceive red colour in the contexts related to achievement might lessen the performance since this may trigger individuals to refrain from failure, which in the end may hinder the performance. By conducting experiments, they showed that perceiving red colour before an achievement task may hinder performance and this impairment occurs outside of consciousness. For instance, participants who were exposed to red colour by checking pages of a test to see their participant number (which was written in red) had a worse performance on an anagram task than those who were exposed to different colours, more precisely, green and black. Additionally, they demonstrated that motivation of avoidance might be evoked when red is perceived before an achievement task. This means that after the exposure to red colour manipulation, participants tended to select an easier task than a difficult one. Additionally, participants who were exposed to red colour manipulation before completing an IQ test, manifested right frontal activation, an area linked to the avoidance motivation. To sum up, these results suggest that red may have an impact on behaviour.

From the studies cited above, regarding nutritional labels, one can conclude that colours could be used as tools to transmit information representing nutritional quantity since colours can represent emotions which are linked to the quantity of nutriment when its low or high (Muller & Prevost, 2016). On the contrary, it is less common to attribute emotions to numbers (Muller & Prevost, 2016). To conclude, these studies provide evidence that information processing may be easier when colours are provided instead of numbers.

4. Use of Carbon Footprint Labels in Sustainable Consumption

Global food system is one of the main contributors to greenhouse gas emissions. There is no feasible technological solution to this problem (Ritchie, 2019). Moreover, as Green (2006) stated, our consumption and production patterns should change in order to diminish greenhouse gas concentrations. Hence, carbon footprint labels can be used in the context of sustainable consumption in order to change grocery consumption patterns to reduce carbon footprint generated from them. We will review studies which investigated effectiveness of carbon footprint labels on behaviour, either through field/laboratory experiments, real-life data, or choice experiments.

Study conducted by Hornibrook et al. (2015) investigated the Carbon Reduction Label of Carbon Trust implemented on four product categories (later more categories were included) in 2008 in Tesco, a grocery wholesaler in UK. This label contained numerical carbon footprint information concerning the products. From the data gathered from consumer loyalty card, authors demonstrated that carbon labelling did not have an impact on consumption behaviour.

Furthermore, focus groups analyses were conducted in order to examine why this labelling scheme did not influence purchase patterns. Authors concluded that participants had difficulty in understanding information presented on the label and were not aware of the label on products. Moreover, none of them reported labels having an impact on their purchase decision. However, one limitation may be noted in this study; Hornibrook et al. did not report whether the overall carbon footprint of shopping baskets was impacted with the introduction of this labelling scheme. This result could be important to suggest further evidence of how Carbon Trust label influenced consumers' carbon footprint; in other words, whether it decreased (or had no impact) carbon footprint of shopping baskets. Nevertheless, these labels appeared to be ineffective since Tesco stopped their implementation in 2012 (Lucas & Clark, 2012).

Hornibrook et al. (2015) noted the lack of understanding of Carbon Trust numeric labels. One of the reasons for this can be the difficulty for individuals to use information presented in numeric format in their decision-making. However, when numerical carbon footprint is presented in a format which makes the CO2 information easier to comprehend, numerical values might be used in decision-making process (e.g., Cokely et al., 2012; Sedlmeier & Hilton, 2012).

Carbon Trust type of labels were also tested in experimental settings in which they were shown to be effective. In a field experiment, Perino et al. (2014) tested whether Carbon Trust label could alter consumers' product choices from polluting to cleaner ones. In this within-subjects experiment, participants made two consecutive choices on a computer before entering the supermarket: one choice among products without label and one with label. Moreover, they selected products from limited product categories (milk, cola, butter/margarine, and meat) and in each category, limited product options were presented (between 3 and 12). In the second phase of the experiment, participants had to purchase the chosen products from the supermarket to be able to obtain the voucher and finalize the experiment. Although authors demonstrated that carbon footprint labels were effective in altering choices in a sustainable way, one should note limitations of the setting in which they were tested. First of all, making two consecutive product choices, one in the control condition and second in the condition where CO2 information was communicated through carbon labels may increase the salience of these labels for participants. Secondly, in real life, consumers make their decisions in a more complex environment where they are presented with more product categories and options whereas in this experiment, product choices and options were limited which could render carbon label interpretation easier.

Another study, which tested Carbon Trust label in a discrete choice experiment, was conducted by Apostolidis and McLeay (2019). Authors wanted to investigate the impact of the sustainability labels (carbon footprint label, method of production, region of origin) on stated preferences of five types of mince products (beef, turkey, lamb, pork, meat free). Their results showed that carbon labels had only a mild effect on the mince choices for both vegetarians and meat eaters. However, again, this study used a setting where products were presented in a more structured manner compared to real life situation facilitating comparisons between products, whereas participants in real life are exposed to more product attributes in a less structured way.

Meyerding (2016) conducted a quasi-experiment in Germany with the use of a choice-based conjoint analysis, where the task required participants to choose among products with different attributes such as price, origin, and product labels. The aim was to measure participants' preferences for tomato presented with these different product attributes. Moreover, participants had to order the labels according to their level of importance in participants' buying decisions and evaluate the attributes on a Likert scale. There were five different labels used in the experiment: (a) no label, (b) German organic label, (c) Fair trade, (d) carbon footprint which contains emitted CO_2 amount, and (e) carbon footprint without emitted CO_2 amount. Results of the quasi-experiment and direct questions about carbon label preferences (i.e., participants' evaluation of attributes on Likert scale and ordering task) showed that carbon labels always had the lowest preference rank compared to other attributes (origin, price, organic label, fair trade). Nevertheless, in this setting, participants confronted with only one type of product. Moreover, carbon label containing emitted CO_2 product showed only one CO_2 value; in other words, the numerical value of the label did not change in the experiment, which would not enable participants to make comparisons among different products having different carbon footprint. This feature of the design would not reflect the situation in real-life settings where consumers usually compare different products with different footprint.

Grebitus et al. (2016) conducted a discrete choice experiment where they analysed stated preferences and willingness to pay for environmentally friendly products which contained carbon and water print labels in Germany and Canada. Four products (toilet paper, potatoes, ground beef, yoghurt) were used in this experiment and carbon footprint amount was presented in numerical terms. Results showed that consumers were less likely to prefer products with higher carbon footprint and willingness to pay estimates were negative as the carbon footprint of products got higher in both samples. Nevertheless, again, this experiment was conducted with limited range of products in a more structured manner compared to real life environment.

Apart from carbon footprint labels indicating emitted carbon footprint amount in a numerical format, there are also carbon emission reduction labels, which show how much carbon footprint of related product is reduced during its life-cycle. Van Loo et al. (2014) and Tait et al. (2015) investigated stated preferences and willingness to pay regarding products with such labels in choice experiments. While Van Loo et al. tested these emission reduction labels on a chicken breast together with different sustainability claims, Tait et al. tested on fruits along with other product attributes. Both studies found that participants were willing to pay a price premium for products with carbon footprint labels and had positive preferences for them. However, again, these settings made product comparison easier by presenting products in a structured manner compared to what consumers experience in real life. Moreover, only one product is investigated in both studies.

4.1. Comparing Numerical and Colour-Coded Labels in Sustainable Consumption

As we have seen from the studies cited above, numerical carbon footprint labels may be effective in rendering consumer behaviour more sustainable. However, one should notice that these labels tend to be effective in the settings where they are made salient and/or presented in a structured manner so that consumers can use this information easily to make decisions.

There are also colour-coded carbon labels, which are used in the sustainable consumption context. We will first review studies that investigated both numerical and colour-coded labels and then colour-coded labels alone.

In order to compare a numerical Carbon Trust label and colour-coded Carbon Trust label, Thogersen and Nielsen (2016) conducted a discrete choice experiment. Authors found that colouring the British Carbon Trust label using a traffic light scheme (red footprints for high CO2 products, yellow for medium ones, and green for low ones) was more effective than the classic black and white Carbon Trust label in altering consumer choice towards more sustainable products. However, it is important to note that participants in Thogersen and Nielsen's experiment were also presented with a highly simplified and structured intra-categorical choice setting. Thus, they saw only three options from a single category of product (packets of coffee), which were displayed on an horizontal axis on the screen, so making it easy for participants to evaluate which of the products were higher or lower in carbon footprint. It remains an open question as to whether shoppers in a real-life setting would be able to make such evaluations of relative carbon footprint where many more products are displayed on a shelf, often from different product categories.

Similarly, Meyerding et al. (2019), by conducting a choice experiment, assessed stated preferences of Carbon Trust label and five colour-coded labels on tomato along with other product attributes. First of all, labels in the form of Carbon Trust consisted of three separate labels: (a) a Carbon Trust label indicating carbon emissions of product in numerical values, (b) a black and white label indicating company’s commitment to decrease carbon emissions with a stylized footprint logo, and (c) another a black and white label indicating carbon neutrality of the product with a stylized footprint logo. Secondly, traffic lights carbon footprint labels consisted of five labels: (a) a single three-coloured label indicating carbon footprint in numerical values with a footprint coloured either in green (low emission), yellow (neutral), or red (high emission); (b) a three-coloured label indicating carbon emissions of product along with its numerical value as in the previous label, a three-coloured label indicating company’s carbon emission reduction commitment together with the percentage of reduction, and a three-coloured label indicating an overall score form the first two labels; (c) three-coloured labels expressing the same three information as in previous labels with a different format; (d) a single label indicating carbon content of product on a three-coloured scale (green [low emission], yellow [neutral], red [high emission]) along with its numerical value; (e) a single label indicating carbon content of product on a five-coloured scale (green [lowest emission], light green, yellow, orange, red [highest emission]) along with its numerical value. Authors showed that carbon footprint labels had an impact on food choice as shown by Thogersen and Nielsen (2016). It was demonstrated that all the labels with traffic lights colour scheme were more effective compared to original Carbon Trust label. However, these two studies implemented a choice experiment where the same product with different attributes was presented in a more structured manner. This feature of the design may have facilitated comparison of carbon footprint.

Finally, Spaargaren et al. (2013) conducted a field experiment to examine the impact of coloured-cues on carbon footprint labels on meal choice in a canteen setting. They demonstrated that Carbon Trust type numerical label was not effective in reducing carbon footprint, whereas when the label was accompanied with coloured cues, consumption patterns were changed. Nevertheless, other interventions (e.g., displaying informative posters) implemented during the introduction of the second labelling scheme may have contributed to its effectiveness.

4.2 Use of Colour-Coded and Traffic Lights Labels in Sustainable Food Consumption

Studies cited above showed that carbon footprint labels accompanied with coloured-cues might be more effective compared to the formats containing only a numerical value. Next, we will review, studies investigating colour-coded labels through field/laboratory experiments and choice experiments.

Osman and Thornton (2019), Feucht and Zander (2018), Emberger-Klein and Menrad (2018) conducted choice experiments to test the impact of traffic lights carbon footprint labels on food choice. Osman and Thornton tested the impact of coloured-pastilles (green: low emission, amber: medium emission, red: high emission) on participants' hypothetical meal choices and showed that they were successful in shifting choices towards more sustainable alternatives. Nonetheless, some limitations may be noted. Meal alternatives presented to participants were not perfectly substitutable and information about product price was not provided. Secondly, Feucht and Zander tested the effectiveness of two types of traffic lights carbon footprint labels on milk:

a label inspired from carbon index of the French retailer Casino and another label adapted from EU energy label. They showed that carbon label inspired from carbon index of the French retailer Casino was preferred to its alternative and similarly, participants had higher willingness to pay for this label. However, both carbon labels were preferred against milk without any label. Lastly, Emberger-Klein and Menrad investigated the effectiveness of two types of carbon labels: one scale label coloured in traffic light colours (from dark green [lower emission] to red [higher emission]) based on European Energy Label and inspired by French VOC and second label consisted of a form of a tick indicating carbon reduction approval. While the first label tested on tomatoes, the latter was tested on apples. Authors showed that participants had a preference for carbon labels (i.e., higher utility levels were reached with the provision of labels); however, these labels were not very important in their decision-making process concerning tomato and apple choice. However, additional information provision concerning carbon labels may increase the use of these labels and focus of consumers' attention against the label while choosing products. Lastly, traffic light coded scale label based on European Energy Label was preferred against the label with a tick indicating carbon reduction approval. Nevertheless, we note that these studies were conducted in a structured environment where participants could easily compare different product options with different attributes or used limited number of products (as in Feucht and Zander and Emberger-Klein and Menrad). Moreover, hypothetical choices may not be translated to actual behaviour. Therefore, conducting field or laboratory experiments may provide evidence about how colour coded carbon labels, influence real purchase decisions.

Brunner et al. (2018) conducted a field experiment in a Student Union Restaurant, in Chalmers University of Technology in Sweden to investigate the impact of a modified Carbon Trust label accompanied with coloured-cues on meal purchase decision. Label consisted of a colour-coded bar (from green [lower emission] to dark red [higher emission]) of which the length showed carbon footprint content together with its numerical amount. Authors demonstrated that meat meals containing green label augmented by 11.5% and dishes containing red labels diminished by 4.9%, an impact that could not reach conventional significance level. Purchase of dishes of fish decreased with the implementation of yellow labels, while purchase of vegetarian meals augmented. Fish and vegetarian meals were not impacted by green labels.

Vlaeminck et al. (2014) conducted a choice experiment through a survey to assess the effectiveness of six different environmental labels, two of which contained coloured-cues. First label consisted of an overall environmental friendliness score expressed in numbers. Second label consisted of information about product's production and numerical values concerning its water use, land use, pesticide use, and transport. Third label was a colour-coded label representing product's energy, water, land use, and information about carbon and soil on a graded coloured scale ranging from light green (very environmentally friendly) to dark red (not environmentally friendly). Fourth label was the combination of the first and second label. Fifth label was the combination of the third and first label and lastly, sixth label was the combination of the first three labels. Results of the survey showed that the fifth label was selected as the most effective in communicating environmental friendliness of products. Next, in a framed-field experiment conducted in an experimental shop in Belgium, the effectiveness of this label was compared to that of the least effective label (second label) and to a control condition where no additional information was given (only the usual message given by supermarket was provided). It was shown that the label selected the most efficient led to more sustainable food product choices compared to other conditions. However, we note a limitation in this study; only three product categories, a vegetable, fruit, and protein stand were used.

Finally, Babakhani et al. (2020) used eye-tracking and conducted a survey research and unstructured interviews to investigate visual attention to carbon labels on a restaurant menu. The carbon footprint label they used contained numerical values indicating carbon content of product accompanied by a single coloured bar (green when low emission, red when high emission). Authors showed that carbon labels were not successful in attracting participants' attention and lack of attention could result from confusion with carbon labels' meaning. However, in this study, participants were aware of eye-tracking and a small sample size was used which could contribute to the result of this research.

4.3 Application of Traffic Lights Carbon Footprint Labels in a Grocery Store Context

Vanclay et al. (2011) conducted a field experiment in a grocery store in Australia by using colour-coded Carbon Trust style labels (green indicating lower emission, amber indicating medium emission, and black indicating higher emission), which were shown to be effective in changing consumer behaviour in a sustainable way. First, a non-significant change was detected. More precisely, 4% more products with the green label and 6% less products with the black label were chosen with the introduction of the labels. However, when the products with green labels were also the cheapest option, response shift from products with black label towards to these products was 20%. Nonetheless, Vanclay et al. implemented labels on only five product categories (non-perishable pet foods, milk, canned tomatoes, bottled water, spreadable butter). Moreover, announcement from media about the introduction of labels may have contributed to its effect and questions the study's internal validity.

Muller et al. (2019) investigated the effectiveness of three environmental labels in rendering shopping baskets more sustainable in an experimental online store. First label consisted of a kilometric format expressing the CO2 emissions in terms of kilometres driven by a car. Second label consisted of a single traffic light label that represented CO2 emissions of products with a traffic lights colour schemed pastille (red representing higher emissions, orange medium emissions, and green lower emissions). Third label consisted of multiple traffic lights, which showed carbon emissions of the product, air acidification, and marine eutrophication each of which was represented with a traffic light colour schemed pastille. Results showed that while all three labels were effective in changing consumption decision in a sustainable way, the most effective one was the multiple traffic lights. Nevertheless, we may note some limitations in this study. The design of the study was within-subject meaning that participants first ordered their products without labelling treatment and then, ordered in a second trial with the introduction of one of the three labels. This procedure may render labels more salient than they usually are and therefore their effectiveness could be overestimated.

5. Conclusion

We have shown that labels can be important means for consumers to be able to do informed choices and that carbon footprint labels can change consumer behaviour in a sustainable way. First of all, we have seen that information provision can help consumers to make informed choices, especially when there are market inefficiencies due to hindered information. Information provision can be used for sustainability concerns. Next, we have demonstrated that carbon footprint labels, a type of product label, have been introduced as a tool to diminish carbon emissions and hence may change consumption in a sustainable way. From a psychological point of view, these carbon labels can alter behaviour by activating consumers' environmental goals and help them to choose products in line with these goals or by conveying an implicit injunctive normative message. Furthermore, we discussed that the format of the labels can also be crucial for consumers to use information in their decision-making. For instance, information on the labels should be concise and in a comparative form in order to be used. Concerning the information presented on product carbon footprint labels, some studies showed that participants might not be able to make sense of the information presented in numerical values; on the other hand, coloured format can be easier to interpret. Moreover, insights from cognitive psychology may also support the effectiveness of colour-coded labels compared to numerical ones. In the next section, we reviewed experimental studies and surveys that investigated the impact of carbon footprint labels on food choice. While some studies did not find an impact of numerical carbon footprint labels (e.g., Hornibrook et al., 2015), some of them found that these labels may successfully change consumption choices (e.g., Perino et al., 2014) or that participants may have positive preferences for products with such labels (e.g., Tait et al., 2015; Van Loo et al., 2014). However, in these studies, products with carbon labels were presented in a more structured way compared to presentation of products in real life situations, which may have rendered product comparison easier. In a more realistic environment, Spaargaren et al. (2013) showed that coloured labels could be more effective compared to its numerical alternative in a canteen setting, but other factors such as poster displays may have contributed to their results. We also reviewed studies which have tested the effectiveness of colour-coded carbon labels in realistic settings. For instance, Vanclay et al. (2011), by conducting a field experiment, found evidence for the effectiveness of colour-coded labels in a supermarket setting, but a media influence might have had an influence on their result. In another experimental study, Muller et al. (2019) showed that multiple traffic lights labels could decrease carbon footprint of shopping baskets in an online supermarket. From these studies, we can conclude that numerical labels might be effective when they are presented in a structured way and when product options are limited. Experimental studies showed that colour-coded labels could be effective to promote sustainable food choices; however, we should note that in some studies, external factors such as media attention might have also contributed to their success.

From this review, we can conclude that carbon footprint labels can be effective tools to attain sustainable goals. Colour-coded labels seem to be successful in communicating carbon footprint information of products. However, further studies are needed to determine their effectiveness so that these tools could be used by policy makers to mitigate emissions generated from food consumption. Moreover, another important point is their effectiveness in the long term; therefore, longitudinal studies may be conducted. Additionally, interaction of these labels with other policy tools such as norms or the design of the stores may increase their effectiveness and hence result in a more substantial reduction of carbon footprint.

Empirical Chapters

Chapter 3: Carbon Labels Have More Effect Than Carbon Taxes and Injunctive Norms on Sustainable Consumption in an Experimental Online Grocery Shop*

*** This chapter is an adapted version of the following: Kanay, A., Waroquier, L., Hilton, D., Ambec, S., Vazquez, E., Goeschl, T., & Cézéra, S. (in preparation). Carbon labels have more effect than carbon taxes and injunctive norms on sustainable consumption in an experimental online grocery shop.**

Abstract

Carbon taxes can be used to change consumers' behaviour in a sustainable way and hence reduce greenhouse gas emissions. By running two laboratory experiments, we investigated the price effect and the psychological impact of a linear carbon tax on the carbon footprint of shopping baskets in an experimental online grocery-shopping platform. We further investigated the independent effect of injunctive norms and of traffic lights carbon labels in a second experiment to see whether they would reduce carbon content of shopping baskets. Moreover, we investigated whether these variables improved product carbon footprint knowledge. In our first experiment, we found that carbon footprint can be reduced only when a carbon tax was implemented together with tax signposts (i.e., making the tax salient) and an injunctive normative message justifying its application. Tax signposts did not improve product carbon footprint knowledge. In our second experiment, we found significant impact of carbon labels on basket carbon footprint and product carbon footprint knowledge. Moreover, we found that carbon knowledge was a mediator of the impact of carbon labels on basket footprint. As in the first experiment, carbon tax on its own, alone, had an impact neither on basket footprint nor on carbon knowledge. As far as injunctive norms were concerned, they improved product carbon footprint knowledge.

Keywords: carbon tax, injunctive norms, carbon footprint labels, sustainable consumption, grocery shopping

1. Introduction

Greenhouse gas emissions is a crucial problem which needs close attention. According to the Intergovernmental Panel on Climate Change (2014), anthropogenic greenhouse gas emissions increased between 1970 and 2010; the largest increase happened between 2000 and 2010, which contributed to global warming. Similarly, according to the European Environmental Agency Report (2019), between 2016 and 2017, greenhouse gas emissions rose by 0.5%. Global warming causes externalities to occur; in other words, greenhouse gas emissions may have negative impacts on others at no cost to the emitter. To counteract this, under the standard theory of externalities, a Pigouvian approach would be to implement a tax to the emitter, which is equivalent to the marginal external cost (i.e., additional cost of the damage) (Leicester et al., 2012; Stern, 2006). There are three variations of the Pigouvian approach for using the revenues earned by imposing an environmental tax. First, as in the conventional Pigouvian tax, pollution tax revenues can be transferred to the public. Second, the totality of the revenue can be used for environmental purposes. Third, there is no restriction on how the tax revenue will be used unlike in the first and second cases (Jiang, 2001).

Carbon emissions generated by an individual may have a substantial impact on others and if the agent did not cover the cost of the damage caused by these emissions, externalities occur. One of the monetary instruments introduced to diminish greenhouse gas emissions is the carbon tax, which is a method of pricing the externalities (i.e., damages) generated from the activities/individuals (Stern, 2006; Stern, 2008). The objective is to set a price on activities generating emissions that expresses their social cost (Fullerton et al. 2008). Moreover, carbon taxes are considered as a cost effective tool (Hoeller et al., 1992). For instance, studies have used econometric analysis to investigate carbon tax implemented in British Columbia in 2008 and its impact on demand for gasoline. Thus, Rivers and Schaufele (2015), Antweiler and Gulati (2016), and Xiang and Lawley (2019) found that after the introduction of carbon tax, the short-run demand response on the gasoline price declined, the share of fuel-efficient cars increased in the market, and per capita residential natural gas consumption decreased.

However, it seems difficult to explain the effectiveness of carbon taxes in purely monetary terms. For example, as noted by Rivers and Schaufele (2015), the impact of the carbon tax in the gasoline market in British Columbia was greater than what would be expected on the basis of a purely econometric analysis. They found that carbon tax decreased gasoline demand more than an equivalent but differently introduced price change; this showed that the impact of a carbon tax cannot be explained solely by price effects. The authors suggested that this effect was due to a carbon tax being more salient (e.g., Chetty et al., 2009) than an equivalent price change, but did not discuss in detail what this salience might involve. For example, other factors may have been relevant in explaining the fact that the effect of carbon tax was stronger than what would be expected on the basis of price effects alone. First, carbon tax in British Columbia was presented as an environmentally motivated tax; hence, an injunctive normative message (e.g., undesirability of high usage of gasoline) could be communicated through its introduction, which can explain the strong consumer response. Secondly, the tax was presented as revenue-neutral, meaning that revenue generated by tax will be returned to residents. This aspect can increase the acceptability of tax and therefore may contribute to the decline in gasoline demand.

Other econometric studies have indicated that purely market-mechanism-based explanations of taxation may not always be sufficient in explaining changes in consumer behaviour. For example, the success of a feebate (bonus-malus) fiscal scheme used in France in 2008 to increase market share of more sustainable small-engined cars could not be explained solely by the price effects induced by the fiscal scheme. Consumers responded more strongly to the subsidies (bonus) on cars with lower emissions compared to what econometric models had predicted (d'Haultfoeuille et al., 2014). Findings such as these invite explanation of the effect of fiscal system by non-monetary factors. Various factors of a psychological nature ranging from pro-environmental motivation activated by the imposition of the fiscal system through information conveyed about the carbon emissions of the cars to social justice or patriotism could have motivated consumers to buy smaller-engined cars (Hilton et al., 2014; Schwartz et al., 2019). Finally, it is important to note that imposing environmental fiscal systems may also lead to negative effects on sustainable consumption that are inexplicable in terms of price effects, but which could be explained in terms of psychological processes such as reactance or undermining of intrinsic motivation (Hilton et al., 2014; Perino et al., 2014; Schwartz et al., 2019).

A more detailed understanding of why environmental fiscal systems are effective (or ineffective) in changing consumer behaviour will be important for designing effective policies in the sustainability context. In the present paper, we present and test a psychological approach to understand the effect of an environmentally motivated linear carbon tax in a realistic online grocery-shopping context.

2. Literature Review: Incitations Towards Sustainable Grocery Shopping

According to a report prepared by Intergovernmental Panel on Climate Change (2014), 23% of the anthropogenic greenhouse gas emissions are caused by agriculture, forestry, and other land use. This has led to extensive use of product carbon labels as a way of reducing carbon emissions. However, supermarkets such as Tesco in the UK that introduced product carbon labels have since withdrawn them and studies of carbon labels in real-life or realistic settings have been inconsistent in support of their effectiveness (see Kanay et al., 2021, for a review). Results such as these lead to continuing interest in alternative ways of inciting sustainable grocery consumption, such as environmentally motivated fiscal measures. One question that we will address empirically in Experiment 2 is the relative effectiveness of carbon tax measures and carbon labels in motivating sustainable consumption and learning of product carbon footprint.

A carbon tax can be used as an instrument to diminish emissions associated with food consumption since price is a key factor in food consumption (Reisch et al., 2013; Vermeulen et al., 2019). Similarly, considering the overconsumption of meat products and their harm to health as well as to climate change, Wellesley et al. (2015) presented price changes (e.g., use of a carbon tax) as a mean to change diet patterns in a more sustainable way. However, to our knowledge, groceries have not been directly taxed according to sustainability criteria (in France). However, there are studies that investigated health related taxes on food and beverage consumption (e.g., Acton et al., 2019; Colchero et al., 2016; Colchero et al., 2017; Papoutsi et al., 2015), which showed that these taxes changed behaviour in a healthier direction. Some of the taxes investigated in these studies are indirectly related to environmental concerns, as, for example, decreasing meat consumption may reduce carbon emissions as well as promote a healthier diet (e.g., Panzone et al., 2018). However, the number of studies that have investigated carbon taxes as an emission reduction tool in a grocery-shopping context is limited.

2.1. Carbon Taxes and Grocery Shopping

To our knowledge, there is one experimental study that investigated carbon tax and its effectiveness in an online grocery-shopping context. Panzone et al. (2018) conducted a study on an incentive-compatible experimental online shopping platform and used a carbon tax as a strategy to reduce carbon footprint of shopping baskets. In their experiment, participants made two visits to the experimental market in two consecutive weeks where they made real purchase decisions. They were presented with the same products in both weeks, while in the second week, prices were increased with a carbon tax which corresponds to £70 per ton of CO_2. The authors demonstrated that the application of a linear carbon tax was successful in decreasing the carbon footprint content of shopping baskets. Moreover, the authors also investigated the effectiveness of a nudge (a reminder of participants' past pro-environmental behaviour) in promoting sustainable consumption. This reminder came in the form of a questionnaire probing the frequency of environmentally friendly behaviour participants had performed in the previous seven days, which resulted in a message indicating their estimated carbon savings during that period before they started shopping. The environmental recall treatment led to baskets with lower carbon footprint but did not interact with carbon tax.

However, we may note several limitations with this study. For example, Panzone et al. (2018) only reported the impact of the tax on the total carbon footprint of baskets. Therefore, a perceived income effect may have influenced their results, as participants who decided to spend all their budget in the shop would de facto have been able to buy less items as tax made them more expensive thus reducing the overall CO_2 footprint of their basket. We tried to overcome this issue by reporting the carbon footprint per kg of basket, which allowed us to better assess whether imposing the tax actually affected the type of products (high, medium, or low CO_2) purchased. Moreover, participants in the Panzone et al. study could keep a part of the budget and spend it in a store where they pay no carbon tax. We tried to overcome this limitation by requiring participants to spend most of their budget; this procedure allowed participants to purchase groceries with the budget allocated to them in our experimental store and not to keep an amount of the budget to spend it elsewhere.

2.2. The Effects of Tax Salience (Signposting) on Shopping

Incentives should be salient to have an effect (Sunstein, 2015). One study that investigated the effectiveness of tax salience on consumer behaviour is the field experiment conducted by Chetty et al. (2009) who investigated the salience of sales tax but not a carbon tax. This study was conducted in Northern California in a convenience store, where around 30% of the products received a local sales tax. This tax was implemented at the register and was not included in the prices displayed in the store (i.e., price tags did not include sales tax). Authors described salience of tax as the visibility of prices including taxes. In their study, to detect the impact of tax salience, authors investigated consumers' demand for certain commodities (cosmetics, deodorants, and hair care accessories) when their tax inclusive prices, prices which included sales tax, together with their initial price were displayed on the price tag (i.e., tax salience group) compared to two control groups where price tags contained only tax exclusive prices, meaning prices which did not include sales tax (i.e., as how the price tags were usually displayed). The first control group consisted of produces (i.e., similar toilet products), which were displayed in the same aisleway as the products in the treatment group in the same store. Second control group included all toiletries in some other stores. They found that agents underreacted to taxes, which were not added to the posted price on the price tags; thus, they showed the importance of tax salience in behavioural responses. The authors suggested two reasons for this result: (a) consumers are not provided with the sales tax rates information, (b) the salience of the tax matters meaning that consumers disregard taxes that are not transparent during their decision making process. Authors explained that the first reason would be less likely. However, we may note some limitations in this study. First of all, this study was conducted in the USA, where prices of the products are usually displayed without their sales tax amount on the price tags, which is added later at the store cash register. Consumers visiting the store might have thought that products with sales taxes displayed with the item price (as in the treatment group) would be more expensive compared to the prices in other grocery stores. While Chetty et al. reported a later questionnaire study which they claimed rules out this interpretation, it seems to us impossible to rule out the possibility that consumers *in situ* might have been deterred for this reason from buying products where the sales tax was added. Secondly, there were only three product categories included in the treatment group (i.e., only the price tags of cosmetics, deodorants, and hair care accessories were changed in the experimental sessions by including tax inclusive prices). These categories were chosen because of not being sales leaders so as not to cause revenue losses for the part of grocery store where the experiment was conducted. We tried to overcome this limitation by using all the products in our experimental grocery store to implement the tax salience manipulation. Most importantly, in our studies, we investigated the tax salience with the application of a linear carbon tax to the products in our shop, which was not tested empirically in sustainable grocery consumption context to our knowledge.

A study that tested the effectiveness of tax salience in a grocery-shopping context was conducted by Zizzo et al. (2016) in the United Kingdom. They conducted an experimental study on a website which mimicked an online supermarket platform where participants undertook shopping tasks and made real purchases with two product categories: cereals and soft drinks. Taxes were imposed either on less healthy products or on healthier products with rates of 20% or 40%. In order to manipulate tax salience, the tax imposed on the products were either signposted (displayed) or not. The authors showed that when signposted, both tax rates were effective in reducing purchase of the products that they were implemented on. However, when prices were not signposted, the 20% level of tax was effective in diminishing demand only for cereal products but not for less healthy soft drink products, whereas the 40% level of tax was still effective for both types of products. However, a limitation of this study was having only two product categories in the online supermarket. In addition, although the tax was imposed as a function of product calories, its rationale was not explained to participants. Justifying the application of a tax (e.g., to reduce carbon emission to fight against climate change) may increase its impact (e.g., Hilton et al., 2014). In order to make the shopping environment more realistic and to gain insights on how to design more effective policies, we included different product categories and tested the effectiveness of tax signposts along with justifications of the tax (in the form of injunctive norms) in our studies.

2.3. The Effect of Injunctive Norms on Sustainable Consumption

Injunctive norms may be relevant in the sustainable consumption context; for instance, they could be used together with environmentally motivated taxes in order to justify their application (e.g., Hilton et al., 2014). Injunctive norms refer to “rules or beliefs about morally approved and disapproved conducts” (Cialdini et al., 1990, p. 1015) and may have an impact on behaviour such as reducing littering (Cialdini et al., 1990), alcohol drinking (Larimer et al., 2004), or petrified wood theft (Cialdini et al., 2006). They are likewise used to change consumer behaviour in a sustainable way and shown to be effective (e.g., Cialdini, 2003; Schultz et al., 2007). Moreover, Hilton et al. (2014) showed a significant effect of injunctive norms in altering hypothetical travel choices towards a sustainable way; after being exposed to an injunctive normative message, participants tended to choose environmentally friendly travel option to travel between two cities in France.

3. Our Approach and Hypotheses

Our aim in our studies is to go beyond the economical approach to taxation by integrating psychological factors that can contribute towards understanding their effectiveness in modifying consumer behaviour. Our approach draws on that used by Hilton et al. (2014) in the transport domain by investigating the impact of an environmentally motivated linear carbon tax on online grocery shopping and extends this by studying the potential effects of tax salience by signposting the amount of carbon tax imposed on each product (or only to the products with higher carbon footprint) together with their initial price. We test the impact of a carbon tax in a realistic experimental online grocery shop with multiple products presented under different product categories. Second, we adopt an incentive-compatible scheme meaning that giving participants a chance to win the products they choose which may increase the likelihood to reveal their true preferences. We consider that this provides a choice environment similar to that used by Panzone et al. (2018) and which is more realistic than that used in previous experimental studies (e.g., Hilton et al., 2014; Zizzo et al., 2016), as it presents the participants with a wide range of product categories from which to select.

With the considerations discussed above, we argue that imposing a linear carbon tax can have an impact on sustainable behaviour through at least three mechanisms. First, and in line with standard economic models, economic agents make their choices by maximising their utility considering their budget and prices (Leicester et al., 2012), indicating that demand for a product whose price was increased through a tax should be lower compared to an alternative without a tax. The standard economic approach makes similar predictions to the theory of reinforcement principles proposed by Skinner (2005). This theory posits that the likelihood of a response can be augmented with the presentation of a stimuli or adding stimuli to a situation which are called positive reinforcers; punishment, on the other hand, is used to weaken the response which could be done by adding an unpleasant stimulus or eliminating a rewarding one. As adapted to a taxation scheme, these principles indicate that increasing the amount of tax applied to products with high carbon footprint should work as an unpleasant stimulus to weaken the act of purchasing these products.

Secondly, taxes can have a normative aspect by conveying message concerning which behaviours are desirable and undesirable (Schwartz et al., 2019). An environmental tax can *signal* that pro-environmental behaviour is desirable and so promote it (Fullerton et al., 2008). Injunctive norms were shown to be efficient in altering consumer behaviour in a sustainable way (e.g., Cialdini, 2003; Hilton et al., 2014; Schultz et al., 2007). Moreover, tax can convey messages concerning which products are *good* and *bad* and indicate the importance of carbon emissions (Schwartz et al., 2019). Therefore, justification of carbon taxes through an injunctive normative message can increase the impact of carbon tax. Moreover, announcement of tax with an injunctive norm can emphasize the prominence of carbon consumption (Schwartz et al., 2019).

Taxes can also allow consumers to understand which products are environmentally friendly or not (Schwartz et al., 2019). If consumers know that high-carbon products have been taxed, they may use price information to infer that higher-price products are likely to have high carbon footprint and so decide not to buy them for sustainability reasons. This tendency is likely to be re-inforced by signposting the tax amount imposed on each product (e.g., Zizzo et al., 2016). More specifically, making the tax salient by displaying the amount of the tax (i.e., tax signposting) is expected to have an impact on consumer behaviour. Moreover, tax signposting may also work as an informative label about environmental friendliness of products by informing about their carbon content (i.e., signalling bad and good products as stated by Schwartz et al.). This informative aspect of signposting may allow consumers to improve their knowledge of product carbon footprint.

Based on the foregoing analysis, we examined the following questions in our two experiments. First, we investigated the price effect of the linear carbon tax. Next, we tested whether injunctive norms could increase the impact of linear carbon tax on sustainable consumption. In the second experiment, we also investigated their independent effects on sustainable consumption. Similarly, we investigated whether making the tax salient through tax signposts can enhance sustainability of shopping baskets. We were also interested in product carbon footprint knowledge and analysed whether tax signposting (i.e., making the tax salient) will improve participants' knowledge. In addition, in a second experiment, we tested the impact of carbon labels in the form of traffic lights on basket carbon footprint and carbon footprint knowledge. The design of the second experiment allowed us to detect whether there was any interaction between carbon tax, injunctive norms, and traffic lights carbon footprint labels.

4. Experiment 1

Our principle aim in this experiment was to test the impact of a linear carbon tax on the carbon content of online shopping baskets. We also tested the impact of injunctive norms and tax salience. We tested two different forms of tax salience. Firstly, we displayed the tax amount of all products in our shop together with their initial and final price. Secondly, we only displayed carbon tax amount of products that have the highest carbon footprint, products in the highest carbon footprint tercile, in our shop together with their initial and final price.

To test our hypotheses, we used an experimental online grocery-shopping platform we call *GreenShop*. This high fidelity online grocery-shopping platform contained several grocery items, which were presented in six different shelves (fruits and vegetables, meat and fish, dairy products and eggs, prepared foods, savoury goods, sweet goods). Our platform was designed to closely resemble to real online grocery stores where consumers can easily navigate, see what they choose, and how much of their budget they spend.

In this experiment, we had five experimental conditions. While in the first condition (control) we used baseline prices and gave no additional information, in the rest of the conditions, we increased prices with a linear carbon tax. In the second condition, we applied the tax but did not give any information about it and any normative message. In the third condition, we explained that we applied a carbon tax (which was not displayed) and displayed an injunctive normative message justifying its application. In the fourth condition, we gave the same normative message and announced the carbon tax as in the third condition, but we also displayed the amount of the tax attributed to each product together with their initial price. The fifth condition was similar to the fourth one, except that we only displayed tax amount of the products with higher carbon footprint. We tested the following hypotheses:

Price effect of imposing a linear carbon tax on sustainable consumption: We predicted that the condition where prices are modified with a carbon tax with no normative message and with no tax display (i.e., announced tax) will reduce carbon footprint of shopping baskets compared to the condition with baseline prices (Hypothesis 1).

Psychological effect of a linear carbon tax on sustainable consumption: We predicted that an injunctive normative message justifying the application of tax (with no tax display) will reduce carbon footprint compared to the condition where prices are modified with a carbon tax (but not announced) with no normative message and with no tax display (Hypothesis 2).

Displaying the amount of tax, (i.e., making the tax salient) may influence consumer response and therefore impact purchase decisions (e.g., Zizzo et al., 2016). Therefore, making tax salient through tax signposts may have an influence on consumer behaviour. Additionally, we argue that displaying tax amount of products can function as informative labels about carbon impact of products. Therefore, consumers can learn about the environmental impact of products.

Effect of tax signposting on sustainable consumption: We hypothesized that making the tax salient through displaying the amount of tax attributed to each product together with their initial price along with an injunctive normative message justifying the application of tax will further decrease carbon footprint of shopping baskets compared to the condition where an injunctive normative message justifying the application of tax (with no tax display) was applied (Hypothesis 3a). We hypothesized that making the tax salient through displaying the amount of tax and initial price only for the products with higher carbon footprint along with an injunctive normative message justifying the application of tax will decrease carbon footprint of shopping baskets compared to the condition where an injunctive normative message justifying the application of tax (with no tax display) was applied (Hypothesis 3b).

Effect of tax signposting on learning product CO2 footprint: We hypothesized that making the tax salient through displaying the amount of tax attributed to each product with their initial price along with an injunctive normative message justifying the application of tax will improve product carbon footprint knowledge compared to the condition where an injunctive normative message justifying the application of tax (with no tax display) was applied (Hypothesis 3c). We hypothesized that making the tax salient through displaying the amount of tax and initial price only for the products with higher carbon footprint along with an injunctive normative message justifying the application of tax will improve product carbon footprint knowledge compared to the condition where an injunctive normative message justifying the application of tax (with no tax display) was applied (Hypothesis 3d).

4.1. Method

4.1.1. Participants

In the campus of University Toulouse-Jean Jaurès, France, we initially recruited 217 participants in April 2019; however, because of the technical reasons, the data of 19 participants was lost which reduced our sample to 198 participants 153 of which were females. Participants were aged between 18 and 60 (M = 21.63, SD = 4.79) and had an average 0.87 years of higher education post-baccalauréat (SD = 1.08). For our further analyses, one participant was discarded due to having a low French level. The experiment was between-subject design with one independent variable with five levels. Participants were assigned to one of the five experimental conditions (see Appendix A for further information concerning the sample description).

4.1.2. Materials and Procedure

In both experiments, according to the procedure, participants seated in front of a laptop computer to conduct the experiment by ordering grocery products on our experimental platform. After signing a consent form, participants were provided with instructions. Through instructions, they were informed that they had a budget of €25 to spend and that they had one chance out of five to win the products they selected through a dice roll. Moreover, participants were informed that to be able to leave the shop, they had to spend minimum €20 and that they would not be given the non-spent budget. Due to this procedure, the design of our experiment was incentive-compatible and the reveal of participants' true preferences was encouraged.

In the shopping platform, 116 food and drink products were presented in six different shelves: fruits and vegetables, meat and fish, dairy products and eggs, prepared foods, savoury goods, and sweet goods that they could reach via tabs. A tab for the landing page was also displayed in the platform, which was the first page that was seen when entering the shop. Participants could select one of the corresponding tabs to reach the shelf they wanted. In each shelf, products with their image and their price were displayed. In the platform, selected products could be seen on the right side by clicking on a basket icon together with the budget they spent.

After finishing their grocery shopping, they continued by responding to a questionnaire. They started by completing a validated version of Environmental Attitudes Inventory in French by Moussaoui et al. (2016), then they answered to questions in regard to their grocery purchasing criteria and habit, familiarity with online shopping, diet, and socio-demographic information. Prior to last demographic items (age, gender, French level), participants filled a survey which measured their product carbon footprint knowledge.

4.1.3. Measures

French validation of the Environmental Attitudes Inventory (Moussaoui et al., 2016): The brief version of Environmental Attitudes Inventory developed by Milfont and Duckitt (2010) was validated in French by Moussaoui et al. Authors also tested a very short version of this questionnaire that was composed of 12 items. We used this very short version to measure environmental attitude of participants to assess whether attitudes were related to participants' basket footprint or product carbon footprint knowledge.

Grocery purchase criteria: To describe the characteristics of the sample, seven grocery shopping purchase criteria of which the importance was evaluated on a Likert-type scale varying from 1: *not at all important* to 7: *extremely important* were included to our questionnaire: quality, price, value for money, number of calories, nutritional value, production mode, environmental impact.

Grocery purchase habits: Purchasing habits were assessed. Participants were asked to determine the frequency (1: *never*, 7: *very often*) with which they buy their grocery goods from: hypermarkets, supermarkets, minimarkets, hard discount stores, convenience stores, organic shops, associations for the maintenance of peasant farming, producers, food markets.

Familiarity with online shopping: Participants were asked to indicate how frequently they do online grocery shopping (1: *never*, 7: *very frequently*) by responding the following item: "How often do you shop online in similar stores to this one?"

Diet: We asked participants to indicate whether they followed a diet, if yes, which diet.

Socio-demographics: To determine if socio-demographic factors have an effect on participants' consumption patterns and to describe characteristics of the sample, they were required to indicate their revenue (not mandatory to answer), level of education, field of education or activity, political orientation (not mandatory to answer), age, gender, and knowledge of French (1: *much less good level than my mother language*, 4: *mother language*).

Carbon footprint survey: In this survey, participants were asked to evaluate carbon footprint of 36 products chosen in our food catalogue as low, medium, or high. Participants were provided with default response as "I do not know". Representative products from each of the six categories (fruits and vegetables, meats and fish, dairy products and eggs, prepared foods, sweet goods, and savoury goods) were chosen to be included in the questionnaire. To rule out the possible use of the food-mile heuristic, we excluded produces coming from other countries (Sale, 2012). Likewise, we discarded organic products from the survey. A paragraph about carbon footprint definition was presented before the launch of the questionnaire and products' order was randomly generated. A knowledge score was calculated such that higher scores showed that participants' answers were closer to the correct answers and hence more accurate.[2]

4.1.4. Experimental Conditions:

Control condition (*n* = 37): This condition informed participants that they could do their shopping by browsing different shelves. The prices of the products were baseline prices (see Appendix B for the message displayed on the landing page).

No norm no display carbon tax condition (*n* = 40): The same message as in the control condition was displayed on the landing page (see Appendix C). The prices were increased with a carbon tax. Carbon tax was applied according to each product's carbon content at a rate of €80 per ton of carbon footprint (similar to Panzone et al., 2018); hence, the higher the absolute carbon footprint of a product, the higher the tax amount applied to it[3]. In this condition, the amount of tax was not displayed and participants were not informed about the implementation of the tax.

Norm no display carbon tax condition (*n* = 41): In addition to what was shown in the landing page as in the control condition and no norm no display carbon tax condition, participants were presented with a normative message with the mention of the application of the tax (see Appendix D for the normative message). Prices were increased with a carbon tax as in

---

[2] "I do not know" option was coded as "medium".

[3] Concerning the information about product carbon footprint, we referred to Casino's website providing this information http://www.produits-casino.fr/developpement-durable/dd_indice-carbone-demarche.html. If this information was not available, we referred to Product Carbon Summary prepared by Tesco (2012), website prepared by Environmental Working Grouphttp://static.ewg.org/reports/2011/meateaters/pdf/methodology_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf, information provided by ADEME http://www.bilans-ges.ademe.fr/documentation/UPLOAD_DOC_FR/index.htm?produits_laitiers.htm, information provided by wedodata http://www.wedodata.fr/greencode.php , http://www.eatlowcarbon.org/food-scores/#, paper prepared by Nilsson et al. (2010), article prepared by Smithers, (2018) https://www.theguardian.com/lifeandstyle/2018/jan/25/scientists-calculate-carbon-emissions-of-your-sandwich and information provided by Openfoodfacts https://fr.openfoodfacts.org

the no norm no display carbon tax condition and, again, the amount of tax attributed to products was not displayed.

Norm carbon tax display condition (*n* = 38): The same message as in the norm no display carbon tax condition was displayed on the landing page. All the prices were increased with a carbon tax as in the norm no display carbon tax condition and no norm no display carbon tax condition. Additionally, carbon tax amount applied to each product was displayed together with the initial and final prices (see Appendix E).

Norm high-CO2 display carbon tax condition (*n* = 41): A normative message informing participants about the application of the tax to high CO2 products was displayed on the landing page (see Appendix F for the message). All the prices were increased with a carbon tax as in the no norm no display carbon tax condition, norm no display carbon tax condition, and norm carbon tax display condition. In this condition, the tax amount and the initial price were displayed in addition to the final price for the products in the highest carbon footprint tercile only[4]. For the products of which the carbon footprints were in the lowest and medium tercile, only the final prices were displayed.

4.2 Results

4.2.1. Descriptive Statistics With Self-Reported Measures

Across conditions, the mean of the carbon footprint per kg of basket was 3.31 kg (*SD* = 1) and the mean of absolute carbon footprint of shopping baskets was 18.24 kg (*SD* = 3.45). Concerning the purchase criteria while grocery shopping, participants indicated value for money (*M* = 5.85, *SD* = 1.13) and price (*M* = 5.62, *SD* = 1.23) as the most important criteria and number of calories (*M* = 2.87, *SD* = 1.78) as the least important. Moreover, participants indicated that

[4] Products with the highest CO2 in 100 g of product.

they shop most frequently in hypermarkets (*M* = 4.89, *SD* = 1.65) and supermarkets (*M* = 4.47, *SD* = 1.74) and least frequently in associations for the maintenance of peasant farming (*M* = 1.59, *SD* = 1.35).

Moreover, we computed Cronbach's alpha to evaluate internal consistency of the environmental attitude variable ($\alpha = .62$). Since the level of Cronbach's alpha was low, we did not conduct further analysis with this variable.

Lastly, we analysed whether there was an association between carbon footprint per kg of basket and age, income, level of education, and gender. A significant negative weak correlation was found between carbon footprint per kg of basket and education level ($r(195) = -.15$, $p < .05$, *two-tailed*). However, correlation of carbon content with age and income was not significant (*p*s > .05). Lastly, carbon content did not differ significantly between female (*M* = 3.23, *SD* = 0.9) and male (*M* = 3.6, *SD* = 1.26) participants (t(58.1, *corrected for inequality of variances*) = -1.84, $p = .07$, Hedges' *g*[5] = -.37)[6].

4.2.2. Assessing the Impact of Carbon Tax on Carbon Footprint of Shopping Baskets

For our analyses concerning carbon footprint of shopping baskets and to operationalize sustainable consumption, we used kilograms of carbon footprint per kg of shopping basket as the measure of the dependent variable. We used this measure to assess the sustainability of shopping baskets, although we reported absolute carbon footprint amount (in kg) as well (see Table 1). Moreover, we reported number of products bought in the low carbon footprint, medium carbon footprint, and high carbon footprint categories (see Table 1).

---

[5] Formula for Hedges' *g* (Hedges, 1982, p. 492). $g_i = \frac{\bar{Y}_i^E - \bar{Y}_i^C}{S_i}$, *i* = 1,…, *k* $S_i = \frac{(n_i^E - 1)(S_i^E)^2 + (n_i^C - 1)(S_i^C)^2}{n^E + n^C - 2}$; $g_i^u = c(m) g^i$, $c(m) \approx 1 - \frac{3}{4m-1}$, $m = n_i^E + n_i^C - 2$

[6] Although some of the variables were non-normally distributed, we used Pearson correlation since we had large sample size. The pattern of results showed similarities with Spearman correlation and Mann-Whitney test.

Table 1

*Descriptive Statistics (Experiment 1)**

Experimental conditions	CO2/kg (in kg)	Absolute CO2 of shopping basket (in kg)	Mean of number of products bought in the low CO2 group	Mean of number of products bought in the medium CO2 group	Mean of number of products bought in the high CO2 group	Product carbon footprint knowledge test score	*n*
Control	3.76 *(1.34)*	19.97 *(2.75)*	8.22 *(5.92)*	4.84 *(2.15)*	4.65 *(1.98)*	.36 *(.14)*	37
No norm no display carbon tax	3.27 *(0.8)*	18.34 *(3)*	9.5 *(5.12)*	4.95 *(1.5)*	3.98 *(2.09)*	.4 *(.12)*	40
Norm no display carbon tax	3.29 *(1.05)*	17.56 *(3.2)*	9.59 *(5.54)*	4.88 *(2.86)*	3.78 *(2.08)*	.38 *(.14)*	41
Norm carbon tax display	3.02 *(0.87)*	16.81 *(3.61)*	9.53 *(3.87)*	4.97 *(1.44)*	3.29 *(2.18)*	.44 *(.16)*	38
Norm high-CO2 display carbon tax	3.24 *(0.8)*	18.58 *(3.87)*	8.27 *(4.88)*	4.66 *(1.88)*	4.41 *(2.61)*	.4 *(.12)*	41

***** Standard deviations are shown in parentheses.

In order to examine the effect of carbon tax presentation on the carbon footprint of shopping baskets, we first ran a one-way ANOVA[7] with the condition as between-subjects variable. Results showed that the main effect of carbon tax presentation was significant (F(4, 192) = 2.79, $p < .05$, $\eta_p^2 = .06$). Next, we compared the different conditions with a post-hoc comparison Gabriel test as recommended by Field (2009) for the unequal sample sizes across experimental conditions (please refer to Table 1 for means of each experimental condition).

This analysis revealed a significant difference between the norm carbon tax display condition (M = 3.02, SD = 0.87) and the control (M = 3.76, SD = 1.34, $p < .05$) with a medium effect size (Hedges' g = -.65). Hence, combining a norm and a signposted tax led to a decrease of shopping baskets' carbon content. We reported below more specific comparisons with the aim of disentangling the price, norm, and tax signposting effects; and testing our different hypotheses.

[7] To test the normality of the data, Shapiro-Wilk test was used which showed non-normal distribution of the residuals of the mean carbon footprint of baskets in three experimental groups (*p*s < .05). However, considering the robustness of ANOVA in terms of control of Type-1 error against non-normality (cf. Blanca et al., 2017; Schmider et al., 2010), we conducted our analyses by running ANOVA test.

Price effect of imposing a linear carbon tax on sustainable consumption: Results showed that participants in the no norm no display carbon tax (*M* = 3.27, *SD* = 0.8) condition did not have significantly lower carbon footprint per kg of basket than those in the control condition even though the magnitude of the price effect was close to medium (*M* = 3.76, *SD* = 1.34, *p* = .27, Hedges' *g* = -.44). Therefore, first hypothesis was not supported.

Psychological effect of a linear carbon tax on sustainable consumption: Similarly, participants in the norm no display carbon tax condition (*M* = 3.29, *SD* = 1.05) did not have significantly lower carbon footprint compared to participants in no norm no display carbon tax condition (*M* = 3.27, *SD* = 0.8, *p* = 1, Hedges' *g* = .02). Our second hypothesis was not supported.

Effect of tax signposting on sustainable consumption: Again, results showed that participants in the norm carbon tax display condition (*M* = 3.02, *SD* = 0.87) did not have significantly lower carbon footprint compared to those in the norm no display carbon tax condition (*M* = 3.29, *SD* = 1.05, *p* = .92, Hedges' *g* = -.28). Hence, Hypothesis 3a was not supported. Finally, Hypothesis 3b was not confirmed: Results showed that participants in the norm high-CO2 display carbon tax condition (*M* = 3.24, *SD* = 0.8) did not have significantly lower carbon footprint compared to participants in the norm no display carbon tax condition (*M* = 3.29, *SD* = 1.05, *p* = 1, Hedges' *g* = -.05).

In sum, combining an injunctive norm and a signposted tax did have an effect on sustainable consumption, but the results did not allow to disentangle the different components of this effect.

4.2.3. Assessing the Impact of Carbon Tax on Product Carbon Footprint Knowledge

Further, we conducted a one-way ANOVA[8] to investigate the impact of carbon tax presentation on carbon footprint knowledge. The main effect of our manipulation failed to reach significance ($F(4, 192) = 1.95$, $p = .1$, $\eta_p^2 = .04$; please refer to Table 1 for means in each experimental condition). Therefore, our hypotheses concerning the effect of tax signposting on learning product CO2 footprint (Hypotheses 3c and 3d) were not supported.

4.3. Discussion of Experiment 1

This first experiment showed that the addition of a signposted tax (i.e., displaying the amount of the tax attributed to each product along with their initial price) and an injunctive normative message has an impact on the sustainability of shopping baskets. However, we could not determine which factors underlie this effect. Indeed, each individual effect failed to reach significance. As some of these effects were of small to medium magnitude (e.g., the price effect), the lack of significance could have arisen from a lack of statistical power. Our experimental manipulation did not have either a significant effect on product carbon footprint knowledge.

As our failure to detect individual effect of price, tax signposting, and injunctive norms may be due to a lack of power, we conducted a second experiment with a larger sample and a modified design. Moreover, given its lack of effectiveness in the first experiment, we used a more explicit injunctive normative message. Considering the success of colour-coded carbon labels (e.g., Muller et al., 2019), we introduced carbon footprint labels in the form of traffic lights as a third independent variable. In addition to testing the independent effect of the different variables, the design of this second experiment allowed us to investigate their interactions. This

[8] A Shapiro-Wilk test was used to detect the normality in the data. The results showed that the distribution of the residuals of the carbon footprint knowledge was normal in each experimental group (*p*s > .05).

could be useful from a policy point of view as using a combination of different strategies could be an effective way to foster sustainable consumption.

5. Experiment 2

A carbon tax might be important as a fiscal measure in mitigating carbon emissions and hence could be used to alter grocery-shopping behaviour in a sustainable way. However, traditional monetary instruments are not the only policy tools, that are used to alter consumer behaviour. Economic agents do not always behave rationally as classical economic theories predict and rely on heuristics (Kahneman, 2003), with the result that nudges such as product labels or injunctive social norms can be used to improve policy designs to establish the desired behaviour (Van Deun et al., 2018). In the next section, we will review how carbon footprint labels in the form of traffic lights, a non-monetary instrument, can render behaviour more sustainable and whether non-monetary and monetary instruments can be used together.

5.1. The Impact of Carbon Footprint Labels in the Form of Traffic Lights on Grocery Shopping Behaviour

To mitigate carbon emissions, non-monetary instruments, such as green nudges, were introduced (e.g., Schubert, 2017). Insights from behavioural sciences are applied to policy-making so that individuals could make better decisions for themselves as well as for the society. Nudges are the instruments that are constructed with the progress in behavioural sciences, such as cognitive or social psychology, and can be used in the sustainable consumption context (Mont et al., 2017). Injunctive norms and carbon footprint labels can be examples of nudges.

Labels provide information to consumers about the product they consider purchasing and can be used as a nudge (Cadario & Chandon, 2020). Carbon footprint labels can communicate carbon emission of a product during the period of manufacturing, distribution, use, and disposal;

several studies investigated such labels and their impact on sustainable food purchase behaviour (e.g., Thogersen & Nielsen, 2016; Vanclay et al., 2011). There are different kinds of carbon footprint labels such as colour coded carbon footprint labels which use colours to indicate the emitted carbon amount, numerical carbon footprint labels which indicate emitted carbon footprint amount in numbers (Schaefer & Blanke, 2014); or kilometric format, which expresses the carbon footprint emission equivalent in kilometres driven by car (Muller et al., 2019).

Traffic lights carbon footprint labels, a kind of a colour-coded label, were demonstrated as an effective label in sustainable food choice. For instance, Muller et al. (2019) conducted an incentive compatible lab-experiment study where they demonstrated that a multiple traffic lights label that shows carbon footprint emission, marine eutrophication, and air acidification with either a green, orange, or a red pastille was more effective in fostering the sustainability of grocery baskets than a single traffic light or a kilometric label showing only carbon footprint emission. Another study that tested traffic lights carbon footprint labels in grocery context was conducted by Suchier et al. (in preparation). They investigated the effectiveness of traffic lights carbon footprint labels that express carbon emission of products with three-coloured pastilles (green being the most, orange being the medium, and red being the least sustainable options) in an incentive-compatible experimental online grocery shop and demonstrated that these labels were successful in reducing carbon footprint of shopping baskets.

There might be several reasons for traffic lights carbon labels to be effective in altering behaviour as in the previous studies as explained by Muller and Prevost (2016). For instance, colour perception happens automatically and hence demands little time and effort (e.g., Abadie et al., 2013). Moreover, colours can be attached to emotions, such as red representing danger or signal for caution (Muller & Prevost, 2016).

5.2. The Use of Non-Monetary Instruments and Carbon Tax (Monetary Instrument) on Sustainable Behaviour

The research conducted by Bailey and Harper (2015) suggested that although fiscal measures appear to have the strongest impact in changing food consumption, there is a high likelihood that combining different tools such as price interventions, nudges, and information strategies to be important. Moreover, Mont et al. (2017) indicated that policies that combine fiscal instruments and nudges are being implemented more frequently. Lastly, Stern (2011) indicated that by combining financial incentives and nonfinancial factors, an effective intervention to reduce household carbon emissions could be formed. Author stressed the importance of the mix of psychological and non-psychological elements in effective interventions.

As an example, in their study, Hilton et al. (2014) investigated the effectiveness of a price instrument, a bonus-malus taxation system, and an injunctive normative message justifying its application on the hypothetical choice between an airplane and a train, a less sustainable and a more sustainable option respectively, for a journey. Although authors did not find a significant interaction effect of injunctive norm and bonus-malus (price effect), they found that the likelihood of choosing the train was higher when participants were presented with an injunctive norm and with a price difference of €7 compared to the condition where they were only presented with price difference of €7. Similarly, the likelihood of choosing the train was higher when participants were presented with an injunctive norm and with a price difference of €15 against the condition where they were presented with €15 of price difference alone. This may suggest that the application of a price change in the form of a bonus-malus system with an injunctive norm can be advantageous for sustainable transportation choice.

5.3. Our Approach and Hypotheses

5.3.1. Our Approach

Our aim in this study was not only to detect the price effect of a linear carbon tax but also the psychological impact of this monetary instrument. Therefore, we were interested in examining whether making the tax salient through tax signposts promoted sustainable consumption. Additionally, we extended our first study by investigating the main effect of several non-monetary instruments. More specifically, we tested whether carbon footprint labels in the form of traffic lights and injunctive norms would promote sustainable consumption. The design of this second experiment allowed us to determine whether these different instruments interact, which could not be tested with the design of the first experiment. Additionally, we used a more explicit injunctive normative message and displayed a short version of this message constantly on the shopping platform since the reason of lack of effect of injunctive norms could be due to not being explicit in Experiment 1. Lastly, as in the first study, we were interested in product carbon footprint knowledge and investigated whether tax signposts, traffic lights carbon footprint labels, and its interaction with injunctive norms could improve product carbon footprint knowledge.

5.3.2. Hypotheses:

To test our hypotheses, we used an experimental online grocery shop as in the first study with minor differences. Depending on the condition, participants were assigned to one of the different versions of the shop.

In this second experiment, we used a factorial design crossing three between-subjects variables (3 x 2 x 2). The carbon tax variable had three levels: baseline prices, tax without display, and tax with display. The traffic lights labels variable had two levels: control and carbon labels where the carbon footprint of each product was represented by a coloured-pastille. The injunctive norms variable had also two levels: control and injunctive norm. We tested the following hypotheses:

Price effect of a linear carbon tax on sustainable consumption: We predicted that implementing a carbon tax (without tax display and without announcing the application of the tax) would decrease carbon footprint of shopping baskets compared to baseline condition (Hypothesis 1).

The impact of injunctive norm on sustainable consumption: We predicted that injunctive norm would decrease the carbon footprint of shopping baskets (Hypothesis 4).

The impact of tax signposting (making the tax salient) on sustainable consumption: We predicted that displaying the tax will lower carbon footprint (Hypothesis 5a).

The impact of tax signposting (making the tax salient) on product carbon footprint knowledge: We predicted that participants in the tax with display condition will have higher knowledge score compared to those in the tax without display condition (Hypothesis 5b).

Impact of traffic lights carbon footprint labels on sustainable consumption: We predicted that traffic lights labels would decrease carbon content of shopping baskets (Hypothesis 6a). We predicted an interaction between injunctive norm and traffic lights carbon footprint labels. We expect that traffic lights will have a stronger effect on carbon content of the baskets in the injunctive norm condition than in the control injunctive norm condition (Hypothesis 6b).

Informational impact of traffic lights carbon footprint labels: We predicted that traffic lights labels would enhance product carbon footprint knowledge (Hypothesis 6c). We predicted an interaction between injunctive norm and traffic lights. We expect that traffic lights carbon labels will have a stronger effect on product carbon footprint knowledge in the injunctive norm condition than in the control injunctive norm condition (Hypothesis 6d).

5.4. Method

5.4.1. Participants

We have conducted an *a priori* power analysis with the data of the Experiment 1. Results showed that to detect a tax salience effect (*d* = .28) with a power of 80%, we needed 202 participants in the relevant experimental conditions. This number of participants would allow detecting a price effect (*d* = .44) with 99% of power.

We initially recruited 641 participants in the campus of University of Toulouse-Jean Jaurès. The sample was reduced to a total of 640 due to a participant who did not complete the experiment. Participants were aged between 16 and 43 (*M* = 20.35, *SD* = 3.26)[9] with an average level of 1.38 years of higher education post-baccalauréat (*SD* = 1.48). 60% of the sample was composed of female participants.

For further analyses, five participants who claimed to speak French much less than their mother language were discarded. We used a factorial 3 x 2 x 2 between-subjects design and participants were randomly assigned to one of the 12 experimental conditions (please see Appendix G for more detail concerning sample characteristics).

5.4.2. Materials and Procedure

The same procedure as in Experiment 1 was used with some minor differences. We used a different platform than in the first experiment, although they looked highly similar and functioned the same way. In this platform, participants were able to see their basket and their budget constantly on the right side of the platform.

[9] One participant who wrote “1999” as age was discarded.

5.4.3. Measures

The same measures as in Experiment 1 were used. However, in this experiment, we have added one more item for the purchase criteria, modified the item concerning the diet, and added two items for manipulation check prior to final demographic questions (age, gender, level of French) to test if participants have read the information presented on the landing pages.

Purchase criteria: Same items were used. We have added one more criterion “production place” for participants to evaluate as *not important at all* to *extremely important* on a Likert-type scale ranging from 1-7.

Diet: Participants were asked the following question: “Do you follow a diet for medical, religious, or ethical reasons? Please state for each proposition if you follow that diet”. The diet propositions were as the following to which participants could answer as “yes” or “no”: Halal, Kascher, lactose intolerance, gluten intolerance, vegan or vegetalian, vegetarian, flexitarian (essentially vegetarian).

Manipulation check 1: Participants were required to indicate whether they read the message presented on the landing page with the following question: “Have you read the information displayed on the landing page of experimental shop (the first page when you entered the shop)?”. They could answer as “Yes, I am sure of reading them”, “I think yes, but I am not sure”, “I don’t know”, “I think no but I am not sure”, “No, I am sure I did not read them”.

Manipulation check 2: Participants were required to indicate whether the message about the injunctive norm was displayed. This item was used to understand if they perceived the normative message. The following item was used: “Was the following information displayed on the screen of the shop: ‘According to the experts, I should buy products with lower carbon footprint to reduce greenhouse gas emissions'". Participants could answer as: "Yes, I am sure", "I think yes, but I am not sure", "I don't know", "I think no but I am not sure", "No, I am sure".

5.4.4. Experimental Conditions:

For this experiment, we had a full factorial experimental design of 3 x 2 x 2 crossing independent variables of carbon tax (baseline vs. tax without display vs. tax with display) with injunctive norm (injunctive norm vs. control norm), and traffic lights carbon footprint label (traffic lights carbon footprint label vs. no traffic lights carbon footprint label). This resulted in 12 experimental conditions.

Carbon tax variable had three levels. First, in the baseline level, we used baseline prices. The following message was displayed on the landing page: "You can now use the tabs to gain access to the different shop shelves and proceed with your shopping". Secondly, tax without display level referred to the prices of products that were increased with a linear carbon tax as in the Experiment 1. The amount of tax attributed to each product was not displayed and there was no mention of an application of a tax. The same message used in the previous condition was displayed on the landing page (see Appendix H). Third, tax with display level referred to the prices which were increased with a linear carbon tax as in Experiment 1 and the amount of this tax attributed to each product together with their initial price were displayed. Participants were informed about an application of a carbon tax (see Appendix I).

Injunctive norm variable had two levels. First, injunctive norm level referred to the use of an injunctive normative message in the shop. This message was displayed on the landing page, as well as on the bottom right corner of the shop, in a light green rectangular box, which could be seen all the time during shopping (see Appendix J for the message). In the bottom right corner of the page, the following message was displayed: “According to the experts, to reduce greenhouse gas emissions, one should buy products with low carbon footprint.”. Secondly, in control norm, no injunctive normative message was displayed.

Traffic lights carbon footprint label variable had two levels. First, traffic lights carbon footprint label level referred to the carbon footprint labels in the form of traffic lights that was implemented for each product in our shop. According to their carbon footprint per kg of product, products were divided into three groups (terciles) as products with low carbon footprint, products with medium carbon footprint, and products with high carbon footprint. In the shop, products in the first group received a green pastille, products in the second group received an orange pastille, and products in the third group received a red pastille. Thus, each product in our shop received a coloured-pastille according to their carbon footprint, which could be seen on the screen of the shopping platform. These coloured-pastilles were used as traffic lights carbon footprint labels. The functioning of these labels was explained to participants on the landing page (see Appendix K). Secondly, in no traffic lights carbon footprint label level, these labels were not displayed.

5.5 Results

5.5.1 Descriptive Statistics With Self-Reported Measures

Across all the experimental conditions, the mean carbon footprint per kg of basket was 3.05 kg (*SD* = 0.98) and the mean absolute carbon footprint of baskets was 18.96 kg (*SD* = 3.88). Participants rated value for money and price as the most important grocery purchase criteria (*M* = 5.97, *SD* = 1.18; *M* = 5.64, *SD* = 1.29), while the number of calories rated as the least important (*M* = 2.96, *SD* = 1.82). Concerning purchase habits, participants most frequently purchased grocery products from supermarkets (*M* = 4.28, *SD* = 1.90) and from hypermarkets (*M* = 4.10, *SD* = 2.03), and least frequently from associations for the maintenance of peasant farming (*M* = 1.55, *SD* = 1.31). The sample characteristics showed similarity between Experiment 1 and 2 regarding purchase habit/criteria.

Moreover, we computed Cronbach's alpha to evaluate the internal consistency of the environmental attitude scale ($\alpha = .56$). Since the attitude variable had low internal consistency, we did not conduct further analysis with this variable.

Carbon footprint per kg of basket was significantly correlated to level of education ($r(633) = -.12$, $p < .01$, *two-tailed*) but not to age ($r(632) = -.08$, $p = .05$, *two-tailed*)[10] and to income ($r(517) = -.01$, $p = .89$, *two tailed*). Moreover, there was a significant difference of CO2 per kg of basket between female ($M = 2.98$, $SD = 0.98$) and male ($M = 3.16$, $SD = 0.96$) participants ($t(633) = 2.38$, $p < .05$, Hedges' $g = -.18$, *two-tailed*)[11].

Considering manipulation checks, results of the Manipulation check 1 item indicated that 83.6% of participants reported having read the information presented on the landing page of the shop. Regarding Manipulation check 2 item, among the participants who saw the normative message, 63.9% responded positively to the Manipulation check 2 item asking whether normative message was displayed on the screen of the shop; while among the participants who did not receive this message, this rate was only 21.6%.

5.5.2. Assessing the Impact of Carbon Tax, Traffic Lights Carbon Labels, and Injunctive Norm on Carbon Content of Shopping Baskets

As in Experiment 1, we used kilograms of carbon footprint per kg of basket as our

[10] Participant who wrote "1999" as age was discarded.
[11] Although having variables of which the distribution was non-normal, since we had a large sample, we used Pearson correlation for our analysis. Results with Spearman correlation showed similar pattern of results with Pearson correlation except from the significant correlation between age and carbon content ($r_s(632) = -.12$, $p < .01$, *two-tailed*). Results of *t*-test and Mann-Whitney test showed similar pattern of results as well.

dependent variable to measure sustainable consumption. To detect the main effect of carbon tax, injunctive norm, and traffic lights carbon labels as well as the interaction between carbon labels and injunctive norms, we conducted a three-way ANOVA[12] (please refer to Table 2 to see carbon footprint mean in each experimental condition). Contrary to our expectations, the main effect of carbon tax ($F(2, 623) = 0.97$, $p = .38$, $\eta_p^2 = .00$) on basket CO2 was not significant, disconfirming Hypothesis 1 (i.e., price effect of carbon tax) and 5a (i.e., the impact of tax signposting). Similarly, the main effect of injunctive norms ($F(1, 623) = 0.8$, $p = .37$, $\eta_p^2 = .00$) was not significant; hence, Hypothesis 4 was not supported. Only traffic lights had a significant main effect on the carbon content of shopping baskets with a small effect size ($F(1, 623) = 20.24$, $p < .001$, $\eta_p^2 = .03$). The mean no traffic lights conditions ($M = 3.22$, $SD = 0.95$) and traffic lights conditions ($M = 2.88$, $SD = 0.97$) were in the expected direction, supporting Hypothesis 6a. Lastly, no significant interaction was found between traffic lights carbon labels and injunctive norms ($F(1, 623) = 0.79$, $p = .38$, $\eta_p^2 = 0$) showing that Hypothesis 6b was not supported. Further results showed that all the other interactions were not significant (ps > .05).

[12] To test the normality of the data in each experimental condition, Shapiro-Wilk tests were used. It was shown that in some experimental conditions, the distribution of the residuals of carbon footprint variable was not normal. However, considering the robustness of ANOVA in terms of control of Type-1 error against non-normality (cf. Blanca et al., 2017), we conducted our analyses by running ANOVA test.

Table 2

*Descriptive Statistics (Experiment 2)**

Cond. tax	Cond. norm	Cond. TL[a]	CO2/kg (in kg)	Absolute CO2 of shopping basket (in kg)	Nbr. of low CO2 products	Nbr. of medium CO2 products	Nbr. of high CO2 products	Knowledge	*n*
Baseline	Control norm	TL	3.13	20.72	11.5	5.2	3.74	.53	54
			(1.06)	*(4.65)*	*(5.91)*	*(2.24)*	*(2.32)*	*(.16)*	
		No TL	3.28	20.09	11.15	5.19	4.3	.37	54
			(1)	*(3.42)*	*(6.83)*	*(1.77)*	(2.15)	(.16)	
	Injunctive	TL	2.87	18.84	12.42	5.4	3.28	.61	53
			(0.9)	*(3.53)*	*(6.3)*	*(2.06)*	*(2.18)*	*(.15)*	
		No TL	3.17	20.66	11.92	4.91	4.34	.39	53
			(0.92)	*(4.51)*	*(6.3)*	*(1.91)*	*(1.76)*	*(.12)*	
Tax without display	Control norm	TL	2.74	17.82	13.19	4.58	3.08	.56	52
			(0.74)	*(3.78)*	*(5.99)*	*(2.02)*	*(2.08)*	*(.14)*	
		No TL	3.32	19.4	11.43	5.23	4.15	.35	53
			(1.17)	*(2.94)*	*(5.59)*	*(1.83)*	*(2.05)*	*(.18)*	
	Injunctive	TL	2.95	18.16	11.19	4.56	3.5	.54	52
			(1.21)	*(3.48)*	*(6.15)*	*(2.42)*	*(2.26)*	*(.19)*	
		No TL	3.20	19.29	10.5	4.54	4.48	.41	52
			(0.92)	*(3.35)*	*(6.27)*	*(1.82)*	*(2.03)*	*(.13)*	
Tax with display	Control norm	TL	2.77	17.81	12.94	4.34	2.79	.52	53
			(1)	*(3.76)*	*(7.41)*	*(2.19)*	*(2.07)*	*(.14)*	
		No TL	3.27	18.78	9.64	4.68	4.11	.37	53
			(0.79)	*(3.4)*	*(4.87)*	*(1.66)*	*(1.93)*	*(.15)*	
	Injunctive	TL	2.81	17.53	12.28	4.57	3.09	.57	53
			(0.83)	*(3.71)*	*(6.18)*	*(2.07)*	*(2.18)*	*(.14)*	
		No TL	3.09	18.35	10.89	4.85	4.25	.43	53
			(0.91)	*(4.28)*	*(6.96)*	*(1.75)*	*(1.92)*	*(.14)*	

***** Standard deviations are shown in parentheses.

[a] Traffic lights carbon labels.

Additionally, we conducted further analyses concerning Manipulation check 2 item. Among participants who were assigned to the injunctive norm conditions, we conducted a *t*-test to see if the mean carbon footprint of shopping baskets differed as a function of their response to Manipulation check 2 variable[13] (i.e., whether they responded positively or negatively to the question asking whether the injunctive normative message was displayed). Results showed that among participants who were exposed to injunctive norm message, those who responded positively to the Manipulation check 2 item had a lower mean carbon footprint (M = 2.93, SD = 0.81) compared to those who responded negatively[14] (M = 3.16, SD = 1.16) and this difference was statistically significant (t(176.48, *corrected for inequality of variances*) = -1.89, $p < .05$, Hedges' g = -.24, *one-tailed).*

5.5.3. Assessing the Impact of Carbon Tax, Traffic Lights Carbon Labels, and Injunctive Norm on Product Carbon Footprint Knowledge

We ran a three-way ANOVA[15] to investigate the impact of carbon tax, traffic lights carbon label, and its interaction with injunctive norm on product carbon footprint knowledge (please refer to Table 2 for means in each experimental condition). As expected, the main effect of traffic lights carbon footprint labels on knowledge was significant with a large effect size (F(1, 623) = 192.80, $p < .001$, $\eta_p^2 = .24$). The mean difference between traffic lights condition (M = .55, SD = .16) and no traffic lights conditions (M = .39, SD = .15) was in the expected direction; therefore, Hypothesis 6c was supported. However, against our expectations, the main

---

[13] Answers as "Yes I am sure" and "I think yes but I am not sure" were coded as 0 and "I do not know", "I think no but I am not sure", and " No, I am sure" coded as 1.
[14] Including participants responded as "I do not know" to the Manipulation check 2 item.
[15] Shapiro-Wilk tests were used to detect the normality of the distribution of the residuals in each experimental condition. In some conditions, the distribution of the residuals of the carbon footprint knowledge was not normal. Nevertheless, regarding the robustness of ANOVA in terms of control of Type-1 error against non-normality (cf. Blanca et al., 2017), we conducted our analyses by running ANOVA test.

effect of carbon tax was not significant ($F(2, 623) = 0.31$, $p = .73$, $\eta_p^2 = .0$), disconfirming Hypothesis 5b concerning the impact of tax signposting (i.e., tax salience) on product carbon footprint knowledge. The main effect of injunctive norm was significant with a small effect size ($F(1, 623) = 10.71$, $p < .01$, $\eta_p^2 = .02$). However, against our expectations, the interaction between injunctive norms and traffic lights carbon labels was non-significant ($F(1, 623) = 0.31$, $p = .58$, $\eta_p^2 = 0$), disconfirming Hypothesis 6b. Lastly, there were no significant interaction between injunctive norms, carbon tax, and carbon labels (*p*s > .05).

5.5.4. Mediation Effect of Carbon Footprint Knowledge on the Relation Between Traffic Lights Labels and Basket Carbon Footprint

As reported above, traffic lights labels decreased carbon footprint and enhanced carbon footprint knowledge. In addition, we found a significant negative correlation between carbon footprint knowledge score and basket carbon footprint ($r(633) = -.17$, $p < .001$, *two-tailed*). We thus tested whether product carbon footprint knowledge mediated the impact of traffic lights carbon labels on baskets carbon content with a bootstrapping procedure (Preacher & Hayes, 2004). More precisely, we used 5000 bootstraps via PROCESS (Model 4; Hayes, 2018). We found a significant indirect effect of carbon footprint labels on carbon content of baskets through product carbon footprint knowledge 95% CI [- .18, -.03][16]. Since the total effect of traffic lights carbon labels on carbon content was significant, it can be concluded that an effect of mediation was present.

5.6 Discussion of Experiment 2

The results of Experiment 2 suggest that traffic lights carbon footprint labels are effective

[16] When using heteroscedasticity consistent standard error and covariance matrix, HC4 (Cribari-Neto) (cf. Cribari-Neto, 2004), and bootstrap inference for model coefficients, we still had significant indirect effect (95% CI [-.18, -.03]).

in reducing carbon footprint of shopping baskets and in improving product carbon footprint knowledge. Contrary to our expectations, carbon tax and injunctive norm had no significant effect on basket carbon footprint. However, injunctive norm did have an effect among participants who remembered the normative message. Participants who were exposed to injunctive normative message and indicated that the normative message was displayed had lower carbon footprint than those who indicated that it was not displayed (including participants who chose "I do not know" as an option). This suggests that for a normative message to be effective, people need to pay attention and remember it. Using salient messages could improve their effectiveness. As far as product carbon footprint knowledge is concerned, against our expectations, tax signposts had no impact but injunctive norms did. Moreover, no interaction between carbon footprint labels and injunctive norm was detected on basket footprint and knowledge. Importantly, we demonstrated that the impact of labels on sustainability of shopping baskets was mediated by product carbon footprint knowledge. Hence, traffic light labels were effective in reducing carbon footprint, because they enable participants to improve their knowledge about products' carbon footprint.

6. General Discussion

Across two experiments, we wanted to test the effectiveness of linear carbon tax on sustainable grocery consumption by adopting not only an economical but also a psychological approach. We were also interested in the impact of injunctive norms and traffic lights carbon labels on sustainable grocery consumption and carbon footprint knowledge.

The first experiment showed that the combination of a signposted (displaying the amount of the tax of all the products together with their initial price) linear carbon tax and an injunctive norm was effective in reducing basket carbon footprint. However, the individual effect of price, norm, and tax signposts was too small to reach significance. Moreover, price, tax signposts, and injunctive norms did not have an impact on carbon footprint knowledge.

Second experiment showed that against our expectations, the carbon tax did not seem to have an effect on the sustainability of shopping baskets and on product carbon footprint knowledge. Moreover, although the overall effect of injunctive norms on carbon footprint of shopping baskets was insignificant, participants who indicated that the normative message was displayed in the shop made more sustainable choices than those who did not or indicated not knowing whether it was. These results may suggest that normative messages may be effective, if consumers pay attention to them. Rendering these messages salient for consumers is therefore very important. Additionally, we also demonstrated that provision of a normative message may lead to a better knowledge concerning carbon footprint of products.

Second experiment also showed that traffic lights carbon footprint labels significantly reduced basket CO2. This result is in line with the findings in the literature (e.g., Muller et al., 2019). Moreover, carbon labels also improved carbon footprint knowledge. Another important result was that the impact of carbon labels on basket CO2 was mediated by product carbon footprint knowledge. Hence, traffic lights carbon labels work effectively in reducing carbon footprint of shopping baskets, because they improve consumers' knowledge. Hence, knowledge concerning sustainability of products is crucial. To be an environmentally friendly consumer, one should have some knowledge about which products are *good* or *bad* for the environment.

We did not find a reliable effect of carbon tax on the shopping behaviour. There could be some theoretical reasons for this. First of all, the tax rate we used (€80 per ton of carbon footprint) may not be large enough to have an impact on behaviour. The study of Gneezy and Rustichini (2000) showed that offering a compensation which is not high enough to increase performance can backfire and lose its effectiveness. Accordingly, the amount we used for carbon tax rate may not be an optimum level to have an impact on behaviour. Another factor that can explain the low impact of tax is moral licence. According to this theory, a good act displayed in the past can *licence* a morally problematic behaviour later on. It was also shown that moral licensing can appear in the behavioural context linked to green consumption (Blanken et al., 2015; Mazar & Zhong, 2010). Therefore, participants paying a carbon tax for the products might have thought that paying a tax gave them a moral license to buy products with high CO2. Another reason of the lack of impact could be explained by motivational crowding-out theory (Frey & Jegen, 2001). The mere introduction of the carbon tax as an external motivator might be perceived controlling by participants and hence reduce their intrinsic motivation to behave environmentally friendly. As a result, carbon tax could not work as an effective tool in reducing carbon footprint. Finally, lower acceptance level of carbon tax can be another reason of the lack of effect; nevertheless, actions related to tax revenue usage could be taken so that carbon taxes could be socially acceptable. For example, transfer of the collected revenue to households (e.g., through a decrease in the income tax) can increase its acceptance (OECD, 2013).

We note that Panzone et al. (2018), by using a similar rate for carbon tax and by using a similar shopping platform to ours, found significant impact of carbon tax on basket footprint. One reason of this effect could be the use of absolute carbon footprint in Panzone et al. study. An additional analysis showed that when absolute carbon content was used in our second experiment as the outcome variable, the impact of carbon tax on basket footprint reached significance level ($F(2, 623) = 15.31$, $p < .001$, $\eta_p^2 = .05$)[17], showing a significant price effect as Panzone et al. However, this variable may not be the optimal indicator of sustainability of baskets. Therefore,

[17] Shapiro-Wilk test showed that the distribution of the residuals was normal in experimental groups except in carbon tax & injunctive norm & no carbon label condition ($p < .05$). However, since the skewness value was only moderate (.897) (cf. Bulmer, 1979), we ran ANOVA test for this analysis.

we used kilograms of CO_2 per kg of basket, as we believe that this measure is a better indicator for the sustainability of shopping baskets. For example, while a basket full of low CO_2 products and a basket full with high CO_2 products (with the same budget) may have similar absolute CO_2; the one with low carbon products might have a lower CO_2/kg. Similarly, an advantage of using CO_2 per kg of basket is that this measure could allow consumers to substitute high CO_2 products with products having lower CO_2, which would diminish CO_2/kg of baskets without necessarily reducing consumption. Another reason for using kilograms of CO_2 per kg of basket is that this measure could enable to overcome the income effect caused by the carbon tax. By contrast, the significant impact of carbon tax found on *absolute* carbon content could be a result of an income effect.

Our studies may have important implications as our findings provide important information for policy makers who are aiming to reduce carbon emissions caused by food consumption. Carbon footprint labels in the form of traffic lights could be effective tools in reducing basket carbon footprint through the improvement of product carbon footprint knowledge. An advantage of these labels compared to carbon taxes is that their implementation could be accepted more easily than the application of a tax. Our findings also suggest that if normative messages are used as tools to foster sustainable consumption, it is important to use salient messages that attract consumers’ attention.

Our studies also have some limitations. First of all, participants knew that they were using experimenter’s budget, which could lead them to choose more expensive products than the ones they usually choose. Moreover, although we provided an incentive for participants, they had only one chance out of five of winning their shopping basket. For some participants, this could impact their behaviour, as they know that the chance of winning their basket is not very high.

The provision of shopping baskets to all participants could increase the chances that participants reveal their true preferences.

Secondly, the number of participants that we recruited may not be large enough to detect significant interaction effects, as their effect sizes are usually smaller. Third, our sample composed of participants recruited in the campus of a university may not be representative of the overall population in France. Lastly, although participants reported rarely using online shops similar to ours, it is important to conduct future studies regarding online shopping, as it gives opportunity to provide simultaneous information to consumers about their carbon footprint. Moreover, with the increase in delivery services, the use of online shops might be more common.

Future studies could use a more representative sample to make inferences about the overall population in France. We used carbon tax as monetary instrument and labels and norms as nudges. Future studies may use different monetary instruments and nudges to find effective tools and combination of tools to mitigate carbon emission from food consumption. Another important point is to test different tax rates to detect the most efficient one. Finally, investigating the effectiveness of these instruments in a more realistic setting, such as the field experiments, may give insights about how these tools may work in a less controlled environments.

7. General Conclusion

Our studies question the effectiveness of the overall effect of carbon taxes on sustainable grocery consumption and knowledge, at least with the tax rate we used. Although norms did not have an effect on carbon footprint of baskets, salient messages might have an impact on the sustainability of shopping baskets. Furthermore, norms can improve product carbon footprint knowledge. We have shown that traffic lights carbon footprint labels decreased basket carbon footprint in an experimental online grocery store and improved product carbon footprint knowledge. Most importantly, we demonstrated that the impact of carbon labels on the basket carbon footprint was mediated by product carbon footprint knowledge.

Chapter 4: The Impact of a Bonus-Malus Tax in Online Grocery Shop*

*** This chapter is an adapted version of the following: Kanay, A., Waroquier, L., Ambec, S., Hilton, D., Vazquez, E., Goeschl, T., & Cézéra, S. (in preparation). The impact of a bonus-malus tax in online grocery shop.**

Abstract

Bonus-malus taxation scheme has been used as an economic instrument to decrease CO2 emissions caused by different sectors such as transportation. In two experiments, we investigated the impact of this taxation scheme on carbon content of shopping baskets and on CO2 knowledge in an experimental online grocery shop. More specifically, we disentangled bonus-malus price effect from its psychological effect. To do that, we isolated the effects of price adjustment, tax salience (i.e., provision of tax signposts), and justification messages. In a second experiment, we also investigated the effectiveness of traffic lights carbon labels on basket CO2 and on CO2 knowledge. Over the two experiments, we found no impact of bonus-malus in decreasing carbon footprint of shopping baskets. However, we found a significant impact of traffic lights carbon labels on basket carbon footprint as well as on product CO2 knowledge. A mediation analysis revealed that the reduction of the carbon footprint by traffic lights was due to an increase in CO2 knowledge. Additionally, we found evidence that the bonus-malus tax signposts improved CO2 knowledge. Our results have important implications for policy makers aiming to reduce carbon emissions from groceries.

Keywords: bonus-malus, carbon footprint labels, tax salience, groceries

1. Introduction

According to Fifth Assessment Report written by the Intergovernmental Panel on Climate Change (2014), it is clear that the climate system is influenced by humans and that anthropogenic greenhouse gas emissions are at their highest level in history. Current climate changes had influenced environment and human system. Sea level rose, ocean and atmosphere warmed, and the volume of snow and ice decreased (IPCC, 2014). One sector that emits substantial amount of greenhouse gas is agriculture. This sector is responsible for around 22% of total global emissions, which is higher than the emissions caused by transport sector and similar to emissions generated by industry (McMichael et al., 2007).

Environmental taxation has been introduced as a mean to integrate environmental and social cost (i.e., externalities) generated by economic agents to the cost of their activities and to alter agents' behaviour in a sustainable way. One of the principle aim of this taxation system is to address problems related to climate change. This policy tool is justified in French regulation as *pollueur-payeur* principle (Pourquier & Vicard, 2016).

In 2007, an environmental taxation scheme, bonus-malus, was introduced in France with the aim of increasing the proportion of vehicles with lower CO2 emissions in vehicle fleet (Pourquier & Vicard, 2016). In this system, a *bonus écologique* is defined as a financial aid for the consumers who aim to buy vehicles with lower emissions (CEDEF, 2021) and a *malus écologique* is defined as a penalty aimed at punishing consumers who aim to buy higher CO2-emitting cars (ADEME, 2020). The target was to encourage consumers to buy cars with lower emissions and to instigate producers to supply energy efficient vehicles (Pourquier & Vicard, 2016). Moreover, bonus-malus can be a better taxation scheme than the introduction of a mere carbon tax since it allows creating a budget neutral scheme by using the revenue collected from tax (i.e., malus) to finance subsidies (i.e., bonus) (e.g., de Perthuis et al., 2014). By conducting an econometric study, d'Haultfoeuille et al. (2014) demonstrated that the response to bonus-malus was stronger than what was expected and that macro-economic situation may not explain this effect. Therefore, an extra-monetary effect of this scheme may have had an impact on consumer behaviour.

The investigation of bonus-malus taxation scheme in the sustainable grocery consumption context is limited. Studying bonus-malus to promote sustainable grocery consumption can be useful considering substantial carbon emissions from the food sector. Most importantly, studying non-monetary impact of bonus-malus is crucial for the effective implementation of this scheme to have an impact on consumer behaviour in the desired way since, as indicated by d'Haultfoeuille et al. (2014), price effect may not explain the overall effect of bonus-malus on choices. Additionally, non-monetary instruments such as carbon footprint labels or injunctive norms can be effective in changing the behaviour in the sustainable way to reduce CO2 emissions. Throughout two laboratory experiment studies, our aim was to test not only the price effect of bonus-malus in the sustainable online grocery consumption context but also its psychological effect. Moreover, in our second experiment, we also investigated whether traffic lights carbon footprint labels (TL) are effective in this context and the design of this experiment allowed us detecting whether TL and bonus-malus interacted. Our secondary aim was to investigate whether TL and tax signposts (i.e., display of the amount of the bonus and malus attributed to products) would improve product carbon footprint knowledge.

To investigate our research questions, we created an incentive-compatible experimental online grocery shop we call *Greenshop*. This shop contained several grocery products presented under different shelves (fruits and vegetables, meat and fish etc.; see below for details).

In the remainder of the article, we will discuss the use of bonus-malus in the contexts where it was implemented with sustainability concerns and then we will focus on the use of this scheme in the sustainable food consumption. We will discuss the non-monetary impact of this scheme in these sections. Lastly, we will explain TL, injunctive norms, and their use in sustainable grocery consumption context.

2. Literature Review

2.1. Bonus-Malus Taxation System in the Sustainability Context

Considering substantial CO2 emissions and their impact on climate change, different policies have been introduced to reduce carbon emissions generated from different sectors. In France, to reduce carbon emissions from vehicles, a bonus-malus system (i.e., a feebate system) in 2008 and colour coded energy labelling on cars in 2005 have been introduced as policy tools (d'Haultfoeuille et al., 2013). To understand the reaction from consumer side to these policies and whether they altered their preferences between 2003 and 2008, d'Haultfoeuille et al. conducted a study. They demonstrated a decrease of CO2 emissions from new cars due to these policies and indicated that 20% of this decrease can be attributed to consumers' altered preferences, while price effect explained 51% of it. Moreover, they found that willingness to pay for 10 g of CO2 per km reduction increased in 2008 in comparison to the period of 2003-2006. In sum, these environmental policies can alter consumer preferences towards purchase of vehicles with lower emissions; authors argued that this preference shift could be due to the signal generated by bonus-malus policy indicating the importance of choosing cars with lower carbon emissions, to the easiness to do comparisons between cars with different emissions due to the informational effect of energy labels, or to the increase of advertisements about low CO2-emitting cars. It is also important to note that without this shift of preferences, authors indicated that reduction of emission would be 20% lower. Moreover, they pointed out that while 75% of this preference change was attributed to energy labels, 25% of it to extra-price effect of bonus-malus scheme. Overall, d'Haultfoeuille et al. study showed the importance of non-price effects of environmental policies in diminishing CO2 emissions.

Similarly, d'Haultfoeuille et al. (2014) conducted an econometric study where they analysed the bonus-malus taxation scheme applied in France in 2008. Although this system was designed to be budget-neutral, it costed 285 million euro in 2008 as a result of higher demand to lower CO2-emitting cars. In other words, consumers altered their purchase behaviour towards cars with lower emissions in a substantial way, which was not predicted by the forecasts. Authors argued that they could not explain this effect by macroeconomic situation and seasonal effects. Similarly, d'Haultfoeuille et al. (2011) indicated that consumers reacted more strongly to this scheme than to the typical response to mere price changes and explained this effect of bonus-malus as not resulting from price effect. This also points out that the increase in small-engine cars cannot be explained solely by econometric analysis and that there are other extra-monetary factors that explain this effect.

The results demonstrated by d'Haultfoeuille et al. (2011, 2013, 2014) might be in line with the signalling effect of taxation, which refers to the fact that the price increase through tax generates a greater consumption change compared to price change through producer (Brockwell, 2013). Brockwell indicated that signalling effect may change consumption behaviour via two mechanisms. First, it may inform consumers by signalling properties of commodities, such as implementing a carbon tax to inform about pollution issues generated from cars. Secondly, signalling characteristics of commodities may change norms and therefore alter purchase patterns. Moreover, author showed that signalling negative public effects generated by electricity consumption via environmental taxation was effective in Denmark, Sweden, and UK and from petrol and electricity consumption in UK. Overall, these studies suggested that a taxation scheme, such as bonus-malus, may have an impact on sustainable consumption, which can be attributed not only to a mere price change but also to its non-monetary effects. Bonus-malus can, indeed, inform consumers about the relation of the commodity to climate change or can convey a normative message about consumption. Therefore, we argue that the investigation of the psychological impact (i.e., extra-monetary) of bonus-malus taxation scheme in the sustainable consumption context is important to be able to detect its overall effect on consumers and whether it will be an effective policy tool.

To our knowledge, there are two studies which took a psychological approach to analyse bonus-malus on sustainable consumption and analysed its extra-monetary impact. Hilton et al. (2014) investigated the impact of a bonus-malus scheme and injunctive norms on sustainable transport choices. The authors conducted an experiment where participants made hypothetical transportation choices between an airplane (polluting option) and train (sustainable option) to travel in France. Results demonstrated that bonus-malus and injunctive norms had significant impact on choices. Hilton et al. concluded that bonus-malus could influence sustainable consumption via its normative and price effects. Nevertheless, their study consisted of making a hypothetical choice between two options for which participants did not have to pay and it is possible that they would make different decisions in a more realistic context.

Secondly, Raux et al. (2020) analysed the impact of bonus-malus along with other carbon pricing framing schemes, such as carbon tax and personal carbon allowance, on hypothetical travel choices (choice of train, bus, car, and airplane) for a long distance journey in a discrete choice experiment. The authors also analysed the impact of a psychological variable, social norms, and the impact of providing CO2 information (of travel means). Raux et al. argued that carbon price framing schemes may have an impact beyond their price effects. For instance, it was hypothesized that a bonus-malus scheme may provide normative impact, as malus applied when current carbon emissions exceed CO2 threshold and a bonus when one stayed under this threshold. Although their results showed a significant price effect, framing of bonus-malus did not yield to choices of more sustainable transport alternatives, which was against their expectations. They explained that this lack of effect could be due to crowding-out of intrinsic motivation. Additionally, they found a significant effect of providing CO2 information, which diminished choice of the most polluting travel alternative (airplane) and promoted the most sustainable one (train). Moreover, injunctive normative message enhanced the impact of CO2 information on the choice of airplane. Lastly, framing carbon pricing as personal carbon allowance moderately reduced choice of the least sustainable option. However, as in Hilton et al. (2014), participants made hypothetical choices; hence, no real purchases occurred. They may display different behaviours when choosing a travel mean in real life. Therefore, in our studies, we aimed to provide a more realistic setting to participants where they made real purchase decisions as they had a chance to win the products they selected in our online grocery shop. This design feature may enable us to detect how bonus-malus change behaviour when consumers make real purchase decisions as in real-life contexts and hence have better insights about the functioning of this fiscal measure. Moreover, instead of choosing among limited options, we provided a wide rage of grocery products among which participants could choose, again, a feature reflecting a real-life situation. Lastly, as opposed to these studies, we investigated the impact of bonus-malus in an online grocery shop, in a context where the psychological impact of this taxation scheme has not been tested in an experimental setting.

2.2. The Use of Bonus-Malus System in Sustainable Food Consumption

Interventions from government such as implementation of a tax on food products can be a solution to reduce carbon emissions. Lykkeskov and Gjerris (2017) argued that conducting activities such as contributing to global warming, which could cause serious harm to individuals' rights is considered as morally wrong. Hence, governments ought to implement a tax to the food sector to diminish emissions generated from it. Additionally, from their systematic review, Hallström et al. (2015) and Aleksandrowicz et al. (2016) concluded that altering dietary choices towards sustainable ones were likely to reduce greenhouse gas emissions.

It has been proposed to implement a bonus-malus taxation scheme to improve dietary choices by increasing the price of unhealthy foods and decreasing that of healthier foods (Powell & Chriqui, 2011). Papoutsi et al. (2015) demonstrated in a discrete choice experiment that implementing a fat tax on unhealthier choices and subsidy on healthier ones had a significant impact on parental food choices. Moreover, this taxation scheme was more effective when participants were provided with an informative message explaining why the taxation scheme was implemented (due to the child obesity) together with the information that a fat tax to be applied to unhealthy products and subsidy to healthy ones compared to the condition where they were not provided with the reason of the price changes. Additionally, these fiscal policies with the use of subsidy and tax do not only give information about the increase or decrease of the prices but also may convey normative messages. Another related study is the laboratory experiment conducted by Darmon et al. (2014) who investigated two different price interventions, a subsidy on fruits and vegetables and a subsidy on healthier products accompanied with tax on less healthier products, to see their impact on healthiness of food choices. The authors indicated that under the latter policy, participants reduced the choice of unhealthy product and that this policy was effective in the healthy food choice context. Authors also noted that these policies could not nevertheless diminish economic inequalities in dietary intake. To sum up, these studies demonstrate the potential impact of bonus-malus schemes in healthy food choice context; therefore, it is crucial to test this instrument in the context of sustainable food consumption.

Moreover, Jensen and Smed (2007) conducted an econometric study to compare seven different scenarios with different price instruments (three types of instruments, subsidies, taxes, or combination of the two) to improve dietary choices. The authors indicated that scenarios that combined subsidies (or VAT reductions) on fibres or on vegetables and fruits and taxes on sugar and fat had an influence on the nutrient intake in the desired way; in other words, with these scenarios, while fibre intake increased, that of sugar and fat reduced. Lastly, as Jensen and Smed (2007), Nnoaham et al. (2009) conducted an econometric study to evaluate four different scenarios with different price interventions on food choices to see whether they promoted healthier food consumption. Authors concluded that implementing tax on less healthy foods and proving subsidy for vegetables and fruits at a convenient rate can result in improvements in health.

In sum, these econometric studies suggest that the use of a tax and a subsidy can be effective to improve diets. Nevertheless, it is also important to test these economic instruments in realistic settings where participants make real purchases; therefore, one can detect their impact when agents are facing the outcome of their decisions, which can result differently than the forecasts predicted by econometric analyses (see d'Haultfoeuille et al., 2014). Additionally, considering the potential success of bonus-malus scheme on altering food choices in health context, it is important to test whether this scheme is also effective altering food consumption in sustainable context.

Abadie et al. (2016) conducted an econometric study to investigate combination of a bonus (i.e., a subsidy) and malus (i.e., tax) amount applied on food products to decrease carbon emissions while taking into account their impact on nutrition intake. By using a sample from Norway, authors demonstrated that by implementing a tax on polluting products and a subsidy on sustainable products, dietary changes and carbon emission reduction could be achieved. Although this study, as the other econometric studies cited above, may give useful information about how this policy scheme could work, the use of bonus-malus schemes should be also tested in a more realistic settings, such as experiments or field studies where participants make real purchase decisions.

To our knowledge, there is one study that investigated the bonus-malus in the context of sustainable online grocery shopping context. Panzone et al. (2021) conducted a framed field experiment to detect the impact of a choice architecture manipulation (displaying the products in low, medium, and high carbon footprint aisles in the shop), bonus-malus, moral goal prime, and the interaction of the former with the others on the carbon content of shopping baskets. Participants ordered their products on an online grocery-shopping platform (incentive-compatible) in three consecutive weeks where each participant was assigned to one of the experimental conditions in the second and third week, first week being the control. Their results showed that while choice architecture effectively diminished basket CO2 in the last week by the substitution of high CO2 products with lower ones, goal priming did not. Moreover, bonus-malus decreased basket carbon content in both weeks through the decline of budget spent in the shop. Our experiments extended this study by investigating the psychological aspect of bonus-malus; as a consequence, we also tested the impact of making the tax salient through display of tax signposts (i.e., display of bonus and malus amounts attributed to products) as well as the effect of tax justification messages for the implementation of this fiscal measure. Moreover, in our studies, participants had a higher minimum budget limit to be able to quit the store; that way, participants had to spend most of their budget in our store instead of spending it elsewhere. Consequently, the effect we may detect could not be a result of a lower expenditure in our store. Lastly, we also examined whether bonus-malus (through its signposts) would ameliorate product carbon footprint knowledge.

2.3. Psychological Aspect of Bonus-Malus

2.3.1. Tax Salience

Chetty et al. (2009) demonstrated that individuals' behavioural response was different when the sales tax was applied at the register or when it was included in the posted price by conducting a field experiment in a grocery store in California. In this store, they implemented a new price tag displaying the tax inclusive price (i.e., price including the sales tax) of certain products (deodorant, hair care accessories, and cosmetic) along with the old tags showing tax exclusive prices (i.e., prices which did not include sales tax). Their results showed that demand towards these products reduced by 8% when displaying tax inclusive prices on tags compared to two control conditions. Authors provided two explanations for this result. The first one was that consumers did not know about the rates of sales tax and these tags informed them. The second one was that increasing tax salience would make them pay attention to the tax what they do not usually do when they shop. Nevertheless, authors pointed out that the first explanation would be less likely. To sum up, authors emphasized the fact that whether a tax was salient or not had an impact on consumers' responses. Therefore, as Chetty et al., we tested the impact of tax salience in our studies. But differently from them, we tested this through provision of tax signposts indicating bonus or malus amount attributed to products. By displaying the tax signposts for all the products, we extended Chetty et al. study that only changed price tags of certain toiletry products. Moreover, the impact of tax salience of a bonus-malus in sustainable online grocery consumption context has not been tested before to our knowledge.

Similarly, in the healthy food consumption context, Bogenschneider (2017) discussed sin taxes that he defined as an implemented tax in order to diminish purchase of a product. He considered taxes as signposts and argued that these taxes would have an impact on consumer behaviour not only through its incentive aspect but also through its direct communication about the healthiness of the product. For tax signposting, author developed 15 benefits some of which are the fact of it being simple, objective, and clear visual aid. Author argued that the use of taxes as labels would be simple since the total tax amount could be expressed as one number and that this number would be easier to interpret for a person with low nutritional knowledge. Moreover, a label of tax could be considered as a visual aid, which indicates healthiness of the product. To sum up, from his review, author asserted that conveying information concerning product tax is a knowledge-strengthen strategy and that for fiscally motivated individuals, tax labelling could boost the impact of nutritional labels or surpass it in altering consumer behaviour.

2.3.2. Injunctive Norms

"The injunctive meaning of norms refers to rules or beliefs as to what constitutes morally approved and disapproved conduct" (Cialdini et al., 1990, p. 1015). When these norms are activated, they may yield conducts which are socially favourable (Cialdini et al., 1991). Injunctive norms can be a motivator or demotivation for our behaviour through its expected social penalties or prize for behaving or not behaving in a particular manner (Jackson, 2005).

Injunctive norms may also promote sustainable consumption. Steg and Vlek (2009) considered concerns related to norms and moral as a motivational determinant of environmental behaviour. For example, Hilton et al. (2014) demonstrated that providing an injunctive normative message could help participants to alter their hypothetical travel choices towards the sustainable alternative in an experiment. Moreover, De Groot et al. (2013) provided evidence for the effectiveness of injunctive norms in reducing the use of plastic bags. By conducting a field study in a supermarket in United Kingdom, authors showed that consumers who saw a message containing an injunctive norm along with an environmental message used fewer plastic bags than those who were only exposed to the environmental message.

Similarly, Green (2006) stated that consumer behaviour could be changed not only through price increases or decreases but also through the influence of norms, which was an important construct in making improvements in environmental context. Moreover, author also mentioned about the possible impact of taxes on values and norms since they (also subsidies) convey messages about the matters concerning global warming instead of imposing penalty or responsibility. Similarly, Schwartz et al. (2019) stated that implementation of taxes such as carbon tax would inform individuals about the seriousness of carbon emissions and facilitate recognition of environmentally friendly and non-friendly alternatives. As a result, we can conclude that bonus-malus could be viewed as an injunctive norm.

2.4. Carbon Footprint Labels in the Sustainability Context

Carbon footprint labels are a type of eco-labels introduced in order to achieve sustainable consumption and production. Carbon footprint labels communicate how products contribute to climate change and provide aid for individuals and firms willing to diminish their carbon footprint (Shewmake et al., 2015). They display information concerning products' greenhouse gas emissions generated from their production until disposal (Nishino et al., 2014).

Effectiveness of different types of carbon footprint labels has been tested in experimental studies. In a discrete choice experiment, Thøgersen and Nielsen (2016) compared the effectiveness of a numerical Carbon Trust label and the same label accompanied with coloured cues. By choosing coffee as the experimental product, participants were divided into two groups so that while one group was presented with the former label, the other group with the latter. The authors demonstrated that the impact of the numerical Carbon Trust label was enhanced when it was accompanied with traffic light colour scheme. They also demonstrated that the use of carbon labels in the decision-making was positively related to participants' concern for the environment. However, the design of the experiment may have rendered the comparison of the same experimental product with different attributes easier as the presentation format was systematic, which may be more complex in real-world settings as consumers tend to compare different products from different categories. We tried to overcome this limitation in our studies by creating an online shop, which mimicked real-life online grocery stores. In our shop, different grocery products were presented under different shelves, where participants had to compare different products from the same and/or different product categories as they usually do in real-life supermarkets.

There are other studies showing the success of colour coded carbon footprint labels in the context of sustainable consumption. Muller et al. (2019) conducted an experiment to test the effectiveness of three environmental labels in rendering shopping baskets sustainable in an experimental grocery store. First label, a single traffic light carbon footprint label, was constituted of a pastille of which the colour depended on the carbon emissions of the product (green when lower emission, orange when medium emission, and red when higher emission). Secondly, multiple traffic lights label indicating three criteria (carbon emissions, air acidification, and marine eutrophication) consisted of three colour-coded pastilles (following the same colouring principle as single traffic light label). Lastly, a kilometric format label indicating carbon emissions as kilometres conducted by a car was used. The authors showed that all labels were effective in altering grocery product choices in a sustainable way; however, it was multiple traffic lights label that diminished carbon emissions the most. However, this study used a within-subjects design, where participants first selected grocery products in a reference condition where no label was presented, before selecting products in a second condition where they were presented with one of the three labels. This procedure may have made labels more salient to the participants and created a demand effect. However, our studies have overcome this limitation by using a between-subjects design, where each participant was exposed to only one experimental condition.

Study conducted by Vanclay et al. (2011) investigated the effectiveness of traffic light-schemed carbon footprint labels (green indicating lower carbon emissions, amber medium emissions, and black higher emissions) in a grocery store in Australia. They demonstrated that the purchase of products with a green label increased and that of black-labelled products decreased. Although these results were non-significant, authors found out that when products with green labels were also the cheapest option, consumers altered their choices from products with black label towards products with green labels at a substantial level. Although this study had promising results, we may note some limitations such as the media attention to the label implementation in the supermarket, which was covered in local television and radio.

The successful impact of colour coded carbon labels can be a result from a need for a benchmark to evaluate sustainability of products. In their systematic review, Cowburn and Stockley (2005) stated that integrating a benchmark could help individuals to assess information provided on nutritional labels. Therefore, the colour-codes could be used as a benchmark by consumers; hence, sustainability of products could be easily evaluated and comparison between products could be facilitated. As a result, these labels could help consumers to choose sustainable products.

3. Experiment 1

Our aim in this experiment was to investigate the effectiveness of bonus-malus on sustainable grocery consumption, more specifically, on the carbon content of shopping baskets. We began by investigating price effect of this scheme. Moreover, we were also interested in the psychological aspect of this fiscal measure. To do this, we examined the impact of tax salience (through the display of tax signposts) and of an injunctive normative message justifying the application of the bonus-malus on carbon content of shopping basket. Additionally, we tested whether a normative message would decrease basket carbon footprint. Finally, we investigated whether making the tax salient through tax signposts would ameliorate knowledge concerning product carbon footprint.

In order to test our hypotheses, we constructed an online shopping platform that we call Greenshop. In this experimental online shopping platform, there were 116 grocery products presented in six different shelves (fruits and vegetables, meat and fish, dairy and eggs, prepared food, sweet goods, and savoury goods). On this platform, participants could see a landing page that presented different information depending on the experimental condition. Participants could also see the prices of the products, their budget, and the products they put in their basket (depending on the condition, participants were presented with other information concerning products).

In this first experiment, we had eight experimental conditions (see below for details). In the no norm baseline condition, we used baseline prices. In the no norm medium bonus-malus without display condition, prices were adjusted with a bonus-malus at a medium rate; however, the amount of bonus and malus attributed to products was not displayed. The no norm large bonus-malus without display condition was similar to the previous condition expect that the price adjustment was larger. In the norm baseline condition, we used baseline prices and presented an injunctive normative message about the danger of CO2 generated from groceries. In the norm medium bonus-malus without display condition, we used the same normative message as in the previous condition and also explained that we implemented a bonus-malus scheme; prices were adjusted with a bonus-malus at a medium rate, but the amount of bonus and malus attributed to products was not displayed. The norm medium bonus-malus display condition was similar to the previous condition except that the bonus-malus amount attributed to each product was displayed. In the norm large bonus-malus without display condition, the normative message was displayed, implementation of bonus-malus was announced, and prices were changed at a high rate, but this adjustment was not displayed. The norm large bonus-malus display condition was the same as the previous condition, but the amount of bonus and malus attributed to each product were displayed.

Half of the products in the Greenshop was subsidized (i.e., provision of a bonus) and the other half was taxed (i.e., provision of a malus) according to their carbon footprint relative to that of *median* product. We have chosen two different amounts for bonus and malus to see whether the adjustment rate would have an impact on carbon content of shopping baskets and on product CO2 knowledge. First, the rate of the tax (i.e., malus) and subsidy (i.e., bonus) applied to each product's initial price was 5.5%. We have chosen this amount since it was a rate close to VAT on food products in France (cf. Service-Public, 2021). Secondly, since we wanted to compare a lower and larger amount of bonus and malus, we chose 15% as the second rate in our experiment.

Lastly, the injunctive normative message we used was similar to the one used by Hilton et al. (2014), as the authors have found a significant impact of the normative message they used on the sustainable mobility choices.

3.1. Hypotheses

Price effect of bonus-malus on sustainable consumption: Participants in the no norm medium bonus-malus without display condition (Hypothesis 1a) and in the no norm large bonus-malus without display condition (Hypothesis 1b) will have lower carbon footprint compared to those in no norm baseline condition.

Signposting effect of bonus-malus on sustainable consumption: Participants in the norm medium bonus-malus display will have lower carbon footprint compared to those in norm medium bonus-malus without display (Hypothesis 2a). Participants in the norm large bonus-malus display will have lower carbon footprint compared to those in norm large bonus-malus without display (Hypothesis 2b).

Signposting effect of bonus-malus on product carbon footprint knowledge: Participants in the norm medium bonus-malus display will have higher carbon footprint knowledge compared to those in norm medium bonus-malus without display (Hypothesis 2c). Participants in the norm large bonus-malus display condition will have higher product carbon footprint knowledge compared to those in norm large bonus-malus without display (Hypothesis 2d).

Psychological impact of bonus-malus on sustainable consumption: Participants in the norm medium bonus-malus without display will have lower carbon footprint compared to those in no norm medium bonus-malus without display (Hypothesis 3a). Participants in the norm large bonus-malus without display will have lower carbon footprint compared to those in no norm large bonus-malus without display condition (Hypothesis 3b).

Effect of norm: Participants in the no norm baseline condition will have higher carbon footprint compared to those in norm baseline condition (Hypothesis 4).

3.2. Method

3.2.1. Participants

One hundred and ninety-six participants were initially recruited in Toulouse School of Economics from its subject pool in January and February 2019. Participants were aged between 17 and 37 (M = 20.58, SD = 3.01) with an average of 1.97 (SD = 1.58) years of higher education (post-baccalauréat). Sample composed of 119 female and 77 male participants. Three participants indicated speaking French much less than their mother language; therefore, we discarded them from further analyses.

3.2.2. Materials and Procedure

Participants completed the experiment in a computer laboratory in Toulouse School of Economics, France. They seated in front of a computer and were separated with a cardboard from other participants. First, they signed consent forms and were provided with written instructions. Afterwards, they started shopping on the computer. Instructions provided information concerning their budget. Participants had €30 to spend and had to spend minimum €25 to be able to exit the shop; moreover, the unspent budget would not be returned to them. They were also informed that they had 1/5 chance of winning the selected products. Therefore, this design could help us to detect participants' true preferences, as the experiment was incentive-compatible.

Once having finished their grocery shopping and validated their basket, participants responded to several questions. First, they completed the Environmental Attitude Inventory validated in French by Moussaoui et al. (2016). Next, they completed questions regarding the criteria they consider during their food purchase, the type of store they visit to purchase food, and the frequency of online grocery shopping. They also completed a carbon footprint knowledge survey and answered to socio-demographic questions. In the end of the experiment, participants rolled a dice to find out if they won their basket. The winners were provided with instructions explaining the basket collect procedure.

3.2.3. Measures

Environmental Attitudes Inventory (validated in French by Moussaoui et al., 2016): A very short version of this inventory (IAE-12) containing 12 items was used to assess participants' environmental attitudes. This questionnaire is a French validated version of the Environmental Attitudes Inventory developed by Milfont and Duckitt (2010) and enabled us to detect whether attitudes were associated with participants' basket carbon footprint and knowledge.

Criteria and habits of food purchase: Seven food criteria were evaluated for their importance on a Likert scale (1: *not at all important*; 7: *extremely important*) which allowed us to describe the characteristics of the sample: quality, price, quality over price, number of calories, nutritional values, production mode, environmental impact. Habits concerning food shopping were also measured. Participants revealed how often they buy their groceries on a Likert scale (1: *never*; 7: *very frequently*) in: hypermarkets, supermarkets, minimarket, hard discounts, convenience stores, organic stores, associations for the maintenance of peasant farming, producers, and food markets.

Frequency of online grocery shopping: Participants were asked to determine how frequently they purchase their groceries on online shops similar to this shop on a Likert scale (1: *never*; 7: *very frequently*).

Socio-demographic questions: To determine whether participants' socio demographic characteristics are related to their consumption and describe the characteristics of our sample, they were required to indicate their revenue (non-obligatory item), field of activity or education, level of education, political opinion (non-obligatory item), age, gender, level of French.

Carbon footprint knowledge questionnaire: To assess their carbon footprint knowledge, participants were asked prior to last demographic questions to evaluate carbon footprint of 36 products that were chosen from Greenshop catalogue. Representative products from each food category (fruits and vegetables, meat and fish, dairy products and eggs, prepared food, sweet goods, and savoury goods) were selected for the survey and participants could evaluate carbon footprint as high, medium, or low. They were also provided with "I do not know" option. They were presented with a brief explanation of carbon footprint before starting questionnaire. The environmental knowledge score assessed how accurate participants' answers were[18]; thus, higher score meant a higher knowledge.

3.2.4. Experimental Conditions

1. No norm baseline condition: Baseline prices were used (see Appendix L for the message displayed on landing page).
2. No norm medium bonus-malus without display condition: Prices were adjusted with a bonus-malus scheme at a medium rate. The malus and bonus rate implemented to initial price of each product was 5.5%. Participants were not

[18] "I do not know" option was coded as "medium".

informed about the implementation of the bonus-malus and the bonus or malus amount attributed to each product was not displayed.

3. No norm large bonus-malus without display condition: Prices were modified with a large bonus-malus scheme at a rate of 15%. Participants were not informed about the bonus-malus implementation and the bonus or malus amount attributed to each product was not displayed.
4. Norm baseline condition: Baseline prices were used and participants were provided with an injunctive normative message about the danger of CO2 generated from grocery shopping (see Appendix M for the normative message displayed on the landing page).
5. Norm medium bonus-malus without display condition: Prices were modified with a medium bonus-malus. An injunctive normative message justifying the implementation of the bonus-malus because of the danger of CO2 generated from grocery shopping was presented on the landing page (see Appendix N for the normative message), but the bonus or malus amount attributed to each product was not displayed.
6. Norm medium bonus-malus display condition: Prices were modified with a medium bonus-malus whose implementation was justified by the injunctive normative message (i.e., same message as in the norm medium bonus-malus without display condition was used). The bonus or malus amount attributed to each product was displayed (see Appendix O).
7. Norm large bonus-malus without display condition: Prices were modified with a large bonus-malus. The implementation of the bonus-malus was justified by the

injunctive normative message (i.e., same message as in the norm medium bonus-malus without display condition was used), but the bonus or malus amount attributed to each product was not displayed.

8. Norm large bonus-malus display condition: Prices were modified with a large bonus-malus whose implementation was justified by the injunctive normative message (i.e., same message as in the norm medium bonus-malus without display condition was used). The bonus or malus amount attributed to each product was displayed.

3.3 Results

3.3.1. Descriptive Statistics With Self-Reported Measures

Across all conditions, participants had an average 3.39 kg carbon footprint per kg of shopping basket (*SD* = 1.14) and a mean total carbon footprint of 16.57 kg (*SD* = 3.27). Participants rated the highest value for money (*M* = 6.18, *SD* = 1.01) and price (*M* = 5.71, *SD* = 1.14) as the criteria they consider during food purchase and the least number of calories (*M* = 3.10, *SD* = 1.84) and nutritional values (*M* = 3.98, *SD* = 1.82). Moreover, they indicated that they do grocery shopping more often in supermarkets (*M* = 4.97, *SD* = 1.68) and in hypermarkets (*M* = 4.74, *SD* = 1.83) and less frequently in associations for the maintenance of peasant farming (*M* = 1.35, *SD* = 1) and directly from producers (*M* = 1.95, *SD* = 1.46) (see Appendix P for more details concerning the sample).

We computed Cronbach's alpha to assess reliability of IAE-12 (α = .54). Since we have found a low level of Cronbach's alpha, we did not conduct further analysis with the attitude variable. Additional analyses were conducted to assess the association between age, income, level of education, and gender, and sustainable consumption (i.e., carbon footprint per kg of basket). No significant mean difference was detected between female (*M* = 3.33, *SD* = 1.24) and male (*M* = 3.5, *SD* = 0.98) participants ($t(191) = -1$, $p = .32$, Hedges'[19] $g = -.15$, *two-tailed*). Similarly, carbon footprint per kg of basket was not significantly correlated to income, level of education, or age (*p*s > .05)[20].

3.3.2. Assessing the Impact of Bonus-Malus on Carbon Footprint of Shopping Baskets

To measure the sustainability of the shopping baskets, we used kilograms of carbon footprint per kg of basket as our dependent variable; however, we also reported the mean total carbon footprint (in kg) and carbon footprint per euro (in kg) as well (see Table 3).

Table 3

*Descriptive Statistics (Experiment 1)**

Experimental conditions	CO2/kg (in kg)	Absolute CO2 of shopping basket (in kg)	CO2/€ (in kg)	Product carbon footprint knowledge test score	*n*
No norm baseline condition	3.19 (1.01)	16.97 (3.21)	0.57 (0.11)	.38 (.15)	22
No norm medium bonus-malus without display condition	3.59 (1.65)	17.18 (4.25)	0.58 (0.14)	.35 (.12)	27
No norm large bonus-malus without display condition	3.47 (1.28)	16.14 (2.91)	0.54 (0.1)	.35 (.14)	24
Norm baseline condition	3.23 (0.62)	16.85 (3.09)	0.57 (0.1)	.43 (.1)	19
Norm medium bonus-malus without display condition	3.27 (0.89)	16.35 (3.65)	0.55 (0.12)	.37 (.13)	25
Norm medium bonus-malus display condition	3.54 (1.25)	15.61 (3.37)	0.53 (0.11)	.46 (.1)	24
Norm large bonus-malus without display condition	3.45 (0.92)	16.47 (2.09)	0.55 (0.07)	.4 (.13)	26
Norm large bonus-malus display condition	3.34 (1.17)	16.99 (3.22)	0.57 (0.11)	.4 (.14)	26

* Standard deviations are shown in parentheses

[19] Formula for Hedges' g (Hedges, 1982, p. 492). $g_i = \frac{\bar{Y}_i^E - \bar{Y}_i^C}{S_i}$, $i = 1,\ldots, k$ $S_i = \frac{(n_i^E-1)(S_i^E)^2 + (n_i^C-1)(S_i^C)^2}{n^E + n^C - 2}$; $g_i^u = c(m)g^i$, $c(m) \approx 1 - \frac{3}{4m-1}$, $m = n_i^E + n_i^C - 2$

[20] Although some of our variables had a non-normal distribution, we used Pearson correlation for our correlational analysis since we had a larger sample (cf. Field, 2009). Non-parametric Spearman and Mann-Whitney tests showed similar pattern of results with the results we reported.

To detect whether our experimental manipulation had a main effect on the carbon content of shopping baskets, we conducted a one-way ANOVA[21] of which the results showed a non-significant effect ($F(7, 185) = 0.39$, $p = .91$, $\eta_p^2 = .02$). Therefore, our hypotheses concerning price effect of bonus-malus (Hypotheses 1a, 1b), tax signposting (i.e., tax salience; Hypotheses 2a, 2b), psychological impact of bonus-malus (Hypotheses 3a, 3b), and effect of normative message on carbon content of shopping baskets (Hypothesis 4) were not supported (please refer to Table 3 for means in each experimental condition).

3.3.3. Assessing the Impact of Bonus-Malus on Product Carbon Footprint Knowledge

First, we conducted a one-way ANOVA[22], to detect whether our experimental manipulation had a significant main effect on product carbon footprint knowledge. Results showed a significant main effect ($F(7, 185) = 2.12$, $p < .05$, $\eta_p^2 = .07$).

Next, as recommended by Field (2009), since the size of the experimental groups was unequal, we conducted post-hoc Gabriel comparison to test our hypotheses concerning the effect of tax signposts (i.e., tax salience) on product carbon footprint knowledge.

Results showed that carbon footprint knowledge score in the norm medium bonus-malus display ($M = .46$, $SD = .1$) and norm medium bonus-malus without display ($M = .37$, $SD = .13$) conditions did not differ significantly ($p = .3$, Hedges' $g = .76$). Therefore, Hypothesis 2c was not supported. Similarly, carbon footprint knowledge score in norm large bonus-malus display ($M = .4$, $SD = .14$) was not significantly different than that in norm large bonus-malus without

[21] To determine whether the distribution of the residuals was normal, we conducted Shapiro –Wilk tests. The results showed that the distribution of the residuals of the carbon footprint per kg of basket was not normal in some experimental groups (*p*s < .05). However, as explained by Blanca et al. (2017) and Schmider et al. (2010), ANOVA is a robust test to control for type 1 error against non-normality. Therefore, we conducted further ANOVA test with this variable.

[22] To determine whether the distribution of the residuals was normal, we conducted Shapiro –Wilk tests. The results showed that the distribution of the residuals of the product carbon footprint knowledge was not normal in some experimental groups (*p*s < .05). However, as explained by Blanca et al. (2017), ANOVA is a robust test to control for type 1 error against non-normality. Therefore, we conducted further ANOVA test with this variable.

display (*M* = .4, *SD* = .13, *p = 1*, Hedges' *g* = 0). Hence, Hypothesis 2d about the impact of tax signposts on product CO2 knowledge was not supported. Further results showed no significant differences between experimental conditions (*p*s > .05).

We conducted further analyses by creating a new display factor with three levels (no norm without display vs. norm without display vs. norm with display) by excluding no norm baseline condition and norm baseline condition. Moreover, we created a new adjustment factor with two levels (medium bonus-malus vs. large bonus-malus) always by excluding no norm baseline condition and norm baseline condition. Next, we ran a two-way ANOVA with these two factors as independent variables. This analysis revealed a significant main effect of display factor on product CO2 knowledge ($F(2, 146) = 5.02$, $p < .01$, $\eta_p^2 = .06$)[22]. Post-hoc comparison Gabriel test showed a significant difference between norm with display (*M* = .43, *SD* = .13) and no norm without display level (*M* = .35, *SD* = .13, *p* < .01, Hedges' *g* = .61). This result showed the effectiveness of tax signposts when accompanied by a normative message that announces the implementation of the taxation scheme.

3.4 Discussion of Experiment 1

In this experiment, we wanted to investigate the impact of bonus-malus on sustainable consumption. More specifically, we wanted to investigate the price effect of bonus-malus on carbon content of shopping baskets. Additionally, we were also interested in psychological impact of this taxation scheme and investigated whether psychological aspect of bonus-malus had an impact on carbon content of shopping baskets. In order to test this, we analysed whether displaying tax (i.e., malus) or subsidy (i.e., bonus) amounts of each product or presenting an injunctive normative message justifying the implementation of the taxation scheme alter consumption behaviour. Another aim was to detect whether these tax signposts could increase product carbon CO_2 knowledge. We found that bonus-malus taxation scheme altered carbon content of shopping basket neither through its price effect nor its psychological impact. Signposting tax amounts (i.e., making the tax salient) or justifying the application of the tax through an injunctive normative message did not alter carbon content of shopping baskets. Similarly, displaying a normative message about CO_2 emissions from grocery shop did not have an effect. Additionally, while initial analyses did not provide evidence for our hypotheses that tax signposting enhanced product CO_2 knowledge, when contrasting tax display with norm (i.e., displaying tax signposts together with a normative message) and no display without norm (i.e., without provision of a normative message and without the display of the amount of the bonus/malus) conditions, we found a significant effect. Hence, gaining statistical power by aggregating several conditions provided evidence for the positive impact of tax signposts together with an injunctive normative message announcing the implementation of bonus/malus on product CO_2 knowledge.

There could be different reasons for the lack of effect of our experimental manipulation on basket carbon footprint in this first study. First, the sample we used was not large, which could result in lack of statistical power. Secondly, the way we described the bonus-malus system could be confusing for participants (e.g., to explain the “bonus-malus” on the product choice pages, the words “taxe” and “bonus” were used, while a different wording was used on the landing page). Third, bonus and malus amounts attributed to each product might not have been clearly communicated to participants, because (a) they might have thought that “bonus” corresponded to a fee they would receive at the end since “bonus” implies something gained; (b) the bonus-malus amount was not positioned in a systematic and distinct manner on the screen, which might have led participants to overlook this information; (c) participants may have confused the initial price without bonus/malus and the final price they will pay. Additionally, participants may not have clearly understood how bonus and malus affected the prices, because we did not provide enough information about the functioning of this scheme. Finally, because the message about the danger caused by greenhouse gas emissions was difficult to understand, it may have been difficult for participants to understand the implication of buying high carbon products; hence, effectiveness of the normative message could be diminished. We thus run a second experiment in which the framing of the bonus-malus was modified with a larger sample size as suggested by the power analysis.

4. Experiment 2

4.1. Aim and Hypotheses:

4.1.1. Aim

Our aim in this study was to detect the impact of bonus-malus on sustainable grocery consumption operationalized as carbon content of shopping baskets. First, we tested the price effect and then in order to test the psychological impact of this scheme, we investigated the impact of tax signposts (i.e., making the tax salient) together with a message justifying the application of the bonus-malus scheme on the sustainability of shopping baskets. Moreover, considering the success of colour-coded labels on sustainable shopping (e.g., Muller et al., 2019), we examined the impact of TL. We tested whether TL had a main effect on the sustainability of shopping baskets. Our secondary aim was to test the impact of bonus-malus (more specifically the impact of tax signposting) and TL on product carbon footprint knowledge. Additionally, the modified experimental design allowed us to detect interactions between bonus-malus and TL.

We changed the way malus and bonus amounts were computed to better reflect the impact of carbon footprint of products on their prices. Products were divided into three groups according to their CO2 per 100 g. Products belonging to the highest carbon footprint group received a tax (i.e., malus) and its amount was determined according to each product's total carbon footprint. Products belonging to the group of medium emission received neither a tax nor a bonus (i.e., subsidy). Products belonging to the lowest carbon footprint group received a bonus (i.e., a subsidy).

We used two different tax amounts for malus and computed the bonus in a way to have a budget neutral design. First rate we used for malus amount was €80 per ton of CO2 (i.e., medium rate) which was chosen following the study of Panzone et al. (2018) in which a carbon tax of £70 per ton of CO2 was used. In this study, carbon tax worked effectively and reduced carbon footprint of shopping baskets in an experimental grocery store. It was found that the average increase rate of prices of products receiving malus was 7.63% in our shop; hence, we used this as the bonus (i.e., subsidy) rate on the initial prices of low carbon footprint products. Second rate of malus, €250 per ton of CO2 (i.e., high rate) was chosen following the suggestion of carbon price to be implemented in 2030 to achieve carbon neutrality in 2050 in France (Bueb et al., 2019). Similarly, this malus rate increased prices of the products to which it was applied by 23.8%. This rate then used as bonus (i.e., subsidy), which was applied to low carbon products' initial price. As a result, the high bonus-malus rate we used in this experiment was higher compared to the high rate we used in Experiment 1 and similarly, the medium rate we used was higher than the one we used in the first experiment. This could increase the likelihood of having an effect on consumer behaviour.

To test our hypotheses, we made several modifications to our experimental grocery store as compared to Experiment 1. First, we explained the danger of greenhouse gas emissions in an easier way. Additionally, we aimed to describe the bonus-malus in a simpler way along with a message which clearly communicated how this scheme functioned. Moreover, we modified the way we presented the amount of bonus-malus attributed to each product. Under the name and the image of the product, we displayed its initial price on a first line, the amount of the bonus or the malus on a second line, and the final price on a third line. Finally, we simplified the design of the experiment by combining tax justification message and tax signposts in order to increase statistical power.

The design of the experiment was a 5 x 2 factorial design crossing bonus-malus and TL variables. Bonus-malus variable had five levels (see below for the details). In the first level, baseline prices were used. In the second level, prices were adjusted with a medium rate bonus-malus scheme, but price changes were not displayed. In the third level, a medium rate bonus malus whose implementation was justified by a message was implemented and the bonus or malus amount applied to each product was displayed. In the fourth level, prices were changed with a high rate bonus-malus scheme that was not displayed. In the fifth level, a high rate bonus malus whose implementation was justified by a message was implemented and the bonus or malus amount applied to each product was displayed. Finally, depending on the condition, half of the participants were presented with TL while the other half did not see any label.

4.1.2 Hypotheses:

Price effect of a bonus-malus on sustainable consumption: Participants in the medium bonus-malus without display (Hypothesis 5a) and in large bonus-malus without display (Hypothesis 5b) conditions will have lower carbon footprint than those in baseline condition.

Psychological impact of the bonus-malus on sustainable consumption: Participants in medium bonus-malus with display will have lower carbon footprint compared to those in medium bonus-malus without display (Hypothesis 6a). Participants in large bonus-malus with display condition will have lower carbon footprint compared to those in large bonus-malus without display condition (Hypothesis 6b).

Psychological impact of bonus-malus on carbon footprint knowledge: Participants in medium bonus-malus with display will have higher carbon footprint knowledge scores compared to those in medium bonus-malus without display (Hypothesis 6c). Participants in large bonus-malus with display condition will have higher carbon footprint knowledge scores compared to those in large bonus-malus without display condition (Hypothesis 6d).

Effect of TL on sustainable consumption: TL will reduce carbon content of shopping baskets (Hypothesis 7a).

Effect of TL on carbon footprint knowledge: TL will enhance product carbon footprint knowledge (Hypothesis 7b).

4.2. Method

4.2.1. Participants

We pre-registered our study on Open Science Framework that could be reached via the following link https://osf.io/r8asy/?view_only=58c8eb51da2d4c728fc906db9c06fc15. Moreover, before launching the experiment, we conducted a power analysis to compute the number of participants needed for this experiment. We calculated that with 600 participants, we could detect an effect as small as .02 of bonus-malus with 80% power.

Six hundred and sixteen participants were initially recruited in University Toulouse-Jean Jaurès between January and March 2020. However, because of a technical problem of the computer used by one participant, we excluded them from the data, which resulted in a final sample of 615 of which 68.3% was composed of female participants. Participants were aged between 17 and 45 (M = 20.91, SD = 3.35) with an average of 1.67 (SD = 1.34) years of higher education (post-baccalauréat). Twelve participants indicated speaking French at a much lower level than their mother language; therefore, further analyses were conducted by discarding these participants.

4.2.2. Materials and Procedure

We used the same procedure as in the Experiment 1 with some differences: Participants had €25 to spend in the shop and had to spend minimum €20 to be able to quit. We used a very similar shop to the one used in Experiment 1.

Compared to the first experiment, we reduced baseline prices with an amount of 33% and therefore decreased the budget to €25. We made this change in order to display initial prices which were more representative of the prices in the supermarkets not located in the city centre.

After completing their grocery shopping, participants started to fill questionnaires. The items we used were the same items used in Experiment 1 with minor modifications as explained below.

4.2.3. Measures

Criteria and habits of food purchase: Same items as in the first study were used. Nevertheless, we used one more item for the criteria which was assessed the same way as the others: production place.

Diet: Participants were asked whether they follow a specific diet for medical, religious, or ethical reasons by answering as “yes” or “no” to the following: Halal, Kasher, lactose intolerance, gluten intolerance, vegan, vegetarian, flexitarian (mainly vegetarian).

Manipulation check: Prior to last socio-demographic questions, we asked participants whether they read the information given on the landing page (i.e., first page they saw when entering to shop). They could answer as “Yes, I am sure of reading it”, “I think yes, but I am not sure”, “I do not know”, “I think no, but I am not sure”, “No, I am sure of not reading it”.

4.2.4. Experimental Conditions

In this experiment, we had two independent variables and used a fully crossed design (5 x 2): bonus-malus with five levels and TL with two levels resulting in 10 experimental conditions.

Bonus-malus variable had five levels (see Table 4 for a summary):

1. Baseline: This level corresponded to the condition where participants were presented with baseline prices of products (for the message presented on the landing page, see Appendix Q)
2. Medium bonus-malus without display: This level referred to the condition where product prices were changed with a bonus-malus with a medium rate, but participants were not informed about the price change. The amount of bonus and malus attributed to products were not displayed. Same message as in the baseline condition was used on the landing page (see Appendix R).
3. Medium bonus-malus with display: This level referred to the condition where product prices were changed with bonus-malus the same way as in the medium bonus-malus without display level. However, in this condition, a text justifying the application of the bonus-malus was displayed on the landing page of the shop and malus or bonus amounts attributed to each product were displayed (to make the tax salient through tax signposts) for each product along with their initial prices (for the message displayed on the landing page see Appendix S).
4. Large bonus-malus without display: This level referred to the condition where product prices were modified with a bonus-malus with a high rate, but

participants were not informed about the price change. The amount of bonus and malus attributed to products were not displayed. Same message as in the baseline condition was used on the landing page.

5. Large bonus-malus with display: This level referred to the condition where product prices were changed with a large bonus-malus the same way as in the previous condition. However, in this condition, a text justifying the application of the bonus-malus was displayed on the landing page of the shop and malus or bonus amounts attributed to each product were displayed (to make the tax salient through tax signposts) for each product along with their initial prices (the same message as in the medium bonus-malus with display was used).

Table 4

Explanation of the Levels of Bonus-Malus Variable of the Experiment 2

Experimental conditions	Malus (tax) rate	Bonus (subsidy) rate	Bonus-malus display and justification	Neither bonus nor malus (use of baseline prices)
Baseline				Baseline prices were used for all the products.
Medium bonus-malus without display	€80 per ton of CO_2	7.63% reduction on initial product prices	Neither bonus-malus display nor justification message was presented.	Products with medium carbon emissions
Medium bonus-malus with display	€80 per ton of CO_2	7.63% reduction on initial product prices	Bonus, malus amounts were displayed; the scheme was justified with a message.	Products with medium carbon emissions
Large bonus-malus without display	€250 per ton of CO_2	23.8% reduction on initial prices	Neither bonus-malus display nor justification message was presented.	Products with medium carbon emissions
Large bonus-malus with display	€250 per ton of CO_2	23.8% reduction on initial prices	Bonus, malus amounts were displayed; the scheme was justified with a message.	Products with medium carbon emissions

TL variable had two levels:

1. Control TL: This level referred to the condition where participants were not presented with TL.

2. TL: This level referred to the condition where each product received a TL according to their carbon emissions. Products were divided into three groups according to their CO2 per 100 g to form high, medium, and low carbon emission groups to receive a label. Products having the highest carbon footprint received a red pastille, those with medium carbon emission received an orange pastille, and those with the lowest carbon emission received a green pastille. Participants were also provided with an informative text on the landing page of the shop explaining the functioning of these labels (see Appendix T).

4.3. Results

4.3.1. Descriptive Statistics With Self-Reported Measures

Overall, the mean total carbon footprint of shopping baskets was 19.71 kg (SD = 3.87) and the mean carbon footprint per kg of basket was 3 kg (SD = 1.02). Participants rated the highest the value for money (M = 5.95, SD = 1.1) and price (M = 5.74, SD = 1.24), rated the lowest the number of calories (M = 3.03, SD = 1.82) and nutritional values (M = 4.10, SD = 1.85) as the criteria they consider for food purchase. Moreover, participants indicated that they shop more frequently in supermarkets (M = 4.43, SD = 1.96) and in hypermarkets (M = 3.99, SD = 2.07) and less frequently in associations for the maintenance of peasant farming (M = 1.54, SD = 1.39) and from producers (M = 1.98, SD = 1.64). Thus, sample characteristics concerning shopping habits and criteria showed similarities between Experiment 1 and 2 (see Appendix U for more details about the sample).

Cronbach's alpha was computed in order to assess reliability of IAE-12 (α = .6). Since the IAE-12 had a low internal consistency, we did not conduct further analysis with this variable. Additionally, we conducted analyses to detect the association between carbon content of shopping baskets (i.e., CO_2 per kg of basket) and income, level of education, age, and gender. Results showed that carbon content of shopping baskets was negatively correlated to level of education ($r(601) = -.11$, $p < .01$, *two-tailed*). By contrast, carbon content was not significantly correlated to income and to age (*p*s > .05). There was no significant difference in CO_2 per kg of basket between female ($M = 2.99$, $SD = 1.03$) and male ($M = 3$, $SD = 0.99$) participants ($t(601) = 0.11$, $p = .91$, Hedges' $g = -.01$, *two-tailed*)[23].

Finally, we computed results related to manipulation check item. A majority (81.1%) of participants expressed having read the information given on the landing page of the shop (i.e., the total of participants selecting “Yes, I am sure of reading it” and “I think yes, but I am not sure” as answer).

4.3.2. Assessing the Impact of Bonus-Malus and TL on Carbon Content of Shopping Baskets

As in the first experiment, we used carbon footprint per kg of shopping basket (in kg) as dependent variable; nevertheless, we also reported the mean total carbon footprint amount (in kg), mean carbon footprint per euro (in kg), and mean number of products bought in green/orange/red carbon footprint groups (see Table 5). Moreover, additional preregistered analyses with absolute carbon footprint (in kg); carbon footprint per euro (kg); and percentage of high (i.e., red), medium (i.e., orange), and low (i.e., green) CO_2 products in baskets were reported in Appendix V.

A two-way ANOVA[24] was conducted to determine the effect of bonus-malus and TL on the carbon content of shopping baskets as well as their interaction (see Table 5 for means).

---

[23] Although some variables did not have a normal distribution, we used Pearson correlation for our analyses due to having a large sample size (cf. Field, 2009). Results computed with Spearman correlation and Mann-Whitney test showed similar pattern of results except for the correlation between age and carbon content ($r_s(601) = -.12$, $p < .01$).
[24] To determine whether the distribution of residuals was normal, we conducted Shapiro –Wilk tests. The results showed that the distribution of the residuals of carbon footprint per kg of basket was not normal in some

Results showed that TL had a significant main effect on carbon content of shopping baskets ($F(1, 593) = 14.07$, $p < .001$, $\eta_p^2 = .02$). In line with Hypothesis 7a, participants in the TL condition ($M = 2.84$, $SD = 1$) built baskets with lower carbon footprint than those in the control TL condition ($M = 3.15$, $SD = 1.01$). By contrast, bonus-malus did not have any effect on carbon content ($F(4, 593) = 0.19$, $p = .94$, $\eta_p^2 = 0$). Therefore, our hypotheses concerning price effect of a bonus-malus on sustainable consumption (Hypotheses 5a and 5b) and psychological impact of bonus-malus on sustainable consumption (Hypotheses 6a and 6b) were not supported. Finally, the interaction between TL and bonus-malus was not significant ($F(4, 593) = 1.72$, $p = .14$, $\eta_p^2 = .01$).

Table 5

*Descriptive Statistics (Experiment 2)**

Cond. bonus-malus	Cond. TL	CO2/kg (in kg)	Absolute CO2 of shopping basket (in kg)	CO2/€ (in kg)	Mean of number of products bought in the green carbon footprint group	Mean of number of products bought in the orange carbon footprint group	Mean of number of products bought in the red carbon footprint group	Product carbon footprint knowledge	*n*
Baseline	Control	3.32 (0.91)	20.92 (4.49)	0.87 (0.18)	10.89 (4.44)	5.03 (1.48)	4.74 (2.83)	.38 (.15)	61
	TL	2.7 (0.91)	18.63 (4.59)	0.78 (0.18)	12.93 (5.55)	4.58 (2.21)	3.05 (2.05)	.56 (.13)	59
BM M[a] without display	Control	3.12 (1.27)	20.70 (3.79)	0.86 (0.15)	12.69 (7.98)	5.37 (1.86)	4.02 (1.95)	.4 (.17)	62
	TL	2.96 (1.08)	18.89 (3.31)	0.79 (0.13)	12.18 (6.26)	4.74 (1.86)	3.2 (1.92)	.52 (.18)	61
BM M with display	Control	3.13 (0.88)	20.09 (2.93)	0.83 (0.13)	11.56 (8.69)	5.95 (1.94)	3.82 (1.95)	.45 (.15)	61
	TL	2.75 (1.06)	18.82 (4.22)	0.78 (0.17)	13.46 (8.13)	5.07 (2.36)	3 (2.32)	.55 (.17)	59
BM L[b] without display	Control	3.16 (0.84)	20.22 (3.65)	0.84 (0.15)	10.92 (6.07)	5.25 (1.87)	4.28 (1.66)	.37 (.15)	60
	TL	2.78 (0.84)	19.6 (3.55)	0.82 (0.14)	14 (7.99)	5.14 (2.09)	3.44 (2.21)	.56 (.15)	59
BM L with display	Control	3.01 (1.11)	19.47 (3.1)	0.82 (0.12)	12.05 (7.26)	5.72 (1.97)	3.5 (1.9)	.45 (.15)	60
	TL	3.01 (1.07)	19.65 (4.22)	0.82 (0.17)	12.46 (8.84)	4.85 (1.82)	3.25 (2.07)	.58 (.15)	61

* Standard deviations are shown in parentheses.

[a] Medium bonus-malus

experimental groups (*p*s < .05). However, as explained by Blanca et al. (2017), ANOVA is a robust test to control for type 1 error against non-normality. Therefore, we conducted further ANOVA test with this variable.

[b] Large bonus-malus

4.3.3 Assessing the Impact of Bonus-Malus and TL on Product Carbon Footprint Knowledge

We conducted a two-way ANOVA[25] to assess the main effect of bonus-malus and TL as well as their interaction on product carbon footprint knowledge (see Table 5 for means). Results showed a significant main effect of TL ($F(1, 593) = 134.81$, $p < .001$, $\eta_p^2 = .19$) on carbon footprint knowledge and in line with Hypothesis 7b, participants in TL condition ($M = .56$, $SD = .16$) had better knowledge scores compared to those in the control TL ($M = .41$, $SD = .16$). Moreover, bonus-malus had a significant main effect ($F(4, 593) = 3.01$, $p < .05$, $\eta_p^2 = .02$), but its interaction with TL was not significant ($F(4, 593) = 1.58$, $p = .18$, $\eta_p^2 = .01$). To test the rest of the hypotheses, we conducted post-hoc comparison Gabriel test (cf. Field, 2009).

Psychological impact of bonus-malus on carbon footprint knowledge: A non-significant mean difference of carbon footprint knowledge score was found between medium bonus-malus with display ($M = .5$, $SD = .17$) and medium bonus-malus without display condition ($M = .46$, $SD = .18$, $p = .32$, Hedges' $g = .23$), disconfirming Hypothesis 6c. Similarly, the mean product carbon footprint knowledge score in large bonus-malus with display condition ($M = .52$, $SD = .16$) was not significantly higher compared to one in the large bonus-malus without display condition ($M = .47$, $SD = .18$, $p = .08$, Hedges' $g = .29$), disconfirming Hypothesis 6d.

Further results showed that the knowledge score in the large bonus-malus with display ($M = .52$, $SD = .16$) was significantly higher than in the medium bonus-malus without display ($M = .46$, $SD = .18$, $p < .05$, Hedges' $g = .35$).

[25] To determine whether the distribution of the residuals was normal, we conducted Shapiro –Wilk tests. The results showed that the distribution of the residuals of product carbon footprint knowledge was not normal in some experimental groups (*p*s < .05). However, as explained by Blanca et al. (2017), ANOVA is a robust test to control for type 1 error against non-normality. Therefore, we conducted further ANOVA tests with this variable.

Additionally, as in the Experiment 1, we conducted further analyses by creating two new factors, each having two levels. First factor was display variable (display vs. without display) and second one was adjustment variable (medium bonus-malus vs. large bonus-malus). Hence, we conducted a three-way ANOVA[25] with display (display vs. without display), adjustment (medium vs. large), and TL (present vs. absent) as independent variables. As in previous analysis, the effect of TL was significant ($F(1, 475) = 92.46$, $p < .001$, $\eta_p^2 = .16$). Additionally, this analysis revealed a significant effect of tax signposting (i.e., display variable) on CO2 knowledge ($F(1, 475) = 10.01$, $p < .01$, $\eta_p^2 = .02$). More specifically, participants who were exposed to tax signposts (together with a taxation scheme justification message) had higher CO2 knowledge score ($M = .51$, $SD = .17$) than those who were not ($M = .46$, $SD = .18$).

4.3.4. Mediation Effect of Product Carbon Footprint Knowledge on the Relation Between Basket Carbon Content and TL

We found a significant negative correlation between carbon footprint knowledge and basket CO2 per kg ($r(601) = -.22$, $p < .01$, *two-tailed*). Considering the significant impact of TL on carbon footprint knowledge and basket carbon footprint, we further investigated whether carbon knowledge was a mediator of the relationship between TL and basket carbon footprint by using bootstrapping procedure (Preacher & Hayes, 2004). We used of 5000 bootstraps through PROCESS macro (Model 4; Hayes, 2018). Results showed a significant indirect effect of TL on basket CO2 through product carbon footprint knowledge, 95% CI [-.24, -.09][26]. Considering the significant total effect of TL on basket carbon footprint, it can be concluded that carbon footprint knowledge is a mediator of the effect of TL on carbon footprint.

4.4. Discussion of Experiment 2

[26] When heteroscedasticity consistent standard error and covariance matrix estimator was used, HC4 (Cribari-Neto) (cf. Cribari-Neto, 2004), and bootstrap inference for model coefficients, the indirect effect was still significant (95% CI [-.24, -.09]).

In this experiment, we investigated not only the price effect of bonus-malus on carbon content of shopping baskets but also its psychological impact. Additionally, we tested the impact of TL on the sustainability of shopping baskets. Finally, we tested whether tax signposts and TL can improve carbon knowledge.

Results showed that while TL were effective in reducing carbon content of shopping baskets, bonus-malus did not have any significant influence on the sustainability of baskets neither through its price effect nor its psychological impact. Concerning product carbon footprint knowledge, while TL improved product CO2 knowledge, displaying the amount of the adjustment neither significantly improved knowledge for large nor for medium bonus-malus. However, participants assigned to the large displayed bonus-malus condition had higher knowledge scores than those assigned to medium bonus-malus condition without tax display. One reason for this effect could be that higher bonus and malus rates could be more prominent and hence lead to a learning concerning product carbon footprint compared to a condition where these rates were much lower and not displayed. Signposting effect (i.e., tax salience) might thus be reinforced by the increase in the tax rate. Moreover, when contrasting display and without display conditions, thereby increasing statistical power, we found evidence that increasing tax salience through signposts (accompanied by a tax justification message) may improve product CO2 knowledge. This result is in line with the findings of the first experiment. Finally, another important result is that TL reduced basket carbon footprint by increasing consumers’ knowledge. In other words, it was shown that carbon footprint knowledge was a mediator of the relation between TL and basket CO2 content.

5. General Discussion

We investigated the price effect of a bonus-malus taxation system and its psychological impact on sustainable grocery consumption over two experiments. Moreover, we tested whether tax signposts could enhance CO2 knowledge. The second experiment also examined whether a non-monetary instrument, TL could reduce basket carbon footprint and increase CO2 knowledge.

In our first experiment, we did not detect any significant impact of bonus-malus taxation system on carbon content of shopping baskets. There was neither a significant price effect nor a psychological impact. Presenting an injunctive normative message informing about the danger caused by the emissions from grocery shopping, justifying the implementation of the bonus-malus, or making the tax salient through tax signposts did not reduce basket carbon footprint. This was the case whether we used a medium or high rate for taxation. As far as product carbon footprint knowledge is concerned in the first experiment, our predictions regarding tax signposts (i.e., tax salience) were not validated. Nevertheless, when contrasting conditions where bonus-malus was justified by a normative message and its amount was displayed with tax signposts to conditions where there was no normative message and no tax signposts, we found a significant impact of tax signposts on carbon footprint knowledge. Participants who were presented with tax signposts and normative message had better knowledge scores than those who did not see such displays and message. Therefore, by increasing the sample size in display (with norm) and without display (without norm) conditions, thereby increasing statistical power, we provide evidence that combining tax signposts and injunctive norms improve product carbon footprint knowledge.

The lack of effect of bonus-malus on carbon content of shopping baskets could be due to small-sized sample we used. Moreover, some important information we presented to participants might have been overlooked such as the amount of bonus-malus or the functioning of this scheme due to lack of clarity in their presentation. As a result, we conducted a second experiment, where we modified the way we presented information to the participants. Most importantly, we used a new method of calculation of bonus and malus amount. This new method reflected better the damage caused by products' carbon footprint on the prices. However, despite of using a larger sample, we did not find any significant impact of bonus-malus on the sustainability of shopping baskets in the second experiment as in the first one. There was neither a price effect nor a psychological effect of this scheme. This was the case when using either a high or medium taxation rate. To sum up, the findings of the two experiments were not in line with previous studies suggesting that bonus-malus is effective (e.g., Hilton et al., 2014; Panzone et al., 2021).

Even though experiments were conducted in similar online shops, differences in how the budget was to be used could explain the difference between our results and those of Panzone et al. (2021). While in Panzone et al. study, the minimum amount to spend to be able to exit the shop was only £7 (out of £25), in our studies this amount was €20 (out of €25) and €25 (out of €30). Moreover, while in Panzone et al. study, participants had the opportunity to receive the unspent budget; this was not the case in our experiments. Therefore, in Panzone et al. study, participants could use the money they did not spent in the experimental shop to buy products without tax in other stores, hence have baskets with lower absolute carbon footprint. Nonetheless, in our studies, participants had to spend most of their budget in our shop, which may make it less likely to have baskets with lower carbon footprint due to decreased expenditure.

Lastly, while the outcome measure was total CO2 amount in Panzone et al. study, we used kilograms of CO2 per kg of shopping basket, as we believed this could be a better measure for sustainability. For example, the absolute CO2 values of two baskets, one filled with low CO2 and the other with high CO2 products (e.g., potatoes vs. chicken) can be similar, but the total basket weight of low Co2 products could be higher than the basket filled with high CO2 products. Therefore, it would be possible to make more meal with the potatoes, as one will have much more quantity with the same budget. This implies longer consumption of lower CO2 product contributing to sustainability.

The unexpected results of bonus-malus system in our two experiments could be a result of different factors. In line with the motivational crowding-out theory (Frey & Oberholzer-Gee, 1997), participants might have felt controlled with the application of a bonus-malus and as a result, their intrinsic motivation to act eco-friendly could be undermined by this external motivator. Similarly, Raux et al. (2020) found evidence for the ineffectiveness of bonus-malus scheme on participants' hypothetical transport choices and argued that crowding-out effects might explain this. Another reason could be the low level of tax acceptability participants had. Acceptability can be defined as agents' attitudes against measures of policy, which are not applied yet (Committee of Experts on International Cooperation in Tax Matters, 2020). Baranzini and Carattini (2017) indicated that earmarking tax can be important for tax acceptability; for instance, explaining that the revenue collected from the tax will be used for environmental purposes may increase acceptability of tax. Moreover, using different labels for taxation scheme such as the use of *climate contribution* instead of *carbon tax* may increase acceptability of the tax and hence consumers could be more likely to support this scheme. Concerning bonus-malus taxation system, explaining that the scheme is revenue neutral and the aim is not to create revenue for government but only to promote sustainable consumption could be a solution to increase acceptability, hence support for this policy. Finding the appropriate terms to describe bonus-malus is also important.

In our second experiment, we demonstrated that TL could reduce carbon footprint of participants' shopping baskets, a result that is in line with the findings in the literature (e.g., Muller et al., 2019; Thogersen & Nielsen, 2016; Vanclay et al., 2011). Moreover, these labels were effective in improving participants' product carbon footprint knowledge. Importantly, we provided the first evidence that the impact of TL on basket carbon footprint was mediated by product carbon footprint knowledge. In other words, TL allowed participants to learn about the carbon footprint of the different products while shopping and this knowledge helped them to shop more sustainably. In sum, these results suggest that TL can be useful tools in rendering consumer behaviour more sustainable by increasing knowledge, at least in online grocery shops.

Moreover, TL can be also effective in supermarkets as well. Studies such as Vanclay et al. (2011) and Vlaeminck et al. (2014) showed that colour-coded labels in supermarket settings can make grocery consumption choices more sustainable. Importantly, our study adds evidence to the effectiveness of such colour-coded labels.

In our second experiment, (although initial analyses did not yield significant results) by contrasting display and without display conditions, we found that participants who were in the conditions with tax signposts had better knowledge scores compared to those who were never exposed to signposts. Therefore, increasing the number of participants in the bonus-malus display and without display conditions enabled us to show a significant impact of tax signposts (together with justification message of bonus-malus), which is a result in line with that of Experiment 1. The findings of these two experiments thus provide evidence for the effectiveness of tax signposts (accompanied by a tax justification message) and suggest that they are useful tools to improve product CO2 knowledge. Moreover, since sustainable shopping behaviour and knowledge is related, in longer term, the knowledge gained by the tax signposts may be translated into behaviour. Lastly, the results showed a small to medium effect size for display, meaning that tax signposts (with justification message) can explain a medium portion of the variance of the knowledge.

Our results have important implications. Policy makers who aim to diminish carbon emissions from grocery consumption may use TL as tools to decrease consumers' carbon footprint through the improvement of their knowledge. TL could be considered as non-coercive policy tools hence their implementation could be easier. Moreover, the survey conducted by Carbon Trust (2020) indicated that across eight countries including France, majority of consumers showed support regarding product carbon labels. Therefore, TL can be effective policy tools. Most importantly, a five-colour-coded sustainability label called *eco-score* which expresses environmental impact of products and which can be used in-store or online markets is considered to be implemented in France (Southey, 2021). Therefore, showing the effectiveness of eco-labels has practical implications. Additionally, tax signposts can also be tools to improve product carbon footprint knowledge. In case where a taxation scheme such as bonus-malus is implemented with environmental purposes, displaying its amount through tax signposts together with a justification message can ameliorate consumers' carbon footprint knowledge.

We may note some limitations in our studies. First, even though we used a between subject design to reduce experimenter demand effect, when we displayed TL, the aim of the experiment was more apparent and may have induced demand or social desirability effects. Future studies can ask participants in the end of the experiments about the aim of the experiment or require them to fill a social desirability questionnaire to control for these effects. Secondly, participants conducted the experiments in universities' experimental rooms. Ordering products when they need to do grocery shopping may yield them to choose different products. Moreover, as we recruited participants in university campuses, our sample may not be representative of households in France. Most households may have different consumption choices compared to a sample recruited in universities for different reasons such as having children. Moreover, our studies were conducted in Toulouse; nevertheless, consumers in different cities may have different consumption behaviour. For instance, cities close to seacoast may prefer fish products more. Finally, some participants may have not found the products they usually consume; for example, our shop did not contain non-packaged meat.

Future studies are needed to test how to enhance acceptability of bonus-malus that could be done, for instance, by explaining its budget neutrality to consumers and to find out the most effective way of labelling this scheme. Moreover, these tools can be tested in real-life stores to detect the impact of labels and price changes in less controlled environments. Furthermore, focus group studies could be conducted after these types of experiments to gain insight into why bonus-malus systems were effective or ineffective. Future studies may use a larger set of products to give participants more options, as they might not be able to find the best substitutes for high carbon footprint products in a shop with limited number of products. Furthermore, future studies could compare the effectiveness of different types of colour-coded labels (e.g., intra vs. inter-categorical labels). Additionally, studies are needed to test whether increasing normative message salience would increase their effect. Finally, a more representative sample would allow making inferences about the overall households in France.

6. General Conclusion

Over two experiments, we found that bonus-malus neither had an impact on sustainable grocery consumption through a price effect nor through a psychological effect. However, we found evidence for the effectiveness of the tax signposts on knowledge. Signposting tax amount, tax inclusive, and tax exclusive prices; and providing a justification for the implementation of the bonus-malus improved product CO2 knowledge. Finally, we demonstrated that TL were effective in reducing basket carbon footprint as well as in improving product carbon footprint knowledge. Most importantly, TL decreased basket carbon footprint through improving participants' product CO2 knowledge.

Chapter 5: Making the Carbon Basket Count: Goal Setting Promotes Sustainable Consumption in a Simulated Online Supermarket*

*** This chapter is an adapted version of the following paper: Kanay, A., Hilton, D., Charalambides, L., Corrégé, J. B., Inaudi, E., Waroquier, L., & Cezera, S. (2021). Making the carbon basket count: Goal setting promotes sustainable consumption in a simulated online supermarket. *Journal of Economic Psychology*, *83*, Article 102348.**

https://doi.org/10.1016/j.joep.2020.102348

Abstract

We compared the effectiveness of basket goal-setting to product information strategies on sustainable consumption in a simulated online supermarket. Experiment 1 found a significant effect of basket goal-setting techniques with carbon basket feedback in either numerical or graphical form on the carbon content of baskets purchased but no effect of numerical product information alone or in combination with basket CO2 information. Experiment 2 also found that basket goal-setting was effective but found no additional effect of introducing five-colour coding of the carbon footprints of either products or baskets. Experiment 3 found that repeated visits to the online supermarket led to improved learning about product carbon footprint in the basket goal-setting condition, which mediated the effect of goal-setting on basket carbon footprint. Our results suggest that goal-setting techniques with feedback can reduce the carbon footprint of online shopping baskets and facilitate learning about product carbon footprint.

Keywords: sustainable consumption, goal-setting, decision-aiding, carbon labels, groceries

1. Introduction

Greenhouse gas emission is an important problem to which economic agents contribute by their consumption choices (Stern, 2008). Food is one of the major causes of these emissions and contributes to about 17% of EU household emissions (Ivanova et al., 2017). According to Hertwich and Peters (2009), about half of the non-carbon dioxide greenhouse gases such as methane are caused from food production. Given that dietary choices can have a significant impact on the greenhouse gases which have been implicated in global warming, interest is growing in how consumers can be encouraged to reduce their carbon footprint when grocery shopping (e.g., Panzone et al., 2018).

We investigate how goal-setting theory can be applied to promote sustainable consumption in an online supermarket setting. Goal-setting theory focuses on the relation between consciously held performance goals and task performance level and defines a goal as "the object or aim of an action, for example to attain a specific standard of proficiency, usually within a specified time limit" (Locke & Latham, 2002, p. 705). In this view, goals can impact performance by four mechanisms: they (a) direct attention to goal-related activities, (b) activate energy and challenging goals lead to greater effort, (c) influence persistence, and (d) impact action by instigating people to use their knowledge and task-relevant strategies. Below, we review how goal-setting techniques have been used to boost sustainable consumption, before drawing on goal-setting theory to formulate specific hypotheses on how carbon basket goal-setting techniques can influence sustainable consumer behaviour and learning in a grocery shopping context. Our results have managerial and policy implications as they show how the use of goal-setting techniques can be incorporated in online grocery stores to boost sustainable consumption and evaluate their effectiveness with respect to more conventional product information strategies.

1.1. Using Goal-Setting Techniques to Promote Sustainable Consumption

Goal-setting theory is based on the premise that conscious behaviour is purposeful and regulated by goals of individuals (Latham & Locke, 1991), and that there is a crucial relation between performance and goals (Lunenburg, 2011). Goals have been used successfully to encourage many sustainable consumption behaviours, including household energy conservation (Abrahamse et al., 2007; Becker, 1978; Katzev & Johnson, 1983) or preferences for loose rather than packaged grocery products (Tate et al., 2014). Various factors have been shown to moderate goal effectiveness. For example, it has been shown that difficult goals lead to greater achievement, but goals that are fixed at a too high level may discourage and demoralize individuals (Locke, 1996). Goals are more likely to be effective motivators if they are accepted as legitimate, feasible, stated in exact terms, and provide precise feedback allowing the agent to evaluate their progress to that goal (Locke & Latham, 2002). In order to legitimise the ideal that consumers should reduce their carbon footprint in the goal-setting conditions, in our studies we communicated an injunctive norm (cf. Schultz et al., 2007) that participants should do so in order to reduce harm to the planet.

Feedback is of crucial importance to the success of goal setting strategies and being precise about what to achieve can diminish variance in performance and thus improve goal attainment. We expected that the most intelligible form of feedback in the context of an online shopping visit would be about the carbon footprint of the shopping *basket* (see below for details). We used aspiration levels (March & Shapira, 1992) in the form of target levels of CO2 reduction in basket carbon footprint. This would allow consumers to regulate their behaviour to approach and in some cases attain the set sustainability goal in a way that is consistent with their need to maintain a positive self-image (Ulph et al., 2017). As belief in the possibility of reaching the goal enhances one's commitment to attaining the goal, we gave our participants an easier intermediate carbon reduction goal than the one that would be required to be fully sustainable (see below). Our first and principal aim was to establish whether sustainability goals set according to these principles did in fact influence consumer behaviour in a realistic experimental online supermarket.

However, we had a second major aim, which was to compare the impact of our basket goal-setting techniques with more conventional informational strategies which give consumers product feedback about sustainable consumption. In comparing basket goal-setting techniques to product information strategies, it is important to note their similarities and differences. We suggest that basket goal-setting may be said to involve both a *motivational* (setting a basket goal) and an *informational* (giving feedback about progress to that goal) component. In contrast, product information strategies do not involve explicit goal-setting (e.g., to attain a given sustainability goal), but they do give information relevant to the agent's performance with respect to sustainability considerations, often in precise and numerical form about product carbon footprint (e.g., Perino et al., 2014). However, there are two important considerations here. The first is that providing product carbon footprint information may make environmental concerns salient and so *implicitly* activate sustainability goals in a way consistent with Cialdini et al.'s (1990) norm activation model. Consequently, it is important to compare our basket goal-setting conditions (with basket-level carbon footprint goals and basket and/or product feedback) with product information (or *feedback only*) conditions conveying basket or product footprint alone in order to assess the impact of setting goals.

The second consideration is that informational strategies may only affect consumer behaviour under certain conditions that facilitate product information uptake and use such as by making carbon footprint information accessible and understandable (McGuire, 1976). To this end, we begin by reviewing research on the effectiveness of product information strategies on sustainable consumption in real or realistic grocery supermarket settings. We then present a framework that highlights the role of task complexity in product information acquisition and use that allows understanding of when product carbon labels are likely to be effective. We then show how a basket-level representation of carbon footprint may provide more intelligible feedback about one's progress to a sustainability goal and so facilitate consumption informed by sustainability considerations.

1.1.1. Do Product Carbon Labels Influence Sustainable Food Consumption in Realistic Supermarket Settings? Contextual Effects in the Construction of Consumer Preferences

Most information-based strategies for boosting sustainable consumption such as eco-labels have focused on *product* information. Where relevant market data is available, results suggest that eco-labels often (but not always) have a positive effect. For example, using econometric methods, Bjørner et al. (2004) reported that eco-labels have been found to affect actual purchase of some consumer goods, such as detergents, dolphin-safe tuna and seafood, toilet paper, recycled toilet paper, paper towels, organic cotton in clothes, and green electricity. Harris (2007) reports that the Green Tick eco-label was followed by substantially increased sales of seven household cleaning products in Australia. In contrast, eco-labels have had no effect on purchases of unbleached toilet paper and use of environmentally friendly dyes in clothes (Bjørner et al., 2004; see also Nimon & Beghin, 1999; Teisl et al., 2002).

Advances in product life cycle analysis have led to the development of a specific kind of eco-label to help inform consumers' choices, namely carbon labels (Sharp & Wheeler, 2013).

The underlying assumption is that these labels will provide the information about a product's carbon footprint that is necessary for concerned consumers to make an informed choice. This information may be displayed in symbolic, numerical or colour coded form, or a hybrid of these. In the grocery domain, numerical CO2 information was displayed from 2008 using the *Carbon Trust* carbon footprint symbol on selected goods in Tesco supermarkets in the UK. French supermarket Leclerc put numerical CO2 information on their products as well as the CO2 content of the basket onto clients' receipts. Colour coding products' carbon footprint has been used in French Casino supermarkets and in RAISIO in Finland (Schaefer & Blanke, 2014).

In theory, carbon labels provide relevant information and so should have an impact on consumer choices. To obtain information about quality or price attributes, consumers can conduct a search before purchasing products, or they can obtain information about some attributes by having experience with regard to these products after purchase (Nelson, 1970). Sustainability traits of food may be considered as credence attributes (Bonroy & Constantatos, 2008; Darby & Karni, 1973), which cannot be directly detected by consumers before purchase and similarly cannot be experienced after purchase. Therefore, the aim of sustainability labels is to aid consumers with their food choice since they can be used as means to communicate sustainability features of products (Van Loo et al., 2015). As a result, consumers may be able to make informed choices with the use of these product labels (Cohen & Vandenbergh, 2012).

In practice, attempts to influence actual consumer behaviour through product CO2 labels have not always been successful. We suggest that this is because information acquisition and evaluation and its expression in a decision may depend on local factors in the choice context, described by Payne et al. (1993) as task effects. Task effects refer to the factors related to decision problems' general structural characteristics such as response mode, number of alternatives and attributes, information display mode and context effects related to the factors concerning the value of the objects in a decision task. These may moderate the impact of information provision through a carbon label on decision-making in an online shop, such as the number of categories of product available, the number of options available within each category, and the use of between- or within-subject comparisons. For example, they may make carbon labels more or less salient and/or difficult to use in the decision-making process. We highlight such aspects in Table 6, where we refer to all labels that give information about product carbon footprint (whether in symbolic, numerical, colour coded, or hybrid form) as product CO2 labels. We only include studies which evaluate the effect of these labels on actual purchase behaviour either in the context of a field study (where carbon labels were introduced in a real-life setting such as a supermarket, and their effect on consumer choice observed) or an incentive-compatible experiment where consumers were given money by the experimenter and asked to use it to buy goods in an experimental shop. We comment on these papers below.

Table 6

Summary of Studies on the Effect of Carbon Labels on Sustainable Consumption in Realistic Settings

Author/Date	Study type	Outcome measurement & population	Type of carbon label used	Relevant results	Possible confounds and limitations
Hornibrook et al. (2015)	Field study with supermarket retail data	Purchase of labelled goods (light bulbs, washing detergent, orange juice, and potatoes [later: milk, toilet tissue, and kitchen towels]) by UK consumers in Tesco supermarkets	Carbon Trust label	No effect of Carbon Trust label on purchase decision reported.	No information about carbon content of shopping baskets was provided.
Elofsson et al. (2016)	Field study	Labelled milk purchase by Swedish consumers	Swedish Climate Certification of Food (CCF) (non-numerical) carbon certification label	CCF increased certified milk demand by 6-8 %.	
Vanclay et al. (2011)	Field study	Purchase of dirty vs. clean products within five categories (spreadable butter, bottled water, canned tomatoes, milk, non-perishable pet foods) by Australian consumers	Colour coded Carbon Trust label	4% more products with the green label (lower CO2) and 6% less products with the black label (higher CO2) were chosen.	Media announcements could account for impact.
Spaargaren et al. (2013)	Field study	Meals purchased in University of Groningen cafeteria	A variation of Carbon Trust label and a colour coded Carbon Trust label	While the variation of Carbon Trust label did not reduce carbon consumption, a colour coded version of this label worked.	A sensibilization campaign was conducted with the labels, which could account for impact.
Brunner et al. (2018)	Field study	Meals purchased in Chalmers University of Technology student cafeteria, Gothenburg	Coloured traffic lights label (from green to dark red) containing a bar whose length depended on the carbon emission along with a numerical value indicating carbon content with a Carbon Trust footprint symbol	Sales of green labelled meat dishes increased by 11.5%, red-labelled ones decreased by 4.9% (a marginally significant change).	Meals offered during the control and label stage were not identical.
Perino et al. (2014)	Field experiment	Purchase of dirty vs. clean products within four categories (cola, milk, meat, butter/ margarine) by UK consumers in Sainsbury's supermarkets	Carbon trust label	Labelling treatment successful in switching behaviour towards cleaner options.	A within-subject design may have increased the salience of the CO2 label.
Vlaeminck et al. (2014)	Field experiment	Choice of products (vegetables, fruit, and protein) placed on stands in a Belgium supermarket	Colour coded environmental label	Labels lead to more sustainable product choice.	Experimental set-up may have increased label salience.
Muller et al. (2019)	Incentive compatible laboratory experiment	Purchase of wide range of groceries by French consumer panel	Kilometric format showing the CO2 emission in terms of kilometers driven by car, and two colour coded labels, a single traffic lights, and a multiple traffic lights labels	Multiple traffic lights carbon labels and single traffic light label reduced basket carbon footprint more than symbolic (car journey) label.	A within-subject design may have increased the salience of the CO2 labels.

A large field study using loyalty card data did not report any effect of Carbon Trust labels used by Tesco, the UK's largest retailer, in encouraging sustainable consumption (Hornibrook et al., 2015). These labels contain numerical information printed on the background of a black footprint (see Figure 1). However, their study makes it difficult to draw definitive conclusions as Tesco initially only put carbon information on four product categories: light bulbs, washing detergent, orange juice, and potatoes (three more categories were added later: milk, toilet tissue, and kitchen towels). Furthermore, no results are reported in their study concerning whether carbon labels actually affected the overall carbon content of consumer baskets. However, it seems likely that these labels had disappointing results, as Tesco withdrew carbon labels from their products in 2012 (Lucas & Clark, 2012). One problem may be that consumers did not pay attention to the numerical information contained in it (Beattie et al., 2010). Hornibrook et al. also noted that focus group data suggested that lack of awareness and understanding of carbon labels, a finding that is unsurprising given that many people have considerable difficulty in using numerical information in decision-making unless the information is presented in user-friendly formats (e.g., Cokely et al., 2012; Reyna et al., 2009; Sedlmeier & Hilton, 2012).

Carbon Trust labels have been shown to be effective in settings where they are made salient and the numerical information they give is easily interpretable in the context of presentation. Thus, Perino et al. (2014) used the Carbon Trust labels in a field experiment where they (a) presented participants with a restricted range of products (cola, milk, meat, and butter/margarine) on a computer screen upon their entry to the shop, (b) presented a restricted range of options for each product type (between 3 and 12), and (c) used a within-subject design whereby consumers were required to make the choices from each category without CO2 information before doing so again with CO2 labels present. This within-subject experimental set up may have made the carbon labels highly salient and simplified the normal choice set as well as creating demand effects. While Carbon Trust labels were effective in shifting consumption to lower carbon products in this study, visitors to real supermarkets do not undergo such a computer-based choice procedure before entering the supermarket proper. In particular, the choice architecture used may not be representative of those used in online shopping interfaces which use a menu-based approach whereby products are displayed together in larger super-ordinate categories or *shelves* such that particular items such as milk, butter, margarine etc. will be displayed along with other *dairy* items such as yoghurts, milk-based desserts, and vegetal-based desserts.

Spaargaren et al. (2013) explored the effect of colour schemes in a restaurant setting using a similar product CO2 label and found that a carbon label similar to the Carbon Trust label that shows only the numerical information printed in white against the black background (see Figure 2) was not successful in reducing carbon consumption in a university cafeteria. A small but significant shift happened when they adapted these product CO2 labels using an intra-categorical colour scheme, but it is important to note that other interventions that were introduced at the same time, notably a sensibilisation campaign, could explain this effect.

Vanclay et al. (2011) tested a colour-coded product CO2 label in a real-life grocery store in Australia and found that a significant number of participants changed their behaviour by buying 4% more products with the green label (indicating lower CO2) and 6% less products with the black label (indicating higher CO2) (see Figure 3). However, this study only displayed labels on a restricted range of products (spreadable butter, bottled water, canned tomatoes, milk, and non-perishable pet foods). Importantly, as well as displaying numerical information, these labels also displayed qualitative information coded (higher, medium, lower CO2) using a modified traffic light approach (black = higher, amber =

medium, green = lower) within categories of products. This format may have facilitated intra-categorical comparisons: for example, Vanclay et al. find that their carbon labels are especially effective when the low-carbon option is also the cheapest in a product category. While the experiment appears to have high external validity, having been conducted in a real life supermarket setting, there are internal validity concerns as the authors note there was considerable media interest in the experiment that may have contributed to the intervention's effectiveness.

Figure 1

Carbon Labels Used in UK (from Liu et al., 2016, p.73)

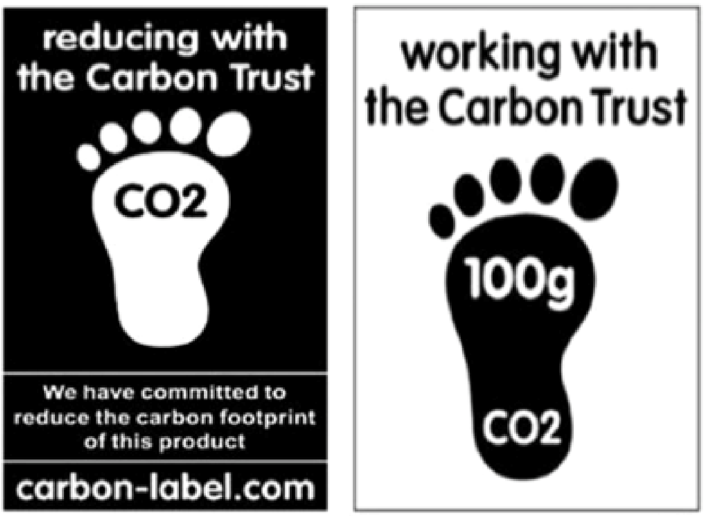


Figure 2

Black and White and Coloured Numerical Product CO2 Labels (Spaargaren et al., 2013, p. 438-439)

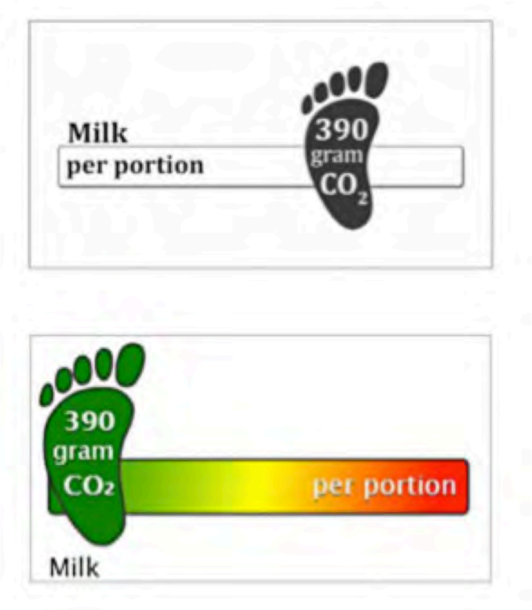


Figure 3

Colour-Schemed Labels (Vanclay et al., 2011, p. 155)

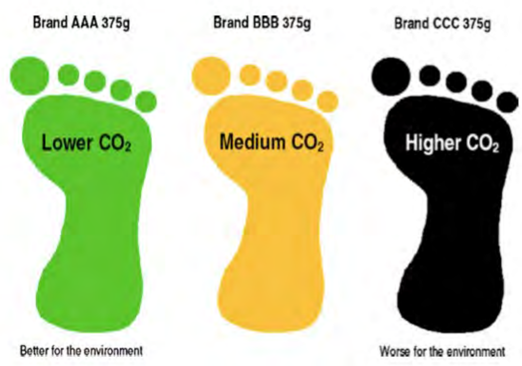
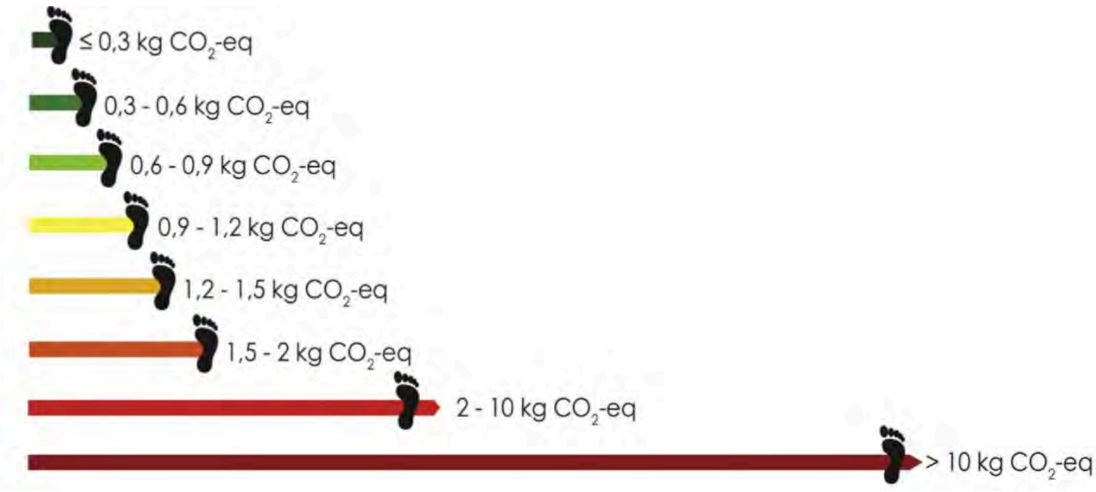


Figure 4

Colour-Coded Label Used in Student Union Restaurant in Sweden (Brunner et al., 2018, p. 660)



In a student union restaurant at Chalmers University of Technology, Sweden, Brunner et al. (2018) investigated a variant of a Carbon Trust containing a colour-coded bar whose length depended on the carbon emission along with a numerical value indicating carbon content with a Carbon Trust footprint symbol (see Figure 4) for each of the seven meals in the restaurant's menu. Information concerning the relation between climate change and food, numerical carbon footprint, and the consumers' role was also given on the restaurant's web site, next to the menus with posters, and on tables. Brunner et al. found that while sales of green-labelled meat dishes increased by 11.5%, red-labelled ones decreased by 4.9% (a marginally significant change). While the yellow label diminished the sales of fish dishes, it increased vegetarian meals. Green labels did not have an impact either on vegetarian or fish dishes.

Finally, other studies have investigated the effectiveness of product CO2 labels that do not use the Carbon Trust footprint or its variants. For example, Elofsson et al. (2016) tested the effect of displaying a climate certification label indicating a commitment from producers to diminish carbon emissions from production in 17 retail stores in Sweden. Compared to a control condition where consumers saw a shelf label announcing the brand of milk sold, consumers who saw a modified shelf label with information that the milk was climate certified bought around 6–8% more milk. In another study, Vlaeminck et al.'s (2014) survey showed that a gradated colour scheme label (red being not eco-friendly and green being very eco-friendly) together with an overall eco-friendliness score combining environmental impact information concerning carbon, land use, or water use (see Figure 5) was selected as the most effective in communicating the eco-friendliness of a product. This was preferred to five other labels giving information about products' sustainability in: three numerical raw formats (three different environmental labels in numeric form giving information about either overall sustainability of product or information about environmental impact of the product, or a combination of these two), a colour coded form that did not mention the overall sustainability score, and a label that combines the numerical and colour coded form. They then conducted a study using the preferred label in an incentive-compatible experimental market and found that it led to more sustainable food consumption. However, again, in this study, the product range is restricted and rendered highly salient in the experimental supermarket (a vegetable stand, a fruit stand, and a protein stand).

Muller et al. (2019) investigated the effectiveness of a product CO2 label presented in a kilometric format showing the CO2 emission in terms of kilometers driven by car and two colour coded labels, a single traffic lights and a multiple traffic lights labels (see Figure 6) communicating the sustainability of the product in the form of coloured pastilles (green being the most, orange being the medium, and red being the least sustainable) in an experimental laboratory store. In this store, participants reviewed options and made their choices on a computer screen before collecting the chosen items from the store. While a single traffic lights label signals information only about one criterion, CO2 emission, a multiple traffic lights label signals information about three criteria (CO_2 emission, the marine eutrophication, and air acidification). The results showed that the multiple traffic lights label led to a greater CO_2 reduction in shopping baskets and the kilometric format led to the least CO_2 reduction.

In sum, product-focused carbon labels have been shown to be effective in influencing sustainable consumption in some field and experimental studies but not others. Consequently, we have proposed a framework in which incidental, contextual factors influence the construction of consumer preferences (for reviews see Hilton, 1997; Payne et al., 1993). For example, presentational format appears to matter: numerical representations of product carbon information are less easily processed than visual representations, leading to lower information uptake. In addition, it seems likely that the complexity of the screen display (e.g., number of categories available, number of options displayed within a category) may lead to information overload affecting product information uptake. As we elaborate in the next section, these conclusions suggest that presenting carbon footprint information in an online shopping environment is likely to be successful when its acquisition and use is rendered intelligible and easy. With these considerations in mind, we now review the potential advantages of a basket level approach to presenting goal and carbon footprint (feedback) information in the context of a realistic online supermarket display with a hierarchical organization wherein several categories of product are available, with numerous options available within each category.

2. Reducing Task Complexity: The Basket-Level Approach to Giving Carbon Footprint Feedback

A major moderator of the effectiveness of goal-setting techniques is task complexity: the more complex the task, the more the impact of the goal depends on the ability to find the appropriate strategy for the task (Locke & Latham, 2002). In particular, the design of feedback is of crucial importance so that relevant information is presented in a form that is clear and intuitively accessible to the consumer. Grocery shopping is increasingly conducted online, which gives an opportunity not only to give feedback about the carbon footprint of each *product* but also the overall carbon footprint of the shopping *basket*. Mental representations of shopping baskets may be thought of as an ad hoc category (Barsalou, 1985) of *things to buy at the supermarket* that constitute a mental unit that is meaningful, routinized, and cognitively undemanding for consumers; and which is recruited in their decision making process. We test the effectiveness of numerical feedback about basket carbon footprint but also introduce a visual representation of the carbon footprint of the shopping basket in the form of a *carbon basket thermometer* that is updated by each product that is placed in the basket. In this experimental condition, consumers are not only able to assess the numerical carbon impact of each product they place in the basket but also to verify how well they are doing in attaining the sustainability goal marked in the form of a desired level on the carbon thermometer. In this way, online representations of basket CO2 footprint may help consumers construct dynamic “mental accounts” (Thaler, 1985) that facilitate “carbon budgeting” (Capstick & Lewis, 2010; Grönborg, 2019) by enabling consumers to make basket-level compensations between high carbon footprint products and low ones. In particular, as inter-categorical comparisons in decision-making are likely to require greater cognitive effort than intra-categorical choice processes (Abelson & Levi, 1985; Payne et al., 1993), we assume that basket level representations may facilitate greater recognition of inter-categorical differences in product carbon footprint and hence reduction of basket carbon footprint through inter-categorical substitutions (e.g., vegetable for meat products).

Figure 5

Label Selected as the Most Effective in Communicating the Eco-Friendliness of a Product (Vlaeminck et al., 2014, p.182)

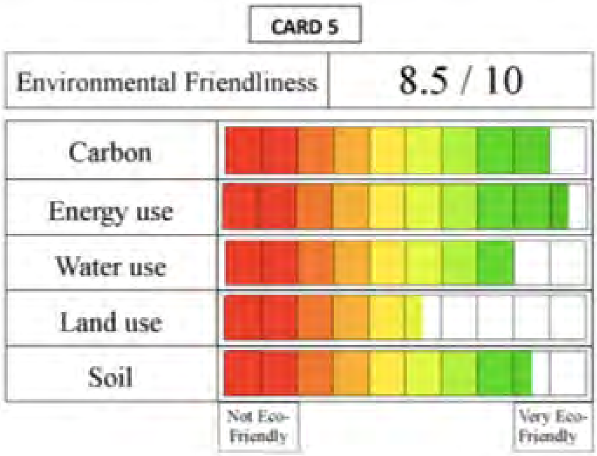


Figure 6

Kilometric Environmental Label (Label on the Left), Single Traffic Lights Environmental Label (Label in the Middle), Multiple Traffic Lights Environmental Label (Label on the Right) (Muller et al., 2019)

As the presentation format of information has an impact on the choice of information processing strategy (Bettman & Kakkar, 1977), we tested different feedback formats such as numerical format, bi-colour graphical, and multi-colour graphical forms. While numerical feedback can be shown effective in changing behaviour in the sustainability context (e.g., Perino et al., 2014), graphical presentation of information can be even more effective. Garcia-Retamero and Cokely (2013) emphasized the importance of properly- designed visual aids in communicating risk information. For instance, Garcia-Retamero and Galesic (2010) demonstrated that numerical information coupled with visual aids such as icon arrays and bar graphs, improved medical decision-making. Similarly, Garcia- Retamero and Hoffrage (2013) showed that information presented in a numerical format accompanied with visual aids lead to better diagnostic inferences compared to the case when information was presented only in a numerical format. Another study conducted by Walker et al. (2019) showed that gambling related judgments were improved when payback percentage was presented in a graphic format instead of a numerical one.

By orienting consumers to buy sustainable baskets, we expect the cognitive dynamics of consumer behaviour to be modified in a number of potentially important ways. First, the basket format allows consumers to compare the environmental impact of different food categories and recognize that certain food categories (e.g., meat and dairy) have much higher carbon footprints than others (e.g., fruit and vegetables). In addition, giving consumers precise feedback about the environmental impact of each item that they put into their basket may enable learning and hence the acquisition of accurate mental representations of product carbon footprint that may guide future choices. Second, repeated experience of action-outcome pairings where high CO2 products placed into the basket lead the carbon basket thermometer to rise substantially in contrast to low CO2 products may be expected to induce a form of instrumental (action-outcome) learning (Dickinson, 1980). As such learning is automatic, it may be assumed to make the task less difficult and indeed research has shown that this kind of experiential learning often leads to more adaptive decision-making than information communicated in narrative form (Hertwig et al. 2018).

3. Overview of Our Protocol and Empirical Studies

With the above considerations in mind, we designed an experimental online shop where the consumer can clearly see and explore six different product shelves (fruits and vegetables, meats and fish, dairy products and eggs, frozen foods, sweet goods, and savoury goods) in a way that is familiar from online shopping interfaces familiar in France, using a variant of a the earlier *GreenShop* platform (Demarque et al., 2015), which used in a high-fidelity simulation of online grocery shopping. The new platform, which we refer to as *GreenShop 2*, offered a selection of 112 food and drink items chosen from the French supermarket chain *Casino*'s catalogue of products. Numerical carbon footprint information was presented about both product and consumer basket carbon footprint in some experimental conditions, based on estimates produced by Tesco (Tesco, 2012) and information available from the French ADEME website.

The GreenShop 2 platform presented numerical and graphical representations of basket carbon footprint in different conditions designed to facilitate processing of carbon footprint information in a way that enables participants to make not only intra-categorical but also inter-categorical product comparisons concerning the carbon content of products. We expected that this online feedback about basket carbon footprint may enable consumers to learn that large reductions of carbon footprint can be obtained by substituting products from low (e.g., fruits & vegetables) carbon footprint shelves for products from high carbon footprint shelves (e.g., meat, dairy products). In addition, this format may facilitate substitutions *within* shelves (e.g., dairy products) of low for high carbon products (e.g., vegetal for milk desserts), resulting in baskets with a lower carbon content.

In the goal-setting conditions participants could also see an ideal level of carbon footprint reduction displayed in a numerical or graphical form (numerical, graphical,

graphical with traffic light colours, etc.). We developed a realistic carbon footprint reduction goal based on data from a pilot experiment involving 21 students from the University of Toulouse-II (Jean Jaurès) conducted in January 2014, whose control condition enabled us to calculate the mean carbon footprint of a €25 shopping basket for our target sample (M = 3.11 kg CO_2 per kg of product, SD = 0.70). Given the Grenelle Environment Forum's conclusions that carbon emissions should be reduced by 75% by 2050, we supposed that a 25% decrease in this footprint would be a fitting first step towards this goal, as well as being attainable and hence motivating for our participants. Thus, in experimental conditions where a goal was set, the sustainable *threshold* corresponded to a mean shopping basket carbon footprint of 2.33 kg CO_2 per kg of product.

Experiment 1 provided an initial test of the effectiveness of basket goal-setting techniques compared to control and to product information strategies. In order to replicate our key results, we then conducted two further experimental studies. These tested whether a modified design of the basket goal-setting graphical interface would influence shopping behaviour (Experiment 2) and whether repeated visits to the shop in the graphical interface condition would influence shopping behaviour and learning about product carbon footprint (Experiment 3). The experimental conditions used in each experiment are set out in Table 7.

4. Experiment 1

In Experiment 1 we tested the following hypotheses: 1. Both goal-setting conditions with carbon basket feedback (numerical goal setting (1a) and graphical thermometer goal setting (1b)) will lead to shopping baskets with lower carbon footprint compared to a control condition. 2. Numerical product feedback (product numerical footprint condition (2a)) and the numerical product & basket footprint condition (2b) will lead to lower basket footprint compared to control. 3. Both goal-setting conditions with carbon basket feedback (numerical goal setting (3a) and graphical thermometer goal setting (3b)) will lead to shopping baskets with lower carbon footprint compared to the numerical product feedback alone (product numerical footprint condition) condition. 4. Both goal-setting conditions with carbon basket feedback (numerical goal setting (4a) and graphical thermometer goal setting (4b)) will lead to shopping baskets with lower carbon footprint compared to numerical basket and product feedback alone (numerical product & basket footprint condition). 5. Visual presentation of the goal and basket feedback (graphical thermometer goal setting) will be more effective than numerical presentation of goal and basket feedback (numerical goal setting).

4.1. Method

4.1.1. Participants

One hundred and eighty-four students were recruited on the campus of the University of Toulouse II (Jean Jaurès) in February 2014. This initial sample was reduced to 176 participants because under-age participants (less than 18 years old) and outliers[27] were identified and eliminated. Thus, our final sample consisted of 115 women and 61 men, between the ages of 18 and 50 (*M* = 21.89, *SD* = 4.59). Their average level of education was 1.85 years of higher education post-baccalauréat (*SD* = 1.72). Data of our three experiments are publicly available via Open Science Framework and accessible through the following link: https://osf.io/nzce9/?view_ only = c44391bb020c4a799e93d49b614a0c14

[27] Eight participants were excluded: those under the age of 18 and those with z-scores > 3.29.

Table 7

Brief Explanation of Each Experimental Condition

Experimental Conditions	Price of products	Product footprint	Basket footprint	Numeric threshold	Colour coding	Landing page text
Control [Expts. 1,2,3]	X					"This shop sells daily usage products. Use the tabs to gain access to the different shop shelves and proceed with your shopping."
Product numerical footprint [Expts. 1, 2]	X	X				"This shop sells daily usage products. Use the tabs to gain access to the different shop shelves and proceed with your shopping. For each product, the carbon footprint is displayed (kg of CO2 emitted for each kg of produce). The greater the carbon footprint, the greater the product's contribution to climate change (during production, transport and distribution)."
Numerical product & basket Footprint [Expt. 1]	X	X	X			"This shop sells daily usage products. Use the tabs to gain access to the different shop shelves and proceed with your shopping. For each product, the carbon footprint is displayed (kg of CO2 emitted for each kg of produce). The greater the carbon footprint, the greater the product's contribution to climate change (during production, transport and distribution). The mean carbon footprint of your shopping basket will also be shown."
Numerical goal setting [Expts. 1,2]	X	X	X	X		"This shop sells daily usage products. Use the tabs to gain access to the different shop shelves and proceed with your shopping. For each product, the carbon footprint is displayed (kg of CO2 emitted for each kg of produce). The greater the carbon footprint, the greater the product's contribution to climate change (during production, transport and distribution). The mean carbon footprint of your shopping basket will also be shown. With a view to limiting climate change, the objective which has been validated by the Grenelle Enviro"nment Forum (*Grenelle de l'Environnement)* is to achieve a 75% reduction of carbon emissions by the year 2050. Reducing CO2 emissions by 25% would be an intermediary objective. For this reason, a threshold representing a 25% reduction of the mean carbon footprint of a shopping basket will be displayed."
Graphical thermometer goal setting [Expt. 1]	X	X	X	X		see Numerical goal setting
Colour coded product numerical footprint [Expt 2]	X	X			X	see Product numerical footprint condition
Multi-coloured thermometer goal setting [Expt. 2, 3]	X	X	X	X	X	"With a view to limiting climate change, the objective which has been validated by the Grenelle Environment Forum (Grenelle de l'Environnement) is to achieve a 75% reduction of carbon emissions by the year 2050. Reducing CO2 emissions by 25% would be an intermediary objective. For this reason, a "carbon thermometer" which will help you evaluate the mean total carbon footprint of your basket, will be displayed. If your emissions are in the green zone, then this objective is respected, since the upper limit of the green zone corresponds to a 25% reduction of the carbon footprint of a shopping basket."

4.1.2. Materials and Procedure

In all three experiments, the procedure required that each participant be seated in front of a laptop computer in order to generate their weekly shopping order on our platform. To accelerate the recruitment process, eight laptop computers were set up in an experimental room of the University of Toulouse-II (Jean Jaurès). Participants were seated a few metres apart and randomly assigned to separate experimental conditions. Immediately preceding their shopping spree, they were informed that they disposed of a €25 budget and that they had one chance out of five of winning the basket of products they selected and were informed that they could not leave the shop until they had spent a minimum of €20. This procedure enabled us to ensure that the experimental design was incentive-compatible and encourage the expression of participants’ true preferences.

Once they had finished their shopping, participants proceeded to respond to a series of questions, generated by the GreenShop 2 interface. They began by filling in an adapted version of the short Environmental Attitudes Inventory (EAI-S, Milfont & Duckitt, 2010), then they responded to questions regarding their purchasing habits/criteria, familiarity with online shopping, and socio-demographic information. Finally, they rolled a dice to determine whether they had won the shopping basket of selected products (5 “you win”; 6 “roll the dice again”). The winners were informed that they would be able to pick up their shopping basket in a downtown Casino grocery store within the following weeks.

4.1.3. Measures

Adapted version of the EAI-S (Milfont & Duckitt, 2010): The EAI assesses two dimensions of people’s beliefs about the environment and the elements affecting its quality: Preservation (e.g., “Whenever possible, I try to save natural resources”) and Utilization (e.g., “It is all right for humans to use nature as a resource for economic purposes”). We used a short version of this questionnaire with 12 questions.

Purchasing criteria/habits: The importance of seven distinct purchasing criteria was assessed on a Likert-type scale ranging from 1: *not at all important* to 7: *extremely important*: quality, price, value for money, number of calories, nutritional value, production mode, environmental impact. Purchasing habits were also gauged. Specifically, participants were required to indicate how frequently (1: *never*, 7: *very often*) they purchased their goods from: hypermarkets, supermarkets, minimarkets, hard discount stores, convenience stores, organic shops, associations for the maintenance of peasant farming[28], producers, food markets.

Familiarity with online shopping: Participants were also required to indicate their level of familiarity with this type of online shopping (1: *never*, 7: *very frequently*) by answering the following question: “How often do you shop online in similar stores to this one?”

Socio-demographics: In order to assess whether any socio-demographic factors might have an impact on their consumption patterns, participants were finally asked to specify their revenue, level and field of education, political orientation, age, gender, and knowledge of French (1: *much less good level than my mother tongue*, 4: *mother tongue*).

4.1.4. Experimental Conditions

Participants were randomly assigned to one of the five experimental conditions:

Control (n = 36): This condition simply informed participants of the fact that they would be able to do their shopping using our virtual platform (cf. Appendix W). The following message was systematically displayed on the landing page: “This shop sells daily

[28] The association for the maintenance of peasant farming, known as *Association pour le maintien d’une agriculture paysanne (AMAP)* in France, enables consumers to annually pre-order their produce directly from farmers.

usage products. Use the tabs to gain access to the different shop shelves and proceed with your shopping.”

Product numerical footprint (*n* = 37): This condition provided participants with the same information as in the control condition, but additionally displayed carbon footprint information for every product in the shop (cf. Appendix X). This information was presented as the amount of CO2 (kg) produced per kg of product (kg CO2/kg) and it was displayed on the bottom right corner of the product display. It was obtained by either by referring directly to Casino’s own estimate for the product or (if this information was not available), by referring to Tesco’s Product Carbon Footprint Summary (2012), or Greenext’s listing of the carbon footprint of the 34 most purchased food products in France (http://www.wedodata.fr/greencode.php)[29]. To make sure that participants would take notice of this information and be able to interpret it, the following explanatory message was displayed on the landing page (in addition to the message used in the control condition): “For each product, the carbon footprint is displayed (kg of CO2 emitted for each kg of produce). The greater the carbon footprint, the greater the product’s contribution to climate change (during production, transport and distribution).”

Numerical product & basket footprint (*n* = 34): This condition provided participants with the same information as in the control and product numerical footprint conditions, but additionally displayed the total carbon footprint per kg of weight of the participant’s shopping basket (cf. Appendix Y). The texts used in the control and product numerical footprint conditions were displayed and an additional sentence was added: “The mean carbon footprint of your shopping basket will also be shown.”

Numerical goal setting (*n* = 35): This condition provided participants with the same

[29] The Environmental Working Group’s “Meat eater’s guide to climate change” was also used.

information as in the control and numerical product & basket footprint conditions while specifying the ideal maximum amount of carbon emissions their shopping basket should aim to have in an inset at the bottom right hand corner of the screen. This amount (2.33 kg CO_2/kg) was indicated numerically in red font under the figure indicating the current total carbon emissions per kg of the basket. Again, the landing page texts used in the previously listed conditions were displayed and a complementary explanation was added: "With a view to limiting climate change, the objective which has been validated by the Grenelle Environment Forum (*Grenelle de l'Environnement)* is to achieve a 75% reduction of carbon emissions by the year 2050. Reducing CO_2 emissions by 25% would be an intermediary objective. For this reason, a threshold representing a 25% reduction of the mean carbon footprint of a shopping basket will be displayed."

Graphical thermometer goal setting (n = 34): This condition provided participants with the same information and explanatory texts as in the numerical goal setting. It also displayed the ideal maximum carbon footprint their shopping basket should have in graphical form. The graph plotted a fixed, red line representing the maximum carbon emissions threshold (2.33 kg CO_2/kg) and a mobile bi-coloured bar (green when under the sustainable threshold and red when above the sustainable threshold) representing the current amount of carbon emissions produced by the participant's shopping basket (fluctuating with each added product). If carbon footprint of basket respected the sustainable threshold, the green bar stayed under the red line showing the current carbon footprint of basket. If the carbon footprint of shopping basket exceeded the sustainable threshold, a red bar went up from the red line to the current level of carbon footprint of basket (cf. Appendix Z).

4.2. Results

4.2.1. Descriptive Statistics and Preliminary Analyses

Overall, participants bought on average 16.59 products (*SD* = 4.92) with their €25 budget. Across conditions, the mean carbon footprint for the shopping baskets was 2.98 kg CO2 per kg of product (*SD* = 0.82), slightly lower than that observed in the pilot study (*M* = 3.11 kg, *SD* = 0.70). The mean total carbon footprint of the baskets was 16.38 kg (*SD* = 3.45; see Table 8 for more details). Participants rated three of the shopping criteria as most important: value-for-money (*M* = 5.90, *SD* = 1.24), price (*M* = 5.73, *SD* = 1.23), and quality (*M* = 5.13, *SD* = 1.36). The criteria rated as least important were: number of calories (*M* = 2.80, *SD* = 1.84) and nutritional value (*M* = 3.76, *SD* = 1.79). Experimental condition only had a significant effect on the rated importance of the number of calories ($F(4, 171) = 3.52$, $p < .01$, $\eta^2p = .08$) with this criterion being rated significantly higher in the product CO2 condition (*M* = 3.41, *SD* = 2.01) than in the basket CO2 condition (*M* = 1.91, *SD* = 1.22). In terms of shopping habits, our participants mostly carried out their shopping in supermarkets (*M* = 4.44, *SD* = 1.94), hypermarkets (*M* = 4.09, *SD* = 1.98), and least often in organic shops (*M* = 2.15, *SD* = 1.71) or associations for the maintenance of peasant farming (*M* = 1.65, *SD* = 1.47). Participants indicated little familiarity with doing online shopping, saying they did not shop often in shops comparable to ours (*M* = 1.42, *SD* = 1.16).

More than half of the participants' (66.5%) field of education/activity was human and social sciences followed by letters and languages (16.5%); art, music, audio-visual, and cinema (6.8%); and medical and paramedical (2.8%). Regarding political orientation, 34.1% indicated belonging to a left-wing party (Front de Gauche, Parti Socialiste, Parti Radical de Gauche), 5.7% to an environmental party (Europe Ecologie Les Verts), 0.6% to a regional party (Union Democratique Bretonne), and 7.8% to a right-wing party (Union pour un Mouvement Populaire, Mouvement Démocrate), with the remainder preferring not to respond.

We also conducted further analyses to determine the relationship between level of education, gender, income, age, and sustainable shopping behaviour. Calculations of Cronbach's α to check reliability of EAI-S revealed for the preservation dimension, α = .37 and for the utilisation dimension, α = .32. We did not investigate the impact of environmental attitude further since this variable had low internal reliability. Education level explained a significant proportion of variance in CO2 per kg of basket, R^2 = .03, $F(1, 174) = 5.44$, $p <$ .05. There was a significant mean difference of CO2 per kg of basket between male (*M* = 3.17, *SD* = 0.95) and female (*M* = 2.88, *SD* = 0.72) participants (*t*(97.99, *corrected for inequality of variances*) = 2.04, $p < .05$, *two-tailed).* Regarding income, 55 participants chose not to indicate their level of income. Results from the remaining participants showed that self-reported income did not explain a significant proportion of variance in CO2 per kg of basket (R^2 = .01, $F(1, 119) = 0.83$, $p = .36$). Lastly, age did not explain a significant proportion of variance in CO2 per kg of basket (R^2 = .01, $F(1, 174) = 1.8$, $p = .18$).

4.2.2. Assessing the Impact of Goal-Setting and Feedback

As our goal-setting interventions oriented participants to achieve targets stated in kilograms of CO2 per kg weight of products, we use this indicator as our target measure of mean basket CO2 footprint although we also report the absolute mean kilograms of CO2 for each basket (see Table 8). In order to test the effect of the different experimental conditions, we first ran an ANOVA which revealed a significant effect of experimental condition on the mean shopping basket carbon footprint ($F(4, 171) = 2.89$, $p < .05$, $\eta^2_p = .06$).

We then conducted planned comparisons in order to test Hypotheses 1a and 1b. The results confirmed both hypotheses concerning the effectiveness of the goal-setting manipulations by indicating that compared to the control condition (*M* = 3.26, *SD* = 0.84), the numerical goal setting condition led to a basket with a significantly lower carbon footprint (*M*

= 2.75, *SD* = 0.67; $t(69) = 2.80$, $p < .005$, *one-tailed*) as did the graphical thermometer goal setting condition (*M* = 2.77, *SD* = 0.93; $t(68) = 2.29$, $p < .05$, *one-tailed*).

However, product information did not have a significant effect on basket carbon footprint, thus disconfirming Hypotheses 2a and 2b. Thus, basket carbon footprint in control condition (*M* = 3.26, *SD* = 0.84) was not significantly higher than that of product numerical footprint condition (*M* = 2.95, *SD* = 0.73; $t(71) = 1.65$, $p = .052$, *one-tailed*) or the numerical product & basket footprint condition (*M* = 3.18, *SD* = 0.8; $t(68) = 0.41$, $p = .34$, *one-tailed*). These results indicate that informational strategies presenting numerical CO2 product or carbon feedback alone were not effective.

Hypotheses 3a and 3b that the goal-setting conditions would lead to lower basket carbon footprint than the product numerical footprint condition were not confirmed although the absolute values of mean carbon footprints were in the expected direction. Participants assigned to product numerical footprint condition (*M* = 2.95, *SD* = 0.73) had non-significantly higher carbon footprint per kg of basket compared to numerical goal setting condition (*M* = 2.75, *SD* = 0.67; $t(70) = 1.22$, $p = .11$, *one-tailed*) and graphical thermometer goal setting condition (*M* = 2.77, *SD* = 0.93; $t(69) = 0.91$, $p = .18$, *one-tailed*).

Hypothesis 4a and 4b were confirmed: Results showed that participants assigned to numerical product & basket footprint condition (*M* = 3.18, *SD* = 0.8) had significantly higher carbon footprint per kg of basket than those assigned to numerical goal setting condition (*M* = 2.75, *SD* = 0.67; $t(67) = 2.39$, $p < .05$, *one-tailed*) and to the graphical thermometer goal setting condition (*M* = 2.77, *SD* = 0.93; $t(66) = 1.91$, $p < .05$, *one-tailed*). These results indicate that in the goal-setting condition, it is important to set a basket goal as well as to give basket-level feedback.

Hypothesis 5 was not confirmed, so indicating that both kinds of basket-level feedback (numerical and graphical) with goal-setting were equally effective: mean basket CO2 in the numerical goal setting condition (*M* = 2.75, *SD* = 0.67) was not significantly different than the mean basket CO2 in graphical thermometer goal setting condition (*M* = 2.77, *SD* = 0.93; *t*(67) = - 0.1, *p* = .46, *one-tailed*).

Table 8

Experiment 1: Mean Carbon Emissions per kg of Basket and Mean of Total Carbon Emission of Basket in kg for Each Experimental Condition

Experimental Conditions	M*	SD	M**	SD	*n*
Control	3.26	0.84	17.67	3.01	36
Product numerical footprint	2.95	0.73	15.95	3.19	37
Numerical product & basket footprint	3.18	0.80	17.37	3.50	34
Numerical goal setting	2.75	0.67	15.64	3.12	35
Graphical thermometer goal setting	2.77	0.93	15.24	3.90	34

*Mean carbon footprint per kg of basket in kg

** Mean total carbon footprint of basket in kg

4.3. Discussion

The first experiment shows that sustainable basket goal-setting conditions had the predicted impact on the carbon footprint of the basket regardless of the form of presentation (graphic or numerical). However, this result was not obtained when numerical product and basket feedback was displayed without a goal. This shows the importance of goal-feedback *pairings*: participants change their purchase choices when they have feedback about the footprint of their basket and when they can evaluate this feedback with respect to a goal in the form of an ideal level of carbon footprint, but do not do so when presented with feedback alone. A perhaps surprising result in view of the greater difficulty people have in using quantitative information conveyed in numerical rather than graphical form (e.g., Cokely et al., 2012) is that we found no difference between numerical and graphical goal feedback in our experiment. One reason for this may be that the numerical basket level representation we used simplified the use of information, as consumers only had to evaluate two items of information (the basket aspiration level and the current CO2 level of the basket) at any given moment. The basket goal and feedback information were presented next to each other on the screen, making them easy to compare. In this respect, it may be significant to note that cases where product numerical information had an impact on judgment and behaviour were also found in studies where visual displays made it easy to compare relative CO2 footprint between a small range of options (Perino et al., 2014; Thogersen & Nielsen, 2016). Such local task effects may explain why numerical representations of carbon footprint at the basket level with goal setting succeeded in influencing purchasing behaviour whereas numerical information at the product level did not.

Although both goal-setting conditions led to baskets with lower carbon footprint than the product numerical footprint condition, these differences were not significant. In addition, neither the product numerical footprint nor the numerical basket & product footprint conditions differed significantly from control, despite being prefaced by an explanation explaining the purpose of this information. One might have expected that displaying these attributes of each option might have activated pro-environmental norms (Cialdini et al., 1990) or served as *signposts* (Ungemach et al., 2017) that would suffice to orient consumers towards choosing more socially desirable, sustainable options, yet we did not observe this in our experiment. We therefore explored ways of making product numerical footprint more salient through colour coding in the next experiment, as this has been shown to enhance sustainable consumption in other contexts. We also included a numerical carbon footprint condition to enable comparisons with the colour coded condition as well as with the numerical goal setting condition.

5. Experiment 2

In the second experiment, we sought to replicate the main results obtained in the first study concerning sustainable goal setting and feedback techniques but also extend them by incorporating colour-coded labels for both product and basket footprint information. In particular, we investigated if a five-colour carbon-coding scheme would enhance the impact of numerical product footprint information and the graphical basket level representation. For products, this was achieved by colouring the borders of the cell in which each product was displayed and for baskets this was achieved by colouring the zones of the thermometer (Multi-coloured thermometer goal setting, where the zone between 0 and 2.33 kg CO2 footprint per kg of basket was coloured green, between 2.33 kg CO2 per kg and 4.66 kg CO2 per kg of basket coloured yellow, between 4.66 kg CO2 per kg and 6.99 kg CO2 per kg of basket coloured amber, between 6.99 kg CO2 per kg and 9.32 kg CO2 per kg of basket coloured vermilion and>9.32 kg CO2 per kg of basket coloured as red). The same principle was used for colouring products.

We tested the following hypotheses in Experiment 2, some of which were replications of comparisons made in Experiment 1 (e.g., Hypothesis 1a) and others involved new comparisons (e.g., Hypothesis 1c): 1.The first hypothesis tested whether our old and new goal-setting manipulations were effective compared to control. Specifically, participants assigned to numerical goal setting condition (replication of test 1a) and multi-coloured thermometer goal setting condition (new Hypothesis 1c) will have shopping baskets with lower carbon footprint than participants assigned to the control condition. 2. We also tested the second set of hypotheses about whether product information alone will lead to reduction in basket carbon footprint: Numerical product feedback (product numerical footprint condition, replication of test 2a) and the colour coded product numerical footprint condition (new Hypothesis 2c) will lead to lower basket footprint compared to control. 3. We also tested whether the two goal-setting conditions were more effective than the corresponding product information strategies. Thus, we hypothesized that participants assigned to the numerical goal setting condition (old Hypothesis 3a) will have baskets with lower carbon footprint than those assigned to the product numerical footprint condition and that the multi-coloured thermometer goal setting condition (new Hypothesis 3c) will have baskets with lower carbon footprint than those assigned to the colour-coded product numerical footprint condition. 4. We also tested whether participants assigned to the multi-coloured thermometer goal setting condition will have shopping baskets with lower carbon footprint than participants assigned to the numerical goal setting condition (Hypothesis 5b). 5. Finally, we tested whether participants assigned to colour-coded product numerical footprint condition have significantly lower carbon footprint compared to those assigned to product numerical footprint condition to see if colour coding (i.e., a visual representation of carbon footprint information) enhanced the impact of numerical carbon information (new Hypothesis 6).

5.1. Method

5.1.1. Participants

Two hundred participants were initially recruited on the campus of the University of Toulouse-2 (Jean Jaurès) in April 2014. Three outliers were excluded[30], leaving a final sample of 196 participants: 137 women and 59 men aged between 18 and 40 (*M* = 21.64, *SD* = 3.70) with an average level of 1.85 years of higher education post-baccalauréat (*SD* = 1.64).

[30] Two participants were excluded because they had total carbon emissions z-scores > 3.29 and one participant was excluded because he had ordered 25kg of potatoes. We also excluded one participant who was under-aged (17 years old).

5.1.2. Materials and Procedure

The same procedure was used as in Experiment 1. One small modification was made in how basket footprint was displayed: it was no longer displayed on the bottom right corner of the screen but rather on the top right corner instead. This was to explore whether this change would increase the salience of the basket-level information. Each participant was randomly assigned to one of the following five experimental conditions (cf. Table 7 for a summary of conditions):

Control (*n* = 39): The same condition as in Study 1.

Product numerical footprint (*n* = 38): The same condition as in Study 1.

Colour coded product numerical footprint (*n* = 40): This condition displayed the carbon footprint of each product, highlighted with a specific colour coding (cf. Appendix AA). This colour coding ranged from light green (weak carbon footprint) to dark red (highest carbon footprint).

Numerical goal setting (*n* = 39): The same condition as the numerical goal setting condition used in Study 1.

Multi-coloured thermometer goal setting (*n* = 40): This condition displayed the same information as the numerical goal setting condition with added colour coding. The colours were used to highlight the carbon footprint of each product as in the colour coded product numerical footprint condition and they were also used to signal the level of emissions of the shopping basket. If the carbon footprint of the shopping basket respected the sustainable level, the cursor stayed in the sustainable green zone showing the current carbon footprint of the basket (cf. Appendix BB). If carbon footprint of the shopping basket exceeded the sustainable level, the cursor went up from the green zone to one of the yellow/amber/vermilion/red non-sustainable zones. The explanatory text displayed on the landing page was therefore adapted to include an additional description of the colour coding: “With a view to limiting climate change, the objective which has been validated by the Grenelle Environment Forum (*Grenelle de l’Environnement)* is to achieve a 75% reduction of carbon emissions by the year 2050. Reducing CO2 emissions by 25% would be an intermediary objective. For this reason, a “carbon thermometer” which will help you evaluate the mean total carbon footprint of your basket will be displayed. If your emissions are in the green zone, then this objective is respected since the upper limit of the green zone corresponds to a 25% reduction of the carbon footprint of a shopping basket.”

5.2. Results

5.2.1. Descriptive Statistics and Correlations With Stated Choice Criteria

Participants purchased on average 17.57 products (*SD* = 6.32). The mean amount of carbon emissions for a basketful of products was 2.98 kg per kg of product (*SD* = 0.98) and the mean of total amount of carbon footprint of shopping baskets was 15.94 (*SD* = 4.07; see Table 9 for the means). Participants reported their most important criteria for selecting items when shopping were: value-for- money (*M* = 5.87, *SD* = 1.12), price (*M* = 5.59, *SD* = 1.17), and quality (*M* = 5.34, *SD* = 1.2). The least important criterion that was mentioned was the number of calories (*M* = 3.12, *SD* = 1.77). There was no significant effect of experimental condition on the rated importance of any of the choice criteria. Regarding purchasing habits, participants most often went shopping in supermarkets (*M* = 4.21, *SD* = 1.85) and hypermarkets (*M* = 4.05, *SD* = 1.94). They reported being less inclined to purchase their food from associations for the maintenance of peasant farming (*M* = 1.60, *SD* = 1.36), in organic shops (*M* = 2.35, *SD* = 1.8), or directly from the producers (*M* = 2.16, *SD* = 1.63). Thus, participants in Study 1 & 2 appear to report matching consumption patterns. Table 10.

We checked Cronbach's α to verify reliability of EAI-S: for the preservation dimension, α = .43 and for utilisation dimension, α = .34. Since the reliability analysis showed low internal consistency, we did not conduct further analysis with this variable.

Participants indicated that they did not often shop online in shops similar to ours (*M* = 1.59, *SD* = 1.26). Moreover, almost more than half of the participants indicated that their field of study/activity was human and social sciences (54.6%) followed by language and letters (30.1%) and art, music, audio-visual, and cinema (4.6%). Concerning political opinion, 39.9% indicated belonging to a left-wing party (Parti Socialiste, Parti Radical de Gauche, Front de Gauche), 11.2% to a right-wing party (L'Union pour un mouvement populaire, Union des Démocrates et Indépendants, Front National/Rassemblement Bleu Marine, Mouvement Démocrate, Parti Chrétien-Démocrate), 5.6% to an environmental party (Europe Ecologie Les Verts) with the remainder preferring not to answer.

We conducted an analysis to see the relationship between the impact of level of education, gender, income, age, and the sustainability of shopping baskets. Education level did not explain a significant proportion of variance in CO2 per kg of basket (R^2 = .01, $F(1, 194) = 1.05$, $p = .31$). There was no significant mean difference between male (*M* = 3.19, *SD* = 1.08) and female (*M* = 2.89, *SD* = 0.93) participants ($t(194) = 1.97$, $p = .05$, *two-tailed*). Regarding income, 76 participants chose not to indicate their level of income. Results from the remaining participants showed that self-reported income did not significantly explain a significant proportion of variance in CO2 per kg of basket ($R^2 = 0$, $F(1, 118) = 0.18$, $p = .67$). Lastly, age did not explain a significant variance in CO2 per kg of basket ($R^2 = 0$, $F(1, 194) = 0.37$, $p = .54$).

Table 9

Experiment 2: Mean Carbon Emissions per kg of Basket and Mean Total Carbon Emission of Basket For Each Experimental Condition

Experimental Conditions	M*	SD	M**	SD	*n*
Control	3.19	0.88	16.78	4.33	39
Product numerical footprint	2.94	1	16.42	4.25	38
Colour coded product numerical footprint	3.16	1.14	16.10	3.57	40
Numerical goal setting	2.88	0.87	15.02	3.78	39
Multi-coloured thermometer goal setting	2.75	0.97	15.41	4.32	40

* Mean carbon footprint per kg of basket in kg

** Mean total carbon footprint of basket in kg

Table 10

Overview of Results of the Three Experiments

Principal hypotheses & *specific contrasts* tested	Expt 1.	Expt. 2.	Expt.1 & Expt 2. (Meta-analysis)	Expt. 3.	Expt. 2. & Expt. 3 (Meta-analysis)
1. Goal-setting will lead to lower carbon footprint baskets compared to control					
1a. Numerical goal setting vs. control	Supported	Not supported	Supported		
1b. Graphical thermometer goal setting vs. control	Supported				
1c. Multi-coloured thermometer goal setting vs. control		Supported		Supported	Supported
2. Feedback only will lead to lower carbon footprint baskets compared to control					
2a. Product numerical footprint only vs. control	Not supported	Not supported	Supported		
2b. Numerical product & basket footprint vs. control	Not supported				
2c. Colour coded product numerical footprint vs. control.		Not supported			
***3.* Goal-setting will lead to lower carbon footprint baskets compared to product feedback.**					
3a. *Numerical goal setting vs. product numerical footprint*	Not supported	Not supported	Not supported		
3b. Graphical thermometer goal setting vs. product numerical footprint	Not supported				
3c. Multi-coloured thermometer goal setting vs. colour coded product numerical footprint		Supported			
***4.* Goal-setting conditions will lead to lower basket carbon footprint compared to numerical basket and product feedback alone**					
4a. *Numerical goal setting vs. numerical product & basket footprint.*	Supported				
4b. Graphical thermometer goal setting vs. numerical product & basket footprint.	Supported				
5. Graphical thermometer goal setting will lead to lower basket carbon footprint than numerical goal setting.					
5a. Graphical thermometer goal setting vs. *numerical goal setting*.	Not supported				
5b. *Multi-coloured thermometer goal setting* vs. *numerical goal setting*		Not supported			
6. Colour-coded product numerical footprint will lead to lower basket carbon footprint compared to product numerical footprint		Not supported			
7a. Multiple visits to shop will decrease basket footprint over visits.				Not supported	
7b. Multiple visits to shop will increase product carbon knowledge over visits				Supported	

5.2.2. Assessing the Impact of Goal-Setting and Feedback

In order to measure the impact of providing different types of carbon information on the mean total carbon footprints per kg of participants' shopping baskets, a one-way ANOVA was conducted. No significant overall differences were found ($F(4, 191) = 1.44$, $p = .22$, $\eta^2_p = .03$). However, focused comparisons again revealed differences in the expected direction. Unlike in Experiment 1, Hypothesis 1a was not confirmed as participants had a non-significantly lower basket carbon footprint in the numerical goal setting condition than the control condition ($M = 3.19$, $SD = 0.88$ vs. $M = 2.88$, $SD = 0.87$; $t(76) = 1.53$, $p = .065$, *one-tailed*). Hypothesis 1c was confirmed as participants had a significantly lower basket carbon footprint in the multi-coloured thermometer goal setting conditions ($M = 2.75$, $SD = 0.97$; $t(77) = 2.11$, $p < .05$, *one-tailed*) compared to control.

As in the previous experiment, we found no effect of product information alone. Thus, the mean carbon content of shopping baskets in the product numerical footprint ((2a), $M = 2.94$, $SD = 1$; $t(75) = 1.13$, $p = .13$, *one-tailed*) condition and the colour coded product numerical footprint condition ((2c), $M = 3.16$, $SD = 1.14$; $t(77) = 0.13$, $p = .45$, *one-tailed*) were not significantly different than control ($M = 3.19$, $SD = 0.88$) condition disconfirming Hypotheses 2a and 2c.

Hypotheses 3a was not supported whereas Hypothesis 3c was. Thus, participants assigned to product numerical footprint ($M = 2.94$, $SD = 1$) did not have significantly higher carbon footprint per kg of basket compared to those assigned to numerical goal setting condition ((3a), $M = 2.88$, $SD = 0.87$; $t(75) = 0.28$, $p = .39$, *one-tailed*). However, Hypothesis 3c was confirmed as participants assigned to the colour coded product numerical footprint condition ($M = 3.16$, $SD = 1.14$) had significantly higher carbon footprint than participants assigned to the multi-coloured thermometer goal setting condition ($M = 2.75$, $SD = 0.97$, *t*(78) = 1.74, *p* < .05, *one-tailed*).

Hypothesis 5b was not supported by the results as both goal-setting manipulations appeared to be equally effective. No difference was found between the numerical goal setting condition (*M* = 2.88, *SD* = 0.87) and the multi-coloured thermometer goal setting (*M* = 2.75, *SD* = 0.97) condition (*t*(77) = 0.66, *p* = .26, *one-tailed*).

Finally, Hypothesis 6 was not confirmed. Participants did not have significantly lower carbon footprints in the colour-coded product numerical footprint (*M* = 3.16, *SD* = 1.14) condition than in the product numerical footprint (*M* = 2.94, *SD* = 1; *t*(76) = -0.88, *p* = .19, *one- tailed*). Therefore, colour coding carbon footprint information did not increase the impact of carbon footprint information alone condition.

5.2.3. Meta-Analysis of the Effects of the Numerical Goal-Setting and Numerical Product Information Conditions

As the numerical goal setting condition was compared to a control condition in both Experiments 1 and 2, we conducted a *meta*- analysis of this contrast to have a better estimation of the significance of the results and of the effect size. We computed a meta-analytical Cohen's *d* (Cumming, 2012) with 95% confidence intervals (CIs) around it (Algina & Keselman, 2003). Across studies, we found a significant goal-setting effect, *t*(147) = 2.98, *p* < .005, *one-tailed*, with a Cohen's *d* = .49, 95% CI [.18, inf.], indicating a small to medium effect size. Although the effect observed in Experiment 2 was not conventionally significant, amalgamating it with that observed in Experiment 1 increases confidence that the numerical goal setting condition has a significant effect.

Similarly, we compared product numerical footprint condition to the control condition and to the numerical goal setting condition in Experiments 1 and 2. This revealed that over the two experiments the product numerical footprint condition did lead to significantly lower basket carbon footprint compared to the control condition $t(148) = 1.92$, $p = .028$, *one-tailed* with a Cohen's $d = .32$, 95% CI [.04, inf.]. However, over the two experiments a non-significant difference was found between the product numerical footprint condition and numerical goal setting condition, $t(147) = 0.94$, $p = .18$, *one-tailed* with a Cohen's $d = .15$, 95% CI [-.1, inf.].

5.3. Discussion

The results of Experiment 2 reinforced the finding of the first study by showing a similar pattern of results in the numerical goal setting on purchases that when combined across experiments was highly significant. In addition, there was a significant effect of the multi-coloured thermometer goal setting condition. The difference between the numerical goal setting condition and the multi-coloured thermometer goal setting condition was non-significant, indicating that both goal setting manipulations were equally effective.

An important null result was that there was no effect of colour coded product information compared to control and to product numerical information. Our failure to replicate earlier studies that found an effect of coloured carbon labels may be explained by the specific form of colour coding used in our experiments, whereby five colours (red, vermilion, amber, yellow, green) were used to colour the borders of the square in which each product was presented, whereas other studies that did find this effect used coloured pastilles (Muller et al., 2019), coloured versions of the Carbon Trust footprint (Thogersen & Nielsen, 2016; Vanclay et al., 2011), or a gradated colour label (Vlaeminck et al., 2014).

However, a meta-analysis of our results over Experiments 1 and 2 indicated that presenting numerical product carbon information along with an explanation of its meaning is sufficient to induce more sustainable consumption in our online supermarket setting. Taken in conjunction with results of Experiment 1, the results of Experiment 2 reinforce our earlier findings concerning the effectiveness of goal-setting by showing that the combination of a basket goal with an injunctive norm and precise feedback consistently leads to purchase of lower CO2 baskets, regardless of whether basket CO2 feedback is presented in numerical or coloured graphical form. Importantly, the multi-coloured thermometer goal setting condition was significantly more effective than the colour coded product information in reducing basket carbon footprint, indicating that the presence of a goal in the goal-setting manipulation contributed independently of product feedback to this effect.

Finally, a comparison of the contrasts between the numerical goal setting and control conditions in Experiments 1 and 2 suggested that there was no advantage to be gained by placing the basket feedback information in the top right-hand corner of the screen.

6. Experiment 3

Research has indicated that consumers have a poor understanding of the carbon footprint of different grocery products (Camilleri et al., 2019; Panzone et al., 2016; Sale, 2012). In the third experiment, we wanted to investigate whether repeated visits to a shop where graphical feedback was given about basket carbon footprint would result in more accurate representations of product carbon footprint through non-verbal (e.g., associative) learning (Dickinson, 1980; Hertwig et al., 2018). We began by replicating the test of Hypothesis 1c that the multi-coloured thermometer goal-setting condition would lead to baskets with lower carbon footprint than control. We also tested two new hypotheses. Specifically, we hypothesized that being more frequently exposed to the multi-coloured thermometer goal setting condition would: (7a) lead to lower CO2 baskets being purchased over visits and (7b) enhance the accuracy of consumers' product carbon footprint knowledge over visits. In order to test these hypotheses, we added a repeated-visit condition where participants made three visits to the GreenShop 2. Product carbon footprint knowledge was measured with a post-experimental survey. As in the previous study, we also expect the multi-coloured thermometer goal setting condition to lead to a reduction in the mean total carbon emission of the baskets.

6.1. Method

6.1.1. Participants

One hundred and thirty-two participants were initially recruited through the Toulouse School of Economics subject pool in March 2018. One participant who claimed to speak French much less than their mother tongue was excluded from the data, which leaves a final sample of 131 participants composed of 61 men and 70 women aged between 18 and 32 (M = 20.83, SD = 1.90)[31] with an average level of 2.50 years of higher education post-baccalauréat (SD = 1.11). We used a 2 × 2 design crossing experimental condition (Goal-setting vs. control) with the number of visits (1 vs. 3). This resulted in four experimental conditions: Control with one visit (n = 29), control with three-visits (n = 34), multi-coloured thermometer goal setting (n = 35), multi-coloured thermometer goal setting with three-visits (n = 33).

6.1.2. Procedure

Upon arrival at the Toulouse School of Economics experimental laboratory, participants were randomly assigned to sit in front of one of a suite of laptop computers, separated from each other by a board, which prevented them from seeing how others are responding. Participants were assigned to the experimental conditions and after having read the instructions, they immediately proceeded to their shopping visit. As in the previous experiments, participants were informed that they disposed of a €25 budget and that they had to spend minimum of €20 to be able to leave the shopping platform. They were also told that the unspent part of the budget would not be returned to them.

[31] One participant who wrote “100” as age was excluded.

Participants could make either one or three visits. This was clarified in the beginning of the experiment. Participants who did three visits saw a page saying, “You are going to do your visit once again. Imagine that your last visit is about one week ago.” between the visits. As in the previous experiments, participants were informed that they had one chance out of five of winning the basket of products they selected. After having finished the experiment, participants who did one visit rolled a dice to determine whether they would receive the basket they ordered and participants who did three visits rolled the dice three times, once for each basket selected to determine whether they would receive the basket or baskets they ordered. This procedure enabled us to augment the ecological validity of the experimental design and encourage the expression of participants’ true preferences on all visits. After finishing their shopping, participants proceeded to answer the same series of questions as in the first two studies but also responded to a carbon footprint knowledge questionnaire, which was presented prior to the final socio-demographic questions.

6.1.3. Measures

As in Studies 1 and 2, we administered an adapted version of the EAI-S (Milfont & Duckitt, 2010) and asked questions about purchasing criteria and habits, familiarity with online shopping, and socio-demographics.

Participants were required to estimate the carbon footprint of 36 products selected from the food catalogue of GreenShop 2 as high, medium, or low (see Appendix CC for an example of an item). A default response category “I do not know” was also provided to the participants. For each of the six categories (fruits and vegetables, meats and fish, dairy products and eggs, frozen foods, sweet goods, and savoury goods), representative products were included in the questionnaire. Products coming from other countries were not included in order to eliminate possible use of the food-mile heuristic (Sale, 2012). Similarly, organic products were excluded from the questionnaire. The order of the products was randomly generated and an informative paragraph about carbon footprint was displayed before starting the questionnaire. An error score was calculated such that lower scores showed that participants' answers were closer to the correct answers and thus more accurate.

6.2. Results

6.2.1. Descriptive Statistics and Preliminary Analyses

Participants purchased on average 17.64 products (*SD* = 5.01) in the one-visit conditions and in the three-visits conditions, they purchased on average 17.93 products in the first visit (*SD* = 7.27), 17.22 products in the second visit (*SD* = 6.51), and 18.54 products in the third visit (*SD* = 7.10). The most important criteria for selecting the items while shopping reported by the participants were: value- for-money (*M* = 6.14, *SD* = 0.99), quality (*M* = 5.56, *SD* = 1.11), and price (*M* = 5.51, *SD* = 1.24) and the least important was number of calories (*M* = 3.20, *SD* = 1.77). Concerning purchasing habits, participants reported that they most often went shopping in supermarkets (*M* = 4.79, *SD* = 1.92), hypermarkets (*M* = 3.75, *SD* = 2.02), and minimarkets (*M* = 3.48, *SD* = 2.02) and least often from associations for the maintenance of peasant farming (*M* = 1.64, *SD* = 1.51), directly from the producers (*M* = 1.75, *SD* = 1.33), or from organic shops (*M* = 2.18, *SD* = 1.66). An ANOVA revealed no effect of goal-setting condition or interaction thereof on number of visits on choice criteria for grocery shopping (i.e., quality, price, value for money, number of calories, nutritional values, production mode, and environmental impact). The mean amount of carbon emissions per kg of products in the single visit conditions was 3.35 kg (*SD* = 1.27) and the total mean CO2 emission was 15.88 kg (*SD* = 3.65). The mean amount of carbon emission per basket of products in the three visits conditions were 3.26 kg (*SD* = 0.97), 3.35 kg (*SD* = 1.31), and 3.28 kg (*SD* = 1.02) respectively and the mean total carbon footprint were 16.80 kg (*SD* = 4.41), 15.95 kg (*SD* = 4.21), and 16.50 kg (*SD* = 4.37) respectively (see Figure 7 & Figure

8).

Among participants who did three visits to the shop, carbon footprint of first basket and that of the second basket was moderately correlated ($r(65) = .49$, $p < .01$), similarly a moderate positive correlation was found between carbon footprint of first and third shopping baskets ($r(65) = .54$, $p < .01$). Finally, a moderate positive correlation was found between shopping baskets of the second and third visits ($r(65) = .68$, $p < .01$).

We checked Cronbach's α to conduct a reliability analysis for EAI-S: for preservation, $\alpha = 0.45$ and for utilisation, $\alpha = 0.4$. Since results showed low reliability, we did not conduct further analysis with this variable. Participants indicated not shopping online frequently in the shops comparable to ours ($M = 1.69$, $SD = 1.43$). Moreover, 45.8% of the participants indicated that economics is their field of study/activity. For 23.7% of participants this was business, finance, and management; 7.6% law and justice; and 7.6% mathematics and statistics. Regarding political opinion, 26% indicated belonging to a left-wing party (Parti Socialiste, France Insoumise), 6.9% to a right-wing party (Les Républicains, Debout la France), 3.8% to an environmental party (Europe Ecologie Les Verts) and 29% to a centre party (La République en marche !) with the remainder preferring not to respond.

Moreover, we investigated the relationship between level of education, gender, income, age, and the sustainability of baskets built during the first visit. Education level did not explain a significant proportion of variance in CO2 per kg of basket ($R^2 = .01$, $F(1, 129) = 1.13$, $p = .29$). Concerning gender, as in the first experiment, baskets purchased during the first visit by female participants ($M = 3.06$, $SD = 0.90$) had a significantly lower carbon footprint than baskets purchased during the first visit by male participants ($M = 3.59$, $SD = 1.28$; t(106.24, *corrected for inequality of variances*) = 2.70, $p < .01$, *two-tailed*). Regarding income, 56 participants chose to not to indicate their income level[32]. Results showed that income did not explain a significant proportion of variance in CO2 per kg of basket (R^2 = .01, F(1, 71) = 0.7, p = .41). Regarding age[33], age did not explain a significant variance in CO2 per kg of basket (R^2 = 0, F(1, 128) = 0, p = .97).

6.2.2. Assessing the Impact of Goal-Setting and Number of Visits on Carbon Footprint of Baskets

In order to measure the impact of goal-setting and the number of visits on the mean total carbon emission of the baskets, a mixed ANOVA was conducted among participants who were assigned to multi-coloured thermometer goal setting with three-visits and control with three-visits conditions. As expected, and replicating the pattern of Experiment 2, Hypothesis 1c was confirmed as baskets in the multi- coloured thermometer goal setting conditions had significantly lower carbon footprint than those on the control conditions over the three visits (F(1, 65) = 6.83, p < .05, η^2_p = .10). However, Hypothesis 7a that repeated visits in the multi-coloured thermometer goal setting condition would lead to lower basket carbon footprint was not supported as there was no significant effect of number of visits on the carbon footprint of the baskets (F(2, 130) = 0.26, p = .77, η^2_p = .00) and no significant interaction effect of number of visits and exposure to multi-coloured thermometer goal setting (F(2, 130) = 1.28, p = .28, η^2_p = .02).

Similarly, when comparing baskets built during the first visit (i.e., first baskets of participants in the three-visit conditions and baskets of participants in the one-visit conditions), the results of one-way ANOVA showed that goal-setting (i.e., multi-coloured

---

[32] One participant who wrote “100000000000000” as their income and one participant who wrote “étudiant” as income were also excluded.

[33] One participant who wrote “100” as age was excluded.

thermometer goal setting condition) had a significant main effect on the basket carbon footprint ($F(1, 129) = 9.5$, $p < .01$, $\eta^2_p = .07$). This result replicates the finding that multi-coloured thermometer goal setting condition leads to baskets with lower CO2 footprint (supporting Hypothesis 1c).

6.2.3. Relations Between Goal-Setting, Number of Visits, Carbon Footprint Knowledge, and Basket Carbon Footprint

Independent two-way ANOVA confirmed Hypothesis 7b that showed that being exposed to multi-coloured thermometer goal setting ($F(1, 127) = 41.41$, $p < .001$, $\eta^2_p = .25$) would improve the accuracy of carbon footprint knowledge[34]. As predicted, the interaction of multi-coloured thermometer goal setting and number of visits on the accuracy of carbon footprint knowledge was statistically significant ($F(1,127) = 9.46$, $p < .01$, $\eta^2_p = .07$) (see Figure 9), and focused *t*-tests confirmed Hypothesis 7b by showing that there was significantly greater accuracy of product CO2 knowledge in the multi-coloured thermometer goal setting ($M = 1.27$, $SD = 0.32$) condition than in the control condition ($M = 1.44$, $SD = 0.23$; t(60.98, *corrected for inequality of variances*) = 2.53, $p < .01$, *one-tailed*). Moreover, accuracy was significantly higher in the three-visit compared to the one-visit multi-coloured thermometer goal setting condition ($M = 1.27$, $SD = 0.32$ vs. $M = 0.96$, $SD = 0.27$; $t(66) = 4.29$, $p < .001$, *one-tailed*) but not in the corresponding control conditions ($M = 1.45$, $SD = 0.34$ vs. $M = 1.44$, $SD = 0.23$; $t(61) = - 0.12$, $p = .45$, *one-tailed*). These results support Hypothesis 7b that the goal-setting condition with graphical feedback enables participants to learn about product carbon footprint and that repeated exposure leads to greater accuracy.

Additionally, we found a moderate significant correlation between product carbon

[34] Given the fact that the option “I don’t know” is not used often by the participants ($M = 2.00$, $SD = 5.08$), while computing the carbon footprint knowledge score, we considered these responses as if the participants chose “medium” as an estimation for these products.

footprint knowledge and carbon footprint of the baskets built during the first visit (*r*(129) = .3, *p* < .01, *two-tailed*). Analyses described above showed that multi-coloured thermometer goal setting increased knowledge and reduced carbon footprint of the baskets built during the first visit. We therefore tested whether product carbon footprint knowledge was a mediator of the impact of multi-coloured thermometer goal setting on basket carbon footprint by using a bootstrapping procedure (Preacher & Hayes, 2004), in particular PROCESS using 5000 bootstraps (Model 4; Hayes, 2018). Results showed a significant indirect effect of multi-coloured thermometer goal setting on basket carbon footprint via product carbon footprint knowledge 95% CI [- .4734, - .0423]. As the effect of the carbon thermometer on basket carbon footprint was no longer significant when carbon footprint knowledge is controlled for, we concluded that carbon footprint knowledge was a full mediator of the effect of the carbon thermometer on basket carbon footprint.

Figure 7

Experiment 3: Mean of Carbon Emission per kg of Shopping Basket For Each Experimental Condition

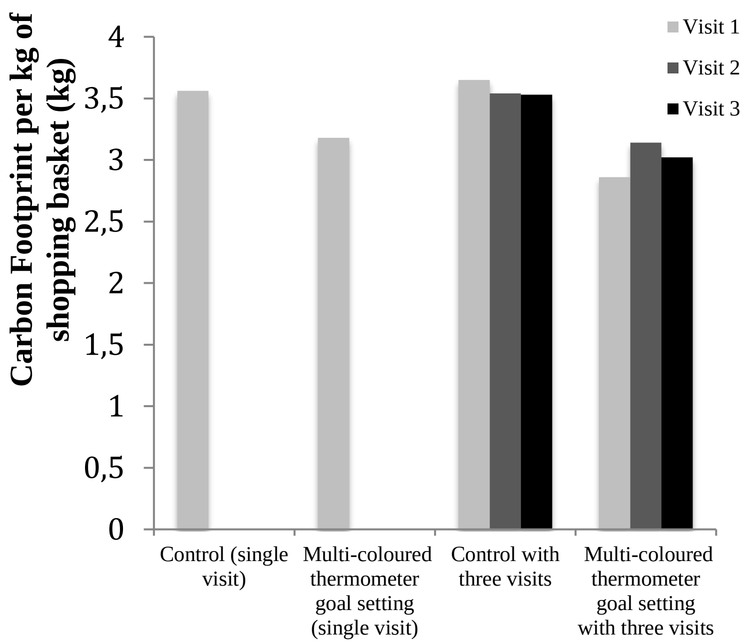


Figure 8

Experiment 3: Mean of Total Carbon Footprint Emission of Shopping Baskets in kg For Each Experimental Condition

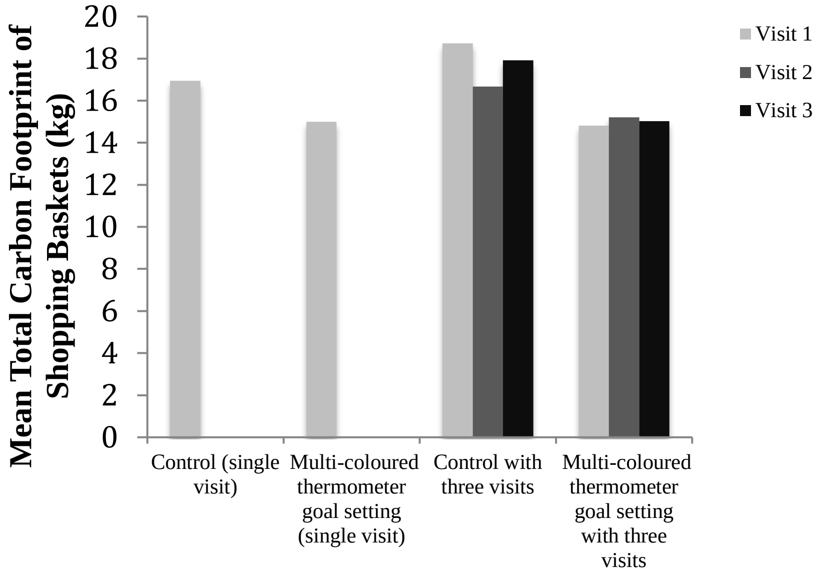
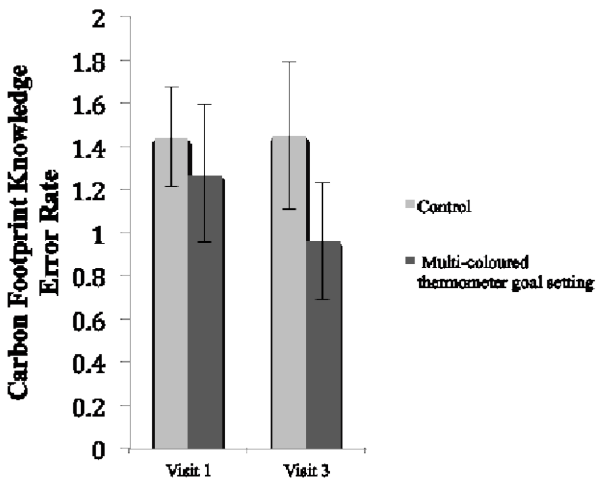


Figure 9

Experiment 3: Carbon Footprint Knowledge Error Score For Each Experimental Condition [Lower error rates indicates increased learning]



6.2.4. Meta-Analysis of the Effect of the Multi-Coloured Goal Setting Condition

As the multi-coloured goal setting condition was compared to a control condition in both Experiments 2 and 3, we conducted a meta- analysis of this contrast. It revealed a significant effect, $t(208) = 3.67$, $p < .001$, *one-tailed*, with a Cohen's $d = .51$, 95% CI [.29, inf.], indicating a medium effect size. This result gave further support to Hypothesis 1c that participants in the multi-coloured thermometer goal setting condition will have shopping baskets with lower carbon footprint than those assigned to the control condition.

6.3. Discussion

The results of Experiment 3 replicate those of Experiment 2 with respect to the effect of the goal-setting condition on basket CO2. Thus, participants bought baskets with significantly less carbon footprint when they were exposed to multi-coloured thermometer goal setting in both the first and third visits. In addition, new findings were that the goal-setting condition led to the acquisition of more accurate knowledge about product carbon footprint and that three visits led to further learning compared to when only one visit was made. Moreover, changes in product carbon footprint knowledge appeared to mediate the effects of the goal-setting condition on basket carbon footprint during the first visit. This suggests that information conveyed about product carbon footprint by our basket *carbon thermometer* enables consumers to learn about product carbon footprint in a way that guides their behaviour. However, acquiring more knowledge across repeated visits did not significantly decrease the carbon footprint of the basket purchased. It is nevertheless possible that acquiring more accurate representations of grocery carbon footprint would lead to more informed consumer choices on future occasions, a question that deserves to be addressed in future research.

7. General Discussion and Conclusions

Using a high fidelity incentive-compatible simulation of an online supermarket, we found over three experiments that our basket goal-setting & feedback manipulations had a significant effect on consumer behaviour. These effects emerged whether the feedback was numerical or graphical in form and whether the graphical feedback used two colours or five (Experiments 1 & 2), and whether the consumer made one or three visits to the online experimental supermarket using the five-colour carbon thermometer (Experiment 3). Experiment 3 also showed that goal-setting with coloured graphical feedback enabled participants to learn about product carbon footprint, and that their representations of carbon footprint became more accurate with increased visits to the online experimental supermarket. Moreover, greater accuracy in product CO2 knowledge appeared to mediate the effect of goal setting in reducing the carbon footprint of baskets built during the first visit.

The basket-level representations of carbon footprint have the advantage of enabling comparisons of the carbon footprint of products within and across product categories as well as enabling consumers to compensate high-carbon products with low carbon ones from different product categories and shelves. They also enable consumers to regulate their carbon footprint with respect to set goals, with clear feedback about their position with respect to that goal. Our results are in line with earlier results on household energy use which showed that goal-setting techniques led both to lower consumption of energy as well as increased knowledge about energy conservation (Abrahamse et al., 2007). Although basket carbon footprint did not decrease significantly across repeated visits, CO2 knowledge underpinned the effect of goal-setting on the carbon footprint of baskets in the first visit. It is thus possible that learning will help motivated consumers to select more sustainable baskets in a longer term perspective. It would be instructive to examine the relationship between using basket-level representations of carbon footprint and learning about product carbon footprint in real-life contexts, such as online supermarket or educational settings.

Our research also suggests that choice architecture – in the form of numerical or graphical feedback about the carbon status of the shopping basket with respect to the aspiration level – can help consumers form a mental representation of their carbon budget (Capstick & Lewis, 2010; Marek et al., 2018) that will guide consumer behaviour in a realistic online grocery shopping setting. Our results thus contribute to research that suggests that techniques that facilitate the construction of mental accounts that are relevant to decision-making can encourage choices of more sustainable options, such as public over private transportation. In addition, the basket level representations have the incidental effect of leading to formation of more accurate representations of product carbon footprint.

In contrast, other methods of promoting sustainable consumption had less effect on sustainable consumption in our realistic online supermarket setting. Thus, combining over Experiments 1 and 2, numerical carbon footprint information had a significant effect on sustainable consumption in our studies. In Experiment 2, colour coded numerical product information did not have a significant effect compared to control and significantly less effect than the colour coded goal setting condition. It is important to note that previous studies that have demonstrated an effect of numerical product information on supermarket shopping (e.g., Perino et al., 2014) did so in highly structured decision environments where the numerical information was made salient in a within-subject design and the number of options available at any given time restricted to between three and 12 within the same category. In related vein, presenting (non- incentivized) experimental participants with *greenhouse gas rating* rather than *fuel economy* information succeeded in directing their choices towards more sustainable options in a structured series of pairwise car comparisons (Ungemach et al., 2017).

The success of our numerical goal-setting condition may be due to the choice architecture features that similarly simplified information processing demands, namely that the two numbers relating the actual and ideal basket carbon footprints were situated next to each other in the screen corner, so making it easy to compare them and regulate behaviour accordingly. However, it may be that presenting numerical product information presented in the more complex environment of real-life supermarket displays will fail to influence consumer behaviour without decision support, as suggested by the experience of supermarket chains such as Tesco in the UK which have experimented with numerical carbon labels only to later withdraw them. Further research using eye-tracking techniques (e.g., Babakhani et al., 2020; Graham et al., 2012) may be able to elucidate whether participants actually scanned the numerical information and manipulation checks performed to see whether they acquired the information presented.

Interestingly, and against expectations based on previous research (e.g., Crosetto et al., 2016; Crosetto et al., 2020) our colour coding of the borders had no effect on sustainable consumption. However, Muller et al. (2019) found a significant effect of a product coding scheme using coloured pastilles in a shopping environment that bears many similarities to our own, wherein consumers first chose products from a computer screen structured in shelves before going on to collect their chosen basket from an experimental shop. It therefore seems possible that the particular scheme we used (coloured borders for product displays) in the present studies is an ineffective way of representing carbon footprint information in an online shopping environment.

8. Limitations and Future Directions

Our studies have some limitations. To begin with, regarding the moderators of goal-performance relationship, we only tested feedback together with the sustainable goal we set in our experiments. Future studies can investigate the impact of other moderators, such as goal commitment, in reducing basket carbon footprint. When one feels committed to the goal, relationship between goal and performance can be straightened and hence might display sustainable behaviour. Moreover, we found no effect of the kind of feedback used (numerical vs. graphical; bi-coloured vs. multi-coloured) on sustainable consumption, but it is possible that other ways of representing feedback about carbon footprint may be easier for participants to use, so further increasing the impact of goal setting techniques. This can be tested in future studies in the sustainable online grocery setting. Additionally, in our experiments, we did not randomize the screen position of the basket level carbon footprint information and product carbon footprint labels on the online shopping platform to eliminate location effects.

It is also possible that manipulation checks would enable us to learn more about why participants did not use numerical product CO2 information (e.g., because they did not perceive and remember it, or because they failed to interpret it in terms of high vs. low carbon footprint). Future studies can integrate different manipulation checks to better interpret results. Questions may also be posed about the external validity of the results. For example, it may be that repeated visits in the space of several minutes (asking them to imagine that there has been a week between each visit) may facilitate learning about product CO2 footprint, but a more realistic test may be to bring participants back at week-long intervals for their repeated visits. More generally, given the promising nature of our results using a realistic experimental online setting, future studies can test this approach in real-life online supermarkets. Such tests will determine the effectiveness of the goal-setting approach in real life online grocery stores and whether they can be used as a tool to decrease consumers' carbon footprint emissions.

In sum, our study introduces an innovative basket-level representation of carbon footprint and might have useful theoretical and practical implications. Goal-setting techniques are effective in inducing sustainable consumption in a realistic online grocery shopping environment and succeeds where numerical product and basket level carbon information alone fails. Our studies also failed to find any significant effect of colour coding on sustainable consumption at either the product level or at the basket level. The use of a basket-level representation of carbon footprint suggests that mental accounts can be constructed on the fly in decision-making that enable consumers to manage their carbon budget, for example by compensating high carbon footprint options with low ones. This form of representing carbon footprint information can be a self-explanatory and intelligible system of communication of carbon footprint information, which will enable consumers to regulate their behaviour in a more sustainable way. Future research should be able to calibrate these techniques in a way that is likely to render them fully effective as a decision aid in online supermarket shopping, for example by systematically modifying the placement of basket carbon footprint information on the screen.

General Conclusion

Our aim in this thesis was to investigate the impact of fiscal measures, non-monetary measures, namely injunctive norms and carbon footprint labels as well as goal-setting techniques on sustainable grocery consumption; more specifically, we tested whether fiscal measures, non-monetary instruments, and goal-setting techniques were effective in reducing consumers' carbon footprint in an experimental online grocery shop. We operationalized sustainable grocery consumption as basket carbon footprint[35]. As fiscal measures, we investigated the impact of a linear carbon tax and a bonus-malus tax on consumer behaviour. We argued that the fiscal measures could have extra-monetary effects beyond their price effect, which can influence consumer behaviour. Therefore, we did not only test the economic aspect of these measures but also their psychological impact on basket carbon footprint. Moreover, we also investigated the impact of non-monetary measures, injunctive norms and traffic lights carbon footprint labels, in the same context. Furthermore, we investigated whether the use of goal-setting techniques, more specifically, the impact of setting a sustainable goal and provision of feedback with respect to this goal will reduce basket carbon footprint and whether this strategy will be more effective than the sole provision of carbon footprint of products (e.g., provision of numerical or five-colour carbon footprint labels) and carbon footprint of basket.

Concerning the impact of carbon tax on sustainable consumption, we conducted two experiments and found little or no effect of the carbon tax in reducing basket carbon footprint. We found that price effect was not significant on basket carbon footprint. Similarly, we could not detect any significant psychological aspect of carbon tax on basket carbon footprint. More specifically, displaying the amount of tax attributed to products with their initial price (i.e., making the tax salient using tax signposts) did not reduce basket CO2, or displaying an injunctive normative message together with the information of application of

[35] We reported kilograms of carbon footprint per kg of shopping basket in our empirical studies.

the tax did not enhance the impact of tax. We found similar results related to the impact of bonus-malus on sustainable consumption. Over two experiments, we detected no significant price effect on basket carbon footprint of shopping baskets. Similarly, bonus-malus did not have a significant psychological aspect on consumer behaviour. In other words, displaying the bonus and malus amount attributed to products (i.e., making the tax salient through tax signposts) or justifying the application of bonus-malus with a normative message did not have an impact on basket carbon footprint. Similarly, the use of tax signposts together with a justification message did not have an impact. This lack of effect of bonus-malus persisted in both cases where the bonus-malus amount was medium or large.

We also tested the impact of tax signposts on product carbon footprint knowledge. While carbon tax signposts did not have an impact on the knowledge, we found evidence for the effectiveness of bonus-malus tax signposts. Although our initial hypotheses were not validated, when we created new factors, we showed that tax display (i.e., tax signposts) together with a tax justification message could improve product carbon footprint knowledge. In other words, when we performed an analysis with only conditions including bonus-malus, we found an effect of tax display regardless of bonus-malus rate.

Concerning the impact of non-monetary instruments, in both chapters where we investigated the impact of three-colour traffic lights carbon labels, we always found that these labels reduced basket carbon footprint and improved carbon footprint knowledge. Importantly, we showed that knowledge was a mediator between the impact of traffic lights carbon labels and basket footprint; to put differently, these labels reduced carbon footprint by improving participants' knowledge. However, we did not find a significant impact of five-colour coded carbon labels on the sustainability of shopping baskets. Similarly, we did not find a significant impact of numerical labels and inclusion of five-colour coding scheme to the numerical format did not render the numerical labels effective. However, numerical product carbon labels were able to decrease basket footprint of basket when the data of the two experiments were combined.

Concerning the main effect of injunctive norms, our initial hypothesis concerning their effect on sustainable consumption was not validated. However, we have found an effect of injunctive norm among the participants who were exposed to injunctive norms and responded positively to the question asking whether this message was displayed in the shop. Moreover, we also found a significant effect of norm on product carbon footprint knowledge. Therefore, norms can improve knowledge.

Goal-setting techniques were also shown to be effective in rendering shopping baskets more sustainable. That is to say, setting a sustainable goal and providing feedback (either presented in numeric terms, in a bi-colour, or in a multi-coloured [i.e., five-coloured] graphic) allowing the agent to compare their performance to the set goal is effective in reducing shopping baskets' carbon footprint. Moreover, we showed that implementing a goal and feedback decrease further basket CO2 compared to a situation where only basket and product CO2 information was presented without a goal and feedback, a result that shows the importance of inclusion of a goal and feedback to have a significant impact. Additionally, we found that goal and feedback presented on a multi-coloured graph can increase participants' product carbon footprint knowledge, and doing multiple visits can further enhance their knowledge over the visits although basket CO2 did not decrease across visits. Most importantly, we also showed that the relation between multi-coloured goal-setting and basket CO2 was mediated by carbon footprint knowledge. This result is in line with the findings that the impact three-coloured traffic lights labels whose impact on basket content was mediated by CO2 knowledge.

Our studies have important implications. First of all, three-colour traffic lights carbon labels (with the use of pastilles) are important tools, which can be used to decrease carbon emissions in an online grocery store through the improvement of consumers' product carbon footprint knowledge. Although three-colour traffic lights were effective, we found no evidence for the effectiveness of five-colour coded labels on the sustainability of shopping baskets. One reason for this difference could be that with three colour-coded labels, it could be easier to interpret a product's environmental friendliness compared to a five-colour coded label. This is in line with the findings of literature where three-colour scheme was effective in the sustainability context (e.g., Muller et al., 2019; Thogersen & Nielsen, 2016). Another reason could be the format of labels we have used. While for the five-colour format, we used arrow-shaped labels situated in the borders of the cells where products were presented, for three-colour labels we used pastilles placed on the down left corner of the cell. Moreover, if bonus-malus tax is decided to be used, displaying its amount attributed to products can be used as a tool to increase consumers' product carbon footprint knowledge. The reason why carbon tax signposts did not work and bonus-malus signposts did could be due to the relative ease of interpretation of the information given by bonus-malus tax signposts compared to carbon tax signposts. With bonus-malus tax signposts, one may learn about the environmental friendliness of a product by verifying whether it received a bonus or a malus without the need to interpret their numerical amount. On the other hand, when carbon tax is applied to all the products, one should interpret the numerical value to learn whether the product is environmentally friendly or not and make comparison between products. Similarly, we could not find any significant effect of carbon signposts on knowledge in the case where the tax amount was only displayed for the products with high CO2. Therefore, it might be possible that carbon tax signposts are tools relatively harder to interpret.

Although bonus-malus signposts improved knowledge, we did not detect any effect of bonus-malus on the consumption behaviour, which is a result not in line with the significant findings in the literature (e.g., Abadie et al., 2016; Hilton et al., 2014). One reason for this difference could be, as opposed to these studies, in our studies participants made real purchase decision (i.e., they had 1/5 chance of winning the products they selected). Therefore, bonus-malus may not be an efficient incentive, which can change consumption patterns. For instance, habit formation can be a reason for this ineffectiveness. Consumption of food can be related to habit formation meaning that one’s current choices might be contingent on consumption in the past. Hence, price changes may not change food consumption patterns in short run (Daunfeldt et al., 2011). On the other hand, Raux et al. (2020), as in our study, could not find an effect of framing the price change as bonus-malus on hypothetical travel choices. They claimed that the reason for this insignificance could be the motivational crowding-out effect. It may be possible that a crowding-out effect occurred in our studies with the implementation of bonus-malus scheme, which might have undermined participants’ intrinsic motivation to act environmentally friendly.

Another important implication from our studies is that in online grocery stores, policy makers can implement a sustainable carbon footprint goal for consumers to respect and also provide feedback about their performance with respect to the goal in order to reduce carbon emissions from groceries and also increase their carbon footprint knowledge. The significant impact of goal-setting techniques in the sustainable grocery consumption is a result in line with the findings in literature (e.g., Becker, 1978). These techniques can be effective tools since they can be easily implemented in online settings, and their application could be more easily accepted compared to an application of a tax.

Finally, to decrease carbon footprint from grocery consumption, injunctive normative messages can be used only if they are rendered salient in a way participants would notice it. Provision of such message could be used as a tool to ameliorate consumers’ product carbon footprint knowledge.

We may note some limitations of our experimental studies. To begin with, our experiments were conducted in an experimental online grocery shop where the number of products available was smaller compared to that of real online grocery stores. The relatively low number of products may be a limitation since it may not give participants all the product alternatives that they usually consume. Therefore, they could choose products that are not in line with their preferences and/or would not be able to do substitutions among products. Moreover, the use of experimenter's budget can have an impact on participants' choices and may yield them to choose products that they do not usually choose. For instance, they may choose expensive products knowing that it is experimenter's budget they are spending from not theirs. Additionally, knowing that they may not receive the basket they construct could have influenced their behaviour. Participants could be more likely to choose the products they usually choose or they need if they know they will definitely obtain the products they select during the experiment. Moreover, we conducted the recruitment in university campuses, which may result in a sample that is not representative of the population in France. Our sample might be mostly composed of students who may have different consumption patterns compared to the overall population in France. For instance, they may have a lower income since they may not have a full-time job. Mean age of the samples was also lower compared to the overall population in France, and in some of our studies the number of female and male participants was not equal. Additionally, we conducted our experiments in Toulouse. However, consumers living in other cities may have different food consumption patterns. For instance, consumers living by the sea coast may prefer fish products more. Furthermore, although in our last experiments we conducted power analyses to detect the number of participants to be recruited, interaction effects can be smaller and may require a larger sample to reach significance.

In our studies, we did not randomize the place of carbon footprint labels or information we gave about the CO2 of baskets; therefore, future studies can randomize the location of these manipulations to discard location effects. Similarly, finding the best place to locate labels (or basket CO2 information) can also be examined so that the effectiveness of these manipulations would be higher. Moreover, in some of our studies, we did not use manipulation checks. To understand whether participants perceived or understand the manipulations, future studies can implement such manipulation checks. Lastly, our multiple visit condition may interfere the external validity of our studies. Future studies can test this manipulation in more realistic settings, for example, where participants conduct the experiment several times in a month. In future studies, participants could be required to visit the experimental shop in three consecutive weeks. This manipulation could reflect better the real-life circumstances rather than ordering products three times in a row in the same experimental session (which might be less likely in real life).

Although we used between-subject design, in the conditions where we presented three or five-colour coded carbon footprint labels, or goal-setting manipulations, participants could understand the aim of the experiment, and as a result demand effects or social desirability effects could occur. To control for these factors, future studies may implement questionnaires to control for social desirability or ask participants the aim of the experiment in the end of the session.

Lastly, in our goal-setting studies, concerning the goal-performance relationship, we only manipulated one factor that was the provision of feedback. Future studies can test other factors as well, such as goal commitment, and investigate different formats of feedback and goal to see whether one format outperforms the other. Finding the most effective format can be crucial in effectively diminishing carbon footprint emissions.

Future studies can test our manipulations in more realistic field settings. Testing our interventions in field studies or experiments in real online grocery stores with a wider product options can give insights about how these variables might work when consumers decide in less controlled environments. In such environments, consumers can be less attentive to the information. For example, Carbon Trust label implemented in Tesco store in UK did not have an effect on consumer behaviour. Even in our laboratory experiment, in a controlled environment, we have demonstrated that not all the participants had indicated that our normative message was displayed in the shop (among those who were exposed to such message), and this message only had an effect on those who responded positively to the manipulation check question. Therefore, to have an effect on behaviour, messages such as the one we used in our shop should be remembered by consumers. If these messages do not capture their attention, they may not be remembered and work effectively. In real life-stores, since consumers are in a less controlled environment (e.g., distractions from other consumers, music or news played in the stores), they may pay less attention to such messages and as a result would not remember them. Hence, consumers would be less likely to use them in their decision-making. Therefore, for such messages, it is important to find the most effective format.

In our studies, to operationalize sustainable consumption behaviour, we used kilograms of carbon footprint per basket as the outcome variable. We have used this measure since we argued that this measure might reflect better the sustainability of shopping baskets. It can give better information about whether environmentally friendly products or non-friendly products were chosen for the basket. Similarly, this measure would allow consumers to do substitutions between products to have a basket with lower emissions without reducing consumption. Future studies can investigate other aspects of sustainable consumption behaviour. For instance, analysis of substitution behaviour can give useful insights about how participants make their decisions, whether they choose sustainable products in the first place or substitute high carbon products with lower ones after choosing the high CO2 products first. Furthermore, future studies can also investigate other ecological impact of consumer behaviour. For instance, water footprint can also be investigated.

Regarding the taxation tools, future studies can test the level of acceptability of different taxation schemes and implement them in a way which is acceptable by consumers. If taxation schemes are acceptable from consumer side, they can be more likely to be effective tools. Furthermore, focus group studies can be conducted after the experiments to understand why participants considered (or not) the tax measures in their decisions. This may give insights about why consumers tend or do not tend to use such manipulations in their decision-making. Additionally, although participants in our experiments indicated having low familiarity with online shopping (in the shops similar to ours), with the new simple delivery services, online shopping can be used more frequently in the future. Since this type of online shops gives the possibility to show consumers' overall carbon footprint or easily display carbon information of products, further studies could be conducted on such platforms. Finally, the impact of other non-monetary instruments and other fiscal measures (with different tax rates) as well as their interaction can be tested on consumer behaviour to detect the most effective instrument (or combination of instruments) in decreasing carbon footprint from grocery consumption.

To sum up, our aim in these studies was to promote sustainable consumption. The greenhouse gas emissions generated from different sectors have had substantial adverse impacts on the climate. Although some irreversible changes have already been occurred, we can still take a responsibility and act upon this matter. I hope this thesis can contribute, albeit small, to a better world…

References

Abadie, L. M., Galarraga, I., Milford, A. B., & Gustavsen, G. W. (2016). Using food taxes and subsidies to achieve emission reduction targets in Norway. *Journal of Cleaner Production, 134*, 280-297. https://doi.org/10.1016/j.jclepro.2015.09.054

Abadie, M., Villejoubert, G., Waroquier, L., & Vallee-Tourangeau, F. (2013). The interplay between presentation material and decision mode for complex choice preferences. *Journal of Cognitive Psychology, 25*(6), 682-691. https://doi.org/10.1080/20445911.2013.786721

Abelson, R. P., & Levi, A. (1985). Decision making and decision theory. In G. Lindzey, & E. Aronson (Eds.), *Handbook of social psychology* (3rd ed., pp. 231–310). New York: Random House.

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2007). The effect of tailored information, goal setting, and tailored feedback on household energy use, energy- related behaviors, and behavioral antecedents. *Journal of Environmental Psychology, 27*(4), 265–276. https://doi.org/10.1016/j.jenvp.2007.08.002

Acton, R. B., Jones, A. C., Kirkpatrick, S. I., Roberto, C. A., & Hammond, D. (2019). Taxes and front-of-package labels improve the healthiness of beverage and snack purchases: a randomized experimental marketplace. *International Journal of Behavioral Nutrition and Physical Activity, 16*(1), Article 46. https://doi.org/10.1186/s12966-019-0799-0

ADEME. (2020, August 5). *Bonus et malus écologiques en 2020.* agirpourlatransition.ademe.fr. https://agirpourlatransition.ademe.fr/particuliers/finances/aides-deplacements/bonus-malus-ecologiques-2020

ADEME. (n.d.). *Évolution du taux moyen d'émissions de co2 en France.* Carlabelling.ademe. http://carlabelling.ademe.fr/chiffrescles/r/evolutionTauxCo2

Aleksandrowicz, L., Green, R., Joy, E. J., Smith, P., & Haines, A. (2016). The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: A systematic review. *PloS ONE, 11*(11), Article e0165797. https://doi.org/10.1371/journal.pone.0165797

Algina, J., & Keselman, H. J. (2003). Approximate confidence intervals for effect sizes. *Educational and Psychological Measurement, 63*(4), 537–553. https://doi.org/10.1177/0013164403256358

Angyal, A. (1952). A theoretical model for personality studies. In D. Krech & G. S. Klein (Eds.), *Theoretical models and personality theory* (p. 131–142). Duke University Press. https://doi.org/10.1037/10803-008

Antweiler, W., & Gulati, S. (2016). Frugal cars or frugal drivers? How carbon and fuel taxes influence the choice and use of cars. How Carbon and Fuel Taxes Influence the Choice and Use of Cars (May 11, 2016). http://dx.doi.org/10.2139/ssrn.2778868

Apostolidis, C., & McLeay, F. (2019). To meat or not to meat? Comparing empowered meat consumers' and anti-consumers' preferences for sustainability labels. *Food Quality and Preference*, *77*, 109-122. https://doi.org/10.1016/j.foodqual.2019.04.008

Babakhani, N., Lee, A., & Dolnicar, S. (2020). Carbon labels on restaurant menus: do people pay attention to them?. *Journal of Sustainable Tourism*, *28*(1), 51-68. https://doi.org/10.1080/09669582.2019.1670187

Bailey, R., & Harper, D. R. (2015). *Reviewing interventions for healthy and sustainable diets* (Research Paper). Chatham House, The Royal Institute of International Affairs. https://www.chathamhouse.org/sites/default/files/field/field_document/20150529HealthySustainableDietsBaileyHarperFinal.pdf

Baranzini, A., & Carattini, S. (2017). Effectiveness, earmarking and labeling: testing the acceptability of carbon taxes with survey data. *Environmental Economics and Policy Studies*, *19*, 197-227. https://doi.org/10.1007/s10018-016-0144-7

Barsalou, L. W. (1985). Ideals, central tendency, and frequency of instantiation as determinants of graded structure in categories. *Journal of Experimental Psychology: Learning, Memory, and*

Cognition, 11(4), 629–654. https://doi-org.gorgone.univ-toulouse.fr/10.1037/0278-7393.11.1-4.629.

Beattie, G., McGuire, L., & Sale, L. (2010). Do we actually look at the carbon footprint of a product in the initial few seconds? An experimental analysis of unconscious eye movements. *The International Journal of Environmental, Cultural, Economic and Social Sustainability, 6*(1), 47–65. https://doi.org/10.18848/1832-2077/cgp/v06i01/54719

Becker, L. J. (1978). Joint effect of feedback and goal setting on performance: A field study of residential energy conservation. *Journal of Applied Psychology*, *63*(4), 428. https://doi-org.gorgone.univ-toulouse.fr/10.1037/0021-9010.63.4.428

Bettman, J. R., & Kakkar, P. (1977). Effects of information presentation format on consumer information acquisition strategies. *Journal of Consumer Research, 3*(4), 233–240.

Bettman, J. R., Payne, J. W., & Staelin, R. (1986). Cognitive considerations in designing effective labels for presenting risk information. *Journal of Public Policy & Marketing, 5*(1), 1-28. https://doi.org/10.1177/074391568600500101

Bjørner, T. B., Hansen, L. G., & Russell, C. S. (2004). Environmental labeling and consumers' choice—an empirical analysis of the effect of the Nordic Swan. *Journal of Environmental Economics and Management, 47*(3), 411–434. https://doi.org/10.1016/j.jeem.2003.06.002

Blanca, M. J., Alarcón, R., Arnau, J., Bono, R., & Bendayan, R. (2017). Non-normal data: Is ANOVA still a valid option?. *Psicothema*, *29*(4), 552-557. http:doi.org/10.7334/psicothema2016.383

Blanken, I., van de Ven, N., & Zeelenberg, M. (2015). A meta-analytic review of moral licensing. *Personality and Social Psychology Bulletin*, *41*(4), 540-558. https://doi.org/10.1177/0146167215572134

Bogenschneider, B. N. (2017). 'Sin tax' as signpost in food labelling. *European Food and Feed Law Review*, *12*(1), 14-21.

Bonroy, O., & Constantatos, C. (2008). On the use of labels in credence goods markets. *Journal of Regulatory Economics*, *33*(3), 237–252. https://doi-org.gorgone.univ-toulouse.fr/10.1007/s11149-008-9058-z

Bontems, P., & Réquillart, V. (2009). Nutritional policies, food-chain regulation and food consumption. *INRA Sciences Sociales*, *2009*. http:doi.org/DOI: 10.22004/ag.econ.153519

Briggs, A. D., Kehlbacher, A., Tiffin, R., Garnett, T., Rayner, M., & Scarborough, P. (2013). Assessing the impact on chronic disease of incorporating the societal cost of greenhouse gases into the price of food: an econometric and comparative risk assessment modelling study. *BMJ Open*, *3*(10), Article e003543. http:doi.org/doi: 10.1136/bmjopen-2013-003543

Brockwell, E. (2013). *The signaling effect of environmental and health-based taxation and legislation for public policy: an empirical analysis.* (CERE Working Paper No. 3). The Centre for Environmental and Resource Economics (CERE). https://www.diva-portal.org/smash/get/diva2:747887/FULLTEXT02

Brunner, F., Kurz, V., Bryngelsson, D., & Hedenus, F. (2018). Carbon label at a university restaurant–label implementation and evaluation. *Ecological Economics*, *146*, 658-667. https://doi.org/10.1016/j.ecolecon.2017.12.012

Bueb, J., Le Hir, B., Mesqui, B., Pommeret, A., & Combaud, M. (2019, February 18). *La valeur de l'action pour le climat.* Strategie. https://www.strategie.gouv.fr/publications/de-laction-climat

Bulmer, M. G. (1979). *Principles of statistics*. Courier Corporation.

Bryngelsson, D., Wirsenius, S., Hedenus, F., & Sonesson, U. (2016). How can the EU climate targets be met? A combined analysis of technological and demand-side changes in food and agriculture. *Food Policy*, *59*, 152-164. https://doi.org/10.1016/j.foodpol.2015.12.012

Cadario, R., & Chandon, P. (2020). Which healthy eating nudges work best? A meta-analysis of field experiments. *Marketing Science*, *39*(3), 465-486. https://doi.org/10.1287/mksc.2018.1128

Callonnec, G., & Sannié, I. (2009). Evaluation of the economic and ecological effects of the French ‘bonus malus’. *European Council for an Energy Efficient Economy.* 463-470. https://www.tib.eu/en/search/id/BLCP:CN075299540/Evaluation-of-the-economic-and-ecological-effects?cHash=bbbe1f80d22702ab3e3504aa6d38c403

Camilleri, A. R., Larrick, R. P., Hossain, S., & Patino-Echeverri, D. (2019). Consumers underestimate the emissions associated with food but are aided by labels. *Nature Climate Change, 9,* 53-58. https://doi.org/10.1038/s41558-018-0354-z

Capstick, S. B., & Lewis, A. (2010). Effects of personal carbon allowances on decision-making: Evidence from an experimental simulation. *Climate Policy, 10*(4), 369–384. https://doi.org/10.3763/cpol.2009.0034

Carbon Trust. (2020, April 23). *2020 consumer research shows sustained support for carbon labelling on products.* https://www.carbontrust.com/news-and-events/news/2020-consumer-research-shows-sustained-support-for-carbon-labelling-on

Carlsson, F., & Johansson-Stenman, O. (2012). Behavioral economics and environmental policy. *Annu. Rev. Resour. Econ.*, *4*, 75-99. http:doi.org/10.1146/annurev-resource-110811-114547

Caswell, J. A., & Mojduszka, E. M. (1996). Using informational labeling to influence the market for quality in food products. *American Journal of Agricultural Economics*, *78*(5), 1248-1253. https://doi.org/10.2307/1243501

Cecchini, M., & Warin, L. (2016). Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies. *Obesity Reviews*, *17*(3), 201-210. https://doi.org/10.1111/obr.12364

Ceci-Renaud, N., & Khamsing, W. T. (2012). *Les consommateurs face à l’affichage environnemental* (Etudes et documents du CGDD No. 74). CGDD Service De L'économie, De L'évaluation Et De L'intégration Du Développement Durable.

http://temis.documentation.developpement-durable.gouv.fr/docs/Temis/0077/Temis-0077288/20515.pdf

CEDEF. (2021, February 18). *Comment fonctionne le bonus sur l'achat d'un véhicule ?*. https://www.economie.gouv.fr/cedef/bonus-automobile

Chetty, R., Looney, A., & Kroft, K. (2009). Salience and taxation: Theory and evidence. *American Economic Review*, *99*(4), 1145-77. http:doi.org/DOI: 10.1257/aer.99.4.1145

Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science*, *12*(4), 105-109. http:doi.org/DOI: 10.1111/1467-8721.01242

Cialdini, R. B., Demaine, L. J., Sagarin, B. J., Barrett, D. W., Rhoads, K., & Winter, P. L. (2006). Managing social norms for persuasive impact. *Social Influence*, *1*(1), 3-15. https://doi.org/10.1080/15534510500181459

Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). A focus theory of normative conduct: A theoretical refinement and reevaluation of the role of norms in human behavior. In *Advances in experimental social psychology* (Vol. 24, pp. 201-234). Academic Press.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58*(6), 1015-1026. http:doi.org/DOI: 10.1037/0022-3514.58.6.1015

Cialdini, R. B., & Trost, M. R. (1998). Social influence: Social norms, conformity and compliance. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (pp. 151–192). McGraw-Hill.

Cohen, M. A. (2001). Information as a policy instrument in protecting the environment: What have we learned. *Envtl. L. Rep. News & Analysis*, *31*, Article 10425.

Cohen, M. A., & Vandenbergh, M. P. (2012). The potential role of carbon labeling in a green economy. *Energy Economics*, *34*, S53-S63. https://doi.org/10.1016/j.eneco.2012.08.032

Cohen, M. A., & Viscusi, W. K. (2012). The role of information disclosure in climate mitigation policy. *Climate Change Economics*, *3*(04), Article 1250020. http:doi.org/DOI: 10.1142/S2010007812500200

Cokely, E. T., Galesic, M., Schulz, E., Ghazal, S., & Garcia-Retamero, R. (2012). Measuring risk literacy: The Berlin Numeracy Test. *Judgment and Decision Making*, *7*(1), 25-47.

Colchero, M. A., Molina, M., & Guerrero-López, C. M. (2017). After Mexico implemented a tax, purchases of sugar-sweetened beverages decreased and water increased: difference by place of residence, household composition, and income level. *The Journal of Nutrition*, *147*(8), 1552-1557. https://doi.org/10.3945/jn.117.251892

Colchero, M. A., Popkin, B. M., Rivera, J. A., & Ng, S. W. (2016). Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study. *BMJ*, Article 352:h6704. https://doi.org/10.1136/bmj.h6704

Committee of Experts on International Cooperation in Tax Matters. (2020). *Chapter XX: Public acceptability of a carbon tax – conceptual model and policy implications.* https://www.un.org/development/desa/financing/document/chapter-xx-public-acceptability-carbon-tax-conceptual-model-and-policy-implications-carbon

Congdon, W., Kling, J. R., & Mullainathan, S. (2009). *Behavioral economics and tax policy* (Working Paper No. 15328). National Bureau of Economic Research. http:doi.org/10.3386/w15328

Corrégé, J. B., Clavel, C., Christophe, J., & Ammi, M. (2018). Social norms from a goal-system point of view: Contributions of activity analysis. *Basic and Applied Social Psychology*, *40*(2), 73-86. https://doi.org/10.1080/01973533.2018.1437038

Cowburn, G., & Stockley, L. (2005). Consumer understanding and use of nutrition labelling: a systematic review. *Public Health Nutrition*, *8*(1), 21-28. http:doi.org/doi:10.1079/PHN2004666

Cribari-Neto, F. (2004). Asymptotic inference under heteroskedasticity of unknown form. *Computational Statistics & Data Analysis*, *45*(2), 215-233. https://doi.org/10.1016/S0167-9473(02)00366-3

Crosetto, P., Lacroix, A., Muller, L., & Ruffieux, B. (2020). Nutritional and economic impact of five alternative front-of-pack nutritional labels: Experimental evidence. *European Review of Agricultural Economics*, *47*(2), 785-818. https://doi.org/10.1093/erae/jbz037

Crosetto, P., Muller, L., & Ruffieux, B. (2016). Helping consumers with a front-of-pack label: Numbers or colors?: Experimental comparison between Guideline Daily Amount and Traffic Light in a diet-building exercise. *Journal of Economic Psychology*, *55*, 30-50. https://doi.org/10.1016/j.joep.2016.03.006

Cumming, G. (2012). *Understanding the new statistics: Effect sizes, confidence intervals, and meta-analysis*. Routledge.

Darby, M. R., & Karni, E. (1973). Free competition and the optimal amount of fraud. *The Journal of Law and Economics*, *16*(1), 67-88. https://doi.org/10.1086/466756

Darmon, N., Lacroix, A., Muller, L., & Ruffieux, B. (2014). Food price policies improve diet quality while increasing socioeconomic inequalities in nutrition. *International Journal of Behavioral Nutrition and Physical Activity*, *11*(1), Article 66. https://doi.org/10.1186/1479-5868-11-66

Daunfeldt, S. O., Nordström, J., & Thunström, L. (2011). Habit formation in food consumption. In Lusk, J. L., Roosen, J., & Shogren, J. F. (Eds.), *The Oxford Handbook of the Economics of Food Consumption and Policy*. Oxford University Press. http:doi.org/DOI: 10.1093/oxfordhb/9780199569441.013.0032

De Groot, J. I., Abrahamse, W., & Jones, K. (2013). Persuasive normative messages: The influence of injunctive and personal norms on using free plastic bags. *Sustainability*, *5*(5), 1829-1844. https://doi.org/10.3390/su5051829

De Perthuis, C., Jouvet, P. A., Trotignon, R., Solier, B., Meurisse, B., & Quemin, S. (2014). *Economic instruments and the 2015 Paris Climate Conference: the catalyst of carbon pricing* [Policy brief]. The Climate Economics Chair. https://www.chaireeconomieduclimat.org/en/publications-en/policy-briefs-en/policy-brief-5-economic-instruments-and-the-2015-paris-climate-conference-the-catalyst-of-carbon-pricing/

DeCharms, R. (1983). *Personal causation: The internal affective determinants of behavior*. Routledge.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*, *18*(1), 105-115. https://doi.org/10.1037/h0030644

Deci, E. L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. *Journal of Personality and Social Psychology*, *22*(1), 113-120. https://doi.org/10.1037/h0032355

Deci, E. (1975). *Intrinsic motivation* (Perspectives in social psychology). Plenum Press.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, *125*(6), 627-668.

Deci, E., & Ryan, R. (1985). *Intrinsic motivation and self-determination in human behavior* (Perspectives in social psychology). Plenum Press.

Delplanque, S., Lavoie, M. E., Hot, P., Silvert, L., & Sequeira, H. (2004). Modulation of cognitive processing by emotional valence studied through event-related potentials in humans. *Neuroscience Letters*, *356*(1), 1-4. https://doi.org/10.1016/j.neulet.2003.10.014

Demarque, C., Charalambides, L., Hilton, D. J., & Waroquier, L. (2015). Nudging sustainable consumption: The use of descriptive norms to promote a minority behavior in a realistic online shopping environment. *Journal of Environmental Psychology*, *43*, 166–174. https://doi.org/10.1016/j.jenvp.2015.06.008

Dember, W. N., & Earl, R. W. (1957). Analysis of exploratory, manipulatory, and curiosity behaviors. *Psychological Review, 64*(2), 91–96. https://doi-org.gorgone.univ-toulouse.fr/10.1037/h0046861

Deutsch, M., & Gerard, H. B. (1955). A study of normative and informational social influences upon individual judgment. *The Journal of Abnormal and Social Psychology, 51*(3), 629-636.

d'Haultfœuille, X., Durrmeyer, I., & Février, P. (2011). Le coût du bonus/malus écologique. *Revue économique*, *62*(3), 491-499. https://doi.org/10.1037/h0046408

d'Haultfoeuille, X., Durrmeyer, I., & Février, P. (2013). *The effect of public policies on consumers' preferences: lessons from the French automobile market* (Working Paper No. 422). Sonderforschungsbereich/Transregio 15 - Governance and the Efficiency of Economic Systems (GESY). https://www.econstor.eu/handle/10419/93939

d'Haultfoeuille, X., Givord, P., & Boutin, X. (2014). The environmental effect of green taxation: the case of the French bonus/malus. *The Economic Journal*, *124*(578), F444-F480. https://doi.org/10.1111/ecoj.12089

Dickinson, A. (1980). *Contemporary animal learning theory*. Cambridge University Press.

Dogbe, W., & Gil, J. M. (2018). Effectiveness of a carbon tax to promote a climate-friendly food consumption. *Food Policy*, *79,* 235-246. https://doi.org/10.1016/j.foodpol.2018.08.003

Dolan, P., & Metcalfe, R. (2015). *Neighbors, knowledge, and nuggets: two natural field experiments on the role of incentives on energy conservation* (Discussion paper No. 1222). Centre for Economic Performance London School of Economics and Political Science. http://dx.doi.org/10.2139/ssrn.2589269

Douenne, T., & Fabre, A. (2020). *Yellow vests, pessimistic beliefs, and carbon tax aversion* (PSE Working Paper No. 2020-5). https://www.parisschoolofeconomics.eu/docs/douenne-thomas/job-market-paper--yellow-vests,-carbon-tax-aversion,-and-biased-beliefs.pdf

Drews, S., Exadaktylos, F., & van den Bergh, J. C. (2020). Assessing synergy of incentives and nudges in the energy policy mix. *Energy Policy, 144*, Article 111605. https://doi.org/10.1016/j.enpol.2020.111605

Dussaux, D. (2020, February 4). *Carbon tax, emissions reduction and employment: Some evidence from France.* oecdecoscope.blog. https://oecdecoscope.blog/2020/02/04/carbon-tax-emissions-reduction-and-employment-some-evidence-from-france/

Edjabou, L. D., & Smed, S. (2013). The effect of using consumption taxes on foods to promote climate friendly diets–The case of Denmark. *Food Policy*, *39*, 84-96. https://doi.org/10.1016/j.foodpol.2012.12.004

Elliot, A. J., Maier, M. A., Moller, A. C., Friedman, R., & Meinhardt, J. (2007). Color and psychological functioning: The effect of red on performance attainment. *Journal of Experimental Psychology: General*, *136*(1), 154-168. http:doi.org/DOI: 10.1037/0096-3445.136.1.154

Elofsson, K., Bengtsson, N., Matsdotter, E., & Arntyr, J. (2016). The impact of climate information on milk demand: Evidence from a field experiment. *Food Policy*, *58*, 14–23. https://doi.org/10.1016/j.foodpol.2015.11.002

Emberger-Klein, A., & Menrad, K. (2018). The effect of information provision on supermarket consumers' use of and preferences for carbon labels in Germany. *Journal of Cleaner Production*, *172*, 253-263. https://doi.org/10.1016/j.jclepro.2017.10.105

Epstein, L. H., Dearing, K. K., Roba, L. G., & Finkelstein, E. (2010). The influence of taxes and subsidies on energy purchased in an experimental purchasing study. *Psychological Science*, *21*(3), 406-414. https://doi.org/10.1177/0956797610361446

European Commission. (2020, June 04). *EU Ecolabel key figures.* ec.europa.eu. https://ec.europa.eu/environment/ecolabel/facts-and-figures.html

European Environment Agency. (2019). *Annual European Union greenhouse gas inventory 1990–2017 and inventory report 2019.* https://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2019

Evans, N., Eickers, S., Geene, L., Todorovic, M., & Villmow, A. (2017). *Green Nudging: A discussion and preliminary evaluation of nudging as an environmental policy instrument* (No.01-2017). Freie Universität Berlin Forschungszentrum für Umweltpolitik. http://dx.doi.org/10.17169/refubium-25251

Farrow, K., Grolleau, G., & Ibanez, L. (2017). Social norms and pro-environmental behavior: A review of the evidence. *Ecological Economics*, *140*, 1-13. https://doi.org/10.1016/j.ecolecon.2017.04.017

Fawcett, T. (2010). Personal carbon trading: A policy ahead of its time?. *Energy Policy*, *38*(11), 6868-6876. https://doi.org/10.1016/j.enpol.2010.07.001

Feucht, Y., & Zander, K. (2018). Consumers' preferences for carbon labels and the underlying reasoning. A mixed methods approach in 6 European countries. *Journal of Cleaner Production*, *178*, 740-748. https://doi.org/10.1016/j.jclepro.2017.12.236

Field, A. (2009). *Discovering statistics using SPSS*. Sage.

Finkelstein, A. (2009). E-ztax: Tax salience and tax rates. *The Quarterly Journal of Economics*, *124*(3), 969-1010. https://doi.org/10.1162/qjec.2009.124.3.969

Fletcher, J. M., Frisvold, D., & Tefft, N. (2010). Can soft drink taxes reduce population weight?. *Contemporary Economic Policy*, *28*(1), 23-35. https://doi.org/10.1111/j.1465-7287.2009.00182.x

Flues, F. & van Dender, K. (2020). *Carbon pricing design: Effectiveness, efficiency and feasibility: An investment perspective* (OECD Taxation Working Papers, No. 48). OECD Publishing. https://doi.org/10.1787/91ad6a1e-en.

Frey, B. S. (1992). Pricing and regulating affect environmental ethics. *Environmental and Resource Economics*, *2*(4), 399-414. http:doi.org/10.1007/BF00304969

Frey, B. S. (1993). Motivation as a limit to pricing. *Journal of Economic Psychology, 14*(4), 635-664. https://doi.org/10.1016/0167-4870(93)90014-C

Frey, B. S. (1997). *Not just for the money: An economic theory of personal motivation.* Edward Elgar Publishing Company.

Frey, B. S., & Jegen, R. (2001). Motivation crowding theory. *Journal of Economic Surveys*, *15*(5), 589-611. https://doi.org/10.1111/1467-6419.00150

Frey, B. S., & Oberholzer-Gee, F. (1997). The cost of price incentives: An empirical analysis of motivation crowding-out. *The American Economic Review*, *87*(4), 746-755.

Fullerton, D., Leicester, A., & Smith, S. (2008). *Environmental taxes* (Working Paper No. 14197). National Bureau of Economic Research. http:doi.org/10.3386/w14197

Galarraga, I., & Markandya, A. (2006). A proposal to correct external effects in the coffee market: A tax on regular coffee and tea to subsidise the fair trade coffee. *Economía Agraria y Recursos Naturales*, *6*(12), 145-167. http:doi.org/10.22004/ag.econ.7991

Garcia-Retamero, R., & Cokely, E. T. (2013). Communicating health risks with visual aids. *Current Directions in Psychological Science*, *22*(5), 392–399. https://doi.org/10.1177/0963721413491570

Garcia-Retamero, R., & Galesic, M. (2010). Who proficts from visual aids: Overcoming challenges in people’s understanding of risks. *Social Science & Medicine*, *70*(7), 1019–1025. https://doi.org/10.1016/j.socscimed.2009.11.031

Garcia-Retamero, R., & Hoffrage, U. (2013). Visual representation of statistical information improves diagnostic inferences in doctors and their patients. *Social Science & Medicine, 83*, 27–33. https://doi.org/10.1016/j.socscimed.2013.01.034

Gneezy, U., & Rustichini, A. (2000). Pay enough or don't pay at all. *The Quarterly Journal of Economics*, *115*(3), 791-810. https://doi.org/10.1162/003355300554917

Golan, E., Kuchler, F., Mitchell, L., Greene, C., & Jessup, A. (2001). Economics of food labeling. *Journal of Consumer Policy*, *24*, 117-184. https://doi.org/10.1023/A:1012272504846

Goldin, J., & Homonoff, T. (2013). Smoke gets in your eyes: cigarette tax salience and regressivity. *American Economic Journal: Economic Policy*, *5*(1), 302-36. http:doi.org/DOI: 10.1257/pol.5.1.302

Graham, D. J., Orquin, J. L., & Visschers, V. H. (2012). Eye tracking and nutrition label use: A review of the literature and recommendations for label enhancement. *Food Policy, 37*(4), 378–382. https://doi.org/10.1016/j.foodpol.2012.03.004

Grebitus, C., Steiner, B., & Veeman, M. M. (2016). Paying for sustainability: A cross-cultural analysis of consumers' valuations of food and non-food products labeled for carbon and water footprints. *Journal of Behavioral and Experimental Economics*, *63*, 50-58. https://doi.org/10.1016/j.socec.2016.05.003

Green, A. (2006). You can't pay them enough: Subsidies, environmental law, and social norms. *Harv. Envtl. L. Rev.*, *30*, 407-440.

Grönborg, L. (2019). *Budgets for a sustainable future: Monthly budgets as a tool for reflection and goal-setting of carbon emissions*. [Master's thesis, KTH, School of Electrical Engineering and Computer Science]. DIVA. https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1336804&dswid=544

Grunert, K. G., & Wills, J. M. (2007). A review of European research on consumer response to nutrition information on food labels. *Journal of Public Health*, *15*, 385-399. https://doi.org/10.1007/s10389-007-0101-9

Hallström, E., Carlsson-Kanyama, A., & Börjesson, P. (2015). Environmental impact of dietary change: a systematic review. *Journal of Cleaner Production*, *91*, 1-11. https://doi.org/10.1016/j.jclepro.2014.12.008

Hamann, K. R., Reese, G., Seewald, D., & Loeschinger, D. C. (2015). Affixing the theory of normative conduct (to your mailbox): Injunctive and descriptive norms as predictors of anti-ads sticker use. *Journal of Environmental Psychology, 44*, 1-9. https://doi.org/10.1016/j.jenvp.2015.08.003

Harris, S. M. (2007). Green TickTM: An example of sustainability certification of goods and services. *Management of Environmental Quality: An International Journal*, *18*(2), 167–178. https://doi.org/10.1108/14777830710725830

Hartikainen, H., Roininen, T., Katajajuuri, J. M., & Pulkkinen, H. (2014). Finnish consumer perceptions of carbon footprints and carbon labelling of food products. *Journal of Cleaner Production*, *73*, 285-293. https://doi.org/10.1016/j.jclepro.2013.09.018

Hartmann-Boyce, J., Bianchi, F., Piernas, C., Riches, S. P., Frie, K., Nourse, R., & Jebb, S. A. (2018). Grocery store interventions to change food purchasing behaviors: a systematic review of randomized controlled trials. *The American Journal of Clinical Nutrition*, *107*(6), 1004-1016. https://doi.org/10.1093/ajcn/nqy045

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. The Guilford Press.

Hebb, D. O. (1955). Drives and the C. N. S. (conceptual nervous system). *Psychological Review*, *62*(4), 243-254. https://doi.org/10.1037/h0041823

Hedges, L. V. (1982). Estimation of effect size from a series of independent experiments. *Psychological bulletin*, *92*(2), 490.

Hertwich, E. G., & Peters, G. P. (2009). Carbon footprint of nations: A global, trade-linked analysis. *Environmental Science & Technology, 43*(16), 6414–6420. https://doi.org/10.1021/es803496a

Hertwig, R., Hogarth, R. M., & Lejarraga, T. (2018). Experience and description: Exploring two paths to knowledge. *Current Directions in Psychological Science, 27*(2), 123–128. https://doi.org/10.1177/0963721417740645

Hilton, D. J. (1997). Constructive processes in attitudes, judgment and decision-making: Implications for psychology and marketing. *Swiss Journal of Psychology, 56,* 112-126. (Special issue Contexts and biases, edited by F. Butera, P.Legrenzi & M. Oswald).

Hilton, D., Charalambides, L., Demarque, C., Waroquier, L., & Raux, C. (2014). A tax can nudge: The impact of an environmentally motivated bonus/malus fiscal system on transport preferences. *Journal of Economic Psychology*, *42*, 17-27. https://doi.org/10.1016/j.joep.2014.02.007

Hjorth, T., Huseinovic, E., Hallström, E., Strid, A., Johansson, I., Lindahl, B., ... & Winkvist, A. (2020). Changes in dietary carbon footprint over ten years relative to individual characteristics and food intake in the Västerbotten Intervention Programme. *Scientific Reports*, *10*, Article 20. https://doi.org/10.1038/s41598-019-56924-8

Hoeller, P., Dean, A., & Hayafuji, M. (1992). *New issues, new results: the OECD's second survey of the macroeconomic costs of reducing CO2 emissions* (OECD Economics Department Working Paper No. 123). OECD Publishing. https://doi.org/10.1787/725178447352

Hornibrook, S., May, C., & Fearne, A. (2015). Sustainable development and the consumer: Exploring the role of carbon labelling in retail supply chains. *Business Strategy And The Environment*, *24*(4), 266-276. https://doi.org/10.1002/bse.1823

IPCC, (2014). Summary for Policymakers. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J.

Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press.

Ivanova, D., Vita, G., Steen-Olsen, K., Stadler, K., Melo, P., Wood, R., & Hertwich, E. (2017). Mapping the carbon footprint of EU regions. *Environmental Research Letters, 12*(5), Article 054013. https://doi.org/10.1088/1748-9326/aa6da9

Jackson, T. (2005). *Motivating sustainable consumption: A review of evidence on consumer behaviour and behavioural change.* Sustainable Development Research Network. https://timjackson.org.uk/wp-content/uploads/2018/04/Jackson.-2005.-Motivating-Sustainable-Consumption.pdf

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305-360. https://doi.org/10.1016/0304-405X(76)90026-X

Jensen, J. D., & Smed, S. (2007). Cost-effective design of economic instruments in nutrition policy. *International Journal of Behavioral Nutrition and Physical Activity, 4*, Article 10. https://doi.org/10.1186/1479-5868-4-10

Jensen, J. D., & Smed, S. (2013). The Danish tax on saturated fat–short run effects on consumption, substitution patterns and consumer prices of fats. *Food Policy*, *42*, 18-31. https://doi.org/10.1016/j.foodpol.2013.06.004

Jiang, T. (2001). Earmarking of pollution charges and the sub-optimality of the Pigouvian tax. *Australian Journal of Agricultural and Resource Economics, 45*(4), 623-640. https://doi.org/10.1111/1467-8489.00160

Johnson, E. (2008). Disagreement over carbon footprints: A comparison of electric and LPG forklifts. *Energy Policy*, *36*(4), 1569-1573. https://doi.org/10.1016/j.enpol.2008.01.014

Kahneman, D. (2003). Maps of bounded rationality: Psychology for behavioral economics. *American Economic Review*, *93*(5), 1449-1475. http:doi.org/DOI: 10.1257/000282803322655392

Kallbekken, S., & Sælen, H. (2011). Public acceptance for environmental taxes: Self-interest, environmental and distributional concerns. *Energy Policy*, *39*(5), 2966-2973. https://doi.org/10.1016/j.enpol.2011.03.006

Kallgren, C. A., Reno, R. R., & Cialdini, R. B. (2000). A focus theory of normative conduct: When norms do and do not affect behavior. *Personality and Social Psychology Bulletin*, *26*(8), 1002-1012. https://doi.org/10.1177/01461672002610009

Kanay, A., Hilton, D., Charalambides, L., Corrégé, J. B., Inaudi, E., Waroquier, L., & Cézéra, S. (2021). Making the carbon basket count: Goal setting promotes sustainable consumption in a simulated online supermarket. *Journal of Economic Psychology*, *83*, Article 102348. https://doi.org/10.1016/j.joep.2020.102348

Katzev, R. D., & Johnson, T. R. (1983). A social-psychological analysis of residential electricity consumption: The impact of minimal justification techniques. *Journal of Economic Psychology*, *3*(3–4), 267–284. https://doi.org/10.1016/0167-4870(83)90006-5

Kehlbacher, A., Tiffin, R., Briggs, A., Berners-Lee, M., & Scarborough, P. (2016). The distributional and nutritional impacts and mitigation potential of emission-based food taxes in the UK. *Climatic Change*, *137*, 121-141. https://doi.org/10.1007/s10584-016-1673-6

Khemani, R. S. & Shapiro, D. M. (1993). Externalities. In *Glossary of industrial organisation economics and competition law*. Organisation for Economic Co-operation and Development; Washington, DC: OECD Publications and Information Centre. http://www.oecd.org/regreform/sectors/2376087.pdf

Kinzig, A. P., Ehrlich, P. R., Alston, L. J., Arrow, K., Barrett, S., Buchman, T. G., Daily, G. C., Levin, B., Levin, S., Oppenheimer, M., Ostrom, E. & Saari, D. (2013). Social norms and global environmental challenges: the complex interaction of behaviors, values, and policy. *BioScience*, *63*(3), 164-175. https://doi.org/10.1525/bio.2013.63.3.5

Larimer, M. E., Turner, A. P., Mallett, K. A., & Geisner, I. M. (2004). Predicting drinking behavior and alcohol-related problems among fraternity and sorority members: examining the role of descriptive and injunctive norms. *Psychology of Addictive Behaviors, 18*(3), 203-212. https://doi.org/10.1037/0893-164X.18.3.203

Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes, 50*(2), 212–247. https://doi.org/10.1016/0749-5978(91)90021-K

Leicester, A., Levell, P., & Rasul, I. (2012). *Tax and benefit policy: insights from behavioural economics.* Institute for Fiscal Studies. https://www.ifs.org.uk/comms/comm125.pdf

Lewis, A., & Capstick, S. (2008). *Personal carbon trading: a view from psychology and behavioural economics*. Institute of Public Policy Research. https://researchportal.bath.ac.uk/en/publications/personal-carbon-trading-a-view-from-psychology-and-behavioural-ec

Leuba, C. (1955). Toward some integration of learning theories: The concept of optimal stimulation. *Psychological Reports*, *1*, 27-33.

Lin, B., & Li, X. (2011). The effect of carbon tax on per capita CO2 emissions. *Energy Policy, 39*(9), 5137-5146. https://doi.org/10.1016/j.enpol.2011.05.050

Liu, T., Wang, Q., & Su, B. (2016). A review of carbon labeling: standards, implementation, and impact. *Renewable and Sustainable Energy Reviews, 53*, 68-79. https://doi.org/10.1016/j.rser.2015.08.050

Locke, E. A. (1996). Motivation through conscious goal setting. *Applied and Preventive Psychology, 5*(2), 117–124. https://doi.org/10.1016/S0962-1849(96)80005-9

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist*, *57*(9), 705-717. https://doi.org/10.1037/0003-066X.57.9.705

Lucas, L. & Clark, P. (2012, January 31). Tesco steps back on carbon footprint labeling. *Financial Times.* https://www.ft.com/content/96fd9478-4b71-11e1-a325-00144feabdc0

Lunenburg, F. C. (2011). Goal-setting theory of motivation. *International Journal of Management, Business, and Administration, 15*(1), 1–6.

Lykkeskov, A., & Gjerris, M. (2017). The moral justification behind a climate tax on beef in Denmark. *Food Ethics, 1*, 181-191. https://doi.org/10.1007/s41055-017-0017-1

Magat, W. A., Payne, J. W., & Brucato Jr, P. F. (1986). How important is information format? An experimental study of home energy audit programs. *Journal of Policy Analysis and Management*, *6*(1), 20-34. https://doi.org/10.1002/pam.4050060103

March, J. G., & Shapira, Z. (1992). Variable risk preferences and the focus of attention. *Psychological Review*, *99*(1), 172-183.https://doi.org/10.1037/0033-295X.99.1.172

Marek, E., Raux, C., & Engelmann, D. (2018). Personal carbon allowances: Can a budget label do the trick? *Transport Policy*, *69*, 170–178.https://doi.org/10.1016/j.tranpol.2018.06.007

Mazar, N., & Zhong, C. B. (2010). Do green products make us better people?. *Psychological Science*, *21*(4), 494-498. https://doi.org/10.1177/0956797610363538

Mazis, M. B., Staelin, R., Beales, H., & Salop, S. (1981). A framework for evaluating consumer information regulation. *Journal of Marketing*, *45*(1), 11-21. https://doi.org/10.1177/002224298104500102

McGuire, W. J. (1976). Some internal psychological factors influencing consumer choice. *Journal of Consumer Research*, *2*(4), 302–319.https://doi.org/10.1086/208643

McMichael, A. J., Powles, J. W., Butler, C. D., & Uauy, R. (2007). Food, livestock production, energy, climate change, and health. *The Lancet, 370*(9594), 1253-1263. https://doi.org/10.1016/S0140-6736(07)61256-2

Mellström, C., & Johannesson, M. (2008). Crowding out in blood donation: was Titmuss right?. [Abstract]. *Journal of the European Economic Association, 6*(4), 845-863. https://doi.org/10.1162/JEEA.2008.6.4.845

Meng, S., Siriwardana, M., & McNeill, J. (2013). The environmental and economic impact of the carbon tax in Australia. *Environmental and Resource Economics, 54*(3), 313-332. https://doi-org.gorgone.univ-toulouse.fr/10.1007/s10640-012-9600-4

Metcalf, G. E., & Weisbach, D. (2009). *The design of a carbon tax* (University of Chicago Public Law & Legal Theory Working Paper No. 254). http://dx.doi.org/10.2139/ssrn.1324854

Meyerding, S. G. (2016). Consumer preferences for food labels on tomatoes in Germany–A comparison of a quasi-experiment and two stated preference approaches. *Appetite*, *103*, 105-112. https://doi.org/10.1016/j.appet.2016.03.025

Meyerding, S. G., Schaffmann, A. L., & Lehberger, M. (2019). Consumer preferences for different designs of carbon footprint labelling on tomatoes in germany—Does design matter?. *Sustainability, 11*(6), Article 1587. https://doi.org/10.3390/su11061587

Milfont, T. L., & Duckitt, J. (2010). The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes. *Journal of Environmental Psychology*, *30*(1), 80-94. https://doi.org/10.1016/j.jenvp.2009.09.001

Mollen, S., Rimal, R. N., Ruiter, R. A., & Kok, G. (2013). Healthy and unhealthy social norms and food selection. Findings from a field-experiment. *Appetite*, *65*, 83-89. https://doi.org/10.1016/j.appet.2013.01.020

Monschauer, Y. & Kotin-Förster, S. (2018). *Bonus-Malus Vehicle Incentive System in France.* Ecofys and adelphi. https://www.euki.de/wp-content/uploads/2018/09/fact-sheet-bonus-malus-vehicle-incentive-system-fr.pdf

Mont, O., Lehner, M., & Heiskanen, E. (2017). *Nudging a tool for sustainable behaviour?* (No. 6643). The Swedish Environmental Protection Agency.

Moser, R., Raffaelli, R., & Thilmany, D. D. (2011). Consumer preferences for fruit and vegetables with credence-based attributes: a review. *International Food and Agribusiness Management Review*, *14*(2), 121-142. http:doi.org/10.22004/ag.econ.103990

Moussaoui, L. S., Desrichard, O., Mella, N., Blum, A., Cantarella, M., Clémence, A., & Battiaz, E. (2016). Validation française de l’Inventaire d’Attitudes Environnementales. *European Review of Applied Psychology, 66*(6), 291-299. https://doi.org/10.1016/j.erap.2016.06.006

Mullainathan, S., & Thaler, R. H. (2000). *Behavioral economics* (Workin Paper No. 7948). National Bureau of Economic Research. http:doi.org/10.3386/w7948

Muller, L., Lacroix, A., & Ruffieux, B. (2019). Environmental labelling and consumption changes: A food choice experiment. *Environmental and Resource Economics*, *73*, 871-897. https://doi.org/10.1007/s10640-019-00328-9

Muller, L., & Prevost, M. (2016). What cognitive sciences have to say about the impacts of nutritional labelling formats. *Journal of Economic Psychology*, *55*, 17-29. https://doi.org/10.1016/j.joep.2016.01.005

Murray, B., & Rivers, N. (2015). British Columbia’s revenue-neutral carbon tax: A review of the latest “grand experiment” in environmental policy. *Energy Policy*, *86*, 674-683. https://doi.org/10.1016/j.enpol.2015.08.011

Nelson, P. (1970). Information and consumer behavior. *Journal of Political Economy*, *78*(2), 311-329. http:doi.org/DOI: 10.1086/259630

Nilsson, K., Flysjö, A., Davis, J., Sim, S., Unger, N., & Bell, S. (2010). Comparative life cycle assessment of margarine and butter consumed in the UK, Germany and France. *The International Journal of Life Cycle Assessment*, *15*(9), 916-926. https://doi.org/10.1007/s11367-010-0220-3

Nimon, W., & Beghin, J. (1999). Are eco-labels valuable? Evidence from the apparel industry. *American Journal of Agricultural Economics, 81*(4), 801–811. https://doi.org/10.2307/1244325

Nishino, N., Akai, K., & Tamura, H. (2014). Product differentiation and consumer's purchase decision-making under carbon footprint scheme. *Procedia Cirp*, *16*, 116-121. https://doi.org/10.1016/j.procir.2014.02.004

Nnoaham, K. E., Sacks, G., Rayner, M., Mytton, O., & Gray, A. (2009). Modelling income group differences in the health and economic impacts of targeted food taxes and subsidies. *International Journal of Epidemiology*, *38*(5), 1324-1333. https://doi.org/10.1093/ije/dyp214

OECD. (2005). Environmental taxes. In *OECD Glossary of Statistical Terms.* Retrieved September 15 from https://stats.oecd.org/glossary/detail.asp?ID=6437

OECD. (2007). Market-based instruments. In *OECD Glossary of Statistical Terms.* Retrieved September 15 from https://stats.oecd.org/glossary/detail.asp?ID=7214

OECD. (2013). *Climate and carbon aligning Prices and Policies* (Report No. 01). OECD Publishing. https://www.oecd-ilibrary.org/docserver/5k3z11hjg6r7-en.pdf?expires=1617270195&id=id&accname=guest&checksum=5E5A882CBD5637523F3DA3F152DAEDB6

OECD. (2017). *Environmental fiscal reform progress, prospects and pitfalls.* OECD. https://www.oecd.org/tax/tax-policy/environmental-fiscal-reform-G7-environment-ministerial-meeting-june-2017.pdf

OECD. (2018). *Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading*. OECD Publishing. https://doi.org/10.1787/9789264305304-en.

Osman, M., & Thornton, K. (2019). Traffic light labelling of meals to promote sustainable consumption and healthy eating. *Appetite*, *138*, 60-71. https://doi.org/10.1016/j.appet.2019.03.015

Ozturk, O., Shayan, S., Liszkowski, U., & Majid, A. (2013). Language is not necessary for color categories. *Developmental Science, 16*(1), 111-115. https://doi.org/10.1111/desc.12008

Panzone, L. A., Lemke, F., & Petersen, H. L. (2016). Biases in consumers' assessment of environmental damage in food chains and how investments in reputation can help. *Technological Forecasting and Social Change, 111*, 327–337. https://doi.org/10.1016/j.techfore.2016.04.008

Panzone, L., Ulph, A., Hilton, D., Gortemaker, I., & Tajudeen, I. (2021). EXPRESS: Sustainable by Design: Choice Architecture and the Carbon Footprint of Grocery Shopping. *Journal of Public Policy & Marketing*. https://doi.org/10.1177/07439156211008898

Panzone, L. A., Ulph, A., Zizzo, D. J., Hilton, D., & Clear, A. (2018). The impact of environmental recall and carbon taxation on the carbon footprint of supermarket shopping. *Journal of Environmental Economics and Management*. Article 102137. https://doi.org/10.1016/j.jeem.2018.06.002

Papoutsi, G. S., Nayga Jr, R. M., Lazaridis, P., & Drichoutis, A. C. (2015). Fat tax, subsidy or both? The role of information and children's pester power in food choice. *Journal of Economic Behavior & Organization*, *117*, 196-208. https://doi.org/10.1016/j.jebo.2015.06.011

Parag, Y., & Strickland, D. (2009). *Personal Carbon Budgeting: What people need to know, learn and have in order to manage and live within a carbon budget, and the policies that could support them* (Working Paper No. UKERC/WP/DR/2009/014). UK Energy Research Centre. https://ukerc.rl.ac.uk/UCAT/PUBLICATIONS/Personal_Carbon_Budgeting_-_What_people_need_to_know.pdf

Parag, Y., Strickland, D., & Capstick, S. (2009). Judge a book by its cover: the impact of policy framing on the willingness to reduce energy consumption. *First European Conference on Energy Efficiency and Behaviour*.

Payne, J., Bettman, J., & Johnson, E. (1993). *The Adaptive Decision Maker*. Cambridge University Press.

Perino, G., Panzone, L. A., & Swanson, T. (2014). Motivation crowding in real consumption decisions: Who is messing with my groceries?. *Economic Inquiry*, *52*(2), 592-607. https://doi.org/10.1111/ecin.12024

Perman, R., Ma, Y., McGilvray, J., & Common, M. (2003). *Natural resource and environmental economics.* Pearson Education.

Pigou, A. (1929). *The economics of welfare*. Macmillan and Co.

Plumer, B., & Popovich, N. (2019, April 2). These Countries Have Prices on Carbon. Are They Working?. *The New York Times.* https://www.nytimes.com/interactive/2019/04/02/climate/pricing-carbon-emissions.html

Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392), 987-992. http:doi.org/10.1126/science.aaq0216

Pourquier, F. X. & Vicard, A. (2016). *Fiscalité environnementale: Un état des lieux.* Ministere De L'environnement. http://temis.documentation.developpement-durable.gouv.fr/docs/Temis/0086/Temis-0086030/22911.pdf

Powell, L. M., & Chriqui, J. F. (2011). Food taxes and subsidies: Evidence and policies for obesity prevention. In J. Cawley (Ed), *The Oxford handbook of the social science of obesity*. http:doi.org/10.1093/oxfordhb/9780199736362.013.0038

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, *36*(4), 717-731. https://doi.org/10.3758/BF03206553

Raux, C., Chevalier, A., Bougna, E., & Hilton, D. (2020). Mobility choices and climate change: Assessing the effects of social norms, emissions information and economic incentives. *Research in Transportation Economics*, Article 101007. https://doi.org/10.1016/j.retrec.2020.101007

Raux, C., Croissant, Y., & Pons, D. (2015). Would personal carbon trading reduce travel emissions more effectively than a carbon tax?. *Transportation Research Part D: Transport and Environment*, *35*, 72-83. https://doi.org/10.1016/j.trd.2014.11.008

Reisch, L., Eberle, U., & Lorek, S. (2013). Sustainable food consumption: an overview of contemporary issues and policies. *Sustainability: Science, Practice and Policy*, *9*(2), 7-25. https://doi.org/10.1080/15487733.2013.11908111

Reno, R. R., Cialdini, R. B., & Kallgren, C. A. (1993). The transsituational influence of social norms. *Journal of Personality and Social Psychology*, *64*(1), 104-112. https://doi.org/10.1037/0022-3514.64.1.104

Reyna, V. F., Nelson, W. L., Han, P. K., & Dieckmann, N. F. (2009). How numeracy influences risk comprehension and medical decision making. *Psychological Bulletin, 135*(6), 943–973. https://doi.org/10.1037/a0017327

Ritchie, H. (2019, November 06). *Food production is responsible for one-quarter of the world's greenhouse gas emissions.* Ourworldindata. https://ourworldindata.org/food-ghg-emissions

Rivers, N., & Peter, J. (2007). *"Switch Green": Analysis of Feebate for Major Household Appliances in Canada.* Pierre Sadik David Suzuki Foundation. https://davidsuzuki.org/wp-content/uploads/2019/02/switch-green-energy-star-appliance-feebate.pdf

Rivers, N., & Schaufele, B. (2015). Salience of carbon taxes in the gasoline market. *Journal of Environmental Economics and Management*, *74*, 23-36. https://doi.org/10.1016/j.jeem.2015.07.002

Rogissart, L., Foucherot, C., & Bellassen, V. (2019, February). *Estimating greenhouse gas emissions from food consumption: methods and results.* 14ce. https://www.i4ce.org/wp-core/wp-content/uploads/2019/03/0318-I4CE2984-EmissionsGES-et-conso-alimentaire-Note-20p-VA_V2.pdf

Russo, J. E., Krieser, G., & Miyashita, S. (1975). An effective display of unit price information: Can the posting of unit prices change market shares?. *Journal of Marketing, 39*(2), 11-19. https://doi.org/10.1177/002224297503900204

Sale, L. (2012). *Higher or lower? Carbon footprint as consumer guesswork* (Working Paper). Sustainable Consumption Institute, University of Manchester.

Salmivaara, L., & Lankoski, L. (2019). Promoting sustainable consumer behaviour through the activation of injunctive social norms: A field experiment in 19 workplace restaurants. *Organization & Environment.* https://doi.org/10.1177/1086026619831651

Schaefer, F., & Blanke, M. (2014). Opportunities and challenges of carbon footprint, climate or CO 2 labelling for horticultural products. *Erwerbs-Obstbau*, *56*(2), 73-80. http:doi.org/10.1007/s10341-014-0206-6

Schmider, E., Ziegler, M., Danay, E., Beyer, L., & Bühner, M. (2010). Is it really robust? Reinvestigating the robustness of ANOVA against violations of the normal distribution assumption. *Methodology: European Journal of Research Methods for the Behavioral and Social Sciences*, *6*(4), 147–151. https://doi-org.gorgone.univ-toulouse.fr/10.1027/1614-2241/a000016

Schubert, C. (2017). Green nudges: Do they work? Are they ethical?. *Ecological Economics, 132*, 329-342. https://doi.org/10.1016/j.ecolecon.2016.11.009

Schultz, W. P., Khazian, A. M., & Zaleski, A. C. (2008). Using normative social influence to promote conservation among hotel guests. *Social Influence, 3*(1), 4-23. https://doi.org/10.1080/15534510701755614

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychological Science, 18*(5), 429-434. https://doi.org/10.1111/j.1467-9280.2007.01917.x

Schwartz, D., Milfont, T. L., & Hilton, D. (2019). The interplay between intrinsic motivation, financial incentives and nudges in sustainable consumption. In K. Gangl & E. Kirchler (eds.), *A Research Agenda for Economic Psychology* (pp. 87-103). Edward Elgar Publishing. https://doi.org/10.4337/9781788116060.00012

Sedlmeier, P., & Hilton, D. (2012). Improving judgment and decision making through communication and representation. In M. Dhami, A. Schlottmann, & M. Waldmann (Eds.), *Judgment and decision making as a skill* (pp. 229-258). Cambridge University Press.

Service-Public. (2011, January 01). *Application des différents taux de TVA.* https://www.service-public.fr/professionnels-entreprises/vosdroits/F23567

Sharp, A., & Wheeler, M. (2013). Reducing householders' grocery carbon emissions: Carbon literacy and carbon label preferences. *Australasian Marketing Journal (AMJ), 21*(4), 240–249. https://doi.org/10.1016/j.ausmj.2013.08.004

Shewmake, S., Okrent, A., Thabrew, L., & Vandenbergh, M. (2015). Predicting consumer demand responses to carbon labels. *Ecological Economics, 119*, 168-180. https://doi.org/10.1016/j.ecolecon.2015.08.007

Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics*, *69*(1), 99-118. https://doi.org/10.2307/1884852

Simon, H. A. (1978). *Herbert Simon Banquet Speech* [Speech transcript]. nobelprize.org. https://www.nobelprize.org/prizes/economic-sciences/1978/simon/speech/

Simon, H. A. (2000). Bounded rationality in social science: Today and tomorrow. *Mind & Society*, *1*(1), 25-39. https://doi.org/10.1007/BF02512227

Skinner, B. F. (2005). *Science and human behavior*. The B. F. Skinner Foundation.

Slovic, P. (1972). *From Shakespeare to Simon: Speculations--and some evidence--about man's ability to process information* (Research Bulletin Vol. 12 No. 2). Oregon Research Institute. https://scholarsbank.uoregon.edu/xmlui/handle/1794/22179

Smithers, R. (2018, January 25). *Scientists calculate carbon emissions of your sandwich.* Guardian. https://www.theguardian.com/lifeandstyle/2018/jan/25/scientists-calculate-carbon-emissions-of-your-sandwich

Southey, F. (2021, January 12). *First Nutri-Score for nutrition, now Eco-Score for the environment: New FOP lands in France.* Foodnavigator. HTTPS://WWW.FOODNAVIGATOR.COM/ARTICLE/2021/01/12/ECO-SCORE-NEW-FOP-LABEL-MEASURES-THE-ENVIRONMENTAL-IMPACT-OF-FOOD

Spaargaren, G., Van Koppen, C. S. A., Janssen, A. M., Hendriksen, A., & Kolfschoten, C. J. (2013). Consumer responses to the carbon labelling of food: A real life experiment in a canteen practice. *Sociologia Ruralis*, *53*(4), 432-453. https://doi.org/10.1111/soru.12009

Stajkovic, A. D., & Luthans, F. (1997). A meta-analysis of the effects of organizational behavior modification on task performance, 1975–95. *Academy of Management Journal*, *40*(5), 1122-1149. https://doi.org/10.5465/256929

Stancu, V., Haugaard, P., & Lähteenmäki, L. (2016). Determinants of consumer food waste behaviour: Two routes to food waste. *Appetite*, *96*, 7-17. https://doi.org/10.1016/j.appet.2015.08.025

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309-317. https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, N. (2006). What is the economics of climate change? Report to HM Government, Executive Summary.

Stern, N. (2008). The economics of climate change. *American Economic Review*, *98*(2), 1-37. http:doi.org/DOI: 10.1257/aer.98.2.1

Stern, P. C. (2011). Contributions of psychology to limiting climate change. *American Psychologist*, *66*(4), 303-314. https://doi.org/10.1037/a0023235

Stok, F. M., & de Ridder, D. T. (2019). The focus theory of normative conduct. In K. Sassenberg & M. Vliek (Eds.), *Social psychology in action* (pp. 95-110). Springer, Cham. https://doi.org/10.1007/978-3-030-13788-5_7

Suchier, J., Demarque, C., Waroquier, L., Muller, L., Girandola, F., & Hilton, D. (in preparation). Incentivize sustainable consumption: Effects of different designs of carbon labels combined with social norms on carbon footprint, knowledge and purchasing behaviors of consumers in an online shopping context.

Sunstein, C. R. (1996). Social norms and social roles. *Columbia Law Review*, *96*(4), 903-968. https://doi.org/10.2307/1123430

Sunstein, C. R. (2015). Behavioural economics, consumption and environmental protection. In L. A. Reisch & J. Thogersen (Eds.), *Handbook of research on sustainable consumption* (pp. 313-327). Edward Elgar Publishing. https://doi.org/10.4337/9781783471270.00032

Tait, P. R., Saunders, C. M., & Guenther, M. (2015). Valuing preferences for environmental sustainability in fruit production by United Kingdom and Japanese consumers. *Journal of Food Research, 4*(3), 46-55. http:doi.org/doi:10.5539/jfr.v4n3p46

Tate, K., Stewart, A. J., & Daly, M. (2014). Influencing green behaviour through environmental goal priming: The mediating role of automatic evaluation. *Journal of Environmental Psychology*, *38*, 225–232. https://doi.org/10.1016/j.jenvp.2014.02.004

Teisl, M. F., & Roe, B. E. (1998). The economics of labeling: An overview of issues for health and environmental disclosure. *Agricultural and Resource Economics Review*, *27*(2), 140-150. http:doi.org/10.22004/ag.econ.31535

Teisl, M. F., Roe, B., & Hicks, R. L. (2002). Can eco-labels tune a market? Evidence from dolphin-safe labeling. *Journal of Environmental Economics and Management*, *43*(3), 339-359. https://doi.org/10.1006/jeem.2000.1186

Tesco. (2012). Product Carbon Footprint Summary. https://www.tescoplc.com/assets/files/cms/Tesco_Product_Carbon_Footprints_Summary(1).pdf.

Thaler, R. (1985). Mental accounting and consumer choice. *Marketing Science*, *4*(3), 199–214. https://doi.org/10.1287/mksc.4.3.199

Thøgersen, J. (2003). Monetary incentives and recycling: Behavioural and psychological reactions to a performance-dependent garbage fee. *Journal of Consumer Policy*, *26*(2), 197-228. https://doi.org/10.1023/A:1023633320485

Thøgersen, J., & Nielsen, K. S. (2016). A better carbon footprint label. *Journal of Cleaner Production*, *125*, 86-94. https://doi.org/10.1016/j.jclepro.2016.03.098

Ulph, A., Panzone, L. A., & Hilton, D. (2017). A Dynamic Self-Regulation Model of Sustainable Consumer Behaviour. http://dx.doi.org/10.2139/ssrn.3112221

Ungemach, C., Camilleri, A. R., Johnson, E. J., Larrick, R. P., & Weber, E. U. (2018). Translated attributes as choice architecture: Aligning objectives and choices through decision signposts. *Management Science*, *64*(5), 2445-2459. https://doi.org/10.1287/mnsc.2016.2703

Upham, P., Dendler, L., & Bleda, M. (2011). Carbon labelling of grocery products: public perceptions and potential emissions reductions. *Journal of Cleaner Production*, *19*(4), 348-355. https://doi.org/10.1016/j.jclepro.2010.05.014

Van Deun, H., Van Acker, W., Fobé, E., & Brans, M. (2018). Nudging in public policy and public management: A scoping review of the literature. *PSA 68th ANNUAL INTERNATIONAL CONFERENCE. Cardiff University*. 1-27.

https://www.psa.ac.uk/sites/default/files/conference/papers/2018/VanDeun_vanAcker_Fobé_Brans_Nudging_Scoping%20Review.pdf

Van Loo, E. J., Caputo, V., Nayga, R. M., Jr, Seo, H. S., Zhang, B., & Verbeke, W. (2015). Sustainability labels on coffee: Consumer preferences, willingness-to-pay and visual attention to attributes. *Ecological Economics*, *118*, 215–225. https://doi.org/10.1016/j.ecolecon.2015.07.011

Van Loo, E. J., Caputo, V., Nayga Jr, R. M., & Verbeke, W. (2014). Consumers' valuation of sustainability labels on meat. *Food Policy*, *49*, 137-150. https://doi.org/10.1016/j.foodpol.2014.07.002

Vanclay, J. K., Shortiss, J., Aulsebrook, S., Gillespie, A. M., Howell, B. C., Johanni, R., Maher, M. J., Mitchell, K. M., Stewart, M. D., & Yates, J. (2011). Customer response to carbon labelling of groceries. *Journal of Consumer Policy*, *34*(1), 153-160. https://doi.org/10.1007/s10603-010-9140-7

Vandenbergh, M. P., Dietz, T., & Stern, P. C. (2011). Time to try carbon labelling. *Nature Climate Change*, *1*, 4-6. https://doi.org/10.1038/nclimate1071

Vermeulen, S., Park, T., Khoury, C. K., Mockshell, J., Béné, C., Thi, H. T., Heard, B., & Wilson, B. (2019). *Changing diets and transforming food systems* (CCAFS Working Paper No. 282). CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Vlaeminck, P., Jiang, T., & Vranken, L. (2014). Food labeling and eco-friendly consumption: Experimental evidence from a Belgian supermarket. *Ecological Economics, 108*, 180-190. https://doi.org/10.1016/j.ecolecon.2014.10.019

Walker, A. C., Stange, M., Dixon, M. J., Koehler, D. J., & Fugelsang, J. A. (2019). Graphical depiction of statistical information improves gambling-related judgments. *Journal of Gambling Studies, 35*(3), 945–968. https://doi.org/10.1007/s10899-019-09860-1

Wang, Y. C., Coxson, P., Shen, Y. M., Goldman, L., & Bibbins-Domingo, K. (2012). A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. *Health Affairs, 31*(1), 199-207. https://doi.org/10.1377/hlthaff.2011.0410

Weir, E. (2012). *The focus theory of normative conduct: Application to pro-environmental grocery shopping behaviors* [Master's thesis, University of Washington]. Research Works Archive. https://digital.lib.washington.edu/researchworks/handle/1773/20563

Wellesley, L., Happer, C., & Froggatt, A. (2015). *Changing climate, changing diets: Pathways to lower meat consumption.* Chatham House, the Royal Institute of International Affairs. *http://agricultura.gencat.cat/web/.content/de_departament/de02_estadistiques_observatoris/27_butlletins/02_butlletins_nd/documents_nd/fitxers_estatics_nd/2015/0168_2015_MA_CanviClimatic_Dieta-alimentaria-Carnis.pdf*

White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review*, *66*(5), 297-333. https://doi.org/10.1037/h0040934

Wilson, R. (1972). The gift relationship: From human blood to social policy. (Book Review). *Social Forces, 50*(3), 411-412. https://doi.org/10.1093/sf/50.3.411

Wirsenius, S., Hedenus, F., & Mohlin, K. (2011). Greenhouse gas taxes on animal food products: rationale, tax scheme and climate mitigation effects. *Climatic Change*, *108*(1), 159-184. https://doi.org/10.1007/s10584-010-9971-x

Xiang, D., & Lawley, C. (2019). The impact of British Columbia's carbon tax on residential natural gas consumption. *Energy Economics, 80*, 206-218. https://doi.org/10.1016/j.eneco.2018.12.004

Young, H. P. (2015). The evolution of social norms. *Economics, 7*(1), 359-387. https://doi.org/10.1146/annurev-economics-080614-115322

Zizzo, D. J., Parravano, M., Nakamura, R., Forwood, S., & Suhrcke, M. (2016). *The impact of taxation and signposting on diet: an online field study with breakfast cereals and soft drinks*

(CHE Research Paper No. 131). Centre for Health Economics, University of York. https://eprints.whiterose.ac.uk/135810/1/CHERP131_taxation_signposting_diet_breakfast_cereals_soft_drinks.pdf

Appendices

Appendix A

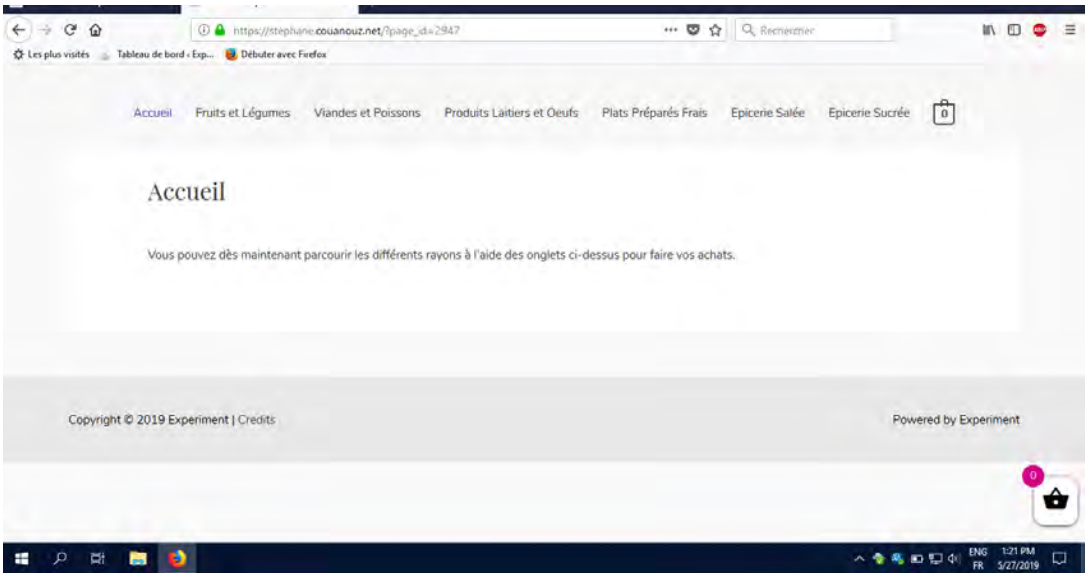
Further Information Concerning Sample Description (Experiment 1)

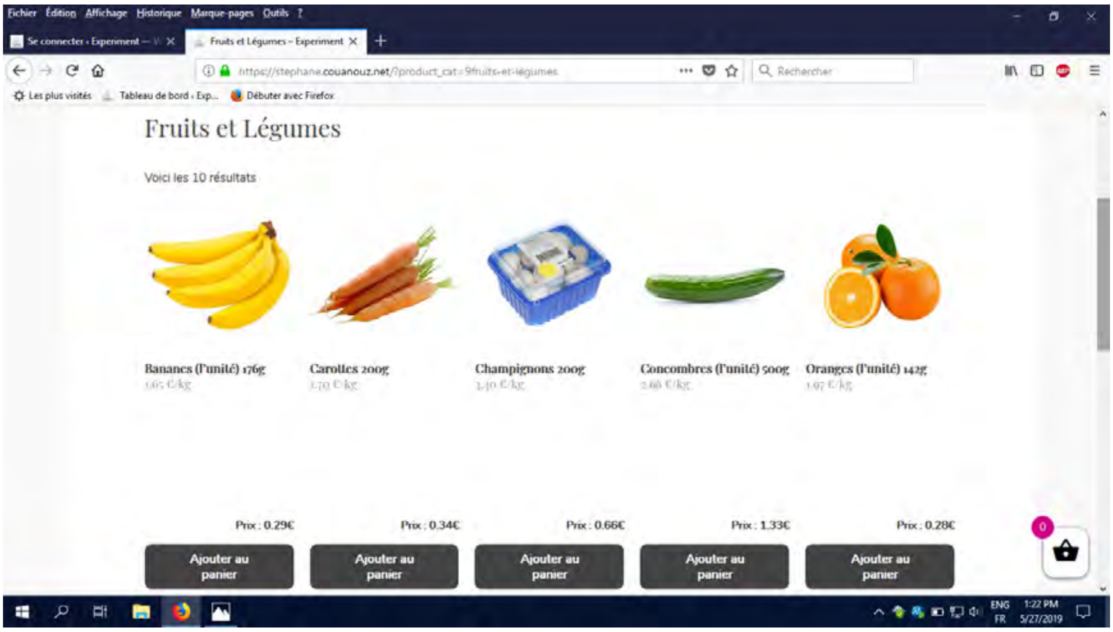
Majority of the participants (77.2%) have chosen human and social sciences as field of study or activity. Arts, music, audio-visual, and cinema (5.6%); letter and language (4.6%); education, teaching, and training (1.5%); and economics (1.5%) were the most chosen field of activity or study by participants. Concerning the revenue, 13.2% of the participants did not respond or chose “I do not want to answer” as option. Most of the participants (54.3%) were in the €0-499 revenue group and in the €500 - €999 group (26.9%). Most of the participants have never used online grocery shopping platforms similar to ours to do grocery shopping (76.8%). Concerning political opinion question, 68.5% of participants chose “other” or “I do not want to answer” or did not respond to the item. Among all the participants, 22.3% of them indicated left-wing parties represent better their political opinions, 5.6% of them ecological party, 1% centre party, and 2.5% right-wing parties. Lastly, 28.4% of the participants claimed following a diet. While 9.14% of the participants were vegetarian, 8.12% of them were flexitarian, 3.05% of them were vegetalian or vegan. Moreover, 1.02% of them were lactose intolerant, and the remainder of the participants expressed other diets.

Appendix B

Control Condition

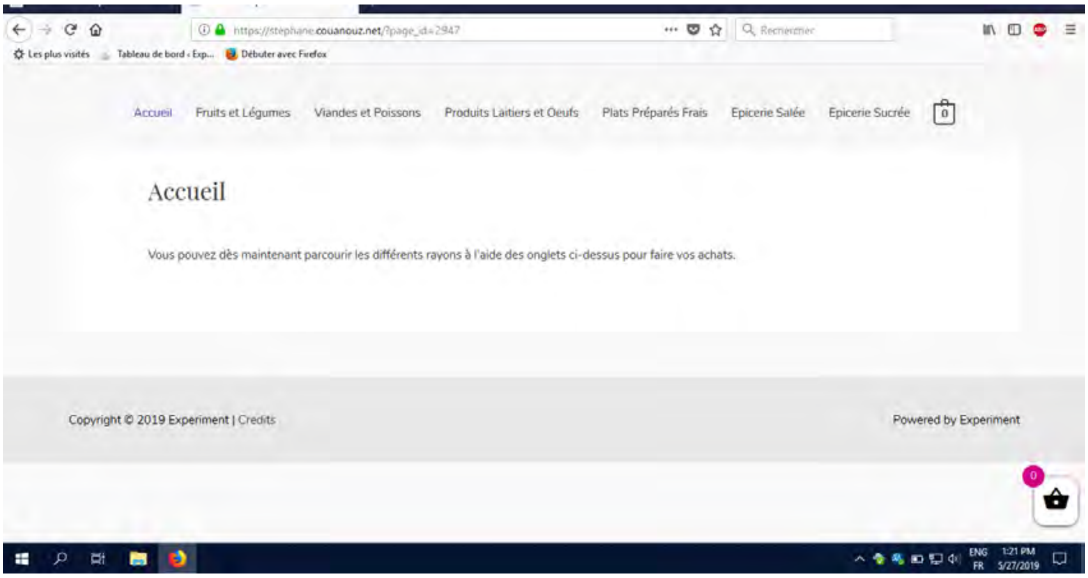
On the landing page, participants were shown the following message: “You can now use the tabs to gain access to the different shop shelves and proceed with your shopping”.

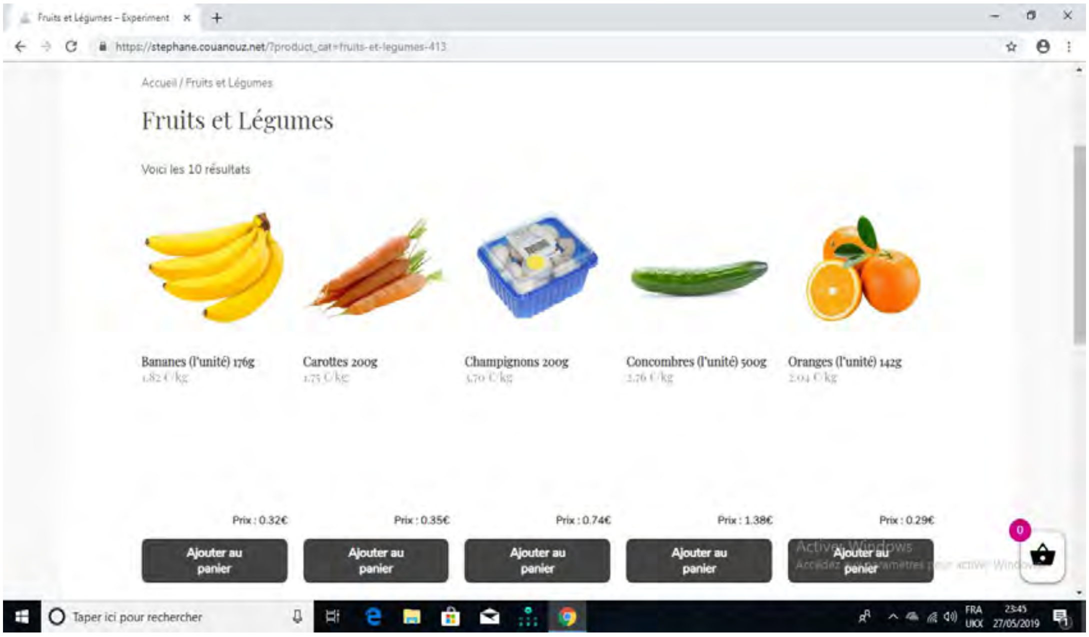




Appendix C

No Norm No Display Carbon Tax Condition

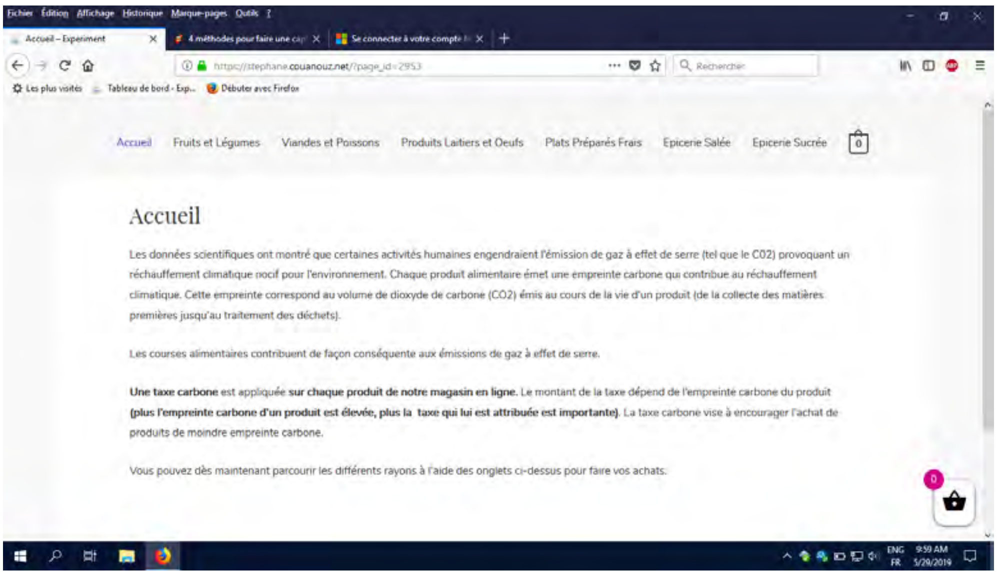


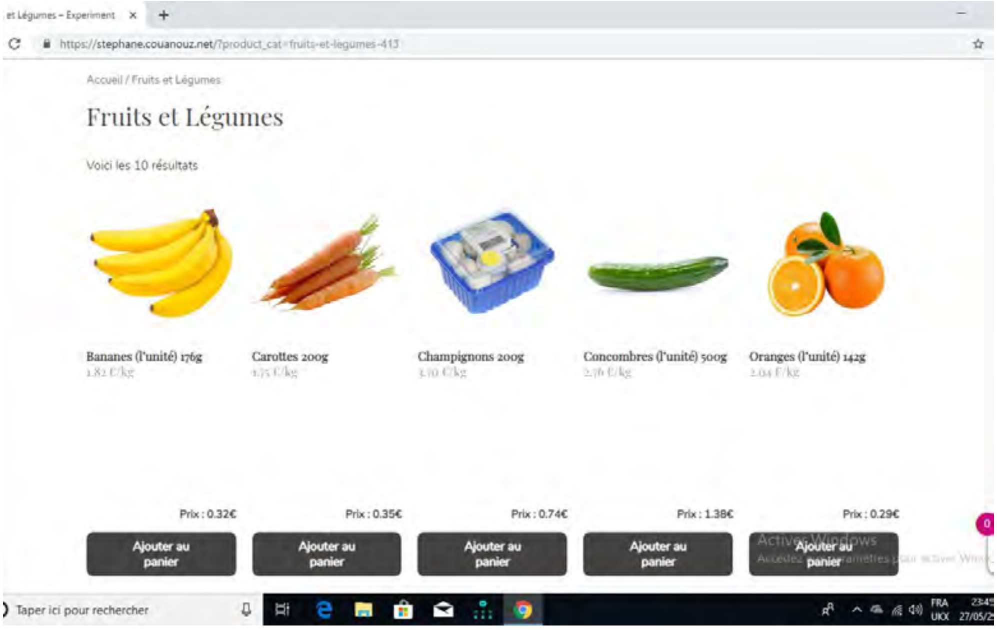


Appendix D

Norm No Display Carbon Tax Condition

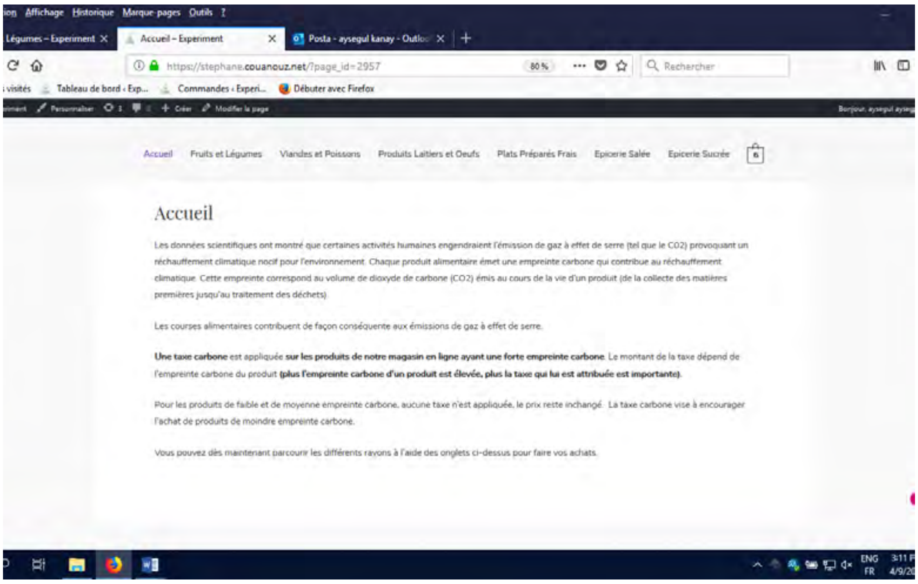
The following message was displayed on the landing page: “Scientific data showed that some activities cause greenhouse gas emissions (such as CO_2), which provokes global warming, which is dangerous for the environment. Each food product has a carbon footprint, which contributes to global warming. This footprint corresponds to the volume of carbon dioxide (CO_2) emitted during the life cycle of a product (from the collection of raw material until the waste management). Grocery shopping contributes substantially to greenhouse gas emissions. A carbon tax was applied to all the products in our online shop. The tax amount depends on the carbon footprint of the product (higher the carbon footprint of the product, higher the tax that is applied to it). The carbon tax aims to promote the purchase of products having lower carbon footprint. You can now use the tabs to gain access to the different shop shelves and proceed with your shopping”

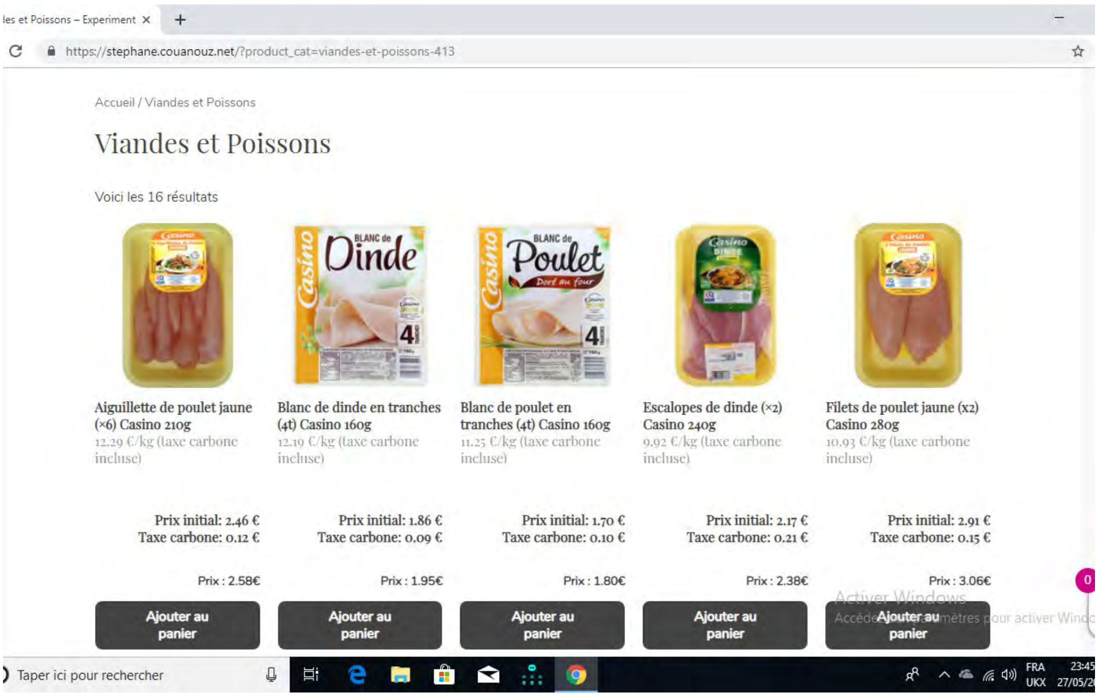



et Légumes – Experiment
https://stephane.couanouz.net/?product_cat=fruits-et-legumes-413
Accueil / Fruits et Légumes
Fruits et Légumes
Voici les 10 résultats
Bananes (l'unité) 176g
1.82 €/kg
Carottes 200g
Champignons 200g
Concombres (l'unité) 500g
Oranges (l'unité) 142g
Prix : 0.32€
Prix : 0.35€
Prix : 0.74€
Prix : 1.38€
Prix : 0.29€
Ajouter au panier
Ajouter au panier
Ajouter au panier
Ajouter au panier
Ajouter au panier
Taper ici pour rechercher
FRA
UKX

Appendix E

Norm Carbon Tax Display Condition

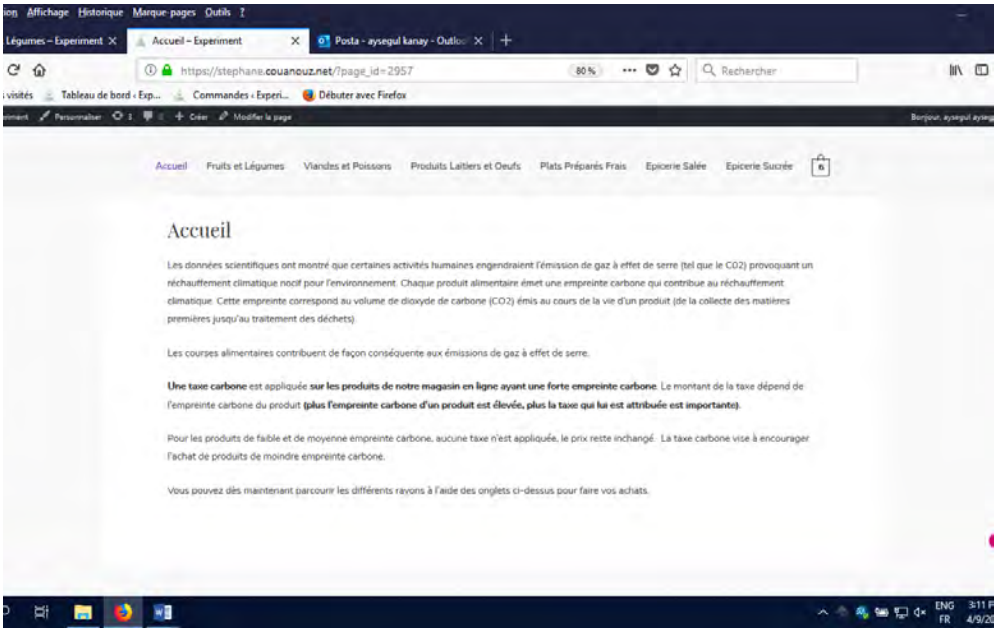


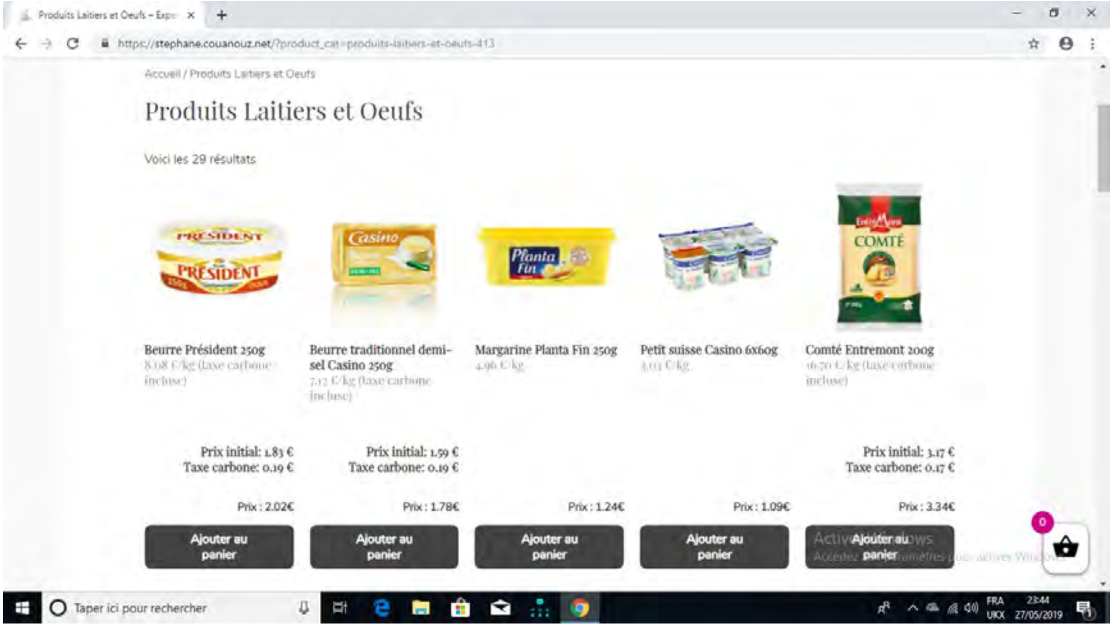


Appendix F

Norm High-CO2 Display Carbon Tax Condition

The following message was displayed on the landing page: "Scientific data showed that some activities cause greenhouse gas emissions (such as CO2), which provokes global warming, which is dangerous for the environment. Each food product has a carbon footprint, which contributes to global warming. This footprint corresponds to the volume of carbon dioxide (CO2) emitted during the life cycle of a product (from the collection of raw material until the waste management). Grocery shopping contributes substantially to greenhouse gas emissions. A carbon tax was applied to the products having a higher carbon footprint in our online shop. The tax amount depends on the carbon footprint of the product (higher the carbon footprint of the product, higher the tax that is applied to it). For the products having low or medium carbon footprint, tax was not applied, prices stayed the same. The carbon tax aims to promote the purchase of products having lower carbon footprint. You can now use the tabs to gain access to the different shop shelves and proceed with your shopping"




Produits Laitiers et Oeufs – Expe
https://stephane.couanouz.net/?product_cat=produits-laitiers-et-oeufs-413
Accueil / Produits Laitiers et Oeufs
Produits Laitiers et Oeufs
Voici les 29 résultats
Beurre Président 250g
8.08 €/kg (taxe carbone incluse)
Prix initial: 1.83 €
Taxe carbone: 0.19 €
Prix : 2.02€
Ajouter au panier
Beurre traditionnel demi-sel Casino 250g
7.12 €/kg (taxe carbone incluse)
Prix initial: 1.59 €
Taxe carbone: 0.19 €
Prix : 1.78€
Ajouter au panier
Margarine Planta Fin 250g
4.96 €/kg
Prix : 1.24€
Ajouter au panier
Petit suisse Casino 6x60g
Prix : 1.09€
Ajouter au panier
Comté Entremont 200g
16.70 €/kg (taxe carbone incluse)
Prix initial: 3.17 €
Taxe carbone: 0.17 €
Prix : 3.34€
Ajouter au panier
Taper ici pour rechercher
FRA
UKX
23:44
27/05/2019

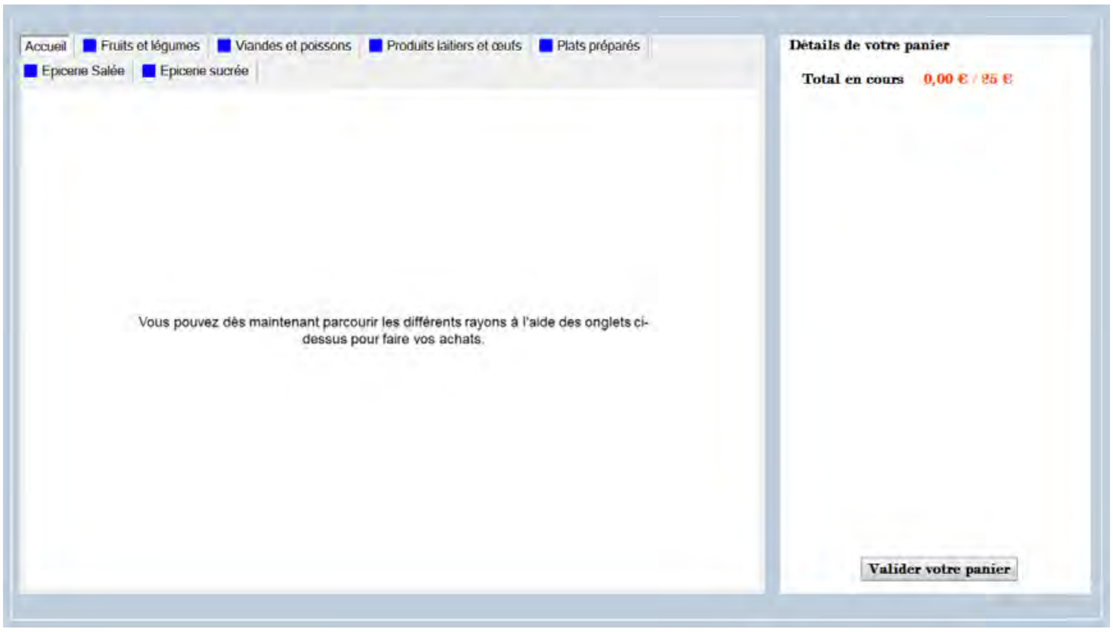
Appendix G

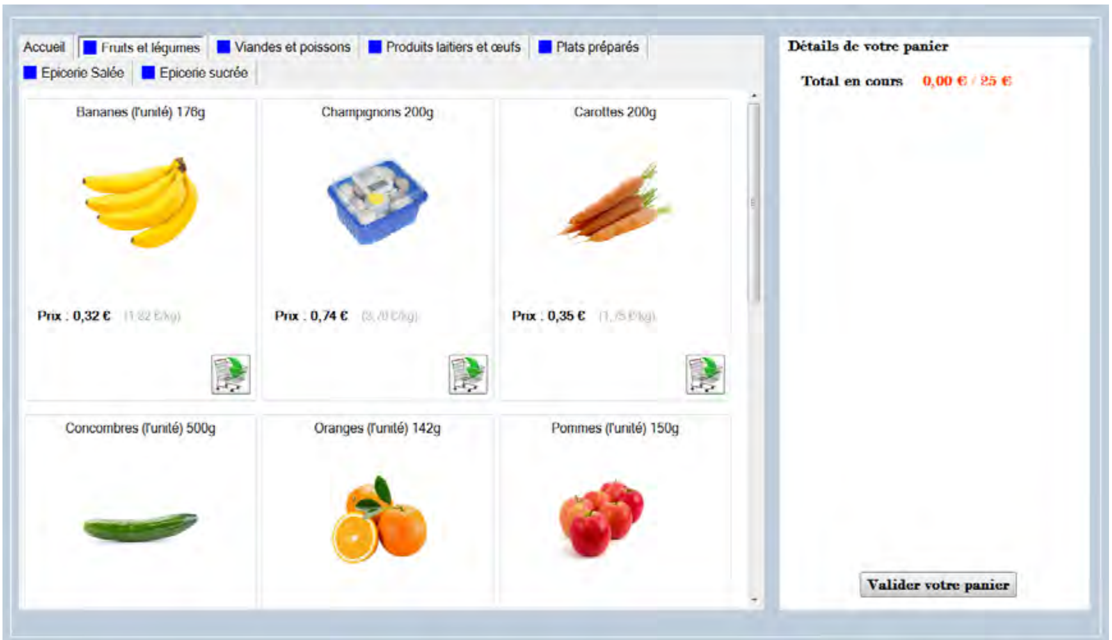
Details Concerning the Sample Recruited For Experiment 2

Human and social sciences was chosen most frequently (42%) as the field of study or activity; language and letter being the second (27.7%); and art music, audio-visual, and cinema being third (6.8%). Concerning the political view item, 62.5% of the participants either chose “I do not want to answer” or “other” as an option or did not respond to it. 18.2% of the participants indicated left-wing parties represent better their political opinion, 13.4% ecological party, 3.3% centre party, and 2.6% right-wing parties. Concerning the revenue, 17.5% of the participants did not respond or chose “I do not want to answer”, and majority of the participants (72.2%) were in 0-999€ monthly revenue group. Most of the participants (78.7%) never did online grocery shopping in the online shops compared to ours. Regarding the diet, 18.3% of the participants were flexitarian, 9.1% of them were vegetarian, and 2.7% of them were vegan or vegetalian. 11.5 % of the participants were following a Hallal diet, 2.5% of them a Kascher diet, and lastly, 7.6% of them had lactose or gluten intolerance.

Appendix H

Carbon Tax Without Display

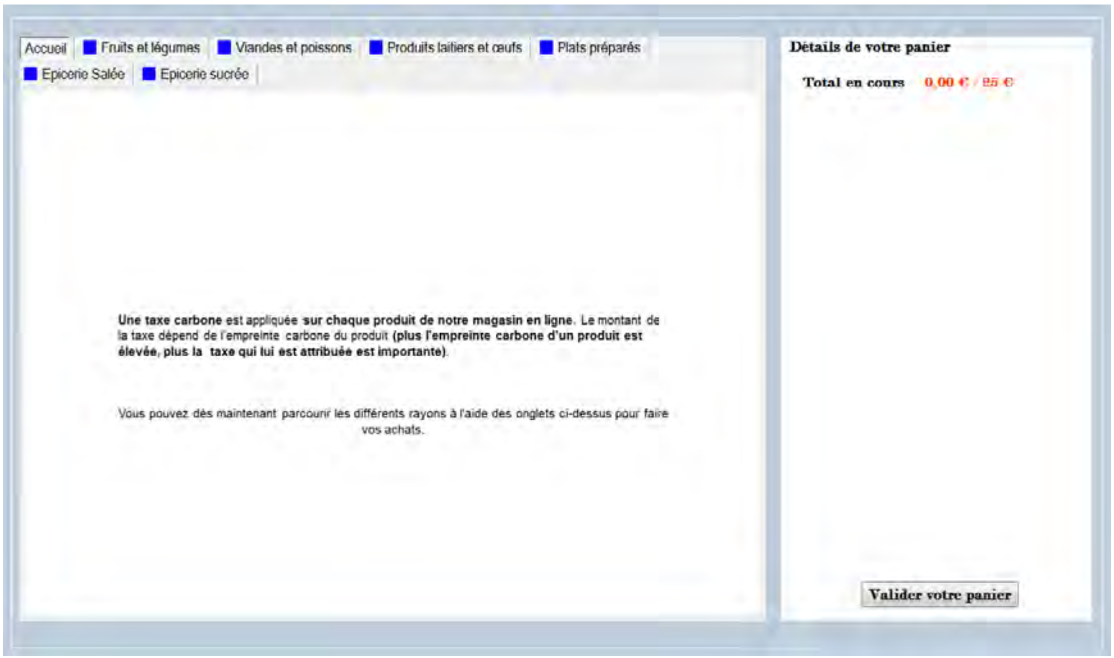


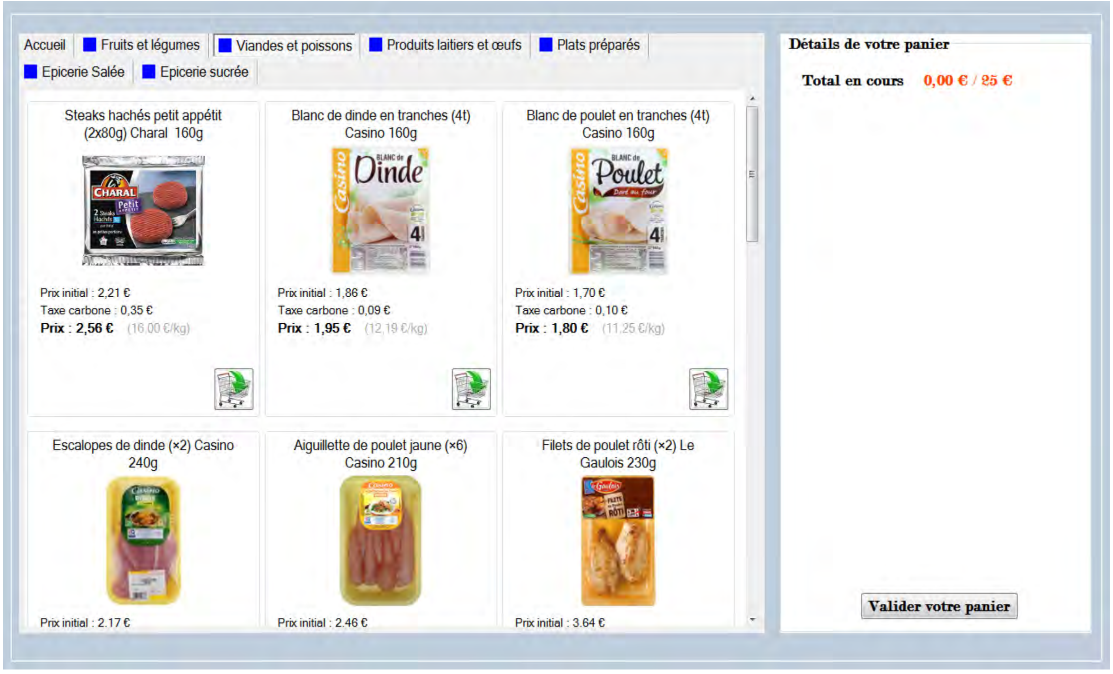


Appendix I

Carbon Tax With Display

The following message was displayed on the landing page: “A carbon tax is applied to all the products in our online shop. The amount of the tax depends on the carbon footprint of the product (higher the carbon footprint of a product, higher the amount of the tax applied to it). You can now use the tabs to gain access to the different shop shelves and proceed with your shopping.”

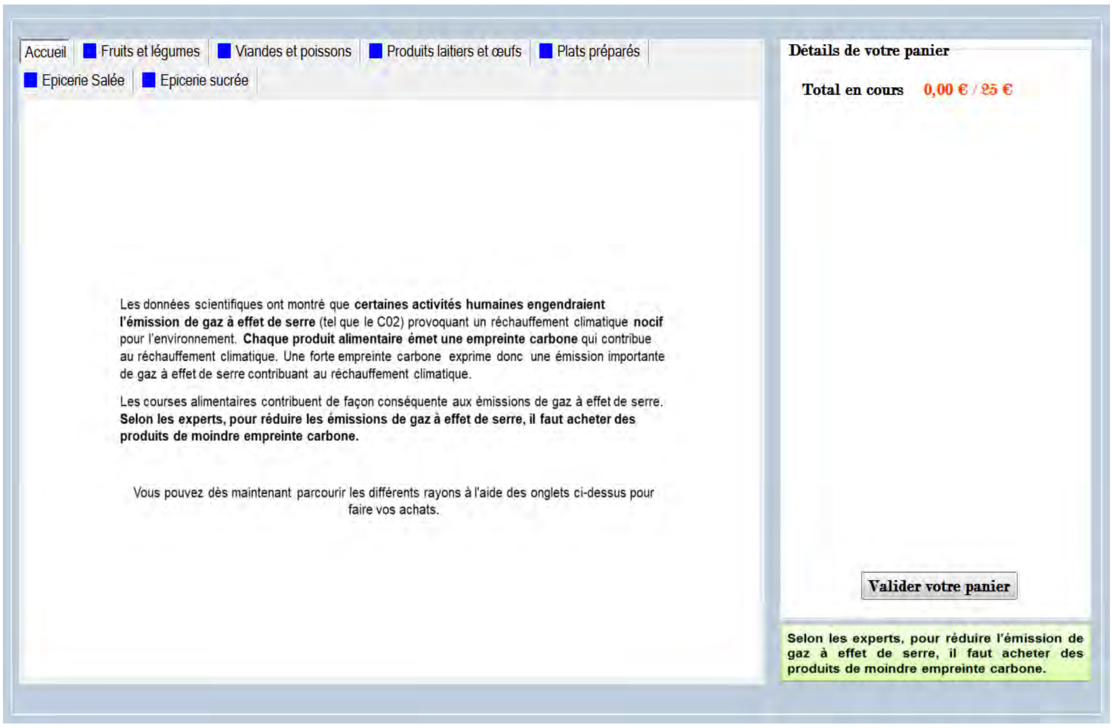


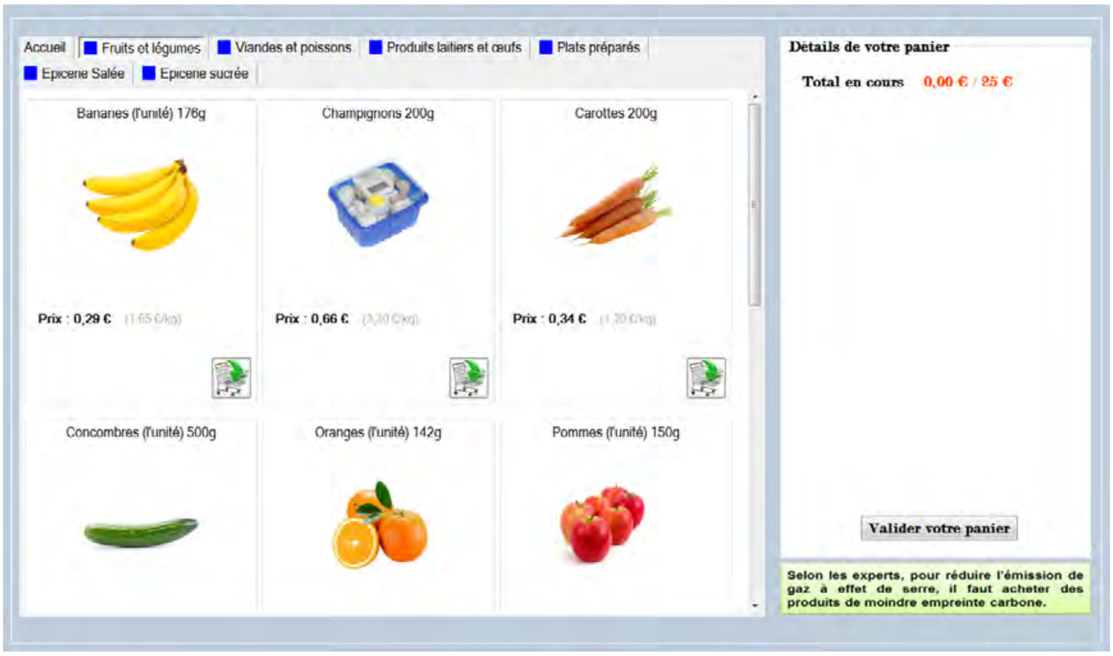

Accueil
Fruits et légumes
Viandes et poissons
Produits laitiers et œufs
Plats préparés
Epicerie Salée
Epicerie sucrée
Détails de votre panier
Total en cours 0,00 € / 25 €
Steaks hachés petit appétit (2x80g) Charal 160g
Prix initial : 2,21 €
Taxe carbone : 0,35 €
Prix : 2,56 € (16.00 €/kg)
Blanc de dinde en tranches (4t) Casino 160g
Prix initial : 1,86 €
Taxe carbone : 0,09 €
Prix : 1,95 € (12,19 €/kg)
Blanc de poulet en tranches (4t) Casino 160g
Prix initial : 1,70 €
Taxe carbone : 0,10 €
Prix : 1,80 € (11,25 €/kg)
Escalopes de dinde (×2) Casino 240g
Prix initial : 2.17 €
Aiguillette de poulet jaune (×6) Casino 210g
Prix initial : 2.46 €
Filets de poulet rôti (×2) Le Gaulois 230g
Prix initial : 3.64 €
Valider votre panier

Appendix J

Injunctive Norm

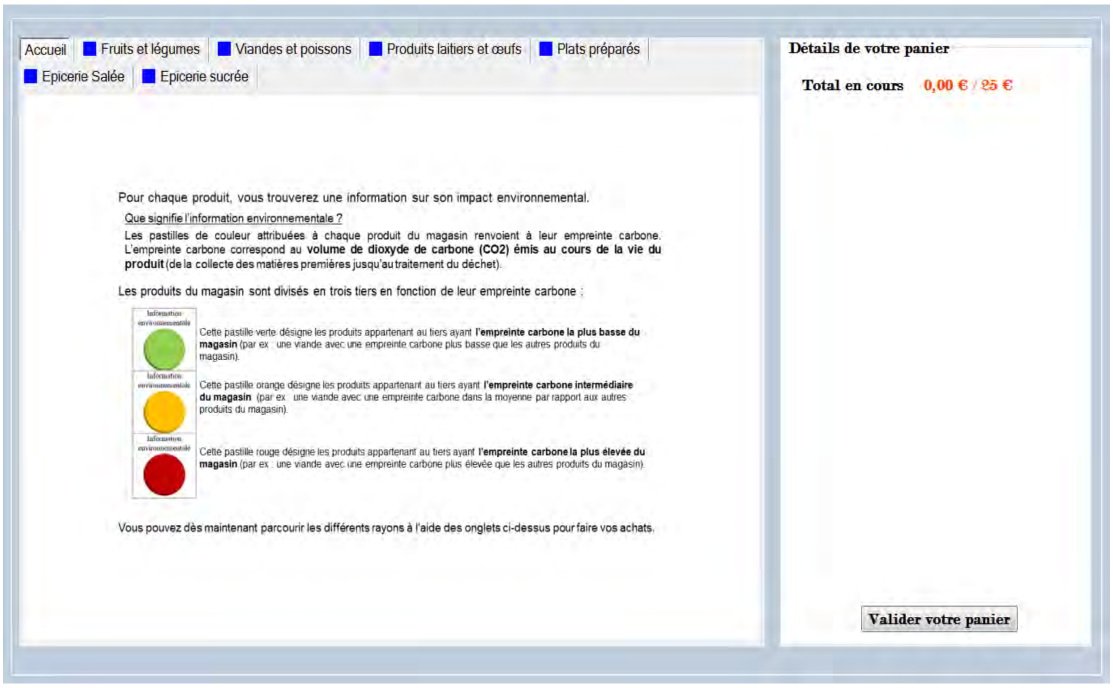
The message on the landing page was the following: “Scientific data showed that some activities cause greenhouse gas emissions (such as CO2), which provokes global warming, which is dangerous for the environment. Each food product has a carbon footprint, which contributes to global warming. Thus, a high carbon footprint corresponds to a high greenhouse gas emission, which contributes to the to the global warming. Grocery shopping contributes substantially to greenhouse gas emissions. According to the experts, to reduce greenhouse gas emissions, one should buy products with low carbon footprint. You can now use the tabs to gain access to the different shop shelves and proceed with your shopping.”

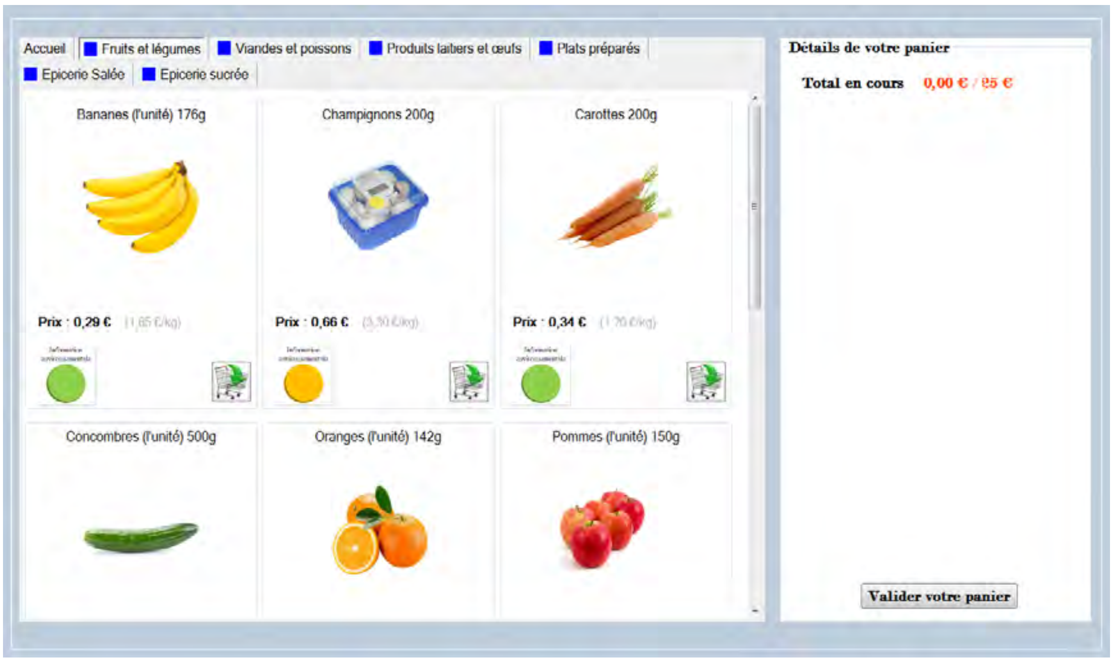



Accueil
Fruits et légumes
Viandes et poissons
Produits laitiers et œufs
Plats préparés
Epicerie Salée
Epicerie sucrée
Bananes (l'unité) 176g
Prix : 0,29 €
Champignons 200g
Prix : 0,66 €
Carottes 200g
Prix : 0,34 €
Concombres (l'unité) 500g
Oranges (l'unité) 142g
Pommes (l'unité) 150g
Détails de votre panier
Total en cours 0,00 € / 25 €
Valider votre panier
Selon les experts, pour réduire l'émission de gaz à effet de serre, il faut acheter des produits de moindre empreinte carbone.

Appendix K

Traffic Lights Carbon Footprint Labels

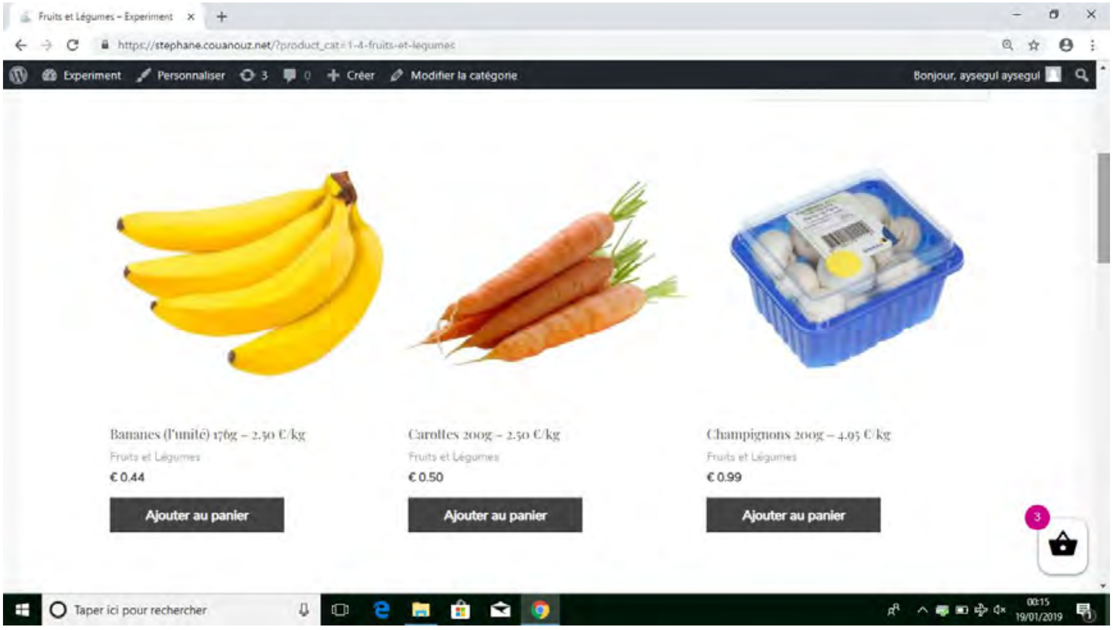




Appendix L

Experiment 1: No Norm Baseline Condition

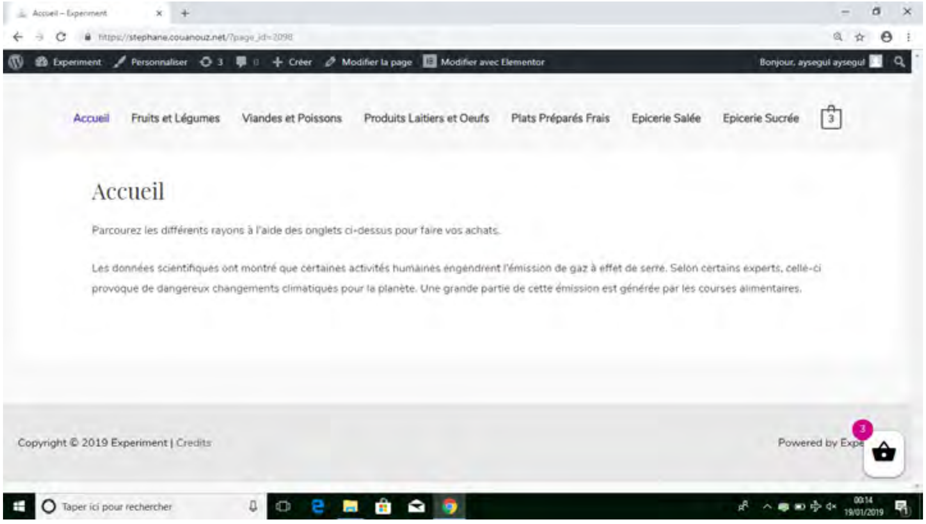
In this condition, a message was displayed on the landing page: “Browse the different shelves using the tabs above to shop”.

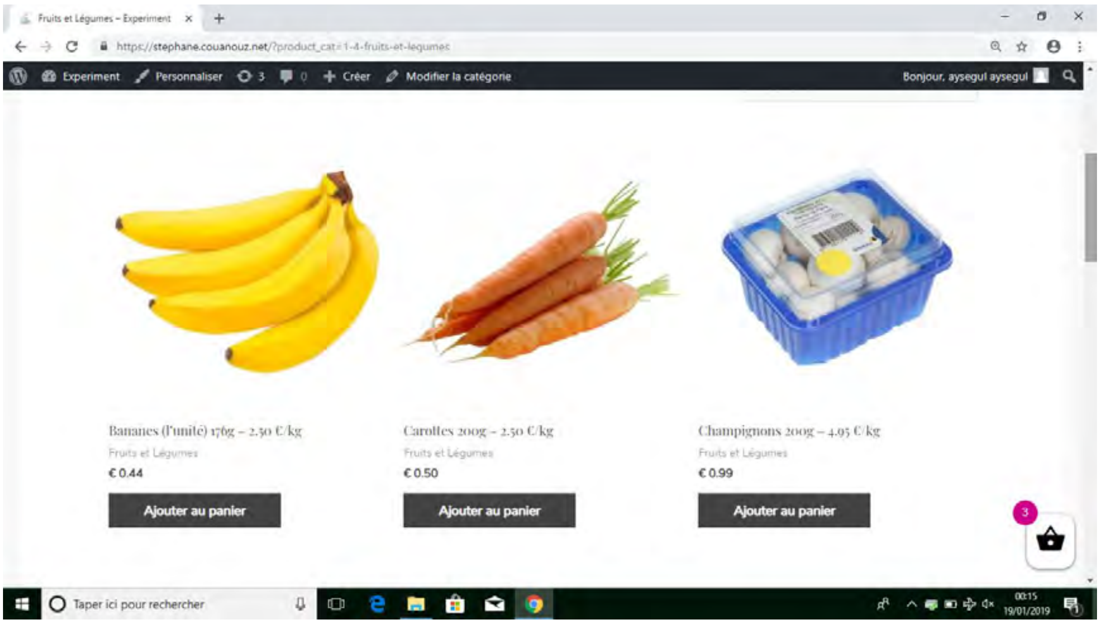


Appendix M

Experiment 1: Norm Baseline Condition

The following text was displayed on the landing page: “Browse the different shelves using the tabs above to shop. Scientific data have established that certain human activities emit greenhouse gases. According to some recognized experts, this is inducing dangerous climate change for the planet. An important part of these emissions is due to grocery shopping”.

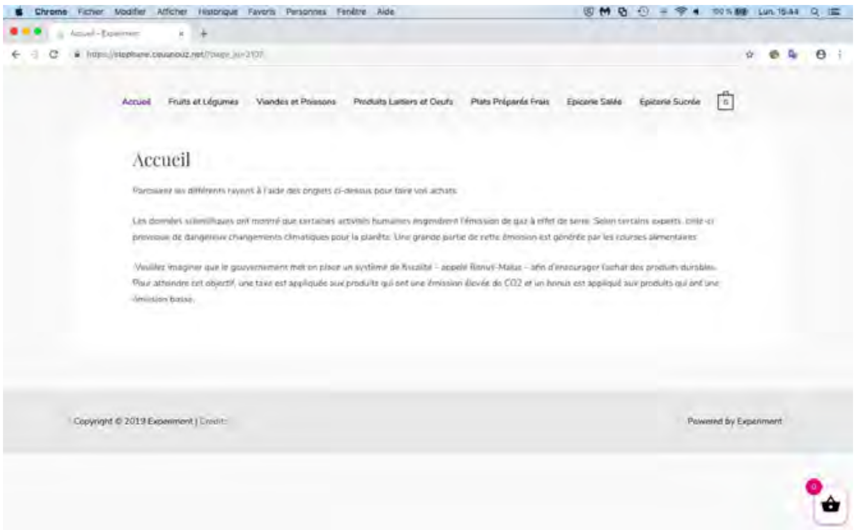


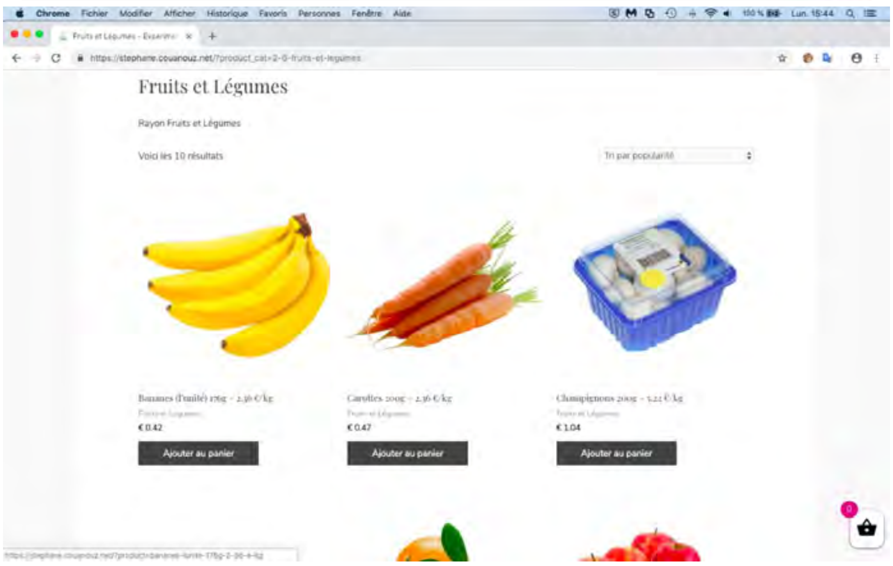


Appendix N

Norm Medium Bonus-Malus Without Display Condition

The following message was displayed on the landing page: “Scientific data have established that certain human activities emit greenhouse gases. According to some recognized experts, this is inducing dangerous climate change for the planet. An important part of these emissions is due to grocery shopping. Please imagine that the government set up a Bonus-Malus scheme aiming to encourage purchase of environmentally friendly products. For this purpose, a tax is applied to the products which have high carbon footprint, and a bonus is applied to the products which have low carbon footprint.”.

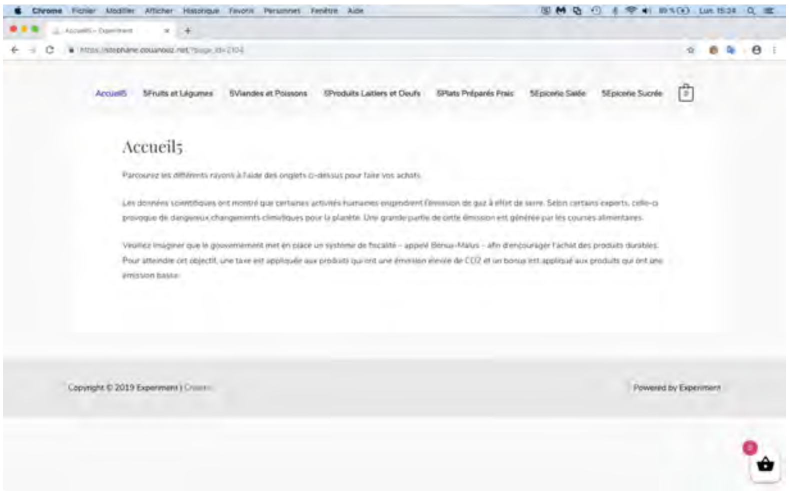


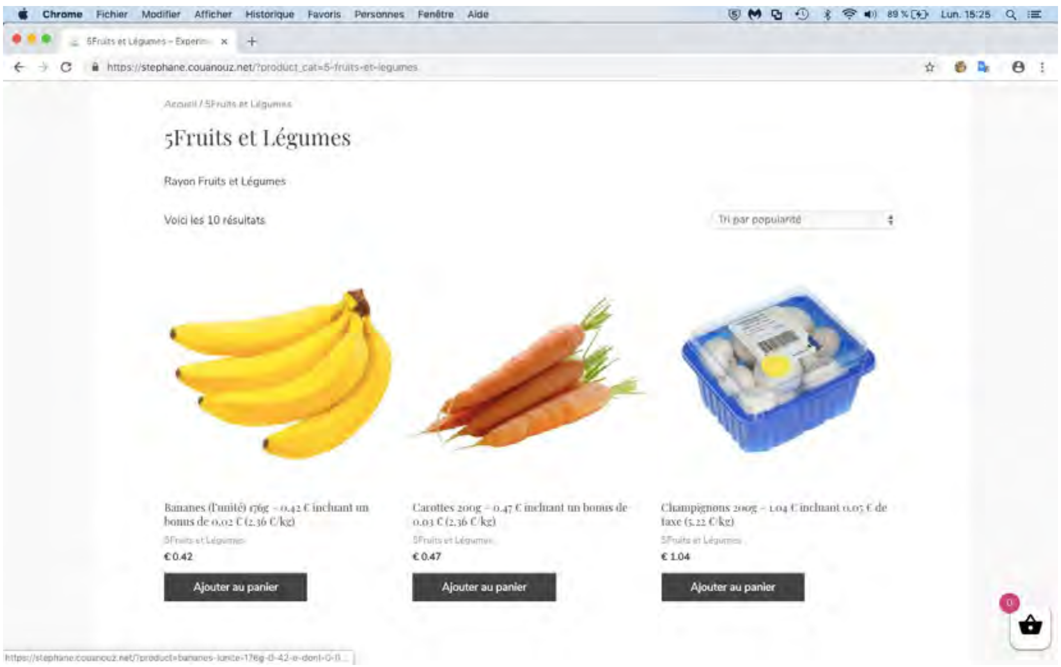


Appendix O

Experiment 1: Norm Medium Bonus-Malus Display Condition

The following message was displayed on the landing page: “Scientific data have established that certain human activities emit greenhouse gases. According to some recognized experts, this is inducing dangerous climate change for the planet. An important part of these emissions is due to grocery shopping. Please imagine that the government set up a Bonus-Malus scheme aiming to encourage purchase of environmentally friendly products. For this purpose, a tax is applied to the products which have high carbon footprint, and a bonus is applied to the products which have low carbon footprint.”.





Appendix P

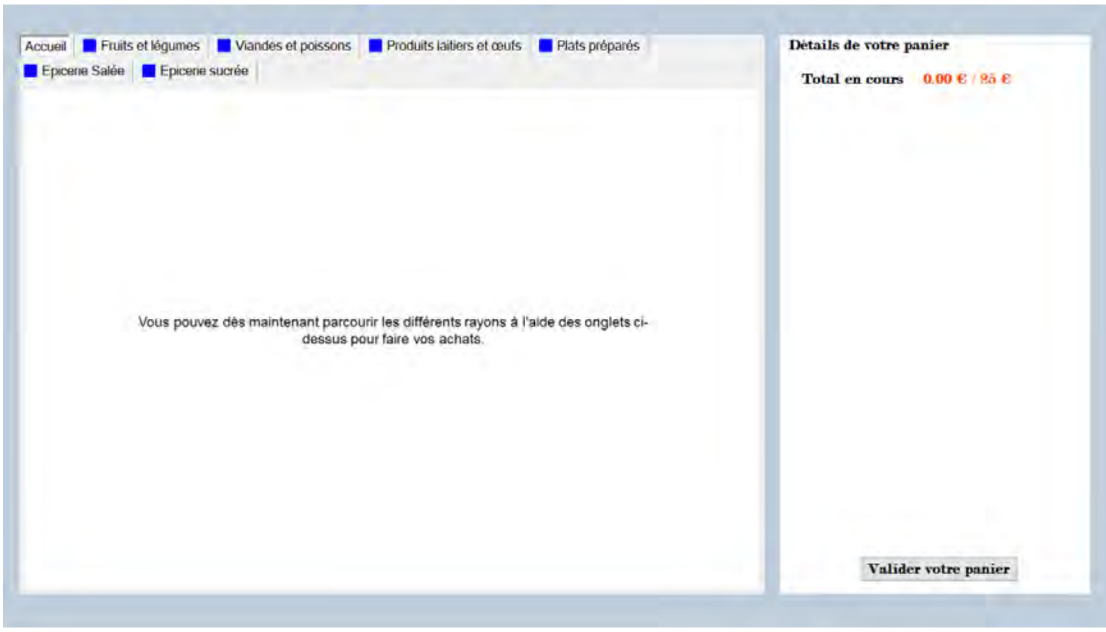
Details Concerning the Sample (Experiment 1)

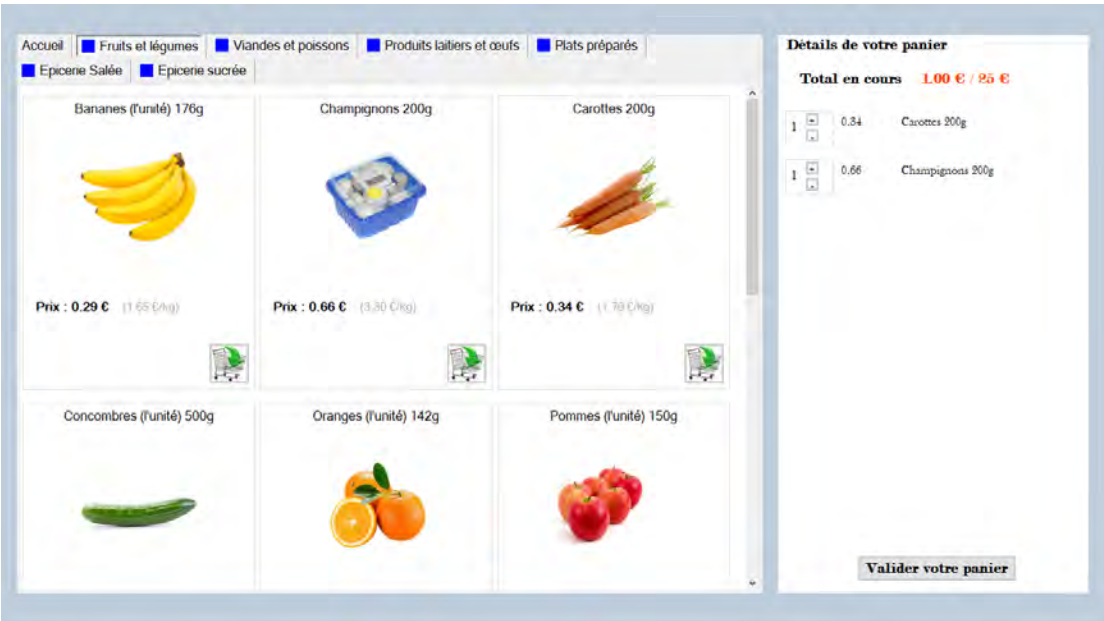
Participants indicated rarely doing online grocery shopping on platforms similar to ours (*M* = 1.55, *SD* = 1.27). Concerning revenue, 26.4% of participants did not respond or chose “I do not want to answer” as option. Moreover, 49.7% of the participants indicated being in the 0-€499 revenue group and 15.5% of them in the €500-€999 group. Three participants did not indicate their field of education/activity. While more than half of the participants’ (53.9%) field of education/activity was economic sciences; 11.9% of them indicated mathematics and statistics; 8.8% commerce, finance, and management; 7.3% law and justice; and 5.7% human and social sciences as their field of education/activity. Regarding political opinion, 49.8% of the participants did not indicate any opinion or chose “other” as an option; concerning the remaining participants, 15.5% of them indicated left-wing parties representing better their political opinions, 9.3% right-wing parties, 7.3% an environmental party, and 18.1% a centre party.

Appendix Q

Experiment 2: Baseline Condition

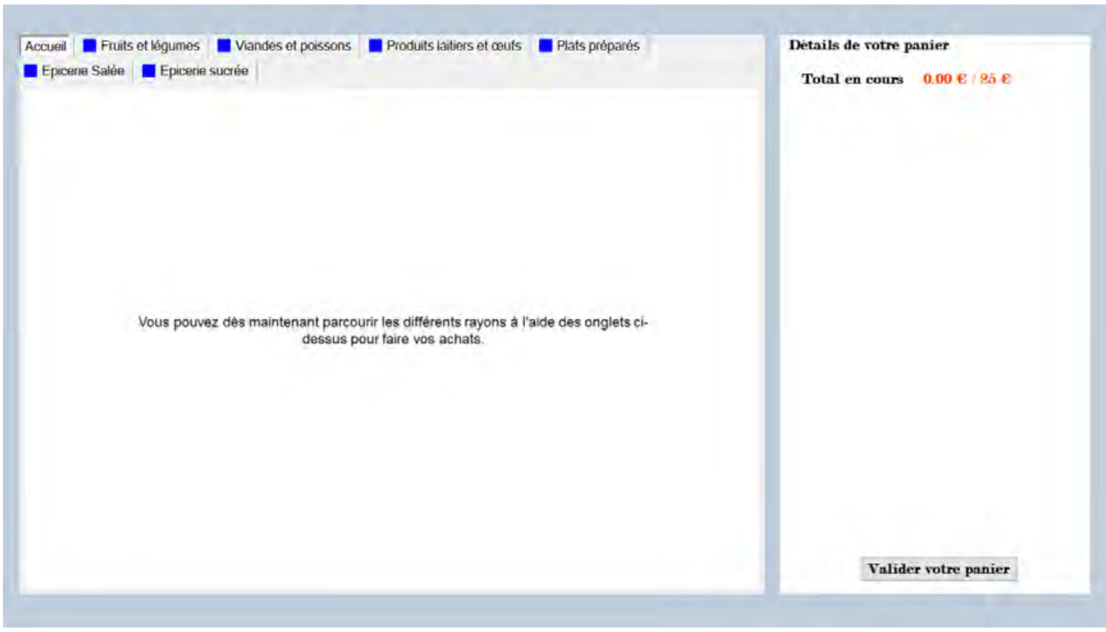
The following message was displayed on the landing page: “You can now start browsing the different shelves using the tabs above to shop”.

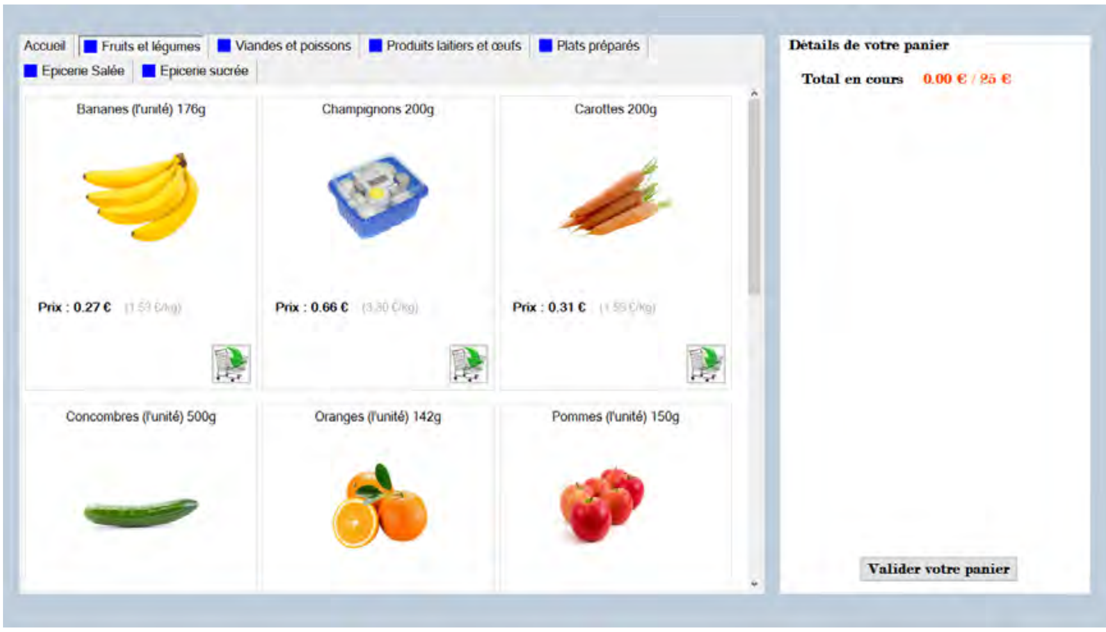




Appendix R

Experiment 2: Medium Bonus-Malus Without Display

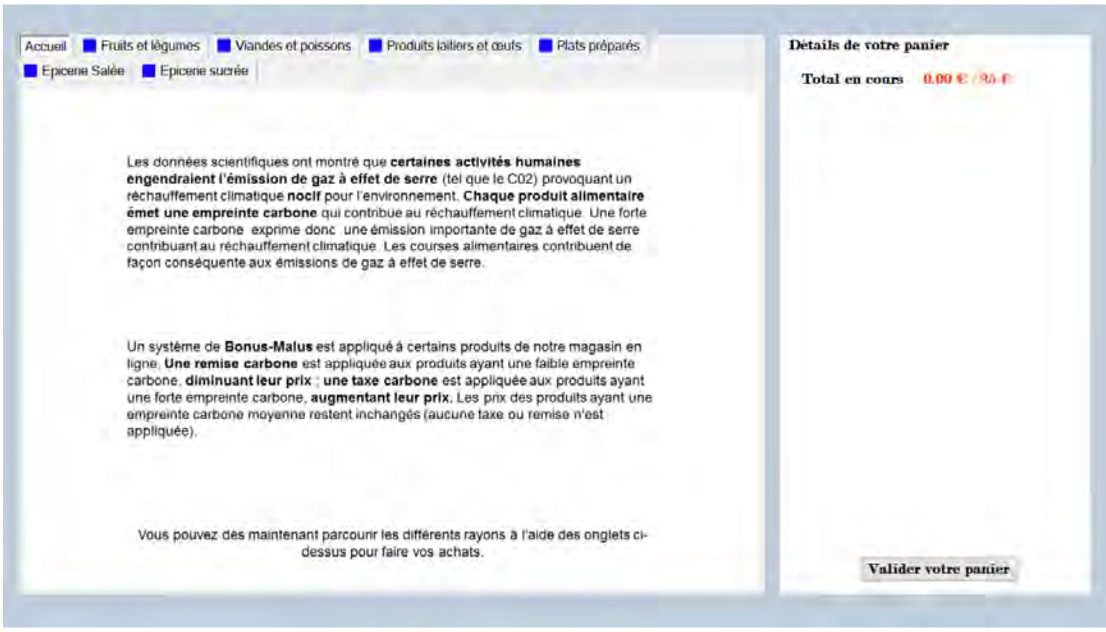


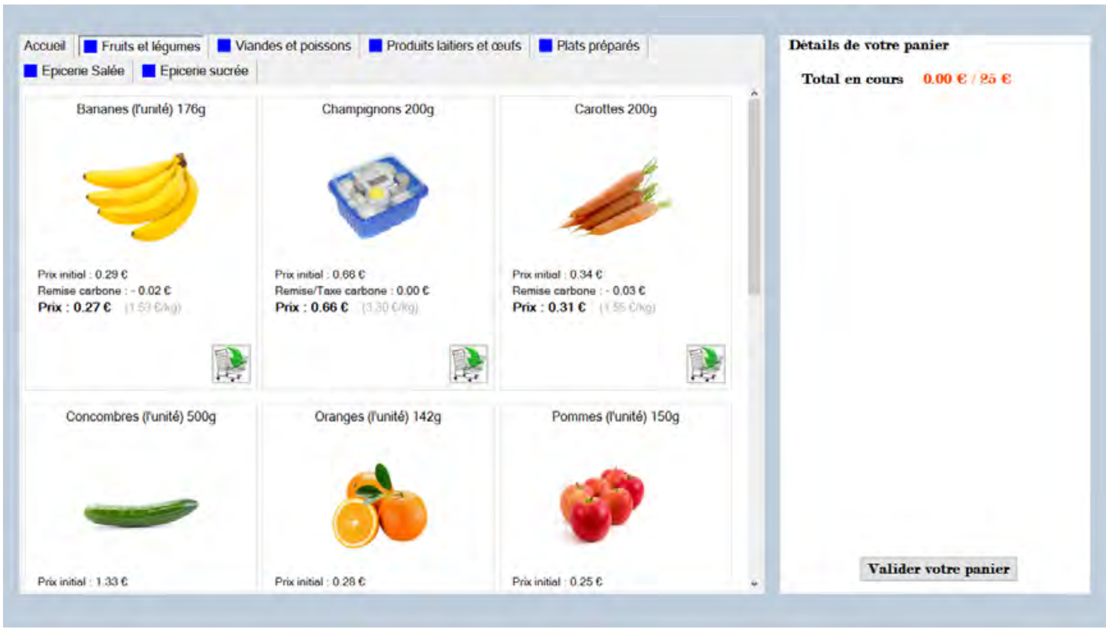


Appendix S

Experiment 2: Medium Bonus-Malus With Display

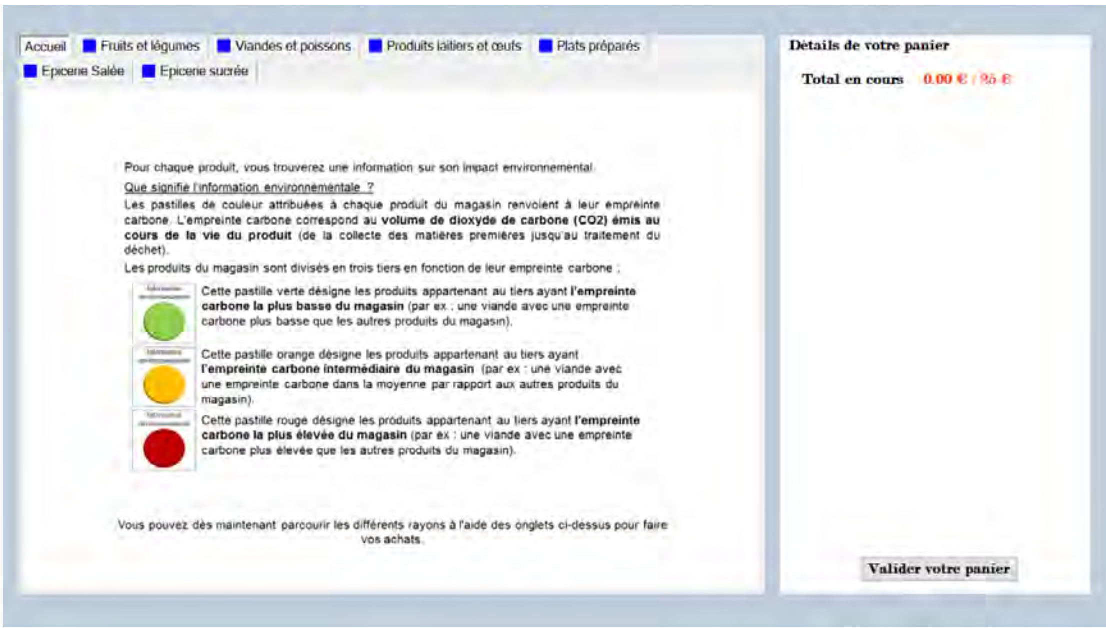
The following massage was displayed on the landing page: “Scientific data showed that certain human activities generate greenhouse gas emissions (such as CO2), which causes global warming, which is dangerous for the environment. Each food product generates a carbon footprint, which contributes to global warming. A high carbon footprint therefore expresses a substantial greenhouse gases emission contributing to global warming. Grocery shopping contributes significantly to greenhouse gas emissions. A Bonus-Malus scheme is applied to certain products in our online store. A carbon subsidy is applied to products with a low carbon footprint, reducing their price; a carbon tax is applied to products with a high carbon footprint, increasing their price. The prices of products with a medium carbon footprint remain unchanged (no tax or subsidy is applied). You can now start browsing the different shelves using the tabs above to shop.”

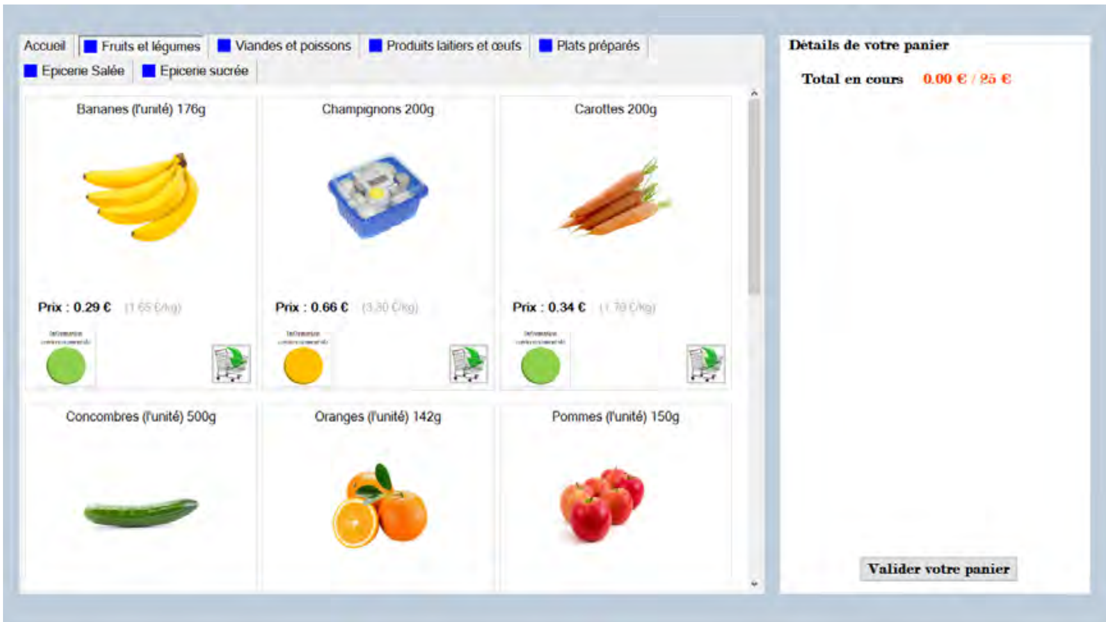



Accueil
Fruits et légumes
Viandes et poissons
Produits laitiers et œufs
Plats préparés
Epicerie Salée
Epicerie sucrée
Bananes (l'unité) 176g
Prix initial : 0.29 €
Remise carbone : - 0.02 €
Prix : 0.27 € (1.53 €/kg)
Champignons 200g
Prix initial : 0.66 €
Remise/Taxe carbone : 0.00 €
Prix : 0.66 € (3.30 €/kg)
Carottes 200g
Prix initial : 0.34 €
Remise carbone : - 0.03 €
Prix : 0.31 € (1.55 €/kg)
Concombres (l'unité) 500g
Prix initial : 1.33 €
Oranges (l'unité) 142g
Prix initial : 0.28 €
Pommes (l'unité) 150g
Prix initial : 0.25 €
Détails de votre panier
Total en cours 0.00 € / 25 €
Valider votre panier

Appendix T

Experiment 2: Traffic Lights Condition





Appendix U

Details Regarding the Sample in Experiment 2

Participants indicated doing rarely online grocery shopping on platforms similar to ours (*M* = 1.61, *SD* = 1.42). Concerning the revenue, 11.8% of the participants either did not respond or chose “I do not want to answer” as option. Majority of the participants (55.7%) indicated being in the 0-€499 revenue group, and 24.9% of them indicated being in the €500-€999 group. Moreover, more than half of them (58.4%) indicated human and social sciences as their field of activity or education; 16.4% of them language and letters; 7.1% art, music, audiovisual, and cinema; and 3.6% education teaching and training. The remainder of the participants indicated different disciplines. Concerning political opinion question, 63.7% of the participants preferred not to answer or chose “other” as option; and 19.8% of them indicated left-wing parties represent better their political opinions, 11.9% an environmental party, 1.7% central party, and 3.1% right-wing parties. Regarding their diet, 7.6% of participants expressed following a Halal diet and 0.8% a Kascher diet. 4.6% of the participants were lactose intolerant and 0.7% of them gluten intolerant. Moreover, while 2.5% of the participants indicated being vegan, 9.8% indicated being vegetarian and 19.9% being flexitarian.

Appendix V

Additional Analyses Regarding Experiment 2

We ran additional analyses by taking absolute CO2, CO2 per euro, mean percentage of green/orange/red products in baskets as dependent variables (see Table V11 for means in each experimental condition). To see whether TL and bonus-malus had an impact on absolute CO2 of shopping baskets, we ran a two-way ANOVA[36]. Results showed that the main effect of TL was significant ($F(1, 593) = 13.82$, $p < .001$, $\eta_p^2 = .02$). Participants in the TL condition ($M = 19.12$, $SD = 4$) had lower absolute carbon footprint compared to those in control TL condition ($M = 20.28$, $SD = 3.65$). However, the impact of bonus-malus ($F(4, 593) = 0.29$, $p = .89$, $\eta_p^2 = 0$) and its interaction with TL ($F(4, 593) = 1.96$, $p = .1$, $\eta_p^2 = .01$) were non-significant.

Moreover, we conducted a two-way ANOVA[37] by taking CO2/€ as the dependent variable and TL and bonus-malus as independent variables. Results showed a significant impact of TL ($F(1, 593) = 15.09$, $p < .001$, $\eta_p^2 = .03$). Participants in the TL condition ($M = 0.8$, $SD = 0.16$) had lower carbon footprint per euro than those in the control TL condition ($M = 0.84$, $SD = 0.15$). Nevertheless, the impact of bonus-malus was not significant ($F(4, 593) = .39$, $p = .82$, $\eta_p^2 = 0$). Similarly, the interaction of bonus-malus and TL was non-significant ($F(4, 593) = 1.7$, $p = .15$, $\eta_p^2 = .01$).

---

[36] Shapiro-Wilk test showed that the distribution of the residuals of the dependent variable was normal in each experimental condition (*p*s > .05) except one condition. In large bonus-malus with display & control TL condition, the distribution was not normal ($W(60) = .96$; $p < .05$), but the skewness was only moderate (.67) (cf. Bulmer, 1979). Therefore, although Levene's test was significant ($F(9, 593) = 2.95$, $p < .01$), since we had roughly equal participants in each experimental condition (≈ 60), we used two-way ANOVA for the analysis (cf. Field, 2009).

[37] According to the Shapiro-Wilk test, the residuals of CO2/€ had a normal distribution in each experimental group (*p*s > .05) except one. In large bonus-malus with display & control TL condition, the distribution was not normal ($W(60) = 0.96$, $p < .05$); however, the distribution was only moderately skewed (.68) (cf. Bulmer, 1979). Levene's test of homogeneity showed violation of the assumption of equal variances ($F(9, 593) = 2.19$, $p < .05$). Therefore, to verify for the assumption of homogeneity of variances, we also tested Hartley's F_{max} test since the sample size in sub-samples were roughly similar (≈ 60). Results verified the assumption of homogeneity of variances ($F_{max} = 2.16$, $p > .05$) (cf. Field, 2009).

Additionally, we conducted further analyses by taking the percentage of green products in baskets as the dependent variable and TL and bonus-malus as independent variables. We ran a two-way ANOVA[38] of which the results showed a significant impact of TL (F(1, 593) = 20.47, p < .001, η_p^2 = .03). Participants who were in the TL condition (M = 57.86, SD = 19.47) had a higher proportion of green products in their basket compared to those who were in control TL condition (M = 51.19, SD = 16.7). Nevertheless, the main effect of bonus-malus (F(4, 593) = 0.31, p = .87, η_p^2 = 0) and its interaction with TL (F(4, 593) = 0.87, p = .48, η_p^2 = .01) were non-significant. Moreover, we ran another two-way ANOVA[39] by taking the mean percentage of orange products in the shopping basket as dependent variable and TL and bonus-malus as independent variables. Results showed a significant impact of TL (F(1, 593) = 8.59, p < .01, η_p^2 = .01). Participants in the TL condition (M = 24.89, SD = 11.72) had lower portion of orange products compared to those who were in control TL (M = 27.61, SD = 11.24). However, either bonus-malus (F(4, 593) = 2.05, p = .09, η_p^2 = .01) or its interaction with TL (F(4, 593) = 0.34, p = .85, η_p^2 = 0) was significant. Lastly, we ran a two-way ANOVA[40] to see the impact of TL and bonus-malus on the mean percentage of red products in baskets. A significant impact of TL was detected (F(1, 593) = 14.13, p < .001, η_p^2 = .02). Participants in the TL condition (M = 17.24, SD = 13.2) had lower proportion of red products than those in control TL condition (M = 21.19, SD = 12.69). However, the impact of bonus-malus was not significant (F(4, 593) = 0.6, p = .66, η_p^2 = 0). Similarly, its interaction with TL was not significant (F(4, 593) = 1.57, p = .18, η_p^2 = .01).

[38] The results of Shapiro-Wilk test showed that the residuals were normally distributed in each experimental condition (*p*s > .05).
[39] The results of Shapiro-Wilk test showed that in some conditions, the distribution of residuals of the dependent variable was not normal (*p*s < .05). Nevertheless, we ran ANOVA for this analysis since it is a robust test to control for type 1 error against non-normality (cf. Blanca et al., 2017).
[40] Shapiro-Wilk test showed that the distribution of the residuals was not normal in some experimental conditions (*p*s < .05). Nonetheless, we ran ANOVA for this analysis, since it is a robust test to control for type 1 error against non-normality (cf. Blanca et al., 2017).

Table V11

*Mean percentage of green, orange, and red products in shopping baskets (Experiment 2)**

Cond. bonus-malus	Cond. TL	Mean percentage of green products	Mean percentage of orange products	Mean percentage of red products	*n*
Baseline	Control	50.9 (14.55)	25.5 (8.64)	23.6 (12.35)	61
	TL	61.09 (18.03)	23.41 (12.4)	15.5 (10.48)	59
BM M[a] without display	Control	52.65 (17.61)	26.11 (10.7)	21.25 (15.34)	62
	TL	57.16 (18.28)	24.63 (9.78)	18.21 (13.17)	61
BM M with display	Control	49.76 (17.1)	30.45 (12.15)	19.79 (11.26)	61
	TL	58.22 (21.14)	25.74 (13.01)	16.04 (14.48)	59
BM L[b] without display	Control	50.02 (16.98)	27.3 (12.32)	22.68 (10.65)	60
	TL	57.78 (19.75)	24.49 (11.67)	17.73 (13.89)	59
BM L with display	Control	52.61 (17.41)	28.76 (11.64)	18.63 (13.01)	60
	TL	55.19 (20.19)	26.15 (11.75)	18.65 (13.78)	61

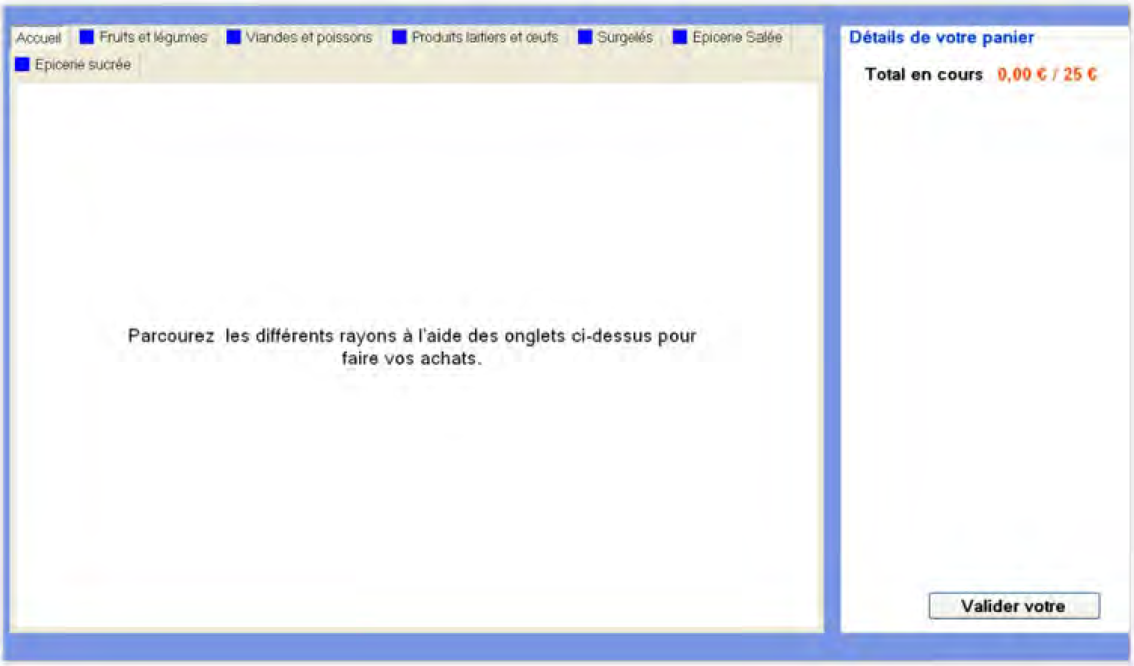
* Standard deviations are shown in parentheses.

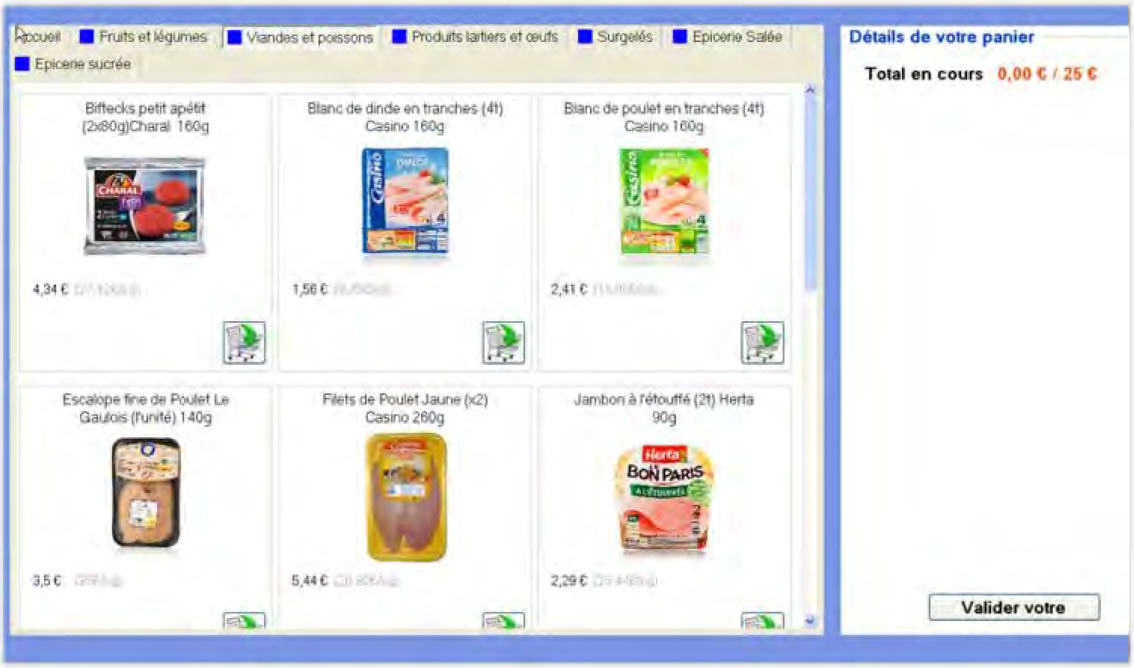
[a] Medium bonus-malus

[b] Large bonus-malus

Appendix W

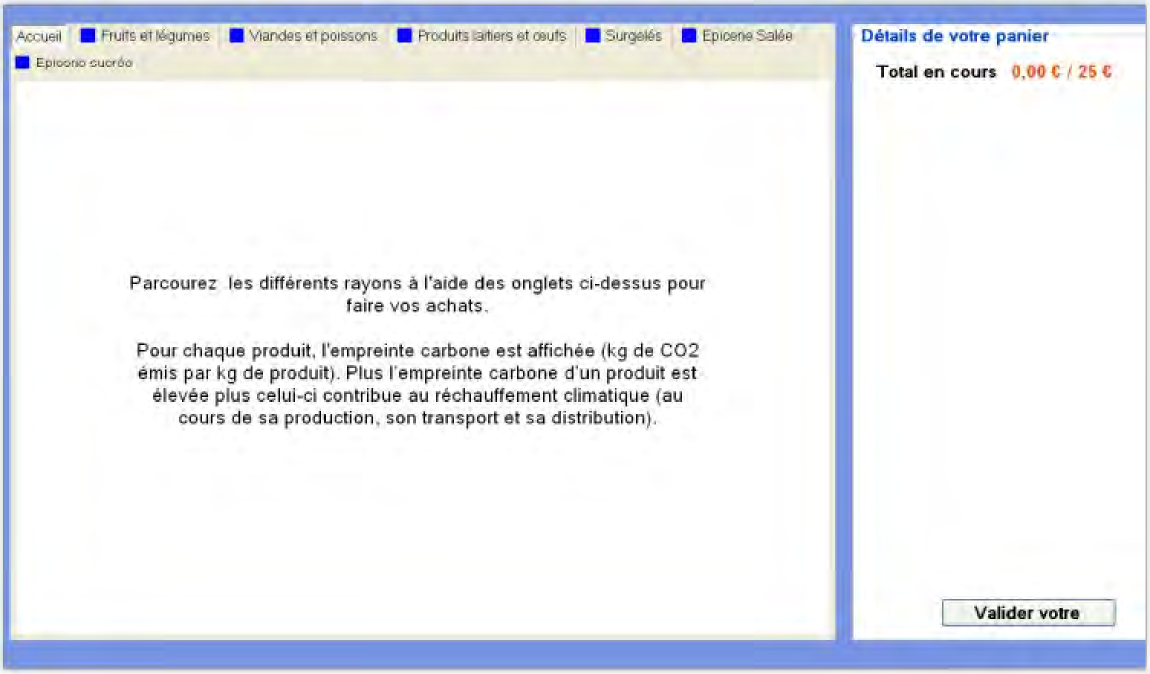
Control Condition

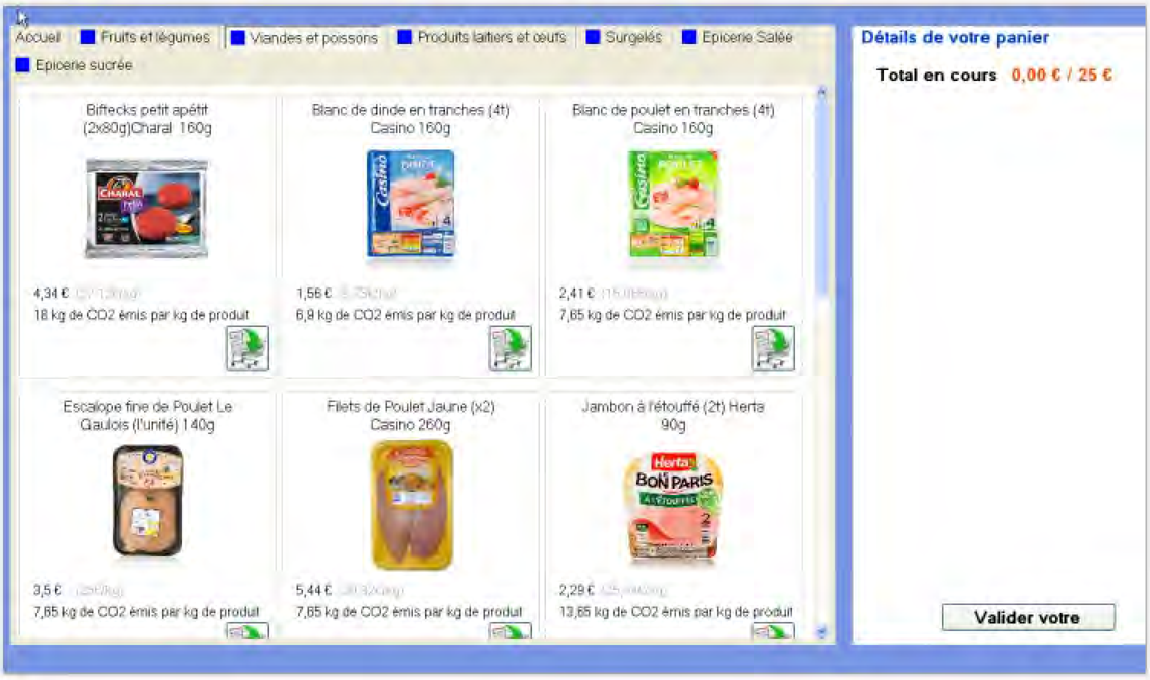




Appendix X

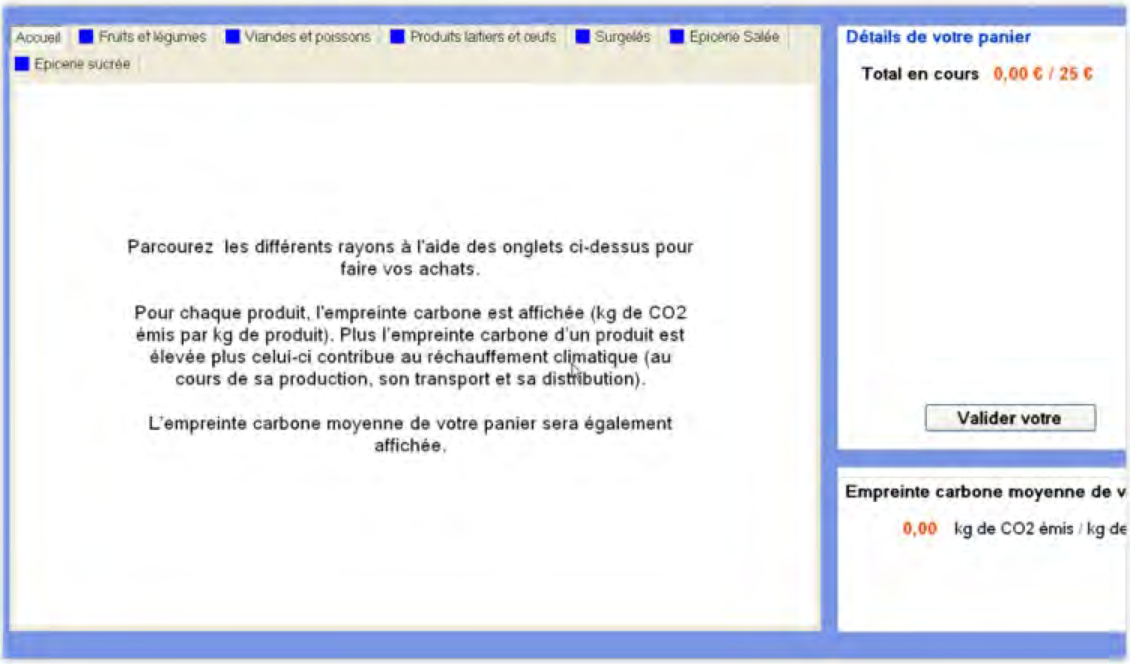
Product Numerical Footprint Condition

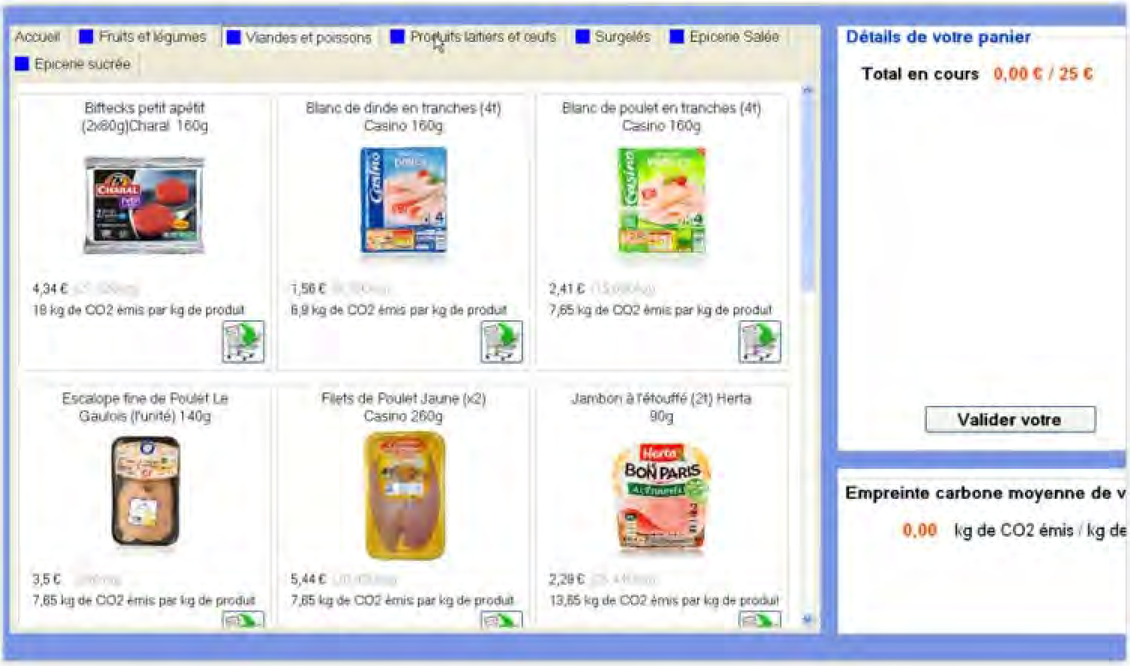




Appendix Y

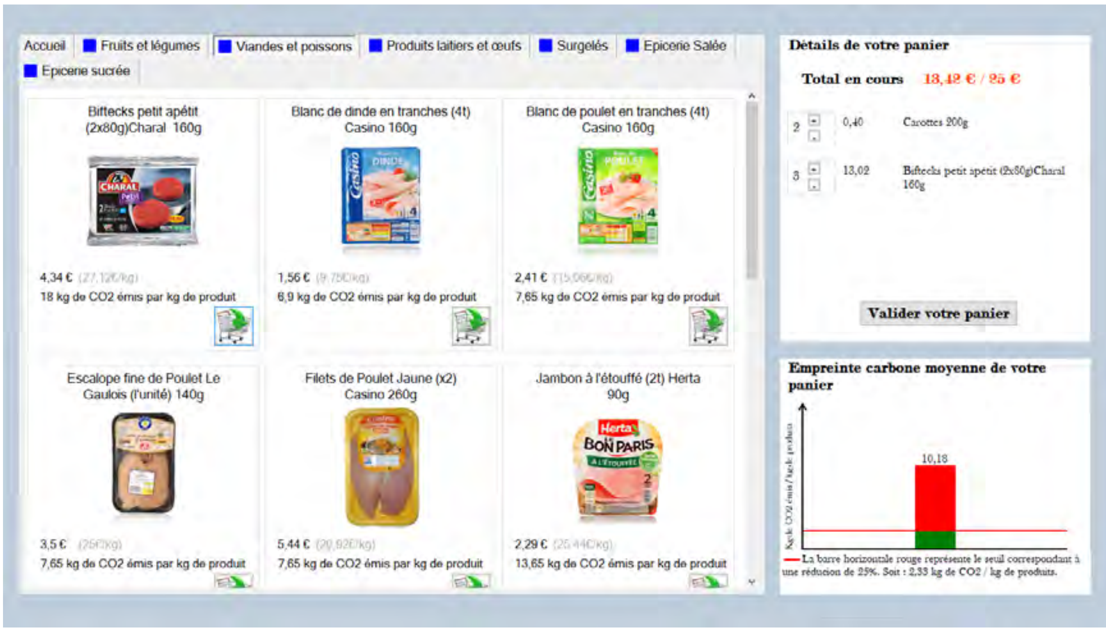
Numerical Product & Basket Footprint Condition





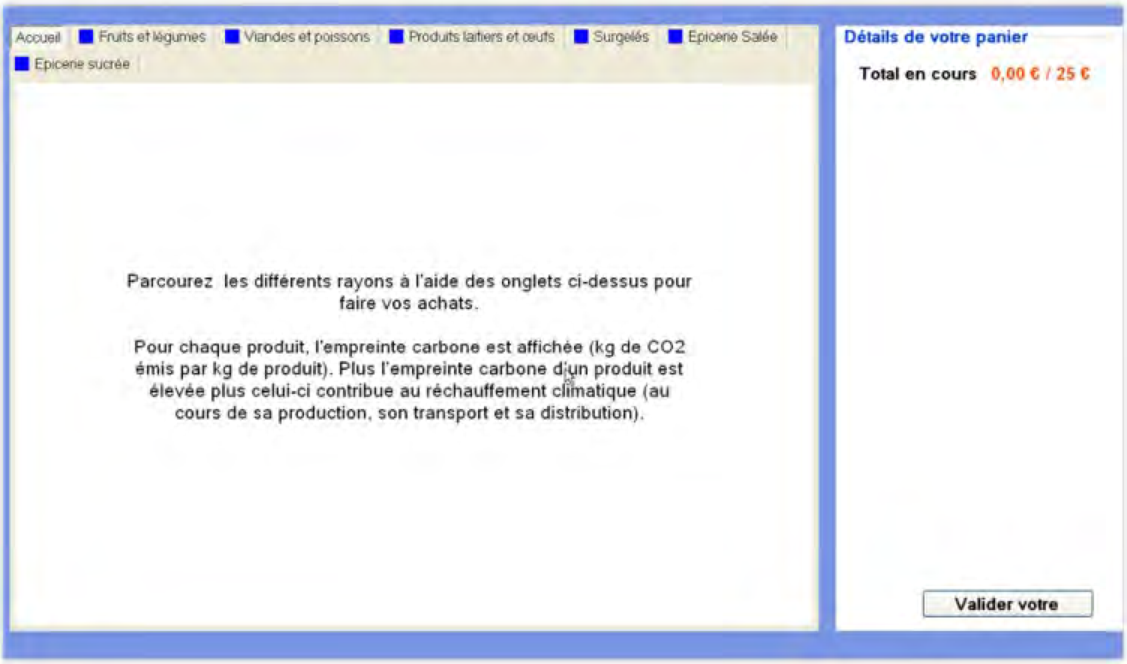
Appendix Z

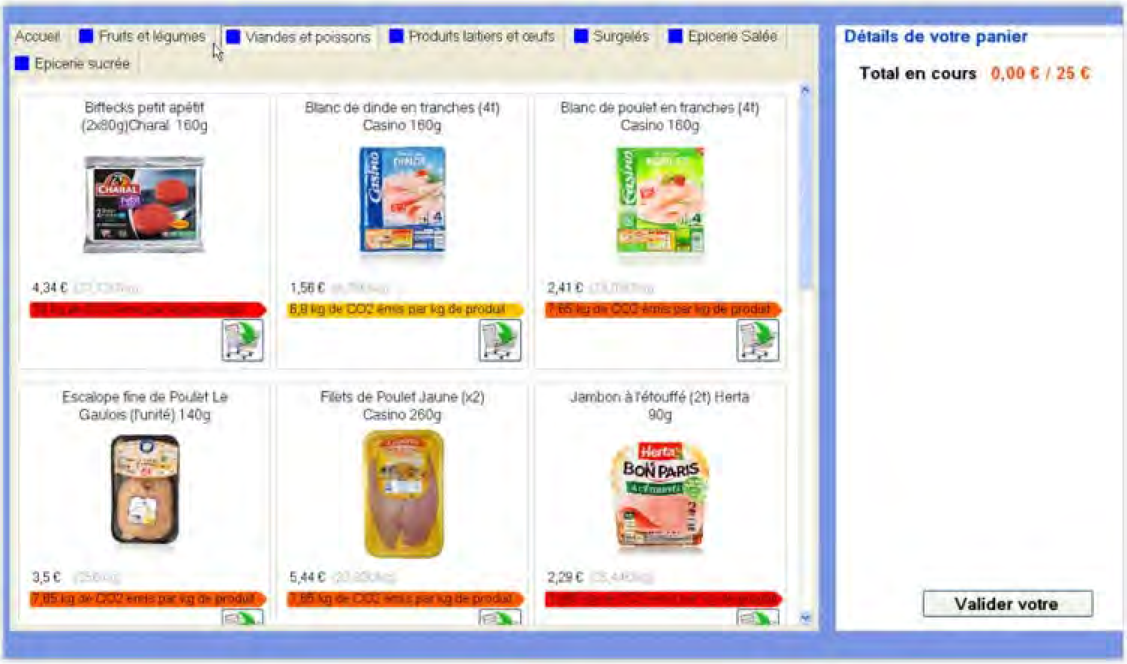
Graphical Thermometer Goal Setting Condition With Example of a Basket Exceeding Sustainable Threshold



Appendix AA

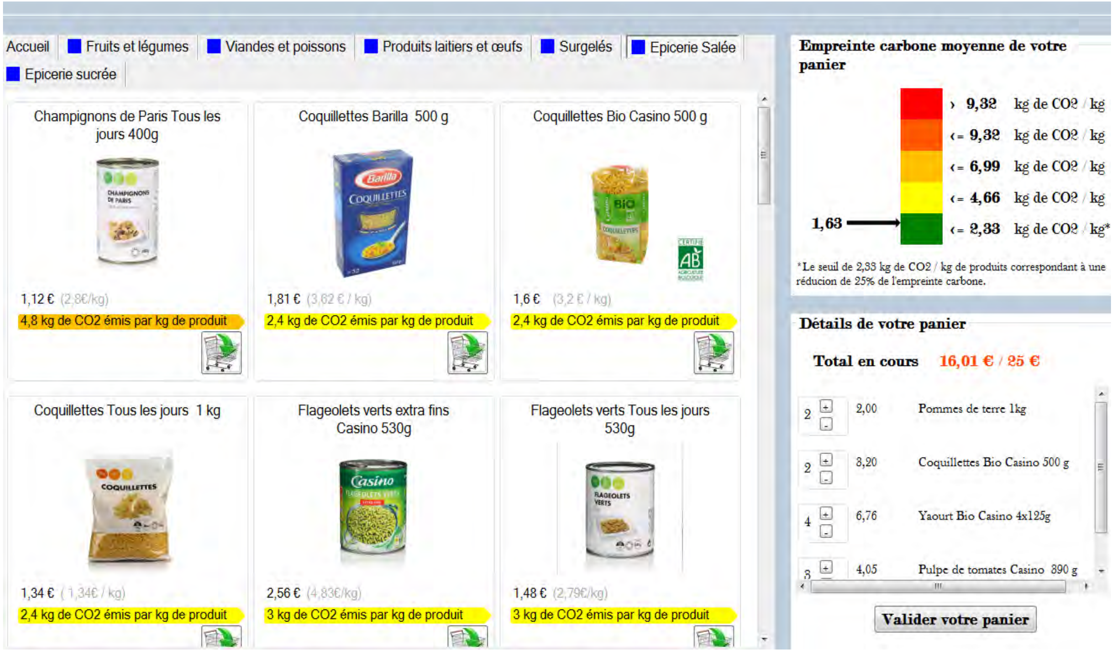
Colour Coded Product Numerical Footprint Condition





Appendix BB

Multi-Coloured Thermometer Goal Setting Condition With Example of a Shopping Basket Respecting the Sustainable Level



Appendix CC

Example of an Item in Carbon Footprint Knowledge Survey

Résumé Français de la Thèse/

French Summary of the Thesis

Encourager la consommation durable : évaluer l'efficacité des instruments économiques et psychologiques dans le contexte des courses en ligne

---

1. Introduction

Les émissions de gaz à effet de serres atrophiques qui ont augmenté entre 1970 et 2010, peuvent provoquer le changement climatique. Pour limiter le risque de changement climatique, il faut une réduction de ces émissions (IPCC, 2014). La consommation alimentaire contribue de manière importante aux émissions de gaz à effet de serre (Rogissart et al., 2019) et le changement du régime alimentaire peut générer une telle réduction (Poor & Nemeck, 2018).

Dans cette thèse, nous avons rédigé deux chapitres de revue. Le premier chapitre de revue est consacré aux mesures fiscales pour expliquer l’efficacité des taxes dans un contexte de consommation durable. Notre deuxième chapitre de revue est consacré à l’efficacité des étiquettes d’empreinte carbone dans un contexte de consommation durable.

L’objectif de cette thèse dans les deux premiers chapitres contenant nos études expérimentales est de tester l’efficacité des systèmes de fiscalité sur la consommation durable. Plus précisément, nous avons testé si une taxe carbone linéaire et une taxe bonus-malus peuvent diminuer l’empreinte carbone des paniers de courses sur un site expérimental de courses en ligne. Pourtant, nous n’avons pas analysé que l’effet de prix de ces instruments monétaires mais aussi l’effet psychologique de ceux-ci.

À part les instruments fiscaux, les instruments non-monétaires comme les étiquettes carbone et les normes injonctives peuvent aussi être efficaces dans un contexte de consommation durable. Nous avons examiné si ces instruments non-monétaires peuvent diminuer l’empreinte carbone des paniers dans la même plateforme de courses en ligne.

Finalement, le design de nos certaines expériences nous a permis de constater si ces variables interagissent.

Même si notre but principal est de constater l'efficacité de ces variables sur la consommation durable, nous avons également examiné si l'utilisation des étiquettes carbone à code couleur (tricolore), son interaction avec des normes injonctives et de l'affichage du montant de taxe sur une plateforme de courses en ligne peut améliorer la connaissance de l'empreinte carbone des produits.

Le but du troisième chapitre empirique de la thèse est de constater si l'utilisation des techniques de théorie de goal-setting (fixation de but) peut être efficace dans un contexte de consommation durable. Nous avons examiné si attribuer un but (une cible idéale d'empreinte carbone) et donner des feedbacks sur la performance par rapport à ce but peut réduire l'empreinte carbone des consommateurs dans un site de courses en ligne. Nous avons également comparé l'efficacité de ces techniques à celle des étiquettes carbone et la présentation de l'empreinte carbone du panier. Pareillement, notre deuxième but dans ce chapitre est de constater si cette technique peut améliorer la connaissance des consommateurs par rapport à l'empreinte carbone des produits.

Dans le reste de ce résumé, en premier lieu, nous expliquerons en détail nos chapitres de revues consacrés aux systèmes de fiscalité et aux étiquettes carbone. Ensuite, les chapitres consacrés à nos études empiriques seront expliqués. Dans la dernière partie, nous allons présenter une conclusion.

2. Chapitre: Revue sur les Mesures Fiscales

Dans cette revue, nous avons expliqué les différentes mesures fiscales et leur impact sur la consommation durable. Nous avons également analysé l'aspect psychologique des mesures fiscales. Pour cela, nous avons examiné les normes injonctives et la théorie de motivational crowding.

2.1. Les Instruments Axés sur le Marché

Les instruments axés sur le marché sont des instruments qui fournissent des incitations pour des firmes ou des individus pour qu'ils changent volontairement leur comportement. Ces instruments peuvent être utilisés pour des raisons environnementales (Perman et al., 2003). Un exemple pour ces instruments est la taxe carbone qui a le but d'internaliser les externalités provoquées par les activités humaines, liées au changement climatique (Metcalf & Weisbach, 2009). Cette taxe a été introduite dans des différents pays ou régions comme la Colombie-Britannique en 2008 (Murray & Rivers, 2015), la Finlande en 1990 (Lin & Li, 2011), ou la France depuis 2014 (Dussaux, 2020).

2.1.1. La Taxe Carbone Et Son Utilisation Dans La Consommation Alimentaire Durable

Les taxes peuvent être utilisées pour changer la consommation alimentaire. Par exemple, il y a des études qui ont analysé si les taxes peuvent rendre les choix alimentaires plus sains. Jensen et Smed (2013), Wang et al. (2012), et Fletcher et al. (2010) ont fait des études économétriques et ont trouvé que mettre une taxe aux produits alimentaires peut être efficace pour construire des régimes plus sains. De plus, Epstein et al. (2010) en menant une expérience de laboratoire, ont démontré que mettre une taxe sur les produits moins sains pouvait diminuer le choix des aliments moins sains et augmenter les choix sains. Vu le succès des taxes dans ce contexte, cela est important de les tester dans des contextes plus réalistes.

Les taxes peuvent être également utilisées dans le contexte de durabilité. Par exemple, les taxes carbone peuvent être utilisées pour diminuer l'émission carbone provoquée par l'alimentation. Edjabou et Smed (2013), Briggs et al. (2013), et Wirsenius et al. (2011) ont analysé comment la taxe carbone pouvait impacter l'empreinte carbone des produits alimentaires en faisant des études économétriques ou des études de scénario. Ils ont trouvé que la taxe carbone pouvait diminuer l'émission carbone; pourtant, comme les études d'alimentation saine, il est important de tester l'efficacité de taxe carbone dans des contextes plus réalistes, par exemple dans des expériences de laboratoire ou de terrain.

Une étude expérimentale qui a analysé l'impact d'une taxe carbone a été menée par Panzone et al. (2018). Ils ont montré que la taxe carbone peut diminuer l'empreinte carbone des paniers des participants sur un site de courses en ligne. Les futures études peuvent développer ces résultats en analysant l'aspect psychologique de taxe carbone pour pourvoir déterminer son impact d'une manière efficace.

2.1.2. L'utilisation de la Taxe Bonus-Malus pour des Raisons de Durabilité

Bonus-malus est un autre type de taxe environnementale (Pourquier & Vicard, 2016). D'Haultfœuille et al. (2014) explique que ceci est appliqué en mettant une taxe sur les voitures ayant des émissions carbone hautes pour internaliser les externalités et en mettant une subvention sur les voitures ayant une émission basse. Ce système peut être neutre en termes de recettes comme les revenus collectés par la taxe peuvent financer les subventions (D'Haultfœuille et al., 2011).

Une taxe bonus-malus a été appliquée sur les prix des voitures en France en 2008. Les prix des voitures ayant une émission moins de 130g de CO2 par km étaient subventionnés et ceux des voitures ayant une émission plus de 160g de CO2 par km étaient taxés (D'Haultfoeuille et al., 2011; D'Haultfoeuille et al., 2014). Au cours des années, le montant de la taxe et de la subvention était modifié pour que le système soit efficace (Monschauer & Kotin-Förster, 2018). Les émissions étaient réduites de 149g CO2/km à 112g CO2/km entre 2007 et 2019 (ADEME, n.d.).

L'utilisation d'un système de bonus-malus a été étudiée par des chercheurs dans le contexte de consommation alimentaire. Papoutsi et al. (2015) a mené une expérimentation des choix et trouvé que l'utilisation d'une subvention sur les produits sains et d'une taxe sur les produits malsains en même temps peut être utile pour choisir des produits sains et un message expliquant la raison de cette taxe et subvention peut encore renforcer cet impact. De même, Darmon et al. (2014) ont trouvé que l'utilisation simultanée d'une subvention et taxe peut être efficace pour choisir des aliments plus sains. Finalement, Galarraga et Markandya (2006) ont fait une proposition pour l'utilisation d'une taxe et subvention pour promouvoir la consommation des produits de thé et café du commerce équitable. Pourtant, le nombre des études qui ont analysé l'impact de taxe bonus-malus sur l'empreinte carbone des consommateurs (durant la consommation alimentaire) par des études expérimentales est limité.

À notre connaissance, il y a une étude qui a analysé l'impact de la taxe bonus-malus sur le comportement durable de courses en ligne dans une expérience. Panzone et al. (2021) ont analysé l'impact d'une taxe bonus-malus dans un magasin expérimental de course en ligne. Ils ont trouvé que cette taxe peut diminuer l'empreinte carbone des paniers. Les auteurs ont indiqué que la raison de la baisse de l'empreinte carbone était la diminution de la part du budget que les participants ont dépensé dans le magasin.

Pour conclure, les études montrent que l'utilisation de taxe carbone ou bonus-malus est efficace pour promouvoir les choix d'alimentaires sains. Cependant, le nombre des études qui examinent leur impact dans un contexte de course en ligne pour promouvoir la durabilité dans un cadre réaliste (c.-à-d., les expériences de laboratoire ou terrain) est limité. Les études futures peuvent faire des recherches sur ce sujet et analyser également l'aspect psychologique de ces mesures fiscales.

2.2. L'Aspect Psychologique des Mesures Fiscales

Pour pouvoir discuter de l'aspect psychologique des mesures fiscales, nous avons examiné comment l'économie comportementale a développé notre compréhension des mécanismes économiques. Tout d'abord, l'économie comportementale a montré que les modèles économiques ne présentent pas une représentation correcte de comportement des consommateurs dans la vraie vie. Au contraire de ces modèles, les individus ne sont pas toujours motivés par leurs propre intérêt, leurs préférences ne sont pas toujours consistantes et ils ne se comportent pas toujours d'une manière rationnelle (Congdon et al., 2009). Ils sont motivés également par des normes sociales et de l'équité (Carlsson & Johansson-Stenman, 2012). Ensuite, Simon (2000) a élaboré l'idée de rationalité limitée comme les individus ont des capacités limitées pour décider entre les besoins concurrents et élaborer les conséquences de leurs actes. De plus, ils ne choisissent pas toujours le choix optimal, par exemple, ils peuvent faire procrastination (Mullainathan & Thaler, 2000). Pour l'élaboration des politiques (efficace), comprendre ces déviations des modèles économiques standards peut être important. De même, l'économie comportementale affirme que les consommateurs peuvent ne pas réagir aux politiques de fiscalité comme les modèles économiques présument ; les facteurs psychologiques peuvent également y avoir un impact (Congdon et al., 2009).

2.2.1. La Saillance de Taxe

La saillance de taxe a été analysée par des chercheurs. À partir d'une expérience de terrain, Chetty et al. (2009) ont montré que les effets de saillance, définit comme de ne pas correctement percevoir la taxe (Congdon et al., 2009), existent quand le prix incluant le montant de taxe de vente n'est pas affiché sur l'étiquette du produit. Ils ont démontré que les consommateurs réagissent différemment quand le prix incluant le montant de la taxe de vente est affiché sur l'étiquette du produit et quand ce montant n'est pas affiché sur l'étiquette de produit mais imposé au registre. Ensuite, Goldin et Homonoff (2013) ont affirmé que les consommateurs de différents groupes de revenu réagissent différemment à la taxe de vente des cigarettes. Finkelstein (2009) a démontré que quand les individus payent le péage électroniquement, le taux de péage devient moins saillant en comparant à la situation où ils payent en liquide. Finalement, Zizzo et al. (2016) ont mené une étude montrant l'importance de l'affichage de taxe dans une plateforme de course en ligne.

2.2.2. L'Acceptabilité de Taxe

L'acceptabilité peut être un facteur extra-monétaire de la taxe qui peut avoir l'impact sur le comportement. Baranzini et Carattini (2017) ont affirmé qu'indiquer comment le revenu collecté par la taxe sera utilisé ou les mots qu'on utilise pour définir la taxe (ex., *taxe carbone* ou *contribution climatique*) peuvent influencer l'acceptabilité de taxe. De plus, Kallbekken et Sælen (2011) ont affirmé que la compréhension que la taxe aura des effets bénéfiques sur l'environnement et réduira les préoccupations concernant les impacts négatifs de l'allocation de taxe peuvent améliorer l'appui pour les taxes. Finalement, Douenne et Fabre (2020) ont affirmé que pour appuyer la taxe, les consommateurs doivent savoir l'incidence fiscale correcte.

2.2.3. Les Normes Injonctives Et l'Aspect Normatif des Mesures Fiscales

2.2.3.1. L'Impact des Normes Injonctives sur le Comportement Durable. Les normes sociales peuvent expliquer ce qui est fréquemment fait (les normes descriptives) et ce qui est approuvé/désapprouvé, ce que les gens doivent faire (les normes injonctives) (Cialdini et al., 1991). Cialdini et al. (1991) ont affirmé que les normes peuvent avoir un impact systématique et efficace sur les comportements. De plus, dès son activation, les normes injonctives sont plus susceptibles de générer un comportement socialement bénéfique en comparaison avec les normes descriptives et personnelles.

L'impact des normes sociales est testé sur des différents comportements socialement bénéfiques. Par exemple, Reno et al. (1993) ont mené trois expériences de terrain et ont trouvé que les normes descriptives et injonctives peuvent être efficaces pour diminuer le fait de jeter des déchets. De plus, ils ont trouvé que les normes injonctives peuvent être efficaces dans un environnement propre ou un environnement où il y a déjà des déchets. Finalement, ils ont démontré que soit rendre les normes injonctives saillant dans le même environnement où les participants peuvent jeter des déchets, soit dans un autre environnement, ils étaient toujours efficaces. Pour conclure, les auteurs ont montré que l'utilisation des normes injonctives est plus pratique et avantageuse que les normes descriptives.

Les normes sociales peuvent également promouvoir les comportements durables. Par exemple, Schultz et al. (2008) ont mené trois expériences de terrain dans un hôtel en mettant des messages normatifs sur la réutilisation des serviettes. Ils ont démontré qu'afficher des messages normatifs peut augmenter la réutilisation des serviettes. Ensuite, Schultz et al. (2007) ont testé l'efficacité des messages normatifs sur l'utilisation d'énergie résidentielle. Quand les foyers utilisant plus d'énergie que leurs voisins ont reçu un message de norme descriptive, ils ont réduit leur consommation. Mais, ceux qui utilisent moins d'énergie que leurs voisins ont augmenté leur consommation après avoir reçu le message de norme descriptive. Cependant, quand ces foyers ont reçu un message injonctif normatif avec message descriptif, ils ont maintenu leur consommation. De même, Dolan et Metcalfe (2015) ont montré que les normes peuvent diminuer la consommation d'énergie chez les foyers. Finalement, Corregé et al. (2018) ont montré qu'un message normatif injonctif peut être efficace pour que les participants fassent des choix pour réduire l'énergie d'un foyer dans une expérience de laboratoire.

Les normes injonctives peuvent être efficaces pour diminuer l'utilisation des sacs plastique dans un supermarché (De Groot et al., 2013) et diminuer le gaspillage du papier (Hamann et al., 2015). L'impact de ces normes est également testé pour changer le choix alimentaire, par exemple, pour promouvoir des régimes sains (Mollen et al., 2013).

Concernant l'impact des normes injonctives sur l'alimentation durable, Stancu et al. (2016) ont trouvé que les normes injonctives sont des déterminants d'intention de ne pas gaspiller des aliments. Finalement, Weir (2012) a montré que les normes sociales injonctives sont les prédicteurs des courses alimentaires écologiques.

2.2.3.2. L'Aspect Normatif des Mesures Fiscales. Les politiques de gouvernement comme les mesures financières peuvent être appliquées pour changer le comportement. Ces mesures peuvent avoir un impact sur les normes sociales ou personnelles à travers des divers mécanismes. Par exemple, les amandes peuvent exprimer l'importance du problème (sur lequel l'amende est appliquée). De ce fait, les mesures financières influencent les comportements au travers du changement des normes en indiquant quels actes sont considérés importants par la société (Kinzig et al., 2013).

L'impact extra-monétaire de l'instrument monétaire peut avoir un impact sur le comportement durable au-delà de son effet de prix (Thogersen, 2003). Tout d'abord, le système d'échanges de quota d'émission personnelle peut avoir un aspect normatif ce qui peut influencer le comportement. Raux et al. (2015) ont suggéré que ce système peut être utile pour promouvoir les choix de transport durable. Même s'ils n'ont pas testé l'effet normatif de ce système, les auteurs ont indiqué que l'aspect normatif de ce système peut instaurer des comportements pro-environnementaux. De plus, ce système mettrait un objectif carbone ce qui devrait être respecté et ce qui pourrait agir comme une norme sociale. Ensuite, Fawcett (2010) a exprimé que ce même système donnerait des nouvelles responsabilités aux individus et rendrait l'émission carbone des achats plus visibles. Finalement, Parag et Strickland (2009) ont indiqué que l'aspect psychologique et social des quotas personnels d'émission de carbone pourrait agir en augmentant la prise de conscience sur l'émission carbone des activités et sur le changement climatique. Pour conclure, ces suggestions doivent être testées par des expériences pour déterminer l'aspect extra-monétaire des mesures financières.

2.2.4. L'impact de L'utilisation des Instruments Non-Monétaires et Fiscaux sur le Comportement

2.2.4.1. L'impact des Récompenses Extrinsèques sur la Motivation Intrinsèque : Motivational Crowding Out. Pour comprendre l'impact de l'utilisation des mesures fiscales et les instruments non-monétaires en même temps, nous avons examiné la théorie de motivational crowding out. Pour cela, nous avons tout d'abord étudié la motivation intrinsèque.

La définition de motivation intrinsèque est de ne pas faire une activité pour recevoir une récompense, mais pour l'activité elle-même. Toutefois, pour une définition plus compréhensive, ses bases psychologiques doivent être comprises. Pour cela, Deci (1975) a étudié les théories qui expliquent la motivation humaine. Surtout, il a donné l'importance aux théories qui expliquent la compétence et l'autodétermination (ex., White, 1959), l'incongruité optimale (ex., Dember & Earl, 1957), la stimulation optimale (ex., Hebb, 1955) et la causalité personnelle (ex., deCharms, 1983). Ensuite, en tenant compte de ces théories, Deci (1975) a affirmé que les comportements stimulés par la motivation intrinsèque sont les comportements qui font sentir les individus autodéterminés et compétents. Il a aussi ajouté qu'il y a deux types de comportements qui sont motivés par la motivation intrinsèque : comporter pour la recherche de stimulation et comporter pour surmonter une situation stimulante/complexe ou diminuer l'incongruité pour se sentir compétent et autodéterminé.

Deci (1972) a expliqué l'impact des récompenses extrinsèques sur la motivation intrinsèque avec trois propositions. En premier lieu, recevoir des récompenses extrinsèques pour mener une activité peut changer la causalité perçue de l'intérieur à l'extérieur qui peut provoquer une diminution de motivation intrinsèque. En deuxième lieu, un changement dans le sentiment de compétence et d'autodétermination peut influencer la motivation intrinsèque. Finalement, quelle proposition aura lieu est dépendante à quel aspect de récompense est plus saillant : l'aspect contrôlant ou l'aspect informatif concernant la compétence et l'autodétermination de l'individu. Deci (1971, 1972) a conduit des études empiriques pour tester ces propositions.

2.2.4.2. Effets de Motivational Crowding. Frey (1992, 1993) a utilisé le terme *motivational crowding out* dans l'économie et Frey et Oberholzer-Gee (1997) ont indiqué qu'utiliser des instruments monétaires peut être inefficaces comme ils peuvent détruire la motivation intrinsèque. De plus, Frey a expliqué les conditions cognitives, selon lesquelles les récompenses monétaires peuvent réduire la motivation intrinsèque pour mener une activité. Par exemple, si l'agent sent que ses efforts sont appréciés et reconnus, recevoir une récompense extrinsèque peut renforcer l'engagement à une activité.

Concernant l'effet de cette théorie sur les comportements durables, les études sont menées. Par exemple, Perino et al. (2014) ont montré que quand un changement du prix d'un produit a été introduit comme une subvention, la motivation intrinsèque des participants pour acheter des produits durables était diminuée en comparaison avec une situation où ce changement a été expliqué par des raisons liées au marché. De plus, Hilton et al. (2014) a trouvé que l'application de la taxe bonus-malus peut diminuer la motivation intrinsèque si le montant de la subvention et la taxe est haute en comparaison avec une situation où leur montant est plus bas (avec les mêmes prix finaux).

En conclusion, dans cette revue, nous avons vu que les instruments fiscaux peuvent être efficaces sur les comportements durables et que les futures études peuvent tester leur impact pour rendre les comportements plus soucieux à l'environnement dans un contexte de courses en ligne. En outre, ces mesures peuvent avoir des aspects extra-monétaires qui peuvent également influencer le comportement.

3. Chapitre : Revue sur les Étiquettes Carbone

Dans cette revue, nous avons expliqué ce que la fourniture des informations voulait dire et comment les labels pouvaient avoir un impact sur les comportements. Après, nous avons analysé l’importance du format dans lequel l’information est donnée et nous avons fini par examiner les études expérimentales et les enquêtes qui ont étudié l’efficacité des étiquettes carbone dans le contexte de consommation durable.

3.1. La Fourniture des Informations et les Étiquettes

3.1.1. Fourniture Des Informations

Quand il y a des informations fausses ou limitées, la défaillance du marché liée à l’information apparaît, dans ces circonstances, les gouvernements peuvent intervenir aux marchés pour corriger ces défaillances. En corrigeant celles-ci, par exemple par la fourniture des informations, les individus peuvent faire des meilleures décisions en ayant des informations complètes et aussi la qualité des produits peut s’améliorer (Mazis et al., 1981). De plus, la fourniture des informations peut être importante pour changer le comportement économique comme Caswell and Mojduszka (1996) ont indiqué.

3.1.2. L’impact des Étiquettes sur les Comportements

Les étiquettes sont considérées comme des moyens appropriés pour la fourniture des informations (Vandenbergh et al., 2011); elles sont déjà utilisées pour transmettre des informations sur l’environnement et la santé (Teisl & Roe, 1998).

Pour comprendre comment les étiquettes peuvent communiquer des informations liées à l’environnement et comment cela peut aider les consommateurs à faire des meilleures décisions, on peut examiner les travaux de Nelson (1970) et Darby et Karni (1973). Les attributs de recherche sont des attributs qui peuvent être examinés avant l’achat, comme le prix ou la taille, par recherche. Les attributs d’expérience sont des attributs qui peuvent être évalués après l’achat et finalement, les attributs de confiance sont les attributs qui ne peuvent pas être examinés même après l’usage. Les attributs environnementaux sont des exemples pour les attributs de confiance (Moser et al., 2011). Le but d’une étiquette du produit est de transformer un attribut de confiance à celui de recherche pour que les consommateurs puissent comparer des différents produits et faire des choix informés (Cohen & Vandenbergh, 2012).

Les étiquettes peuvent également changer les comportements pour qu’ils soient plus bénéfiques en termes sociaux. Par exemple, Teisl et al. (2002) ont indiqué qu’avec l’utilisation des étiquettes, le coût de recherche d’informations peut diminuer et les étiquettes peuvent signaler l’importance de l’information environnementale. En outre, les étiquettes peuvent changer combien d’attributs les consommateurs prennent en considération et l’importance qu’ils y donnent.

3.1.2.1. L’impact des Étiquettes Carbone sur le Comportement. L’empreinte carbone affiche les émissions de gaz à effet de serre générées par une personne, un produit, ou une institution (Johnson, 2008) et l’étiquetage carbone a été créé pour susciter la réduction des émissions de gaz à effet de serre (Liu et al., 2016) qui peuvent provoquer le changement climatique. Comme les produits de courses contribuent de façon importante aux émissions carbone (Liu et al., 2016), l’utilisation des étiquettes carbone sur ces produits peut permettre une diminution d’empreinte carbone. Grâce à l’utilisation de ces étiquettes, les consommateurs peuvent prendre des décisions informées par apport à l’impact environnemental des produits et diminuer leur empreinte carbone (ex., Cohen & Vandenbergh, 2012).

Pour comprendre l’impact des étiquettes sur le comportement, on peut prendre une approche psychologique. Selon Ungemach et al. (2016) les *attributs traduits* (*translated attributes*) sont des caractéristiques distinctes d’un attribut. Ils peuvent activer les objectives des gens (ex., les objectifs environnementaux) et les guider vers les options qui peuvent leur aider à attendre ces objectives. Les étiquettes carbone peuvent être considérées comme un attribut traduit qui peut activer les objectifs environnementaux chez les individus et les aider à choisir les options qui sont en accord avec ces objectifs.

De plus, on peut également considérer la théorie de normative conduct (Cialdini et al., 1991) pour comprendre pourquoi les étiquettes carbone peuvent avoir un impact sur le comportement. La présence des étiquettes carbone peut rendre les préoccupations environnementales et les objectifs environnementaux plus saillants et communiquer une norme injonctive d'une manière implicite. Cela peut avoir un effet sur le comportement.

3.2. L'Importance du Format de Présentation de Fourniture des Informations

L'impact d'une information dépend du format dans lequel elle est transmise (Winett & Kagel, 1984). La même information transmise dans des différents formats peut impacter différemment le comportement (Magat et al., 1986). Par exemple, Russo et al. (1975) ont démontré que changer le format dans lequel le prix unitaire est présenté (présenter les prix dans les rayons vs. présenter les prix sur une liste commençant par le produit le moins cher jusqu'à produit le plus cher) a permis les consommateurs d'acheter des produits moins chers.

3.2.1. Le Format D'étiquetage Carbone

Bettman et al. (1986) ont affirmé des propositions concernant le format des étiquettes pour transmettre l'information sur les risques. Ces propositions peuvent être utiles pour le design des étiquettes carbone. Par exemple, ils ont affirmé que la capacité de traitement d'informations était limitée et que les informations présentées devaient être faciles à traiter pour être utilisées. Pour cela, les formats qui pouvaient faciliter ce traitement pouvaient être utilisés.

Selon Bettman et al. (1986), certains facteurs importants pour le design des étiquettes sont les suivants: l'information présentée doit être facilement localisée et comprise, les étiquettes doivent être dans un format qui permet de faire des comparaisons entre les produits. De plus, Golan et al. (2001) ont précisé que les informations affichées sur les étiquettes doivent être concises et claires.

3.2.2. Une Approche Cognitive: Comparaison des Étiquettes Numériques Et à Code Couleur

Il y a des différents types d'étiquettes carbone, comme l'étiquette carbone à code couleur (ex., Vanclay et al., 2011), l'étiquette numérique (ex., Perino et al., 2014), ou l'étiquette qui exprime l'émission carbone à partir de kilomètres conduits (Muller et al., 2019). Une question importante est que quel type d'étiquette est plus efficace pour changer la consommation.

Dans leur étude, en évaluant des groupes de discussions, Upham et al. (2011) ont affirmé que même si les participants étaient en faveur d'un étiquetage carbone, ils pouvaient ne pas comprendre les étiquettes carbone numériques, par exemple, un participant a indiqué qu'il ne connaissait pas l'impact de 260 g de carbone. Pourtant, les participants étaient en faveur d'un étiquetage simple à code couleur. De plus, Hartikainen et al. (2014) ont affirmé que les participants de leur groupe de discussions ont préféré un étiquetage qui permettait de faire des comparaisons entre les produits.

Comme Upham et al. (2011), Grunert et Wills (2007) ont indiqué que les consommateurs peuvent préférer les étiquettes nutritionnelles à code couleur et pareillement, Cecchini et Warin (2016) ont affirmé que les étiquettes nutritionnelles à code couleur peuvent être plus efficaces pour construire des régimes plus sains. On peut avoir une approche cognitive pour comprendre pourquoi les étiquettes à code couleur peuvent être plus efficaces.

Muller et Prevost (2016) ont fait une revue pour comprendre le mécanisme d'utilisation des étiquettes nutritionnelles. Depuis les recherches qui ont étudié les régions du cerveau, ils ont conclu qu'il faut plus d'énergie pour traiter (c.-à-d., comprendre) les étiquettes numériques ; par conséquent, cela peut être exigeant sur le plan cognitif. Pourtant, la perception de couleur exige moins d’efforts et du temps. Par exemple, Ozturk et al. (2013) ont démontré que les enfants qui avaient huit mois pouvaient percevoir les couleurs d’une manière catégorielle, en d’autres mots, la connaissance de vocabulaire n’est pas nécessaire pour la perception de couleur. De plus, Elliot et al. (2007) ont montré que l’exposition à la couleur rouge peut provoquer la motivation d’évitement. Pour conclure, le traitement d’informations à partir des couleurs peut être plus facile.

3.3. L’utilisation des Étiquettes Carbone pour la Consommation Durable

Il y a des études qui ont analysé l’efficacité des étiquettes carbone pour diminuer l’empreinte carbone des consommateurs. Par exemple, Hornibrook et al. (2015) ont examiné l’utilisation de l’étiquette Carbon Trust, une étiquette numérique, à partir des données des cartes de fidélité dans le supermarché Tesco au Royaume-Uni. Ils ont trouvé que ces étiquettes n’ont pas eu un effet sur les comportements des consommateurs et le groupe de discussion a affirmé que les participants avaient difficulté de comprendre l’information sur ces étiquettes. Pourtant, Perino et al. (2014) ont démontré que les consommateurs pouvaient choisir des produits avec une empreinte plus basse en utilisant l’étiquette Carbon Trust; mais cela peut réaliser, si le nombre des produits et le nombre des catégories de produits ne sont pas hauts. Pareillement, Apostolidis et McLeay (2019) ont montré que l’étiquette carbone de type Carbon Trust pouvait avoir un effet minimal sur les choix de viande hachées (avec une option sans viande) pour les végétariens et mangeurs de viande à partir d’une expérimentation des choix; mais, il faut noter que les produits étaient présentés d’une manière plus structurée aux participants ce qui pouvait avoir un impact sur le comportement. Comme Apostolidis et McLeay (2019), Grebitus et al. (2016) ont mené une expérimentation des choix et trouvé que les participants étaient moins susceptibles de choisir des produits avec une empreinte carbone haute (l’empreinte carbone était affichée en termes numériques). Finalement, à partir d’une quasi-expérimentation, Meyerding (2016) a montré que les participants préféreraient une étiquette carbone (numérique) moins que les autres attributs du produit comme origine ou prix.

Il y a aussi des études qui ont comparé les étiquettes carbone numériques et les étiquettes à code couleur. Premièrement, Thogersen et Nielsen (2016) ont montré que l'efficacité de l'étiquette Carbon Trust a été augmentée quand cette étiquette était modifiée pour représenter l'émission carbone à partir d'un code couleur en menant une expérimentation des choix. Pareillement, avec la même technique, Meyerding et al. (2019) ont démontré que les étiquettes carbone de type Carbon Trust coloré étaient plus efficaces que l'étiquette Carbon Trust. Finalement, en menant une expérimentation de terrain, Spaargaren et al. (2013) ont trouvé que l'efficacité des étiquettes numériques de type Carbon Trust pouvait être augmentée par un code couleur.

Il y a également des études qui ont analysé l'impact des étiquettes carbone à code couleur sur la consommation alimentaire durable. Tout d'abord, Osman et Thornton (2019), Feucht et Zander (2018) et Emberger-Klein et Menrad (2018) ont mené des expérimentations des choix en utilisant des étiquettes à code couleur. Osman et Thornton (2019) et Feucht et Zander (2018) ont démontré que les étiquettes à code couleur peuvent être efficaces sur les choix alimentaires. Pourtant, Emberger-Klein et Menrad ont trouvé que même si les participants préféraient d'avoir une étiquette carbone, celle-ci n'était pas très importante pour leur décision. Ensuite, Brunner et al. (2018), en menant une expérimentation de terrain ont trouvé que les étiquettes à code couleur pouvaient être efficaces pour choisir des plats avec une empreinte plus basse. Finalement, Vlaeminck et al. (2014), en menant une expérience de terrain contrôlée, ont indiqué que les participants peuvent choisir des produits avec moins d'émissions carbone en utilisant des étiquettes carbone à code couleur.

Il est aussi important d'étudier l'impact des étiquettes carbone à code couleur dans un contexte de courses alimentaires. Vanclay et al. (2011), dans un supermarché en Australie, a mené une expérience de terrain et a montré que les étiquettes carbone à code couleur peuvent être efficaces pour que les consommateurs choisissent des produits moins polluants. De plus, Muller et al. (2019) a montré que les étiquettes carbone à code couleur peuvent diminuer l'empreinte carbone des paniers de courses des consommateurs dans un magasin expérimental en menant une expérience de terrain contrôlée.

Pour conclure, nous avons vu que les étiquettes carbone peuvent être un bon moyen pour transmettre l'information d'impact environnemental des produits et que son format est important. Les étiquettes à code couleur peuvent être un instrument promettant pour réduire l'empreinte des consommateurs. Vu l'émission carbone importante des courses alimentaires, les futures études peuvent tester l'efficacité de ces étiquettes dans un ce contexte.

4. Chapitre : L'impacte des Taxes Carbone Dans le Contexte des Courses en Ligne

Le réchauffement climatique peut générer des externalités ce qui veut dire que les émissions de gaz à effet de serre peuvent avoir des impacts importants aux individus sans que le coût de ceux-ci soit couvert par l'émetteur. Afin de contrebalancer cela, selon l'approche pigouvienne, une taxe équivalente du coût social marginal du dommage devrait être impliquée à l'émetteur (Stern, 2006). La taxe carbone est l'un des instruments monétaires introduit pour diminuer les émissions de gaz à effet de serre, selon ce principe pigouvien.

Les études économétriques ont montré que la taxe carbone implantée en Colombie-Britannique était effective ; par exemple, elle a diminué la consommation résidentielle de gaz naturel (Xiang & Lawley, 2019). Pourtant, l'efficacité de cette taxe ne peut pas être expliquée seulement en ayant une approche économique, mais aussi psychologique. Par exemple, Rivers et Schaufele (2015) ont indiqué que l'impact de la taxe carbone appliquée en Colombie-Britannique était supérieur à ce qu'on aurait prévu par des analyses purement économétriques comme cette taxe a eu un impact plus grand qu'un changement de prix de même taux, mais exprimé différemment. Les autres facteurs peuvent contribuer à l'efficacité de cette taxe environnementale, comme la transmission d'un message injonctive à partir d'aspect environnemental de celle-ci. Du coup, des facteurs extra-monétaires, comme des facteurs psychologiques, peuvent contribuer à l'efficacité des instruments fiscaux.

La saillance de taxe est un autre élément qui peut avoir un impact sur les comportements des consommateurs. Par exemple, l'expérience que Chetty et al. (2009) a mené dans un supermarché en Californie du Nord a montré qu'afficher le prix incluant le montant de taxe de vente sur les étiquettes a eu un impact sur les comportements (ex., diminuer la demande pour ces produits). Du coup, afficher le prix incluant le montant de la taxe (de vente) sur l'étiquette des produits peut influencer les consommateurs.

À part les instruments fiscaux comme la taxe carbone, il y a d'autres instruments non-monétaires comme les normes injonctives ou les étiquettes carbone qui peuvent être utiles pour rendre les comportements des consommateurs plus soucieux à l'environnement. Pour ce qui concerne les normes injonctives, règles qui montrent ce qu'aient approuvé ou reprouvé (Cialdini et al., 1990), ils peuvent diminuer les vols des bois pétrifiés (Cialdini et al., 2006) ou promouvoir les choix hypothétiques d'un moyen de transport durable (Hilton et al., 2014). Ensuite, comme Muller et al. (2019) ont montré, les étiquettes carbone à code couleur peuvent diminuer l'empreinte carbone des paniers des courses sur un site expérimental.

Le but de ce chapitre est de ne pas qu'adopter une approche économique pour analyser l'impact d'une taxe carbone linéaire sur les comportements des consommateurs dans un site de courses en ligne expérimental, mais aussi d'avoir une approche psychologique. De ce fait, premièrement, nous avons testé l'effet prix de taxe carbone et après, nous avons testé si les normes injonctives peuvent augmenter l'impact de taxe carbone. Nous avons également examiné si les étiquettes carbone à code couleur, les normes injonctives et leur interaction peuvent diminuer l'empreinte carbone des consommateurs (dans l'expérience 2).

Pareillement, nous avons testé l'impact de la saillance de taxe carbone. En même temps, nous avons examiné si ces variables (c.-à-d., la saillance de taxe, les étiquettes carbone et son interaction avec les normes injonctives) pouvaient améliorer la connaissance des consommateurs par rapport à l'empreinte carbone des produits. Le comportement des consommateurs était opérationnalisé comme l'empreinte carbone des paniers de courses et les participants ont mené l'expérience sur un site de courses en ligne expérimental.

4.1. Première Expérience

Dans cette expérience, nous avons cinq conditions expérimentales. Dans la première condition, nous avons utilisé les prix de base pour les produits dans notre magasin. Dans le reste des conditions, tous les prix ont été augmentés par une taxe carbone linéaire (dont le taux était €80 par tonne de CO2). Alors que dans la deuxième condition, nous n'avons donné aucune information sur l'application de la taxe et présenté aucun message normatif, dans la troisième condition, nous avons indiqué qu'une taxe carbone a été implémentée et nous avons présenté un message injonctif normatif sur la première page du site. La quatrième condition est la même condition que la troisième condition sauf une différence; nous avons affiché, en même temps, le montant de la taxe attribuée à tous les produits dans le magasin avec leur prix initial. Dans la cinquième condition, nous avons affiché le montant de la taxe attribué aux produits ayant l'empreinte carbone la plus hausse (pour les autres produits ayant une empreinte carbone moyenne ou basse, seulement le prix final était présenté).

Nous avons testé les hypothèses suivantes. La première hypothèse est que les participants dans la première condition auront une empreinte carbone plus haute que ceux dans la deuxième condition (effet de prix). La deuxième hypothèse affirme que les participants dans la deuxième condition auront une empreinte carbone plus haute que ceux dans la troisième condition (effet psychologique de taxe carbone). La troisième hypothèse affirme que les participants dans la quatrième condition auront une empreinte carbone plus basse que les participants dans la troisième condition (3a, effet de saillance de taxe) et que les participants dans la cinquième condition auront une empreinte plus basse que ceux dans la troisième condition (3b, effet de taxe saillance). Finalement, les participants dans la quatrième condition auront un meilleur score de connaissance d’empreinte carbone que celui dans la troisième condition (3c) et les participants dans la cinquième condition auront un meilleur score de connaissance d’empreinte carbone que ceux dans la troisième condition (3d).

4.1.1. Méthode, Échantillon, Procédure

Dans le campus de l’Université Toulouse - Jean Jaurès, nous avons recruté 217 participants, mais notre échantillon était composé de 198 participants (dont 153 étaient des femmes) comme les données de 19 participants étaient perdues en raison d’un problème technique. Les participants étaient âgés de 18 à 60 (M = 21.63, SD = 4.79). Pour les analyses suivantes, nous avons éliminé un participant en raison d’avoir un niveau de français nettement moins que sa langue maternelle.

Concernant la procédure, les participants ont mené l’expérience dans une salle d’ordinateur en faisant leurs courses sur un de nos ordinateurs. Ils étaient informés qu’ils avaient une chance sur cinq de gagner leur panier et qu’ils avaient un budget de €25. Après avoir terminé leurs courses sur le site où il y avait 116 produits, ils ont rempli un questionnaire qui contient des items de Environmental Attitudes Inventory validé en français par Moussaoui et al. (2016), critères et habitudes concernant les achats alimentaires, fréquence de faire des courses en lignes et les questions sociodémographiques. Ils ont également rempli un questionnaire où ils ont évalué l’empreinte carbone de 36 produits de notre magasin pour que nous calculions un score de connaissance.

4.1.2 Résultats

Afin de déterminer si notre manipulation expérimentale a eu un impact significatif sur l'empreinte carbone des consommateurs, nous avons fait un test ANOVA un facteur à mesures indépendantes dont le résultat était significatif ($F(4, 192) = 2.79$, $p < .05$, $\eta_p^2 = .06$). Ensuite, pour tester nos hypothèses, nous avons mené des tests de comparaison post-hoc Gabriel. La seule différence significative était trouvée entre quatrième condition ($M = 3.02$, $SD = 0.87$) et la première condition ($M = 3.76$, $SD = 1.34$, $p < .05$) avec une taille d'effet moyen (Hedges' $g = -.65$). Comme il n'y avait pas de différence significative entre les autres conditions (ps > .05), nos hypothèses n'étaient pas validées.

Afin de déterminer si notre manipulation expérimentale a eu un effet significatif sur la connaissance d'empreinte carbone, pareillement, nous avons fait un test ANOVA un facteur à mesures indépendantes. Pourtant, le résultat n'était pas significatif ($F(4, 192) = 1.95$, $p = .1$, $\eta_p^2 = .04$); de ce fait, nos hypothèses n'étaient pas validées.

4.2. Deuxième Expérience

Notre but dans cette expérience est de modifier le design de la première expérience afin de tester l'effet indépendant de la taxe carbone (l'effet de prix et de la saillance de taxe), des normes injonctives et également l'effet des étiquettes carbone à code couleur, une nouvelle variable, sur l'empreinte carbone des consommateurs. Ce nouveau désigne nous permet aussi de déterminer s'il y a des interactions entre ces variables. Nous avons examiné l'effet de ces variables sur la connaissance d'empreinte carbone. De plus, nous avons utilisé un échantillon plus large pour avoir une puissance plus importante pour détecter des effets significatifs.

Pour tester nos hypothèses, nous avons utilisé la même plateforme de courses en ligne. De plus, dans cette expérience, nous avons utilisé un plan factoriel, plan à mesures indépendantes. Trois variables indépendantes ont été utilisées. Premièrement, la variable taxe carbone avait trois niveaux, les prix de base, la taxe carbone sans l'affichage du montant (c.-

à-d., sans saillance de taxe), la taxe carbone avec l'affichage du montant (avec la saillance de taxe). La taxe carbone a été calculée de la même manière que la première expérience. Deuxièmement, les étiquettes carbone à code couleur avait deux niveaux, la présence des étiquettes carbone à code couleur ou l'absence. Troisièmement, la norme injonctive avait deux niveaux, la présence d'une norme injonctive (un message) ou l'absence.

Nous avons testé les hypothèses suivantes. Première hypothèse affirme que les participants dans la condition taxe carbone sans l'affichage du montant auront une empreinte carbone plus basse que ceux dans la condition prix de base (c.-à-d., effet de prix). Quatrième hypothèse affirme que les normes injonctives réduiront l'empreinte carbone des paniers. Cinquième hypothèse affirme que les participants dans la condition taxe carbone avec l'affichage du montant auront une empreinte carbone plus basse que ceux dans la condition taxe carbone sans l'affichage du montant (5a, c.-à-d., effet de saillance de taxe) et que les participants dans la condition taxe carbone avec l'affichage du montant auront un meilleur score de connaissance d'empreinte carbone que ceux dans la condition taxe carbone sans l'affichage du montant (5b). Sixième hypothèse affirme que les étiquettes carbone à code couleur réduiront l'empreinte carbone des paniers (6a) et amélioreront la connaissance d'empreinte carbone (6c). Dernière hypothèse affirme qu'il y aura une interaction entre les étiquettes carbone à code couleur et les normes injonctives; les étiquettes carbone à code couleur auront un impact plus fort sur l'empreinte carbone des paniers dans la condition de présence des normes injonctives que son absence (6c) et les étiquettes carbone à code couleur auront un impact plus fort sur la connaissance dans la condition de présence des normes injonctives que son absence (6d).

4.2.1. Méthode, Échantillon, Procédure

Nous avons recruté 641 participants dans l'Université Toulouse - Jean Jaurès. Pourtant, l'échantillon était composé de 640 participants comme nous avons exclu les données d'un participant qui n'a pas complété l'expérience. Les participants étaient âgés de 16 à 43 (*M* = 20.35, *SD* = 3.26)[41] et 60% d'eux était des femmes. Pour les analyses suivantes, nous avons éliminé cinq participants qui ont indiqué avoir un niveau français nettement moins que leur langue maternelle.

Nous avons utilisé la même procédure que celle de la première expérience. Pareillement, nous avons utilisé une plateforme de courses en ligne similaire à celle qui était utilisée dans la première expérience.

4.2.2. Résultats

Pour tester nos hypothèses concernant l'empreinte carbone des paniers, nous avons fait un test ANOVA factorielle à mesures indépendantes avec nos trois variables indépendantes. Les résultats ont montré que l'effet de la taxe carbone n'est pas significatif ($F(2, 623) = 0.97$, $p = .38$, $\eta_p^2 = .00$), alors, la première hypothèse (l'effet de prix) et l'hypothèse 5a (l'effet de saillance de taxe) n'étaient pas confirmées. Pareillement, l'hypothèse 4 (l'effet de norme injonctive) n'était pas confirmée ($F(1, 623) = 0.8$, $p = .37$, $\eta_p^2 = .00$). L'hypothèse 6a (l'effet des étiquettes carbone) était confirmée ($F(1, 623) = 20.24$, $p < .001$, $\eta_p^2 = .03$). Finalement, il n'y avait pas d'interaction entre les étiquettes carbone et les normes injonctives ($F(1, 623) = 0.79$, $p = .38$, $\eta_p^2 = 0$), donc l'hypothèse 6b n'était pas confirmée.

Parmi les participants qui étaient dans la condition norme injonctive et qui ont indiqué que le message de norme était affiché a une empreinte carbone plus basse (*M* = 2.93, *SD* = 0.81) que ceux qui ont indiqué que le message n'était pas affiché ou qu'ils savaient pas si le message était affiché (*M* = 3.16, *SD* = 1.16; *t*(176.48*, corrigé pour inégalité des variances*) = -1.89, $p < .05$, Hedges' $g = -.24$, *unilatéral).*

[41] Nous avons exclu un participant qui a écrit "1999" comme age.

Pareillement, pour nos hypothèses concernant la connaissance d'empreinte carbone, nous avons mené un test ANOVA factorielle à mesures indépendantes. Les résultats ont montré qu'étiquettes carbone ($F(1, 623) = 192.80$, $p < .001$, $\eta_p^2 = .24$) ont amélioré la connaissance d'empreinte carbone, donc l'hypothèse 6c était validée; mais son interaction avec les normes injonctives n'était pas significative ($p > .05$), l'hypothèse 6d n'était pas supportée. De plus, l'hypothèse 5b (la saillance de taxe) n'était pas validé ($F(2, 623) = 0.31$, $p = .73$, $\eta_p^2 = .0$). On a aussi démontré que les normes injonctives ($F(1, 623) = 10.71$, $p < .01$, $\eta_p^2 = .02$) ont eu un effet significatif.

En outre, en utilisant la procédure de bootstraps via PROCESS (Model 4; Hayes, 2018 ; Preacher & Hayes, 2004), nous avons démontré qu'il y avait un effet de médiation entre les étiquettes carbone et l'empreinte carbone des paniers par la connaissance d'empreinte carbone, 95 % CI [-.18, -.03].

4.3. Discussion

La première expérience a démontré que combiner la taxe carbone, la saillance de taxe, et un message normatif peut diminuer l'empreinte carbone des paniers, mais l'effet individuel de chaque variable n'était pas significatif. De plus, la saillance de taxe, le prix, et le message normatif n'ont pas amélioré la connaissance d'empreinte carbone. Dans la deuxième expérience, la taxe carbone n'a pas réduit l'empreinte carbone des paniers et n'a pas amélioré la connaissance. Pendant que l'effet des normes injonctives n'était pas significatif, les participants qui ont indiqué que le message normatif était affiché dans le magasin ont eu moins d'empreinte carbone que ceux qui ne l'ont pas indiqué. En conséquence, cela peut être important de rendre les messages normatifs saillants pour avoir un impact. Ensuite, les étiquettes carbone à code couleur ont diminué l'empreinte carbone des paniers et amélioré la connaissance. En outre, nous avons montré que la connaissance d'empreinte carbone était une variable médiatrice de la relation entre les étiquettes carbone et l'empreinte carbone des paniers. Les normes injonctives ont également amélioré la connaissance.

Nos résultats peuvent avoir des contributions importantes. Les étiquettes carbone à code couleurs peuvent être utilisées pour diminuer l'empreinte carbone des consommateurs en améliorant leur connaissance. En outre, les messages normatifs doivent attirer l'attention des consommateurs pour avoir un impact sur l'empreinte.

Nos études ont des limites. L'utilisation du budget de l'expérimentateur et la faible probabilité de gagner son panier peuvent avoir un impact sur le comportement. De plus, notre échantillon ne peut pas être représentatif de la population en France et assez large pour déterminer les interactions. Les études futures peuvent tester l'efficacité des différentes mesures fiscales, différents taux de taxes, différentes mesures non-monétaires avec un échantillon plus large, et plus représentatif. Finalement, nos manipulations peuvent être examinées dans un contexte plus réaliste comme dans des expériences de terrain.

5. Chapitre : L'effet du Bonus-Malus Dans le Contexte des Courses en Ligne

En France, un bonus-malus a été introduit en 2007 pour augmenter la proportion des véhicules qui ont de moindre émission carbone (Pourquier & Vicard, 2016). d'Haultfoeuille et al. (2014) ont analysé l'impact de ce bonus-malus en faisant une analyse économétrique. Selon ce système, un bonus a été appliqué sur les prix des véhicules ayant moins d'émission carbone et un malus a été appliqué sur les prix des véhicules ayant plus d'émission. Ils ont trouvé que l'achat des véhicules durables a augmenté considérablement ce qui n'était pas prévu. De ce fait, les analyses économétriques ne peuvent pas suffire pour expliquer cet effet. Pareillement, d'Haultfoeuille et al. (2011) ont indiqué qu'au lieu d'être un système budgétairement neutre, en 2008, cette mesure a coûté 225 millions d'euros. Les consommateurs ont réagi différemment que prévus, en d'autres mots, l'impact de bonus-malus était supérieur à un simple effet de prix. Pour conclure, le bonus-malus peut avoir un effet extra-monétaire au-delà de son effet prix.

5.1. Le Bonus-Malus Dans Le Contexte De Durabilité

D'Haultfoeuille et al. (2013) ont analysé l'efficacité des étiquettes énergie à code couleur et le système de bonus-malus qui ont été introduits en France pour diminuer les émissions de CO_2 des véhicules. Ils ont montré que ces politiques ont diminué les émissions dont 20% étaient attribuées aux changements des préférences vers les véhicules durables.

Il y a des études qui ont étudié l'effet psychologique de bonus-malus par la méthode expérimentale. Par exemple Hilton et al. (2014) ont démontré que la taxe bonus-malus peut avoir un effet prix et également un effet psychologique sur les choix hypothétiques de transport. Pareillement, Raux et al. (2020) ont conduit une expérience en ayant une approche psychologique à la taxe bonus-malus. Cependant, ils n'ont pas trouvé un effet significatif de présenter le changement de prix comme bonus-malus sur les choix hypothétiques de transport.

Les taxes de type bonus-malus ont été testées pour voir si elles sont efficaces pour changer les comportements alimentaires. Premièrement, par les méthodes expérimentales, Papoutsi et al. (2015) et Darmon et al. (2014) ont démontré qu'une taxe sur des aliments moins sains et une subvention sur les aliments plus sains peuvent avoir un effet significatif sur les choix alimentaires. En outre, par des études économétriques et de scénarios, Jensen et Smed (2007) et Nnoaham et al. (2009) ont trouvé les résultats significatifs du système bonus-malus. Finalement, avec une étude économétrique Abadie et al. (2016) a démontré que bonus-malus peut être utile pour réduire les émissions carbone des choix alimentaires.

À notre connaissance, il y a une étude qui a testé l'efficacité de la taxe bonus-malus sur le choix alimentaire dans un site de courses en ligne pour réduire l'empreinte carbone des consommateurs. Panzone et al. (2021) ont démontré que l'implémentation d'une taxe bonus-malus peut réduire l'empreinte carbone des paniers des courses comme les participants ont également réduit leur dépense le magasin en ligne.

5.2. L'aspect Psychologique de Bonus-Malus

L'effet de saillance de taxe a été testé par Chetty et al. (2009). La saillance de taxe peut avoir un effet sur les comportements des consommateurs, ils peuvent changer leur comportement quand le prix incluant le montant de taxe (de vente) est affiché sur l'étiquette du produit et quand celui-ci n'est pas affiché sur l'étiquette du produit et la taxe de vente est imposée au registre.

Les normes injonctives peuvent promouvoir la consommation durable. Par exemple, Hilton et al. (2014) ont montré que les normes injonctives peuvent être utiles pour que les consommateurs choisissent un moyen de transport durable. En outre, De Groot et al. (2013) a démontré que les normes injonctives peuvent diminuer l'utilisation des sacs plastiques.

Concernant les instruments économiques, Schwartz et al. (2019) ont affirmé qu'à part de leur effet prix, ces instruments ont un effet non-monétaire dans le contexte de consommation durable. Par exemple, l'application d'une taxe carbone peut informer les gens sur l'importance des émissions carbone. De même, Green (2006) a affirmé que les taxes peuvent avoir un impact sur les normes.

5.3. Première Expérience

Notre but est de tester l'effet de prix et l'effet psychologique du bonus-malus sur les comportements des consommateurs, plus précisément, sur l'empreinte carbone des paniers des consommateurs dans un site expérimental de courses en ligne. En outre, nous avons examiné si un message normatif peut réduire l'empreinte carbone des consommateurs. Nous avons également testé si la saillance de taxe peut améliorer la connaissance d'empreinte carbone des produits.

Il y avait huit conditions expérimentales dans cette expérience avec une variable indépendante (voir Tableau 12 pour l'explication des conditions expérimentales). Dans les conditions de bonus-malus, les prix des produits ayant une empreinte moins que celle du produit médian ont reçu un bonus (soit 5.5 % ou 15 % sur les prix de base) et les prix des produits ayant une empreinte plus haute que celle du médiane ont reçu un malus (soit 5.5 % ou 15 % sur les prix de base).

Tableau 12

L'explication des Conditions Expérimentales

Les conditions	Prix	Saillance de taxe	Message justifiant l'application de bonus-malus
1	Les prix de base sont utilisés.		
2	Un bonus-malus est appliqué sur les prix des produits avec un taux intermédiaire.		
3	Un bonus-malus est appliqué sur les prix des produits avec un taux important.		
4	Les prix de base sont utilisés.		Uniquement, un message concernant les émissions des courses est présenté. Aucun message sur le bonus-malus n'est donné.
5	Un bonus-malus est appliqué sur les prix des produits avec un taux intermédiaire.		Un message justifiant l'application d'un bonus-malus est présenté aux participants.
6	Un bonus-malus est appliqué sur les prix des produits avec un taux intermédiaire.	Les montants de bonus et malus attribués aux produits sont affichés.	Un message justifiant l'application d'un bonus-malus est présenté aux participants.
7	Un bonus-malus est appliqué sur les prix des produits avec un taux important.		Un message justifiant l'application d'un bonus-malus est présenté aux participants.
8	Un bonus-malus est appliqué sur les prix des produits avec un taux important.	Les montants de bonus et malus attribués aux produits sont affichés.	Un message justifiant l'application d'un bonus-malus est présenté aux participants.

Nous avons testé les hypothèses suivantes : les participants dans la condition 1 auront plus d'empreinte carbone que ceux dans la condition 2 (hyp[42]. 1a, l'effet de prix) et condition 3. (hyp. 1b, l'effet de prix). Les participants dans la condition 6 auront moins d'empreinte carbone que ceux dans la condition 5 (hyp. 2a, l'effet de saillance de taxe sur la consommation durable) et les participants dans la condition 8 aurons moins d'empreinte

[42] L'hypothèse

carbone que ceux dans la condition 7 (hyp. 2b, l'effet de saillance de taxe sur la consommation durable). Les participants dans la condition 6 auront une meilleure connaissance que ceux dans la condition 5 (hyp. 2c, l'effet de saillance de taxe sur la connaissance d'empreinte carbone des produits) et les participants dans la condition 8 auront une meilleure connaissance que ceux dans la condition 7 (hyp. 2d, l'effet de saillance de taxe sur la connaissance d'empreinte carbone des produits). Les participants dans la condition 5 auront moins d'empreinte carbone que ceux dans la condition 2 (hyp. 3a, l'effet psychologique du bonus-malus sur la consommation durable) et les participants dans la condition 7 auront moins d'empreinte carbone que ceux dans la condition 3 (hyp. 3b, l'effet psychologique du bonus-malus sur la consommation durable). Finalement, les participants dans la condition 4 auront moins d'empreinte carbone que ceux dans la condition 1 (hyp. 4, l'effet de norme injonctive sur la consommation durable).

5.3.1. Méthode, Participants, Procédure

À Toulouse School of Economics, nous avons recruté 196 participants âgé de 17 à 37 (*M* = 20.58, *SD* = 3.01). L'échantillon était composé de 119 femmes et 77 hommes. Pour les analyses suivantes, trois participants qui ont indiqué qu'ils parlent français nettement moins que leur langue maternelle étaient exclus.

Les participants ont mené l'expérience dans un laboratoire d'ordinateur sur un ordinateur. Leur budget était €25 et ils avaient une chance sur cinq de gagner leur panier de courses. Ils ont commencé en faisant leurs courses sur notre site et après rempli un questionnaire. Ils ont commencé par remplir Environmental Attitude Inventory, validé en français par Moussaoui et al. (2016), ensuite, les items sur les critères et habitudes d'achat, la familiarité avec les courses en ligne et les sociodémographiques. Ils ont aussi accompli un questionnaire en évaluant l'empreinte carbone de 36 produits.

5.3.2. Résultats

Pour tester nos hypothèses concernant l'empreinte carbone des paniers, nous avons fait un test ANOVA un facteur à mesures indépendantes dont le résultat n'était pas significatif (F(7, 185) = 0.39, p = .91, η_p^2 = .02). De ce fait, notre manipulation expérimentale n'a pas eu d'effet sur l'empreinte carbone des paniers ; donc, les hypothèses, 1a, 1b, 2a, 2b, 3a, 3b, et 4 n'étaient pas validées.

Pour tester nos hypothèses concernant la connaissance d'empreinte carbone, nous avons mené un test ANOVA un facteur à mesures indépendantes dont le résultat était significatif (F(7, 185) = 2.12, p < .05, η_p^2 = .07). Ensuite, le test post-hoc Gabriel a montré que les hypothèses 2c et 2d n'étaient pas validées (ps > .05). Cependant, quand nous avons fait une analyse en prenant compte que les conditions de bonus-malus, nous avons trouvé un effet significatif de saillance de sur la connaissance (F(2, 146) = 5.02, p < .01, η_p^2 = .06). De ce fait, nous avons montré que la saillance de taxe avec un texte normatif justifiant son application peut améliorer la connaissance.

5.4. Deuxième Expérience

Vu le succès des étiquettes carbone à code couleur pour promouvoir la consommation durable (ex., Muller et al., 2019 ; Vanclay et al., 2011), nous avons testé leur impact dans une deuxième expérience. Pareillement, nous avons testé l'effet prix et psychologique du bonus-malus sur l'empreinte carbone des paniers dans un site expérimental de courses en ligne. Nous avons testé aussi l'impact de ces variables sur la connaissance d'empreinte carbone.

Nous avons utilisé un plan factoriel 5 x 2. La variable bonus-malus avait cinq niveaux (voir le Tableau 13 pour les détails de la variable). Dans les conditions de bonus-malus, les produits avec une émission haute ont reçu un malus, ceux avec une émission basse un bonus et ceux avec une émission moyenne n'ont pas changé. La variable étiquette carbone à code couleur avait deux niveaux (la présence des étiquettes carbone ou l'absence).

Tableau 13

Les Détails de la Variable Bonus-Malus

Conditions	Taux du malus (taxe)	Taux du bonus	Affichage du montant de bonus-malus et son justification	Utilisation des prix de base
1				Les prix de base sont utilisés pour les produits.
2	€80 par tonne de CO2	7.63 % de réduction sur les prix de base	Les montants de bonus et malus ne sont pas affichés, aucun message justifiant son application n'est présenté.	Les produits avec une émission moyenne
3	€80 par tonne de CO2	7.63 % de réduction sur les prix de base	Les montants de bonus-malus sont affichés, l'application est justifiée par un message.	Les produits avec une émission moyenne
4	€250 par tonne de CO2	23.8 % de réduction sur les prix de base	Les montants de bonus et malus ne sont pas affichés, aucun message justifiant son application n'est présenté.	Les produits avec une émission moyenne
5	€250 par tonne de CO2	23.8 % de réduction sur les prix de base	Les montant de bonus-malus sont affichés, l'application est justifiée par un message.	Les produits avec une émission moyenne

Nous avons testé les hypothèses suivantes : les participants dans la condition 1 auront plus d'empreinte carbone que les participants dans la condition 2 (hyp. 5a, l'effet prix) et 4 (hyp. 5b, l'effet prix). Les participants dans la condition 3 auront moins d'empreinte carbone que ceux dans la condition 2 (hyp. 6a, l'effet de saillance de taxe sur la consommation durable) et les participants dans la condition 5 auront moins d'empreinte carbone que ceux dans la condition 4 (hyp. 6b, l'effet de saillance de taxe sur la consommation durable). Les participants dans la condition 3 auront une meilleure connaissance d'empreinte carbone que ceux dans la condition 2 (hyp. 6c, l'effet de saillance de taxe sur la connaissance) et les participants dans la condition 5 auront une meilleure condition que ceux dans la condition 4 (6d, l'effet de saillance de taxe sur la connaissance). Finalement, les étiquettes à code couleur réduiront l'empreinte carbone des paniers (hyp. 7a) et amélioreront la connaissance d'empreinte carbone (hyp. 7b).

5.4.1. Méthode, Participants, Procédure

Dans l'Université Toulouse – Jean Jaurès, nous avons recruté 616 participants, mais en raison d'un problème technique, nous avons exclu les données d'un participant (615 participants). 68.3% de l'échantillon était composé des femmes et les participants étaient âgés de 17 à 45 (M = 20.91, SD = 3.35). Nous avons éliminé 12 participants pour les analyses suivantes en raison d'avoir un niveau français nettement moins que la langue maternelle. Nous avons utilisé la même procédure que la première expérience.

5.4.2. Résultats

Pour tester nos hypothèses concernant l'empreinte carbone des paniers, nous avons mené un ANOVA factorielle à mesures indépendantes avec les deux variables indépendantes. L'effet des étiquettes carbone sur l'empreinte carbone était significatif et les moyennes des conditions était de direction prévue (M = 3.15, SD = 1.01 vs. M = 2.84, SD = 1) validant l'hypothèse 7a ($F(1, 593) = 14.07$, $p < .001$, $\eta_p^2 = .02$). Toutefois, l'effet de bonus-malus n'était pas significatif ($F(4, 593) = 0.19$, $p = .94$, $\eta_p^2 = 0$), en conséquence les hypothèses 5a, 5b, 6a, 6b n'étaient pas confirmées. L'interaction de ces deux variables n'était pas significative ($p > .05$).

Pour tester nos hypothèses concernant la connaissance d'empreinte carbone, nous avons mené une ANOVA factorielle à mesures indépendantes avec les deux variables indépendantes. L'effet des étiquettes carbone sur la connaissance d'empreinte carbone était significatif et les moyennes des conditions étaient de direction prévue (M = .56, SD = .16 vs. M = .41, SD = .16) validant l'hypothèse 7b ($F(1, 593) = 134.81$, $p < .001$, $\eta_p^2 = .19$). De plus, l'effet de bonus-malus sur la connaissance d'empreinte carbone était significatif ($F(4, 593) = 3.01$, $p < .05$, $\eta_p^2 = .02$). Le test post-hoc Gabriel a montré que les hypothèses 6c et 6d n'étaient pas validées (ps > .05). Cependant, il y avait une différence significative entre la condition 5 (M = .52, SD = .16) et condition 2 (M = .46, SD = .18, $p < .05$, Hedges' g = .35).

En outre, nous avons trouvé un effet significatif de la saillance de taxe avec un texte justificatif de la taxe sur la connaissance quand nous avons fait une analyse en créant un nouveau facteur de saillance de taxe et un nouveau facteur de taux de bonus-malus et avec aussi TL ($F(1, 475) = 10.01$, $p < .01$, $\eta_p^2 = .02$). Finalement, nous avons démontré que la connaissance est une variable médiatrice de la relation entre les étiquettes carbone et l'empreinte carbone du paniers en utilisant la procédure de bootstraps via PROCESS, 95 % CI [-.24, -.09] (Model 4; Hayes, 2018; Preacher & Hayes, 2004).

5.5. Discussion

Dans la première expérience, nous n'avons pas trouvé d'effet psychologique ou effet de prix de bonus-malus sur l'empreinte carbone des produits. De même, dans la deuxième expérience, aucun effet de bonus-malus sur l'empreinte carbone n'est trouvé sur l'empreinte carbone des paniers. Par conséquent, le bonus-malus ne semble pas avoir un effet sur la consommation durable dans un site expérimental de courses.

Dans la deuxième expérience, nous avons trouvé que les étiquettes carbone à code couleur ont diminué l'empreinte carbone des paniers, amélioré la connaissance d'empreinte carbone et que la connaissance est le médiator de l'effet des étiquettes carbone sur l'empreinte carbone des paniers. Finalement, la saillance de taxe peut améliorer la connaissance.

6. Chapitre: Théorie de Goal-Setting et son Effet sur les Courses en Ligne

Nous avons examiné comment les principes de la théorie de goal-setting peuvent être utilisés pour promouvoir la consommation durable dans un site de courses en ligne. Cette théorie se concentre sur la relation entre les objectives et la performance dans la tâche (Locke & Latham, 2002). Selon cette approche, les objectives peuvent avoir un impact sur la performance à travers quatre mécanismes : (a) ils dirigent l'attention aux activités liées à l'objectif, (b) ils stimulent l'énergie et les objectifs difficiles peuvent générer plus d'effort, (c) ils influencent la persistance, (d) ils affectent l'action en suscitant les gens d'utiliser leur connaissance et les stratégies liées à l'objectif.

6.1. Les Techniques de Goal-Setting pour Promouvoir la Consommation Durable

Il y a des études qui ont testé l'impact de l'attribution des objectives sur les comportements durables comme la conservation d'énergie chez les foyers (Abrahamse et al., 2007; Becker, 1978; Katzev & Johnson, 1983) ou la préférence pour les produits en vrac au lieu des produits emballés (Tate et al., 2014).

Il y a des différents facteurs qui modèrent l'efficacité des techniques de goal-setting. Tout d'abord, les objectives difficiles peuvent générer une meilleure réussite, mais les objectives très complexes peuvent démoraliser et décourager les individus (Locke, 1996). Ensuite, les objectifs sont plus susceptibles de motiver d'une manière efficace les individus s'ils sont acceptés comme légitimes, faisables, exprimés en termes précis, et si les gens sont fournis par un feedback qui leur permet d'évaluer leur progrès par rapport à l'objectif (Locke & Latham, 2002). De plus, si l'individu croit qu'il réussira atteindre l'objectif, son engagement par rapport à l'objective sera renforcé.

6.2. L'impact Des Étiquettes Des Produits Sur La Consommation Alimentaire Durable

Pour promouvoir la consommation durable, les stratégies fondées sur l'information du produit ont été utilisées. Par exemple, pendant que les labels écologiques peuvent augmenter l'achat de certains produits comme les détergents ou l'électricité écologique, ils peuvent avoir aucun effet sur certains comme les colorants écologiques (Bjørner et al., 2004; Nimon & Beghin, 1999).

Les étiquettes carbone qui sont un type d'écolabel ont été introduites grâce au progrès dans les analyses de cycle de vie (Sharp & Wheeler, 2013). Le but de ces étiquettes est de fournir les informations nécessaires pour que les consommateurs fassent des choix informés. Les supermarchés comme Tesco au Royaume-Uni ou Casino en France ont utilisé ces étiquettes (Schaefer & Blanke, 2014).

Les études ont montré que les étiquettes carbone étaient efficaces dans certaines expériences, mais pas dans tous. Par exemple, pendant que Perino et al. (2014) ont trouvé que les étiquettes carbone numériques étaient efficaces, les études de Spaargaren et al. (2013), Vanclay et al. (2011), Brunner et al. (2018), Vlaeminck et al. (2014), et Muller et al. (2019) ont démontré l'efficacité des étiquettes carbone à code couleur. Par contre, Hornibrook et al. (2015) ont indiqué que l'étiquette numérique *Carbon Trust* implémentée dans le supermarché Tesco au Royaume-Uni n'a pas eu d'effet sur la consommation.

6.3. La Complexité des Tâches

Un des modérateurs importants de l'efficacité de technique de goal-setting est la complexité des tâches. Plus la tâche est complexe, plus l'impact de goal-setting dépend de la capacité des gens de trouver la stratégie appropriée pour compléter la tâche (Locke & Latham, 2002). En plus, le design de feedback est également important pour que les consommateurs reçoivent cette information d'une manière claire et compréhensible.

Le format dans lequel l'information est présentée a un impact sur le choix de stratégie de traitement d'information (Bettman & Kakkar, 1977). Pendant que le feedback numérique peut être efficace pour avoir un impact sur le comportement durable (ex., Perino et al., 2014), la présentation graphique de l'information peut être encore plus efficace. Par exemple, Garcia-Retamero et Galesic (2010) ont montré que quand l'information numérique est accompagnée par des appuies visuels comme des graphiques à barres, la prise de décision médicale a été améliorée. De plus, Garcia- Retamero et Hoffrage (2013) ont montré que quand l'information est présentée en termes numériques et accompagnée par des appuies visuels, les inférences de diagnostique étaient perfectionnées comparé à la situation où l'information était présentée qu'en termes numériques.

6.4. Les Études Empiriques

Notre but dans nos expériences est de tester si les techniques de goal-setting peuvent avoir l'impact sur le comportement des consommateurs dans un site expérimental de courses en ligne ; plus précisément, si cette technique peut diminuer l'empreinte carbone des paniers des consommateurs.

Pour tester cela, dans les conditions de goal-setting, pour légitimer l'objective de réduire l'empreinte carbone, nous avons présenté un message injonctif normatif (cf., Schultz et al., 2007). Concernant le feedback, nous avons donné le feedback sur l'empreinte carbone du panier, mais aussi l'empreinte carbone de chaque produit. Ensuite, nous avons donné une cible d'empreinte carbone qui n'est pas très difficile à respecter comme un objectif durable. En outre, nous avons présenté l'empreinte carbone du panier et la cible d'empreinte carbone en termes numériques ou sur un graphique (bicolore ou à code couleur) montrait l'empreinte carbone du panier et qui se modifiait chaque fois un produit était mise au panier; en plus, les participants pouvaient voir leur progrès par rapport à la cible (objective durable). L'empreinte carbone des produits était également présentée à partir des étiquettes (numérique ou numérique et à multi-couleur). Par contre, dans la condition control, l'empreinte carbone des produits et du panier n'était pas présentée, de même, aucun message normatif ou aucun objective durable n'a été communiqué. Les participants ont mené notre expérience sur un site de courses en ligne expérimental.

6.5. Première Expérience

Notre but était de tester l'efficacité des techniques de goal-setting sur la consommation durable (l'empreinte carbone des paniers) et comparer son effet à celui de l'utilisation des étiquettes carbone des produits dans un site expérimental de courses en ligne.

Nous avons testé les hypothèses suivantes : les participants dans les deux conditions de goal-setting (goal setting numérique (1a) et goal setting graphique (1b) auront moins d'empreinte carbone que ceux dans la condition contrôle ; 2. les participants dans la condition empreinte numérique du produit (2a) et empreinte numérique du produit et du panier (2b) auront moins d'empreinte carbone que ceux dans le contrôle ; les participants dans les deux conditions de goal-setting (goal setting numérique (3a) et goal setting graphique (3b)) auront moins d'empreinte carbone que ceux dans la condition empreinte numérique du produit ; Les participants dans les deux conditions de goal-setting (goal setting numérique (4a) et goal setting graphique (4b)) auront moins d'empreinte carbone que ceux dans la condition empreinte numérique du produit et du panier ; 5. La condition goal setting graphique sera plus efficace que la condition goal setting numérique.

6.5.1. Méthode, Participants, Procédure

Notre échantillon était composé de 176[43] participants que nous avons recrutés dans l'Université Toulouse-Jean Jaurès. Les participants étaient âgés de 18 à 50 (M = 21.89, SD = 4.59 et dont 115 était femme.

Les participants ont mené l'expérience dans un laboratoire d'expériences sur un ordinateur. Ils avaient un budget de €25 et une chance sur cinq de gagner leur panier de courses. Ils ont commencé en faisant leurs courses et ensuite, ont répondu au questionnaire. Premièrement, ils ont répondu aux items de Environmental Attitudes Inventory (EAI-S, Milfont & Duckitt, 2010), après, ils ont rempli les items liés aux habitudes et critères d'achat, à la familiarité avec les achats en ligne et aux sociodémographiques.

Nous avions cinq conditions expérimentales dans cette expérience (voir Tableau 14 pour les détails).

[43] Après avoir éliminé les données de 8 participants: ceux qui ont moins de 18 ans et les scores z > 3.29

Tableau 14

L'explication des Conditions Expérimentales Utilisées dans la Première Expérience

Les conditions expérimentales	La présentation des prix des produits	La présentation d'empreinte carbone des produits	La présentation d'empreinte carbone du panier (par kg du panier)	Le seuil durable avec un message normatif (pour les conditions de goal-setting)
Contrôle	X			
Empreinte numérique du produit	X	X		
Empreinte numérique du produit et du panier	X	X	X	
Goal setting numérique	X	X	X	X (le seuil présenté en termes numérique)
Goal setting graphique	X	X	X	X (le seuil présenté sur un graphique)

6.5.2. Résultats

Nous avons utilisé l'empreinte carbone du panier par kg comme la variable dépendante dans toutes nos expériences. Nous avons fait un test ANOVA à un facteur mesures indépendantes dont le résultat était significatif ($F(4, 171) = 2.89$, $p < .05$, $\eta^2p = .06$). Ensuite, nous avons mené des tests *t* pour tester nos hypothèses. Les Hypothèses 1a ($t(69) = 2.80$, $p < .005$, *unilatéral*) et 1b ($t(68) = 2.29$, $p < .05$, *unilatéral*) étaient validées qui montraient l'efficacité de goal-setting. Les Hypothèses 4a ($t(67) = 2.39$, $p < .05$, *unilatéral*) et 4b ($t(66) = 1.91$, $p < .05$, *unilatéral*) étaient également validées. Par contre, les Hypothèses 2a et 2b, 3a, 3b, et 5 n'étaient pas supportées (ps > .05).

6.6. Deuxième Expérience

Notre but dans la deuxième expérience était de répliquer nos résultats liés à la théorie de goal-setting de la première expérience et tester si le code couleur augmentait l'efficacité des étiquettes carbone numériques et de la présentation de l'empreinte carbone du panier (avec le seuil durable dans la condition de goal-setting).

Nous avons testé les hypothèses suivantes : 1. Les participants dans les conditions de goal-setting (goal setting numérique (1a) et goal setting thermomètre à code couleur (1c)) auront moins d'empreinte carbone que ceux dans la condition contrôle. 2. Les participants dans la condition empreinte carbone numérique du produit (2a) et l'empreinte carbone numérique à code couleur (2c) auront moins d'empreinte carbone que ceux dans la condition contrôle. 3. Les participants dans la condition goal setting numérique auront moins d'empreinte carbone que ceux dans la condition empreinte carbone numérique du produit (3a) et les participants dans la condition goal setting thermomètre à code couleur auront moins d'empreinte carbone que ceux dans la condition empreinte carbone numérique à code couleur (3c). 4. Les participants dans la condition goal setting thermomètre à code couleur auront moins d'empreinte carbone que ceux dans la condition goal setting numérique (5b). 5. Finalement, les participants dans la condition empreinte carbone numérique à code couleur auront moins d'empreinte carbone que ceux dans la condition empreinte carbone numérique du produit (6).

6.6.1. Méthode, Participants, Procédure

Notre échantillon était composé de 196[44] participants âgés de 18 à 40 (*M* = 21.64, *SD* = 3.70) dont 137 était femme. Nous avons conduit le recrutement dans l'Université Toulouse-Jean Jaurès. Nous avons utilisé la même procédure que la première expérience.

Il y avait cinq conditions expérimentales dont certaines étaient les mêmes que celles utilisées dans la première expérience (voir Tableau 15 pour les détails).

[44] Après avoir éliminé les données d'un participant qui avait moins de 18 ans (qui avait 17 ans), celles de deux participants qui ont les scores z (de l'empreinte carbone) > 3.29 et celle d'un participant qui a commandé 25 kg de pomme de terre.

Tableau 15

L'explication des Conditions Expérimentales Utilisées dans la Deuxième Expérience

Les conditions expérimentales	La présentation des prix des produits	La présentation d'empreinte carbone des produits	La présentation d'empreinte carbone du panier (par kg du panier)	Le seuil durable avec un message normatif (pour les conditions de goal-setting)	L'utilisation du code couleur
Contrôle	X				
Empreinte numérique du produit	X	X			
Empreinte carbone numérique à code couleur	X	X			X
Goal setting numérique	X	X	X	X (le seuil présenté en termes numérique)	
Goal setting thermomètre à code couleur	X	X	X	X (le seuil présenté sur un graphique, i.e., thermomètre, à code couleur)	X

6.6.2. Résultats

Nous avons fait un test ANOVA à un facteur mesures indépendantes dont le résultat n'était pas significatif ($F(4, 191) = 1.44$, $p = .22$, $\eta^2p = .03$). Ensuite, nous avons mené des tests *t* pour tester nos hypothèses. Pendant que l'hypothèse 1a n'était pas validée ($p > .05$), l'hypothèse 1c était validée ($t(77) = 2.11$, $p < .05$, *unilatéral*). Les hypothèses 2a, 2c, et 3a n'étaient pas validées (*p*s > .05). Pourtant, l'hypothèse 3c était validée ($t(78) = 1.74$, $p < .05$, *unilatéral*). Finalement, les hypothèses 5b et 6 n'étaient pas validées.

De plus, nous avons mené des analyses méta-analytiques en utilisant les données de la première et deuxième expérience. Les résultats ont montré l'efficacité de la condition goal setting numérique par rapport à la condition contrôle ($t(147) = 2.98$, $p < .005$, *unilatéral*, Cohen's $d = .49$, 95 % CI [.18, inf.]). Pareillement, l'efficacité de la condition empreinte numérique du produit par rapport à la condition contrôle ($t(148) = 1.92$, $p = .028$, *unilatérale*, Cohen's $d = .32$, 95 % CI [.04, inf.]) a été démontré. Par contre, la différence entre la condition empreinte numérique du produit et goal setting numérique n'était pas significative.

6.7. Troisième Expérience

Notre but dans cette expérience était de tester si la connaissance d'empreinte carbone des produits des participants sera améliorée en faisant des multiples visites dans la condition goal setting thermomètre à code couleur par d'apprentissage instrumental et expérientiel (Dickinson, 1980 ; Hertwig et al., 2018).

Nous avons testé les hypothèses suivantes : Premièrement, les participants dans la condition de goal-setting auront moins d'empreinte carbone que ceux dans la condition control (1c). Deuxièmement, les participants qui font plusieurs visites à la condition goal setting thermomètre à code couleur auront une meilleure connaissance d'empreinte carbone des produits au cours des visites (7a) et réduiront leur empreinte carbone au cours des visites (7b). De ce fait, certains participants ont fait trois visites à la shop.

6.7.1. Méthode, Participants, Procédure

Nous avons recruté 132 participants au Toulouse School of Economics. Un participant qui a indiqué avoir un niveau de français nettement moins bien que la langue maternelle était éliminée pour les analyses. L'échantillon était composé de 61 hommes et 70 femmes qui sont âgés de 18 à 32 (M = 20.83, SD = 1.90)[45]. Le design de cette expérience était 2 (goal setting thermomètre à code couleur vs. control) x 2 (une visite vs. trois visites).

La procédure était la même que les deux premières expériences. En outre, les participants ont également rempli un questionnaire pour la connaissance d'empreinte carbone des produits en évaluant l'empreinte carbone des 36 produits de notre magasin.

6.7.2. Résultats

Nous avons mené un ANOVA mixte parmi les participants qui ont mené trois visites. L'hypothèse 7a n'était pas confirmée comme l'impact de nombre de visite (F(2, 130) = 0.26, p = .77, η^2p = .00) et l'interaction de goal-setting et le nombre de visite sur l'empreinte carbone des paniers (F(2, 130) = 1.28, p = .28, η^2p = .02) n'étaient pas significatifs. Pourtant,

[45] Un participant qui a écrit "100" pour son âge était éliminé.

l'effet de goal-setting était significatif (F(1, 65) = 6.83, p < .05, η^2p = .10), supportant l'hypothèse 1c. De plus, nous avons mené un ANOVA à un facteur mesures indépendantes pour les paniers construits pendant la première visite, et trouvé que l'effet de goal-setting sur l'empreinte carbone était significatif, (F(1, 129) = 9.5, p < .01, η^2p = .07). Donc, l'hypothèse 1c était confirmée.

Nous avons mené ANOVA factorielle à mesure indépendant pour tester notre hypothèse liée à la connaissance d'empreinte carbone. Nous avons trouvé que l'effet de goal-setting sur la connaissance était significatif (F (1, 127) = 41.41, p < .001, η^2p = .25). De même, l'interaction de nombre de visite et goal-setting était significatif (F(1,127) = 9.46, p < .01, η^2p = .07). Par conséquent, l'hypothèse 2b était confirmée.

En utilisant la procédure de bootstrapping (PROCESS avec 5000 bootstraps, Model 4; Hayes, 2018 ; Preacher & Hayes, 2004), nous avons également trouvé que la connaissance était une variable médiatrice entre la relation de goal-setting et l'empreinte carbone des paniers, 95 % CI [- .4734, - .0423]. De plus, une analyse méta-analytique (avec la première et deuxième expériences a montré que l'effet de goal setting thermomètre à code couleur était significatif par rapport à la condition control (t(208) = 3.67, p < .001, *unilateral*, Cohen's d = .51, 95% CI [.29, inf.]).

6.8 Discussion, Limitations et les Études Futures

Nous avons démontré que mettre un objectif et donner des feedbacks par rapport à cela a un impact sur le comportement durable quel que soit le format de feedback (en termes numériques, graphiques bicolore, ou multi-couleur) ou le nombre de visite au magasin. De plus, cette technique (goal setting thermomètre à code couleur) a amélioré la connaissance d'empreinte carbone et cette connaissance était renforcée au cours des visites. En outre, la connaissance est une médiatrice entre la relation de goal setting thermomètre à code couleur et l'empreinte carbone. Pourtant, faire plusieurs visites dans cette condition n'a pas réduit l’empreinte carbone des paniers au cours des visites. Finalement, les étiquettes carbone à code couleur n’a pas eu d’effet sur le comportement et a eu moins d’effet comparé à la condition goal setting thermomètre à code couleur. Les étiquettes carbone numérique a eu un effet après avoir combiné les données des deux premières expériences.

Notre étude a certaines limites. Par exemple, nous n’avons pas randomisé la location des étiquettes carbone ou le graphique à code couleur. De plus, nous n’avons pas utilisé des items de contrôle de manipulations. Les études futures peuvent tester ces techniques sur des vrais sites de courses en ligne et tester l’impact des autres modérateurs de la relation entre la performance et l’objectif.

7. Conclusion

Notre but dans cette thèse était de tester l’impact des mesures fiscales, les instruments non-monétaires (c.-à-d., les normes injonctives et les étiquettes carbone) ainsi que les techniques de goal-setting sur la consommation alimentaire durable. Nous avons opérationnalisé la consommation durable comme l’empreinte carbone du panier de course. Nous avons analysé à la fois l’impact monétaire et psychologique de la taxe carbone et la taxe bonus-malus sur l’empreinte carbone du panier.

Concernant l’effet de la taxe carbone, nous avons démontré que ceci a un effet minimal sur la consommation durable. Nous n’avons pas trouvé un effet de prix ou un effet psychologique de la taxe carbone. Pareillement, nous n’avons pas trouvé un effet prix ou un effet psychologique de la taxe bonus-malus sur la consommation durable.

Nous avons également testé l’effet de l’affichage de taxe sur la connaissance d’empreinte carbone du produit. Pendant que l’affichage de la taxe carbone n’a pas eu d’effet sur la connaissance, l’affichage de taxe bonus-malus avec un texte justifiant l’application de la taxe a amélioré la connaissance chez les participants (après avoir créé de nouveaux facteurs).

Concernant l'effet des instruments non-monétaires, dans les deux premiers chapitres où nous avons analysé l'impact des étiquettes carbone tricolores, nous avons trouvé que ces étiquettes peuvent diminuer l'empreinte carbone des paniers et aussi améliorer la connaissance d'empreinte carbone. De plus, nous avons démontré que la connaissance est une variable médiatrice de la relation entre les étiquettes carbone et l'empreinte carbone du panier. Pourtant, les étiquettes carbone à cinq couleurs n'ont pas eu d'effet sur la consommation. Les étiquettes numériques ont eu un effet quand la puissance statistique a été augmentée.

Nous avons trouvé que les normes injonctives peuvent améliorer la connaissance et a un effet sur le comportement des participants qui ont répondu positivement à la question demandant si le message normatif a été affiché dans le magasin (et qui étaient dans les conditions où nous avons présenté ce message).

Les techniques de goal-setting étaient également efficaces pour diminuer l'empreinte carbone des paniers. De plus, mettre un objectif et fournir un feedback par rapport à cet objectif était plus efficace que fournir uniquement des informations sur l'empreinte carbone des produits et du panier. Finalement, nous avons démontré que dans la condition où nous avons présenté l'objective et le feedback sur un graphe à multi-couleur (cinq), la connaissance d'empreinte carbone des participants a été améliorée et visiter le magasin sous cette condition a encore amélioré cette connaissance. En outre, nous avons trouvé que la connaissance était le médiateur de l'effet de la condition goal setting thermomètre à code couleur sur l'empreinte carbone.

Nos études ont des implications importantes. Premièrement, l'étiquette carbone tricolore est un instrument important pour diminuer l'empreinte carbone des paniers en améliorant la connaissance. De plus, afficher le montant de bonus-malus peut améliorer la connaissance des consommateurs. Une autre implication importante est que dans les magasins en ligne, les décideurs politiques peuvent établir une cible d'empreinte carbone à respecter pour les consommateurs et en même temps fournir feedback par rapport à cette cible pour diminuer l'empreinte carbone des paniers. Cela peut également améliorer leur connaissance.

Finalement, pour diminuer l'empreinte carbone des paniers, les messages normatifs injonctifs peuvent être utilisés seulement s'ils peuvent être communiqués d'une manière saillante. En outre, les messages normatifs injonctifs peuvent également améliorer la connaissance.

Nous pouvons noter quelques limitations dans nos études. En premier lieu, comparé aux magasins en ligne de vie réelle, il y avait moins de produits alimentaires dans notre magasin expérimental. En plus, comme les participants savaient qu'ils utilisaient le budget d'expérimentateurs. Cela peut conduire les participants de choisir les produits qu'ils ne choisissent pas souvent. Le fait de savoir de remporter les produits sélectionnés avec une chance sur cinq peut également avoir un impact sur le comportement. D'autre part, nous avons recruté notre échantillon dans les campus des universités ce qui peut rendre notre échantillon moins représentatif de la population en France. De plus, nous avons conduits nos études à Toulouse. Les consommateurs habitant dans des différentes villes peuvent avoir d'autres modèles de consommation alimentaires. Finalement, la taille de nos échantillons peut ne pas être assez large pour détecter des effets d'interactions.

Les études futures peuvent tester nos manipulations dans le contexte de vie réelle. Les études futures peuvent également randomiser les places des étiquettes carbone pour trouver la place qui est la plus efficace à avoir un impact. En outre, dans les futures études, les questionnaires de désirabilité sociale peuvent être remplies par des participants. Dans nos études, nous avons utilisé l'empreinte carbone du panier par kg pour opérationnaliser la consommation durable. Les études futures peuvent analyser la consommation durable en analysant d'autres aspects de la consommation durable. Par exemple, l'empreinte hydrique peut être examinée. Les études futures peuvent également tester l'impact des autres instruments monétaires et non-monétaires sur la consommation durable. Les études sur l'acceptabilité des taxes peuvent être menées. En plus, les études post-expérimentales comme des études de groupe de discussion peuvent être réalisées. Finalement, les études sur les plates-formes en ligne peuvent être réalisées comme leur utilisation peut être augmentée grâce au développement des services de livraison.