

**Investigation of How Road Users' Perception and Attitudes  
Influence Intention to Commute by Bicycle in Mexico City**

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## **Abstract**

The thesis aims to explore attitudes and the perceived image of cycling in Mexico City and the extent to which this may be a deterrent for engaging in cycle commuting. It also explores the existence of attitudinal transport segments.

Transport segments were investigated using a questionnaire developed by the Segment Project EU. Data about attitudes were collected in the same survey from a theory-based questionnaire developed from the Theory of Planned Behaviour (TPB), extended with constructs from the Social Comparison Theory (SCT) and the Material Possessions Model (MPM). The survey was distributed on-street and online, with a simple random sample of 401 road users. The sample characteristics were: no cyclists or infrequent cyclists, living and working in Mexico City, and aged 18-60.

The results indicate that the same attitudinal transport segments identified in Europe also exist in Mexico City. They also show that cycling attributes, attitudes to cycling, social comparison, and social image and prestige were the most important factors influencing intention to cycle, explaining 42% of the variance in intention to cycle. Notably, when the evaluation of cycling was negative, the intention to commute by cycling was weaker; when the attributes of cycling and the social image linked to cycling were positive, the intention to cycle commute was strengthened. The effect of social comparison is not clearly established.

Although the results from this study are specific to Mexico City, they indicate areas of interest to transportation planners in other regions, especially in those cities where intention to cycle is linked to its perceived image and there is political ambition to promote a positive image of cycling and stimulate modal shift. Moreover, this study contributes to the current literature developing applications of the TPB. Future research may include further investigating social comparison as a latent construct underlying intention to cycle.

## Table of Contents

<b>Acknowledgements</b> .....	<b>iii</b>
<b>Abstract</b> .....	<b>iv</b>
<b>Table of Contents</b> .....	<b>v</b>
<b>List of Tables</b> .....	<b>ix</b>
<b>List of Figures</b> .....	<b>xii</b>
<b>Chapter 1 The Problem</b> .....	<b>1</b>
1.1 Introduction .....	1
1.2 Problem Background.....	2
1.3 Problem Statement.....	5
1.4 Research Aim and Objectives .....	7
1.4.1 Research Aim.....	7
1.4.2 Research Objectives .....	8
1.5 Structure of the Thesis .....	8
<b>Chapter 2 Perception and Attitudes towards Cycling: An Integrated Literature Review</b> .....	<b>11</b>
2.1 Introduction .....	11
2.2 Overview of barriers for cycling .....	12
2.2.1 External Barriers to Cycling.....	12
2.2.2 Individual barriers for cycling.....	16
2.2.3 Social and Psychological Barriers to Cycling .....	17
2.3 Methodology to explore research problem .....	24
2.3.1 Stage 1: Search Criteria and Time Delimitation .....	25
2.3.2 Stage 2: Sampling Literature.....	26
2.3.3 Stage 3: Analysis and Summary .....	28
2.3.4 Stage 4: Discussion of Results.....	28
2.4 Results and Discussion .....	28
2.4.1 Theoretical Framework.....	28
2.4.1.1 Different Approaches to the Analysis of Behaviour.....	29
2.4.1.2 Choosing Theoretical Framework .....	33
2.4.1.3 Extended Version of the Theory of Planned Behaviour (TPB).....	37
2.4.1.4 Interrelation Between All Constructs .....	42
2.4.2 Research about Attitudes towards Cycling and Cyclists.....	43

2.4.3 Studying the Role of Perceived Image and Identity Influencing Individuals' Choice to or not to Cycle.....	47
2.4.4 Other Socio-Psychological Factors .....	52
2.4.5 Investigating Socio-Economic Status Attached to the Image of Cycling and Cyclists .....	53
2.4.6 Market Segmentation Techniques and Applicability in Cycling .....	56
2.4.6.1 Marketing and Social Marketing in Transport Studies .....	56
2.4.6.2 Segmentation to Increase Cycling Levels .....	57
2.4.6.3 Socio-Demographic Segmentation.....	58
2.4.6.4 Attitudinal Segmentation .....	59
2.5 Conclusions.....	66
2.6 Research Questions and Sub-Questions .....	69
<b>Chapter 3 Research Design and Method.....</b>	<b>71</b>
3.1 Introduction .....	71
3.2 Research Aim and Objectives .....	72
3.3 Research Design.....	73
3.4 Positivist Paradigm.....	75
3.5 Survey Design .....	76
3.5.1 Segmentation Questionnaire .....	78
3.5.2 Theory-Based Questionnaire .....	80
3.5.2.1 Intention, Attitudes, Subjective Norm, Perceived Behavioural Control, and Past Behaviour .....	80
3.5.2.2 Social Comparison Orientation and Feelings from Social Comparison.....	83
3.5.2.3 Affective Motives, Instrumental Motives, and Symbolic Motives .....	84
3.6 Pilot Study and Practicalities .....	86
3.7 Sampling Method .....	88
3.8 Data Collection Procedure .....	89
3.9 Data Processing and Analytical Strategy .....	90
3.9.1 Coding.....	90
3.9.2 Data Entry and First Approach to the Data.....	91
3.9.3 Cleaning the Dataset.....	91
3.9.3.1 Dealing with Missing Data .....	91
3.9.3.2 Unengaged Responses.....	95
3.9.3.3 Outliers.....	95

3.10 Key Methodological Issues.....	99
<b>Chapter 4 Mexico City as the Case Study .....</b>	<b>100</b>
4.1 Introduction .....	100
4.2 Mexico City Background.....	101
4.3 Urban Mobility .....	107
4.4 Cyclist Profile in Mexico City .....	109
4.5 Cycling Environment and Policy.....	112
4.6 Benefits of Cycling in Mexico .....	114
4.7. Barriers and Facilitators of Cycling.....	115
<b>Chapter 5 Introduction to the Analysis of Findings .....</b>	<b>119</b>
5.1 Introduction .....	119
5.2 Sample Background and Description .....	120
5.3 Analysis of Attitudinal Transport Segments in Mexico City.....	123
5.3.1 Assessing Normality of the Data .....	123
5.3.2 Assessing Differences from Distribution Tool.....	127
5.3.3 Data Processing.....	159
5.3.4 Distribution of the Scores of the Segmentation Questions.....	160
5.3.5 Characteristics of the Segments .....	162
5.3.6 Segment Groups and Attitudes towards Transport .....	170
5.3.6.1 Attitudes towards Car Use.....	170
5.3.6.2 Attitudes towards Bus Use .....	176
5.3.6.3 Attitudes towards Cycling .....	178
5.3.6.4 Attitudes towards Walking .....	181
5.3.7 Comparison of Segments in Europe and Mexico .....	186
5.4 Analysis of Perception and Attitudes towards Cycling.....	196
5.4.1 Characteristics of the Sample .....	196
5.4.2 Assessing Normality of the Data .....	197
5.4.3 Assessing Differences from Distribution Tool.....	208
5.4.4 Description of the Observed Variables .....	228
5.4.5 Reliability and Validity .....	232
5.4.6 Exploring the answers .....	233
5.5 Model Development .....	255
5.5.1 Exploratory Factor Analysis (EFA) .....	255
5.5.2 Confirmatory Factor Analysis (CFA) .....	259
5.5.3 Testing Invariance.....	262

5.5.4 Structural Equation Model (SEM) .....	262
5.5.5 Hierarchical Multiple Regression (HMR) .....	265
5.6 Limitations .....	266
5.7 Summary and Conclusions .....	267
<b>Chapter 6 Latent Factors Influencing Intention to Cycle in Mexico City .....</b>	<b>270</b>
6.1 Introduction .....	270
6.2 Attitudes Influencing Behavioural Intention to Cycle .....	271
6.3 Perceived Image of Cycling and Cyclists .....	275
6.4 Other Socio-Psychological Factors Influencing Intention to Cycle .....	279
6.5 Perceived behavioural control, past behaviour and intention .....	285
6.6 Conclusions.....	287
6.7 Limitations .....	290
<b>Chapter 7 Attitudinal transport segments in Mexico City.....</b>	<b>292</b>
7.1 Introduction .....	292
7.2 Characteristics of the segments in Mexico .....	294
7.3 Transferability of methodology .....	297
7.5 Policy implications.....	298
7.6 Limitations .....	300
7.7 Summary and Conclusions .....	300
<b>Chapter 8 Conclusions and Policy Implications.....</b>	<b>302</b>
8.1 Introduction .....	302
8.2 Key findings.....	304
8.3 Policy implications.....	306
8.4 Limitations .....	317
8.5 Key contributions to knowledge.....	319
8.6 Further research.....	320
<b>List of References .....</b>	<b>321</b>
<b>List of Abbreviations.....</b>	<b>336</b>
<b>Appendix A Matrix of Literature Review.....</b>	<b>338</b>
<b>Appendix B Copy of the Questionnaire (Spanish and English) .....</b>	<b>341</b>
<b>Appendix C Protocol of the Questionnaire (Spanish).....</b>	<b>368</b>
<b>Appendix D Pilot study .....</b>	<b>375</b>

## List of Tables

<b>Table 1 Theories using Injunctive and Descriptive Social Norm for understanding attitudes-behaviour .....</b>	<b>30</b>
<b>Table 2 Theories using stages of change for understanding attitudes-behaviour .....</b>	<b>31</b>
<b>Table 3 Theories using observation of others' behaviour for understanding attitudes-behaviour .....</b>	<b>32</b>
<b>Table 4 Theories and constructs used in the model .....</b>	<b>42</b>
<b>Table 5 Characteristics of the Devoted Drivers .....</b>	<b>61</b>
<b>Table 6 Characteristics of the Image Improvers.....</b>	<b>62</b>
<b>Table 7 Characteristics of the Malcontented Motorists .....</b>	<b>62</b>
<b>Table 8 Characteristics of the Active Aspirers .....</b>	<b>63</b>
<b>Table 9 Characteristics of the Practical Travellers .....</b>	<b>63</b>
<b>Table 10 Characteristics of the Car Contemplators .....</b>	<b>64</b>
<b>Table 11 Characteristics of the Public Transport Dependents .....</b>	<b>64</b>
<b>Table 12 Characteristics of the Car-free Choosers .....</b>	<b>65</b>
<b>Table 13 Matrix for research design .....</b>	<b>74</b>
<b>Table 14 Theory of Planned Behaviour Constructs and Their Associated Question Number .....</b>	<b>82</b>
<b>Table 15 Social Comparison Constructs and Their Associated Question Number .....</b>	<b>84</b>
<b>Table 16 Material Possessions Model Constructs and Their Associated Question Number .....</b>	<b>85</b>
<b>Table 17 List of Observations with More than 10% of Answers Missing.....</b>	<b>91</b>
<b>Table 18 Total Answers from Segmentation and Missing Answers (in pink) .....</b>	<b>92</b>
<b>Table 19 Total Answers from Social Comparison Theory and Missing Answers (in Pink).....</b>	<b>92</b>
<b>Table 20 Total Answers from Material Possessions Model and Missing Answers (in pink).....</b>	<b>93</b>
<b>Table 21 Total Answers from Theory of Planned Behaviour and Missing Answers (in pink).....</b>	<b>93</b>
<b>Table 22 Total Answers from Socio-Demographics and Missing Answers (in pink) .....</b>	<b>94</b>
<b>Table 23 List of Replaced Values for Missing Responses.....</b>	<b>94</b>
<b>Table 24 List of Observations and the Unengaged Responses .....</b>	<b>95</b>
<b>Table 25 Tukey's Hinges results .....</b>	<b>96</b>

<b>Table 26 Economic characteristics of each Municipality in Mexico City .....</b>	<b>104</b>
<b>Table 27 Municipalities in Mexico City .....</b>	<b>105</b>
<b>Table 28 Descriptive statistics of the sample and population .....</b>	<b>121</b>
<b>Table 29 Transport mode used to commute to work by sample and population.....</b>	<b>122</b>
<b>Table 30 Normality T-test for Segmentation questions in both data collection tools.....</b>	<b>124</b>
<b>Table 31 Descriptive information from Segmentation Questionnaire.....</b>	<b>125</b>
<b>Table 32 T-Test for population mean of sample online and sample in hard copy.....</b>	<b>128</b>
<b>Table 33 Descriptives for the Segmentation Questions .....</b>	<b>160</b>
<b>Table 34 Distribution of the Segments.....</b>	<b>162</b>
<b>Table 35 Socio-demographic characteristics of each segment .....</b>	<b>164</b>
<b>Table 36 Mobility characteristics by Segment.....</b>	<b>165</b>
<b>Table 37 Summary of Attitudes Towards Transport .....</b>	<b>183</b>
<b>Table 38 Comparison of Segment AA in Europe and Mexico .....</b>	<b>186</b>
<b>Table 39 Comparison of Segment II in Europe and Mexico.....</b>	<b>187</b>
<b>Table 40 Comparison of Segment MM in Europe and Mexico.....</b>	<b>189</b>
<b>Table 41 Comparison of Segment DD in Europe and Mexico .....</b>	<b>190</b>
<b>Table 42 Comparison of Segment CF in Europe and Mexico.....</b>	<b>191</b>
<b>Table 43 Comparison of Segment PrTr in Europe and Mexico .....</b>	<b>192</b>
<b>Table 44 Comparison of Segment CC in Europe and Mexico .....</b>	<b>193</b>
<b>Table 45 Comparison of Segment PTD in Europe and Mexico.....</b>	<b>195</b>
<b>Table 46 Normality test for the Theory-based questionnaire .....</b>	<b>197</b>
<b>Table 47 Skewness and Kurtosis of the observed variables.....</b>	<b>206</b>
<b>Table 48 Frequency distribution of the scores for item feeling_sc1 .....</b>	<b>209</b>
<b>Table 49 Frequency distribution of the scores for item feeling_sc2 .....</b>	<b>210</b>
<b>Table 50 Frequency distribution of the scores for item affective motives2 .....</b>	<b>211</b>
<b>Table 51 Frequency distribution of the scores for item affective motives4 .....</b>	<b>212</b>
<b>Table 52 Frequency distribution of the scores for item instrumental motives1 .....</b>	<b>213</b>
<b>Table 53 Frequency distribution of the scores for item instrumental motives2 .....</b>	<b>214</b>

<b>Table 54 Frequency distribution of the scores for item instrumental motives3 .....</b>	<b>215</b>
<b>Table 55 Frequency distribution of the scores for item instrumental motives4 .....</b>	<b>216</b>
<b>Table 56 Frequency distribution of the scores for item Symbolic motives2 .....</b>	<b>217</b>
<b>Table 57 Frequency distribution of the scores for item Symbolic motives3 .....</b>	<b>218</b>
<b>Table 58 Frequency distribution of the scores for item Intention 1 ...</b>	<b>219</b>
<b>Table 59 Frequency distribution of the scores for item Intention 2 ...</b>	<b>220</b>
<b>Table 60 Frequency distribution of the scores for item Intention 3 ...</b>	<b>221</b>
<b>Table 61 Frequency distribution of the scores for item perceived control .....</b>	<b>222</b>
<b>Table 62 Frequency distribution of the scores for item attitud1 .....</b>	<b>223</b>
<b>Table 63 Frequency distribution of the scores for item attitud2 .....</b>	<b>224</b>
<b>Table 64 Frequency distribution of the scores for item attitud3 .....</b>	<b>225</b>
<b>Table 65 Frequency distribution of the scores for item attitud4 .....</b>	<b>226</b>
<b>Table 66 Frequency distribution of the scores for item past behaviour .....</b>	<b>227</b>
<b>Table 67 Descriptive statistics for each observable variable .....</b>	<b>230</b>
<b>Table 68 Reliability for each construct .....</b>	<b>232</b>
<b>Table 69 Factor Structure from EFA .....</b>	<b>257</b>
<b>Table 70 Factor name and Cronbach alpha .....</b>	<b>259</b>
<b>Table 71 Report from the CFA .....</b>	<b>261</b>
<b>Table 72 Regression weights from the SEM .....</b>	<b>263</b>
<b>Table 73 Model summary form HMR .....</b>	<b>266</b>
<b>Table 74 Initiatives and Policy Recommendations .....</b>	<b>312</b>

## List of Figures

Figure 1 Thesis Structure .....	10
Figure 2 Cycle of Automobile Dependency and Sprawl (Litman, 1995).....	15
Figure 3 Flow diagram of stages of the Literature Review .....	24
Figure 4 Evolution of publications of journal articles about perception and attitudes to cycling .....	27
Figure 5 Theory of Planned Behaviour (Ajzen, 1991).....	35
Figure 6 Conceptual Framework.....	43
Figure 7 Map of Mexico and location of Mexico City .....	102
Figure 8 Map of the MCMA .....	102
Figure 9 Mexico City average min and max temperatures .....	103
Figure 10 Mean monthly precipitation over the year (includes rain, snow, hail etc.) .....	103
Figure 11 Map of the Municipalities in Mexico City.....	106
Figure 12 Map of the Topography of Mexico City.....	106
Figure 13 Travel distance mapped.....	107
Figure 14 Historic Use of Ecobici .....	113
Figure 15 Transport mode most commonly used to commute daily by sample .....	123
Figure 16 Distribution of the responses for Q2 by sample.....	130
Figure 17 Distribution of responses Q2 split by age groups .....	130
Figure 18 Distribution of responses Q2 split by gender .....	131
Figure 19 Distribution of the responses for Q3 by sample.....	132
Figure 20 Distribution of responses Q3 split by age groups .....	132
Figure 21 Distribution of responses Q3 split by gender .....	133
Figure 22 Distribution of the responses for Q4 by sample.....	134
Figure 23 Distribution of the responses Q4 split by age groups .....	134
Figure 24 Distribution of the responses Q4 split by gender .....	135
Figure 25 Distribution of the responses for Q5 by sample.....	136
Figure 26 Distribution of the responses Q5 split by age groups .....	136
Figure 27 Distribution of the responses Q5 split by gender .....	137
Figure 28 Distribution of the responses for Q7 by sample.....	138
Figure 29 Distribution of the responses Q7 split by age groups .....	138
Figure 30 Distribution of the responses Q7 split by gender .....	139
Figure 31 Distribution of the responses for Q8 by sample.....	140

Figure 32 Distribution of the responses Q8 split by age groups .....	140
Figure 33 Distribution of the responses Q8 split by gender .....	141
Figure 34 Distribution of the responses for Q10 by sample.....	142
Figure 35 Distribution of the responses Q10 split by age groups .....	142
Figure 36 Distribution of the responses Q10 split by gender .....	143
Figure 37 Distribution of the responses for Q11 by sample.....	144
Figure 38 Distribution of the responses Q11 split by age groups .....	144
Figure 39 Distribution of the responses Q11 split by gender .....	145
Figure 40 Distribution of the responses for Q12 by sample.....	146
Figure 41 Distribution of the responses Q12 split by age groups .....	146
Figure 42 Distribution of the responses Q12 split by gender .....	147
Figure 43 Distribution of the responses for Q13 by sample.....	148
Figure 44 Distribution of the responses Q13 split by age groups .....	148
Figure 45 Distribution of the responses Q13 split by gender .....	149
Figure 46 Distribution of the responses for Q14 by sample.....	150
Figure 47 Distribution of the responses Q14 split by age groups .....	150
Figure 48 Distribution of the responses Q14 split by gender .....	151
Figure 49 Distribution of the responses for Q15 by sample.....	152
Figure 50 Distribution of the responses Q15 split by age groups .....	152
Figure 51 Distribution of the responses Q15 split by gender .....	153
Figure 52 Distribution of the responses for Q16 by sample.....	154
Figure 53 Distribution of the responses Q16 split by age groups .....	154
Figure 54 Distribution of the responses Q16 split by gender .....	155
Figure 55 Distribution of the responses for Q18 by sample.....	156
Figure 56 Distribution of the responses Q18 split by age groups .....	156
Figure 57 Distribution of the responses Q18 split by gender .....	157
Figure 58 Screenshot of the Excel Tool .....	159
Figure 59 Pie Chart of the distribution of the Segments .....	163
Figure 60 Question two about car use .....	171
Figure 61 Question three about car use.....	171
Figure 62 Question four about car use.....	171
Figure 63 Question five about car use .....	172
Figure 64 Question six about car use.....	172
Figure 65 Question seventeen about car use .....	172
Figure 66 Question eighteen about car use.....	173

Figure 67 Graph question fifteen about bus use .....	176
Figure 68 Graph question sixteen about bus use .....	176
Figure 69 Question seven about cycling .....	178
Figure 70 Question eight about cycling .....	178
Figure 71 Question ten about cycling .....	179
Figure 72 Question eleven about cycling .....	179
Figure 73 Question twelve about walking .....	181
Figure 74 Question thirteen about walking .....	182
Figure 75 Question fourteen about walking .....	182
Figure 76 Histogram data online Subjective Norm .....	199
Figure 77 Histogram data hard copy Subjective Norm .....	199
Figure 78 Histogram data online Attitudes .....	200
Figure 79 Histogram data hard copy Attitudes .....	200
Figure 80 Histogram data online Intention .....	200
Figure 81 Histogram data hard copy Intention .....	200
Figure 82 Histogram data online Social Comparison .....	201
Figure 83 Histogram data hard copy Social Comparison .....	201
Figure 84 Histogram data online Feelings Social Comparison .....	202
Figure 85 Histogram data hard copy Feelings Social Comparison .....	202
Figure 86 Histogram data online Affective motives .....	202
Figure 87 Histogram data hard copy Affective motives .....	202
Figure 88 Histogram data online Instrumental motives .....	203
Figure 89 Histogram data hard copy Instrumental motives .....	203
Figure 90 Histogram data online Symbolic motives .....	204
Figure 91 Histogram data hard copy Symbolic motives .....	204
Figure 92 Histogram data online past behaviour .....	204
Figure 93 Histogram data hard copy past behaviour .....	204
Figure 94 Histogram data online perceived behavioural control .....	205
Figure 95 Histogram data hard copy perceived behavioural control .....	205
Figure 96 Bar Chart distribution of the scores for item feeling_sc1 online and hard copy .....	210
Figure 97 Bar Chart distribution of the scores for item feeling_sc2 online and hard copy .....	211
Figure 98 Bar Chart distribution of the scores for item affective motives2 online and hard copy .....	212

Figure 99 Bar Chart distribution of the scores for item affective motives4 online and hard copy.....	213
Figure 100 Bar Chart distribution of the scores for item instrumental motives1 online and hard copy .....	214
Figure 101 Bar Chart distribution of the scores for item instrumental motives2 online and hard copy .....	215
Figure 102 Bar Chart distribution of the scores for item instrumental motives3 online and hard copy .....	216
Figure 103 Bar Chart distribution of the scores for item instrumental motives4 online and hard copy .....	217
Figure 104 Bar Chart distribution of the scores for item Symbolic motives2 online and hard copy.....	218
Figure 105 Bar Chart distribution of the scores for item Symbolic motives3 online and hard copy.....	219
Figure 106 Bar Chart distribution of the scores for item Intention 1 online and hard copy .....	220
Figure 107 Bar Chart distribution of the scores for item Intention 2 online and hard copy .....	221
Figure 108 Bar Chart distribution of the scores for item Intention 3 online and hard copy .....	222
Figure 109 Bar Chart distribution of the scores for item perceived control online and hard copy.....	223
Figure 110 Bar Chart distribution of the scores for item attitud1 online and hard copy .....	224
Figure 111 Bar Chart distribution of the scores for item attitud2 online and hard copy .....	225
Figure 112 Bar Chart distribution of the scores for item attitud3 online and hard copy .....	226
Figure 113 Bar Chart distribution of the scores for item attitud4 online and hard copy .....	227
Figure 114 Bar Chart distribution of the scores for item past behaviour online and hard copy.....	228
Figure 115 Mean of intention of people owning or not a bicycle .....	234
Figure 116 Mean of intention and past behaviour .....	235
Figure 117 Mean of intention and gender .....	236
Figure 118 Mean intention and occupation.....	237
Figure 119 Mean of attitudes and past behaviour .....	238
Figure 120 Mean subjective norm and past behaviour .....	239
Figure 121 Mean feelings from social comparison and bike ownership .....	241

<b>Figure 122 Mean of feeling from social comparison and past behaviour .....</b>	<b>242</b>
<b>Figure 123 Mean of feelings from social comparison and studies .....</b>	<b>243</b>
<b>Figure 124 Mean of affective motives and bike ownership .....</b>	<b>244</b>
<b>Figure 125 Mean of Affective motives and past behaviour .....</b>	<b>245</b>
<b>Figure 126 Mean of Instrumental Motives and bike ownership.....</b>	<b>246</b>
<b>Figure 127 Mean of the Instrumental Motives and past behaviour .....</b>	<b>247</b>
<b>Figure 128 Mean of symbolic motives and past behaviour .....</b>	<b>249</b>
<b>Figure 129 Perceived behavioural control and bike ownership.....</b>	<b>250</b>
<b>Figure 130 Mean of Perceived behavioural control and past behaviour .....</b>	<b>251</b>
<b>Figure 131 Mean Perceived behavioural control and gender .....</b>	<b>252</b>
<b>Figure 132 Mean perceived behavioural control and age.....</b>	<b>253</b>
<b>Figure 133 Mean of Perceived behavioural control and occupation ..</b>	<b>254</b>
<b>Figure 134 Mean of past behaviour and gender .....</b>	<b>255</b>
<b>Figure 135 Measurement Model and model summary .....</b>	<b>261</b>
<b>Figure 136 Schematic diagram of the SEM.....</b>	<b>263</b>

## **Chapter 1 The Problem**

### **1.1 Introduction**

This chapter introduces this research work in six sections. In this initial chapter the research problem is identified and described and the research aim is presented. The diverse problems that Mexico City is facing as a megacity are explained, including poor air quality related to contaminants due to the city being highly motorized, and a growing population facing health problems linked to the lack of physical activity. Thus, the city would greatly benefit from a mobility shift from driving to cycling. Although different barriers to cycling such as external individual and social psychological are described. Empirical research in Europe has identified attitudes towards cycling and the perceived image of cycling are key factors influencing intention to cycle; yet there is a lack of research about people's attitudes to cycling and the perceived image of cycling in Latin America, and particularly in Mexico City. It is argued that this gap in knowledge is the motivation for carrying out this study. The chapter also states the importance of exploring the social representations of cycling in the case study, in order to understand its possible link with the barriers to cycling that people face. The ultimate aim of this study is to identify the most appropriate policy measures to change the perceived image of cycling and to change people's behaviour and achieve modal shift.

The chapter is organized as follows. The second section contains the background to the problem. It explains how external and individual factors such as infrastructure and facilities, weather, and sociodemographic play an important role in discouraging bicycle use. However, the key role of socio-psychological factors in deterring people from cycling is also emphasised, based on a review of literature in Europe, North America and Latin America. This section contains views and observations from the current situation linking socio-economic position and cycling, and how this might be linked to

the social representations of cycling. In section three the research problem is stated. The section explains the current problems associated with negative attitudes towards cyclists. It highlights the need to understand how the image of cycling and cyclists is perceived and to explore the extent to which the perceived image of cycling influences individuals' choice to cycle or not to cycle. In order to explore this gap, section four describes the research aim and the research questions guiding this study. In this section, it is argued that a key determinant of the choice to cycle or not to cycle is the perceived socio-economic status attached to the image of cycling and cyclists. Further, it explains that the objectives of the research are to explore attitudes towards cycling and the perceived image of cycling in Mexico, to test a methodology to segment the population according to their attitudes towards transport and to develop a statistical model to predict behavioural intention to cycle. Section five contains the assumptions made by the researcher and the limitations faced in the research process. The last section presents a description of the structure of this thesis.

## **1.2 Problem Background**

The population growth and the popularity of private motor vehicles (leading to an increase of the use of cars) have resulted in severe traffic congestion in cities of all sizes around the world (Stefanello et al., 2017). Traffic congestion is the cause of diverse problems, for instance, it increases vehicle emissions because driving at low speed provokes an increase in the pollutants emitted and therefore contributing to air pollution (Zhang and Batterman, 2013). Air pollutants from the combustion of fossil fuels from motor vehicles including carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>) are affecting peoples' health because exposure to those pollutants is leading illnesses from respiratory problems such as bronchitis and asthma to heart disease and lung cancer in the population (Künzli et al., 2000, Kampa and Castanas, 2008, Health Effects Institute, 2010). According to the World Health Organization [WHO] (2018) 3 million

people in the world die every year due to exposure to a very poor air quality.

In addition to the negative effects in air quality, traffic congestion have also negative impacts on travel time which in turns, have other implications in health such as overweight and obesity due to the lack of physical activity. The lack of exercise together with inadequate nutrition worldwide is cause of other illnesses such as diabetes which is leading to a financial burden at individual level but also at country level in terms of access to health services and treatments (McCormack and Virk, 2014, World Health Organization [WHO], 2018). According to the WHO (2018) by 2016 worldwide 39% men and 39% of women over 18 years old were overweight (with an body index mass of  $\geq 25$  kg/m<sup>2</sup>) and 11% of men and 15% of women could be considered obese (body index mass of  $\geq 30$  kg/m<sup>2</sup>).

But not only these are the negative consequences of traffic congestion. Other consequences include reduction in mobility or the individuals' ability to travel "easily, safely, quickly and reliably" (Falcocchio and Levinson, 2015b) and low accessibility or the "traveller's access to one or more destination opportunities available within a specific distance, travel time, or travel cost from the traveller's origin" (Falcocchio and Levinson, 2015a).

Mexico is a highly motorized city which is facing challenges of congestion and pollution (United Nations Human Settlements Programme, 2015) and a population with health problems linked to the lack of physical activity (Secretaria de Salud, 2014). Travelling to and from work at rush hour, for instance, is estimated to take up to 3.5 hours (United Nations Human Settlements Programme, 2015), placing Mexico City as one of the most congested cities in the world (International Business Machines Corporation [IBM], 2011) The population's lack of physical activity together with inadequate nutrition is leading to an increase in obesity in people over 20 years old, which is linked to other health problems such as diabetes (Secretaria de Salud, 2014, Secretaría de Salud, 2016) aa tendency that is expected to increase for all age groups (Rtveladze et al.,

2014). Diabetes and other cardiovascular illnesses are among the main causes of mortality in the country, representing a public health burden (Instituto Mexicano de la Competitividad, 2015).

Bearing in mind the situation described above, Mexico could benefit a lot from an increase in cycling levels. However, to date only 0.9% of the trips in Mexico City are made by bicycle although half of the total trips could in principle be cycled (López, 2013), since all those trips are of less than 8 km and can be cycled in under 30 minutes (Universidad Nacional Autonoma de Mexico-SMA, 2008) . Besides this, for distances of up to 5 km in peak hours the bicycle is faster than private vehicles (Gatersleben and Appleton, 2007, Feng et al., 2014) or at least compete with cars during week days in urban areas (Faghih-Imani et al., 2017). In Mexico City, due to traffic and congestion, in peak time the average speed of private vehicles is 14 km per hour; the average speed of public transport is 12 km per hour (Institute for Transportation and Development Policy., 2017)

Regarding bicycle speed, research about the bike share system in France stated that the average speed of a bicycle is 13.5 km per hour (Jensen et al., 2010). One study in Mexico City, pointed that cycling can reach a maximum speed of up to 16.4 km per hour (Universidad Nacional Autonoma de Mexico-SMA, 2008). But to consider cycling speed, it is important to bear in mind that individual and external factors such as physical endurance, health, topography and weather play an important role.

The literature review found different barriers to and facilitators of cycling. In this study the barriers are divided into three main types: external, such as weather, infrastructure and facilities, individual such as physical endurance, health, distance travelled, etc; and social or psychological, that are linked to individuals' cognitive processes such as attitudes and perception. These barriers are analysed in detail in the Literature Review in the next Chapter Two.

### **1.3 Problem Statement**

To reduce car use for short journeys and promote modal shift towards the use of the bicycle in cities it is important to explore the image of cycling and cyclists and to investigate whether there is a socio-economic status attached to cycling. This will help to inform transport-policy makers and practitioners on the design of soft policy measures focused on promoting change in individual and social behaviour, and on how crucial it is to develop measures to improve the image of cycling in order to persuade and influence targeted road users into cycling. This in turn will ensure that investments in cycling are applied more effectively and that the positive effects of transport interventions in general are maximized.

A recent study about factors influencing the use of the bike-share system in Mexico (Ecobici) found that the principal motivators for using the bicycle were to be active, to avoid traffic and to reduce time spent travelling. Barriers to cycling reported were drivers' lack of road safety education, inadequate physical environment and accident risk (López, 2015). However, that study focuses on people who have membership of the bike-share system, and these are people who have the intention to cycle. To date, there is little research about the motivators and barriers of people who do not cycle, and particularly about the emotional factors influencing their decision, even though this review of the issues surrounding cycling in Mexico City has identified that social image and perception of socio-economic position is linked to attitudes and behaviour.

We can conclude that there is a real gap in the understanding of how the image of cycling and cyclists is perceived, and its relationship to different socio-economic contexts in Mexico City. This gap in understanding was the motivation to explore the extent to which the perceived image of cycling influences individuals' choice to cycle or not to cycle. This is attempted in the present study, in which it is argued that a key determinant of the choice to cycle or not to cycle is the perceived socio-economic status attached to the image of cycling and cyclists.

Dittmar (1994) stated that material goods can be 'stereotypical descriptors of different socio-economic groups'. In this sense Steg (2005) stated that a private vehicle might represent a status symbol. Based on this, the use of bicycle as a mode of transport has a social meaning, which could be related to a socio-economic 'stigma' which Aldred (2013b) described as 'the shame that may be attached both to not being a car owner and to being a car owner'. In a highly motorized city like Mexico City, cycle commuting can be perceived negatively and consequently can lead to an unfavourable attitude.

To date, there is research about the role of attitudes and habits in the decision to cycle in Spain (Rondinella et al., 2012). Fruhen and Flin (2015) investigated the link between aggressive drivers and attitudes towards cyclists. Regarding the concept of the image of cycling, identity, and stereotypes, there is a small, but growing, literature on gender and identity related to cycling, while some studies have focused on the notion of cycling citizenship, identity of cycling activists and identity attached to the level of competency when cycling (Aldred, 2010, Aldred, 2013c, Aldred, 2013b). However, relatively little attention has been given to the perceived socio-economic status attached to the image of cycling and cyclists. Some work has focused on identifying a typology of cyclists associated with their ethnicity, gender and social class, and what role this plays in choosing healthy transport choices (Steinbach et al., 2011). One study in North America explored the validity of a typology of cyclists that was based on people's level of comfort when cycling (fearless, confident, concerned) and on people's interest to commute by bicycle (enthused, interested, no way) (Dill and McNeil, 2013). In Canada, a multidimensional typology of the cyclist population has been developed, but based only on their cycling frequency (Damant-Sirois et al., 2014).

Although Lugo (2012) stressed the existence of marginalization related to Latino or African American men who use the bicycle for economic reasons and low-income cyclists groups in Los Angeles in the USA, there is no known study in Mexico that has explored

specifically the perceived socio-economic status attached to the image of cycling and cyclists as a possible barrier to bicycle use, or that has investigated what are the main influential factors for such 'stigma' (Davies et al., 1997, Anable et al., 2006b, Horton et al., 2007a, Aldred, 2013b, Jones and Novo de Azevedo, 2013).

## **1.4 Research Aim and Objectives**

### **1.4.1 Research Aim**

The overarching aim of this study is to investigate the social psychological barriers towards cycling and whether the perceived socio-economic status attached to the image of cycling and cyclists in Mexico City influence intention to commute by bicycle.

Simultaneously to the study's aim, the existence of attitudinal transport segments was also explored, following the methodology from the Segmentation Project<sup>1</sup> (Anable, 2010). This methodology is useful for detecting and creating groups and subgroups according to their attitudes and beliefs (Anable, 2003, Anable, 2005a, Beirão and Sarsfield Cabral, 2007, Shiftan et al., 2008). In this study is argued that targeting the groups more willing to change their behaviour, would help to maximize transport measures and might lead to a more efficient use of economic resources (Anable, 2010). Investigating attitudinal segments is very important as this research aims also to inform policy makers and practitioners in the design of transport interventions and measures.

In order to achieve the research aims, it is necessary to formulate the research objectives. Following there is the description of the research objectives which derive from the aims explained before and are essential to answer the research questions posed in the following Chapter Two.

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<sup>1</sup> For general information about the project see: <http://www.segmentproject.eu/> .

### **1.4.2 Research Objectives**

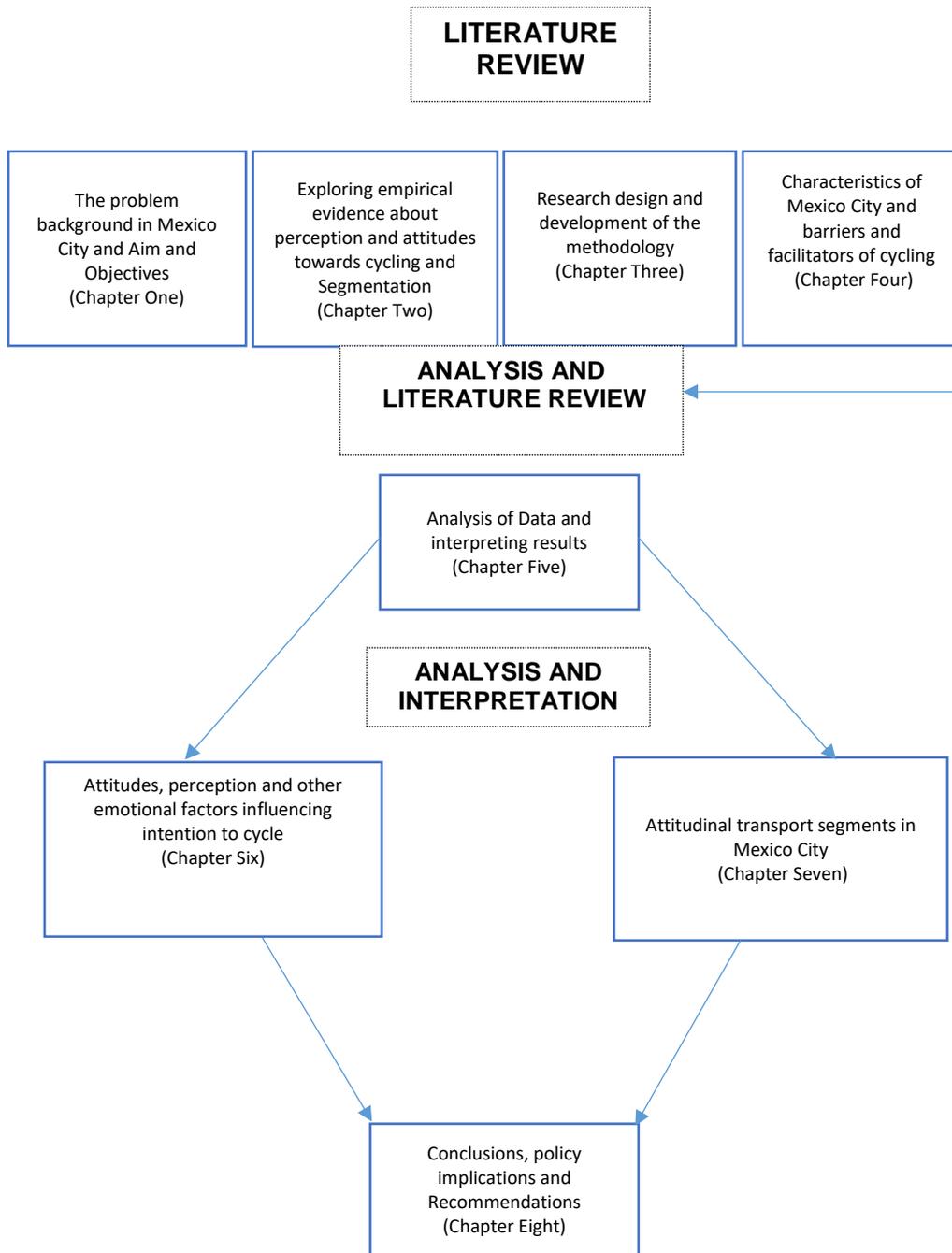
The research objectives are as follows:

- To investigate road users' perception of and attitudes towards cycling
- To identify the extent to which the perceived image of cycling and attitudes towards cycling influences individuals' intention to cycle
- To explore whether there is a socio-economic status attached to the image of cycling and the extent to which this may act as a barrier to choosing to cycle or not.
- To develop a structural model to predict behavioural intention to cycle commute in Mexico City
- To identify the existence of attitudinal transport segments in Mexico City
- To draw attention to the social and psychological factors influencing intention to cycle in Mexico City
- To propose changes in the current policy measures focused on cycling and to recommend new strategies to address issues related with the social and psychological barriers for cycling

### **1.5 Structure of the Thesis**

This thesis consists of eight chapters, which are graphically described in Figure 2. Chapter One describes the nature of the problem and the motivation for researching it. The objectives and the research questions guiding this study are explained here. Chapter Two contains a comprehensive summary of the literature reviewed. This chapter is dedicated to presenting and critically analysing the empirical evidence from other studies about perception of and attitudes towards cycling and other emotional factors influencing intention to cycle. This section also includes a review of the most common theoretical frameworks used for studying cycling behaviour and the justification for the framework selected to investigate the research problem. Additionally there is a section of the review of the use of social marketing and specially the segmentation technique to cluster the population according to their attitudes towards transport.

Chapter Three contains the research design and methodology. It describes the population of the study, the sampling procedure, the sample, the data-collection procedure and development of the questionnaire, the ethical considerations and the pilot study. Chapter Four contains the description of the case study. In this chapter the general information about Mexico City and the current barriers and facilitators for cycling are described. Chapter Five presents the analysis of the data and interpretation of the results. Chapter Six and Seven contain the discussion of the research questions based on the analysis of the findings. In Chapter Six, three related but distinct research questions are discussed. The overall aim of this chapter is to present the discussion about the role of attitudes and other socio-psychological factors influencing behavioural intention to cycle based on the model explained in Chapter Two. Chapter Seven contains the discussion of the remaining research question about the existence of attitudinal transport segments in Mexico. The last chapter, Chapter Eight, is dedicated to explaining the conclusions of this research and providing a summary of the study. This chapter also contains recommendations for policy makers and practitioners as to how to change people's perceived image of cycling and increase cycle commuting.



**Figure 1 Thesis Structure**

## **Chapter 2 Perception and Attitudes towards Cycling: An Integrated Literature Review**

### **2.1 Introduction**

Chapter One focused on describing the current attitudes towards cycling in Mexico City and to explain that those attitudes might act as deterrents for cycling. It was stated that this study aims to investigate those attitudes and the extent to which they influence intention to cycle for commuting purposes. In order to analyse the research problem the research objectives and questions were posed. Having established the relevance of the research problem and the aim of this study, it is necessary to proceed to carry out a review of the state of art on this area. This Chapter, constitutes the review of the literature about the barriers for cycling; the role of attitudes and other socio-psychological factors influencing behavioural intention to cycle based on the research questions described in Chapter One and the review of the use of social marketing and specifically market segmentation techniques as a tool to achieve more effective transport interventions and achieve actual behaviour change.

The chapter has the following structure. Second section contains the review of the literature about the external, individual and social psychological barriers for cycling. External barriers are linked more to weather, topography, air quality, infrastructure, etc; individual barriers refer to socio demographic characteristics such as income, class, age, gender, disability or other factors at personal level that influence cycle use, etc. and finally the social psychological barriers which result from individual's cognitive processes that could be linked to the current societal structures and the daily practices such as perception and attitudes.

The third section contains the methodology followed to carry out the literature review of the socio psychological barriers for cycling. This section describes the search strategy and the criteria for inclusion and exclusion of articles. Section four contains the systematic discussion of the literature and the report of the analysis. The

discussion is organized by themes. The first theme is the empirical evidence about using TPB as framework that provides the foundation for this research and to which the findings will provide a contribution. This section includes the introduction to the conceptual model to predict behavioural intention to cycle. It contains as well an overview of other theoretical frameworks used to study attitudes and behaviour, and the additional social psychological constructs incorporated in the TPB.

The second theme discussed the role of attitudes as motivator or deterrent of commuting cycling. The third theme is the role of perceived image and identity influencing intention to cycle. The following theme is the discussion about empirical evidence of other socio-psychological factors influencing intention to cycle. The theme five discussed the link between socioeconomic status and image of cycling. After the literature review of these five themes, the review showed that behavioural change could be more effective when there is a better knowledge of your audience. Thus, creating meaningful segments of the population according to their attitudes towards transport can be useful to tailor the transport interventions and measures and improve its effectiveness. Therefore the final theme in the literature review is precisely the use of social marketing techniques to explore transport segments and to promote behavioural change towards cycling. The next section of this Chapter contains a summary of the review and the discussion of the findings. The final part of the chapter includes the research questions and sub-questions based on the literature review and that will guide the research.

## **2.2 Overview of barriers for cycling**

### **2.2.1 External Barriers to Cycling**

Cycling levels around the world vary greatly (Tin et al., 2009); this might be linked to the fact that cycling can be easier or more difficult from one place to another (Horton et al., 2007a). The difference in levels can be related to barriers such as adverse weather. For

instance, rain or extremely hot or cold weather represent a barrier for cycling according to different research (Dill and Carr, 2003, Gatersleben and Appleton, 2007, Heinen et al., 2010). However, Buehler and Pucher (2012) only found statistically significant relationship between rain and hot weather but no significance between cycling levels and cold weather. This could be related more with the fact that in cycling in rain or in hot weather conditions lead more to the need for access to facilities like showers in contrast with cycling in cold weather conditions.

Topography could be also a deterrent for cycling (Gatersleben and Appleton, 2007) because the increase in the slope on the roads could discourage cyclists (Vandenbulcke et al., 2011). For instance, a hilly terrain, a prolonged slope or gradient environment can make cycling very challenging, demanding certain level of skill and endurance from the individuals. Therefore, discouraging from cycling the least fit people, for instance people with overweight which in fact would benefit more from being active.

Air quality is another factor that might act as barrier for cycling. Some research had pointed that traffic-related air pollution could be a barrier for cycling. For instance, Weichenthal et al. (2011) concluded in their study about the relationship between traffic pollution and severe changes in heart rate variability that their findings suggest that short-term exposure to air pollution from cycling may contribute to changes in the heart rate. De Hartog et al. (2010) argued that while cycling helps to increase physical activity, cycling in polluted cities expose individuals to inhale more pollutants than individuals commuting by a different transport mode due to the difference in the breathing rate. However, the authors concluded that in overall, considering the benefits from cycling, these compensate the risks.

Another external factor that might deter individuals from cycling is the lack of infrastructure in the urban environment (Gatersleben and Appleton, 2007, Horton et al., 2007b). Specifically about cycling, research suggests that infrastructure influences injury and crash risk (Reynolds et al., 2009). The lack of infrastructure can lead to

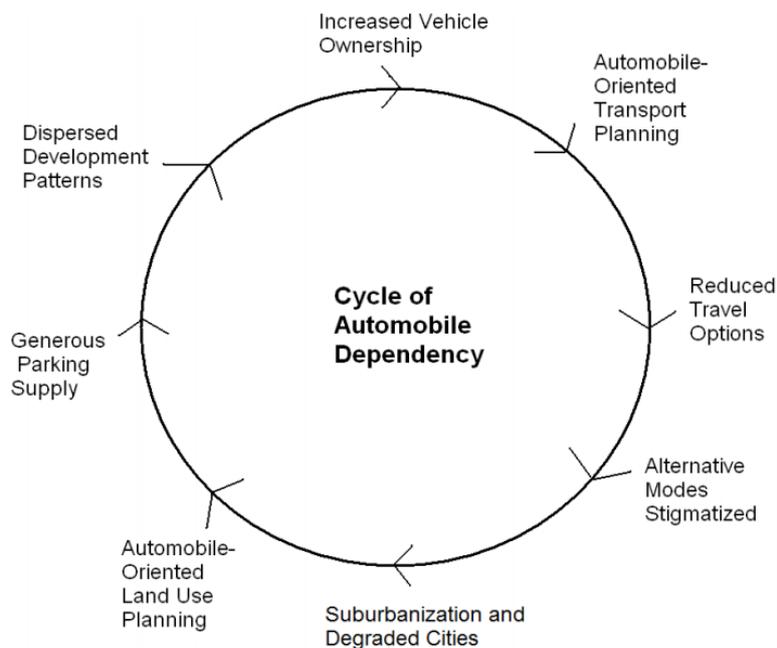
accidents, affecting people's perception of cycling's safety (Heinen et al., 2010). It is argued that where the infrastructure is mainly focused on motor vehicles it entails risks to road users and discourages walking and cycling (Pucher and Dijkstra, 2000).

Although car ownership also could represent a barrier for cycling this is not always the case. Research has shown for instance, that in the Netherlands and Denmark, countries with an elevated number of cycling trips, also have a high rate of car ownership (Horton et al., 2007a). In contrast, Buehler and Pucher (2012) found that the cities with greater car ownership showed lower cycling levels. This could be linked to the speed limits the authors argued, because high speed of cars and public transport on the roads reinforces the choice of car use, discouraging cycling (Jacobsen et al., 2009) such is the case of Los Angeles in the USA (Paterson, 2000, Lugo, 2013). In this regard, Mexico City follows a contradictory transport policy, investing in some cycling projects but simultaneously making investments dedicated to the improvement of the car-oriented infrastructure, such as adding a second tier to the ring road and parking lots to accommodate the demand from motor vehicles (López, 2009). This restricted the use of the bicycle to specific places (with lower speed particularly), which in consequence makes its use less common and almost abnormal.

The risk of injuries and fatal collisions for cyclists results from factors including high-speed roadways, inadequate signalisation, absence of bike lanes or no integrated cycling paths and routes (Pucher and Dijkstra, 2000), but also due to drivers' behaviour (Davies et al., 1997, Fruhen and Flin, 2015). For instance, in Mexico City, a survey revealed that 76% of cyclists (bike-share system users solely) would prefer to cycle on the pavement because it is safer and 56% of them also considered riding on local streets as a better option in order to avoid accidents (López, 2015).

Perception of safety can be improved with adequate infrastructure and purpose-built, bicycle-specific facilities. Cycling infrastructure and facilities are important measures to promote bicycle use since these reduce not only the fear of cycling related to the perception of

safety (Horton et al., 2007b) but also the risk of incidents and injuries from actual crashes (Reynolds et al., 2009). Although a poor cycling environment or wrong infrastructure and facilities may discourage people from cycling, it is important to highlight that creating new infrastructure or improving the current conditions will not automatically increase numbers of commuter cyclists (Lugo, 2013). One example is the study carried out by Goetzke and Rave (2011). With a sample of 3281 records of home-based, weekday trips taken by the adolescent and adult population in Germany, the authors studied the impact of social networks and bicycle culture on bicycle trips. They evaluated four models according to different trip purposes: model one was school and work combined, model two was trips for shopping, model three was errands, and model four was recreational cycling. The authors concluded that bicycle culture influences recreational trips and in some degree trips for shopping but there is no influence on commuting by bicycle for school or work; whereas they found that infrastructure for cycling only increases trips for shopping and errands (Goetzke and Rave, 2011). Deterrents for cycling are very diverse, but those linked to infrastructure are strongly related with car use as we can see in Figure 2



**Figure 2 Cycle of Automobile Dependency and Sprawl (Litman, 1995)**

The cycle of automobile dependency is helpful explaining the factors affecting the image and the use of bicycle. For instance, suburbanization, land-use and housing policies have contributed to increase travel time. Transport planning has contributed to the transformation of the urban space with roads prioritized for high speed vehicles and the encouragement for construction of parking spaces. As well as the poor quality in other transport alternatives, giving a negative image for instance, of the public transport in some places. All these, have contributed to the increase in the use of private vehicles (Horton et al., 2007b, Paterson, 2000, Pucher and Dijkstra, 2000) and eventually determines who uses the space (Basford and Britain, 2002).

### **2.2.2 Individual barriers for cycling**

Other barriers for cycling could be linked to individual or personal factors such as sociodemographic characteristics. For instance, Rietveld and Daniel (2004) in a study of cycling in Netherlands, argued that income determines levels of ownership of vehicles, this means who owns a bicycle, whereas gender might be associated with the level of risk from cycling at a late time. The authors suggested also that age might be linked to level of physical fitness which in turns affect the choice of cycling or not. In a different study comparing the differences in levels of cycling in German cities, Goetzke and Rave (2011) stated the importance of gender, age and income explaining that:

“Sex, age and income are considered the most important personal variables to determine bicycle use. Males are on average more likely to use a bicycle, while bicycle riding decreases with age. Poor people tend to ride their bicycle more often” (Goetzke and Rave, 2011, p. 429).

Physical disabilities could be also a barrier for cycling because a conventional bicycle would require a minimum of physical flexibility to sit and ability to keep the balance. Some physical impairment might limit people's ability to use a conventional bicycle. In the UK, for

instance, disabled people represent only a low rates of the cycling share (Clayton and Parkin, 2016). These low levels might be result of the lack of support and adequate infrastructure. However, the use of adapted bicycles (which in fact could be cheaper than investing in adapted vehicles) would positively impact people with physical disadvantages by improving their health but also accessibility and freedom (Aldred and Woodcock, 2008).

Travel distance and time are factors that might act as barrier for cycling (Gatersleben and Appleton, 2007). Length of the trip is an important barrier to consider too, according to Goetzke and Rave (2011) “the longer the trip, the less likely the bicycle is chosen as the mode” (Goetzke and Rave, 2011, p. 432). Commuting for long distances make necessary first of all having the physical endurance, and then having access to cycling facilities such showers. Besides that, it is also needed better infrastructure. Larsen and El-Geneidy (2011) concluded in a study in Canada, that the cycling focused infrastructure positively affected trip distance.

Maybe not as a barrier but as a factor influencing variation in cycling levels is the ethnic composition (Rietveld and Daniel, 2004). In the USA for instance, the minority ethnic groups (Black and Hispanic) usually with low income are more likely to cycle (Lugo, 2013, Corona Insights, 2016). In this case, ethnicity is not acting as a barrier but as a motivator for a specific ethnical background, since it represents the cheapest transport option.

### **2.2.3 Social and Psychological Barriers to Cycling**

Many researchers have discussed the role that psychological barriers – such as intention, perception and attitudes (Milakis, 2015, Fernández-Heredia et al., 2014, Heinen et al., 2011, Gatersleben and Appleton, 2007, Davies et al., 1997), as well as cycling history and culture (Fruhen and Flin, 2015, Aldred and Jungnickel, 2014, Bamberg et al., 2003, Parkin et al., 2007c) – play as deterrents to cycling.

In some places, the perceived social status linked to the mode of transportation plays an important role as motivator or deterrent to use

it. The car, for instance, is often linked to individual “status” (Sheller, 2004). In the USA, for example, the car has for decades represented an indicator of wealth or success, and transport mode choice in general has functioned as an indicator of class belonging (Hoffmann and Lugo, 2014). It is argued that using public transport to commute is seen as inferior compared with commuting in a private car (Ibraeva and Sousa, 2014). This was also found in research in the UK when Mann and Abraham (2006) in a qualitative research interviewed eighteen drivers to explore the role of affect associated with decisions to drive or use public transport to travel to work. The authors found that respondents considered driving to be superior to public transport, although the authors highlighted that the distinction between the utilitarian and affective benefits of driving were not clear.

Regarding cycling, Handy et al. (Handy et al., 2010) explored the factors associated with cycling in different cities of the USA. The authors found that people who perceive cycling as an activity for children or for people who cannot afford to have a car were less likely to cycle. In Latin American cities the perceived image of cycling is linked to lower-income travellers (Bauman et al., 2013). And in Mexico social status linked to cycling is considered a barrier for cycling (Lastra et al., 2016). These perceived images of cycling can be formed by distinct sources, such as previous experiences (Capron and López, 2016), built environment resulting from a car-based approach to transport planning (Jacobsen et al., 2009), and also communications and media (Horton et al., 2007b).

In a study about the daily experience of car use in Mexico, Capron and López (2016) found that people’s previous experiences of using mostly the car to commute ingrained car use as part of their customs and social habits, leading them to perceive other modes of transport more negatively. This is consistent with the principle that “attitudes based on direct experience are more predictive of subsequent behaviour”, as stated by Ajzen and Fishbein (2005) (citing Fazio and Zanna, 1982). Capron and López (2016) also argued in the same study that people of medium- and higher-income social classes who

had experience travelling abroad compare public transport with that in foreign cities (particularly in Europe), and these respondents showed more negative social representations about public transport and the people using it in Mexico.

The car is a mode of transport that is very attractive and convenient to use. The car is a tool with very diverse attributes. Schwanen and Mokhtarian (2005) and Domarchi et al. (2008) argued that emotions, attitudes and normative beliefs play an important role in the decision to drive. From the perspective of the accessibility<sup>2</sup> that a private vehicle can provide, Schwanen and Lucas (2011) highlighted how distances are shortened, and also that it provides flexibility of when and where to travel. In a study in Spain (López-Sáez et al., 2014) the respondents rated the cars much higher than any public mode of transport in terms of speed and availability. But Urry (2007) also stated that cars fulfil needs that go beyond accessibility. For instance, the private car fulfils symbolic and affective needs such as sensations of freedom, thrill and adventure, feelings of social status, power and control (Steg et al., 2001, Anable, 2005a, Steg, 2005), but also the idea of personal space and autonomy (Mann and Abraham, 2006). Some research has even found a link between social class and mobility patterns, concluding that in geographical zones with higher income the car was the preferred mode of transport (Oliveira, 2015). Most of the suggested attributes of the car are usually not found in the bicycle, except for freedom, which is a characteristic frequently mentioned by cyclists in social media. However, car ownership not necessarily is linked to cycling levels. As showed in the previous section about the individual barriers for cycling.

While the generalized use of cars has built the basis of a negative perception of cycling, this has been reinforced by commercial and political interests (Steg, 2005, Pooley et al., 2010). These interests

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<sup>2</sup> Accessibility, understood here as explained by Schwanen and Lucas (2011), “concerns the potential to move from one place to another”, *Understanding Auto Motives*, chapter 1, p. 4).

are expressed particularly through communications and media. Jones and Novo de Azevedo (2013) argued that in Brazil, for instance, the national automobile industry has been heavily involved in influencing peoples' choices by attaching the idea of success to car ownership through spreading the idea. And by stimulating car ownership through easy access to credit and payment plans given by the automobile companies.

Looking at the current images of cycling and cyclists in Mexican newspapers, there are mainly two types of cyclists depicted: the first type is the professional cyclist who cycles for sport, called the 'proper cyclist' by Aldred (2013b) in research carried out in UK and this is who uses the full equipment and clothes for cycling. The second type is the user of the bike-share system (Ecobici). However, ordinary people cycling to commute are almost never shown, leading to the conclusion that cycling for commuting purposes is not viewed as conventional (Daley and Rissel, 2011).

Those two images of cyclists, the professional cyclist and the bike share system user, make cycling appear to be an uncommon activity, or only for people with specific characteristics and skills. Horton et al. (2007b) and Granville et al. (2001) argue that this has the effect of affecting the perception of cycling, and thus the intention to cycle in general. Davies (1997) stated that images of sport cyclists make cycling look like an activity to be practised only by fit and sporty people. Aldred (2013b) supported this when she concluded that presenting cycling as a sport will not necessarily increase cycle commuting. This situation represents an obstacle to bicycle use, since the images showing cycling as an uncommon activity may impact the levels of cycling (Granville et al., 2001, Horton et al., 2007b), as Aldred (2013b) concluded, stating that cycling as a sport will not necessarily increase cycle use for commuting purposes.

But the perceived image of cycling in Mexico City is not only considered uncommon or linked to sports. Cycling as a mode of transport can be also be linked to a specific socio-economic status (Hoffmann and Lugo, 2014). Socio-economic status defined here as

the position of a person within a social structure associated with economic and social factors such as income, wealth, education, occupation<sup>3</sup>, and residency. The perceived image associated with a cyclist as an individual can play an important role as a barrier or motivator to cycle. The perceived socio-economic status attached to bicycle users may differ according to the type of cyclists and the context. Horton et al. (2007a) said:

“Sometimes cycling conveys high status; sometimes it is stigmatized; sometimes it depends on what the person riding looks like, what they wear and the machine they ride” (Horton et al., 2007a, p. 7)

For instance, the status reflected by a cyclist in the Tour of France compared with a cycle courier or a student riding a bike will not be perceived in the same way. As Lugo (2012) argues, not all cyclists are the same and some cyclists can face more marginalization than others. Lugo (2012) also stated that this differentiation and marginalization results from social forces and cultural practices, forming the idea of a stigma attached to cycling as it becomes associated with a particular individual in specific socio-economic conditions (Aldred, 2013b). In this regard, to date, the review of the literature indicates that cycling in Latin-American countries such as Brazil, Colombia and Mexico is associated with being poor (Jones and Novo de Azevedo, 2013, López, 2013, Moller, 2006). In fact, Enrique Peñalosa, the former Mayor of Bogota, Colombia, declared in an interview during the Rio+20 Summit in June 2012 that in developing countries ‘bicycles have a stigma, they are identified with being for the poor’.<sup>4</sup>

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<sup>3</sup> Parkin et al. (2007c) argue that cycling behaviours are related with certain identities. Such is the case of linking cycling with the chosen occupation. They give as an example from their interviews that some of the respondents, being engineers, cycle to work, and that they looked at their ‘professional identity as cycle-friendly’.

<sup>4</sup> See: <http://youtu.be/oVhmjklRkM>, Consulted 30<sup>th</sup> September, 2014.

Understanding the perceived image of cycling and cyclists lead us to reflect on the importance of understanding the concept of identity and its role as a deterrent to cycling. Parkin et al. (2007c) stated that:

“The notion of identity can help us move beyond a ‘rational choice’ model of transport behaviour posited on an abstract universal individual, and replace it with an account of the differences in perspective and action that emerge from cultural variations between social groups” (Parkin et al., 2007c, p. 85)

The review of literature in Mexico City indicated that there is a negative identity associated with cyclists. For instance, some groups in Mexican society link cycling with a negative image and even with low-income travellers (López, 2013). As an example, in 2012 when the local government in Mexico City wanted to extend the perimeter of stations of Ecobici (the bike-share system), some residents from the high-income areas where the extension was planned opposed bicycle infrastructure in their neighbourhood, claiming that the presence of cyclists there would reduce the residential value of their property and would increase the levels of insecurity and criminality (López, 2013). From different meetings between the Minister of Environment of Mexico City and the residents of the Polanco neighbourhood (an area with a high density of jobs, business and shops, and where 80% of the household trips are made by car and only 0.22% of the residents’ trips are made by bike), López (2013) identified that residents argued that ‘the implementation of Ecobici will lead to a deterioration in the public space nearby and a devaluation of the value of the residential space’ (López, 2013).

The identity associated with cycling and cyclists might be linked to the variance in how cycling was adopted across countries. In Europe, for instance, it was the most affordable means for mobility of the masses by the 1950s, passing later from a means of transport to a leisure item, whereas for the population of the USA it was not as influential (Cox, 2015).

Benítez (1984) argued that in Mexico public transport was the predominant mode of transport for the working class from the 1940s,

and although by 1979 the car was starting to dominate, the private car was related more to the middle class, who had different needs (Benítez, 1984). This showed, as mentioned by Guerra (2015), a relationship between income and car ownership, limiting the use of the bicycle to the most disadvantaged social classes. These lower social classes used the bicycle as a mode of transport to reach their jobs and their homes, originating the link between social position and transport mode in the social imaginary of the upper social classes (Herrera Miranda et al., 2014).

Negative attitudes from drivers to cyclists have been also noticed when the infrastructure planned to be for the use of cyclists is frequently occupied by private cars and motorcycles. Meneses-Reyes (2013) in his ethnographical study about the segregated cycle facilities in Mexico City suggested that invading the cycling lines or the paths (even those with physical barriers) to avoid traffic or for momentary parking was frequent and recurrent behaviour from drivers, who, he argued, can afford to pay the monetary sanctions. Other examples of negative attitudes towards cyclists have been spotted recently in the news. For example, several incidents in which drivers verbally offended or physically attacked cyclists have been recently reported (Arrieta, 2016, Fernández, 2016, Proal, 2012), and the aggression came particularly from those drivers using luxury or expensive cars.

Drivers' negative attitudes towards cycling, strong attachment to cars, the lack of normality in the use of bicycles and social representations about cycling are psychological barriers that cannot be overcome with policy measures focusing only on infrastructure and facilities, as Meneses-Reyes (2013) concluded. Thus, identifying and implementing the most appropriate measures is a challenge that can be overcome first and foremost by exploring systematically, with the appropriate theoretical framework, what are the attitudes and the perception towards cycling and cyclists in Mexico City, and the extent to which these might influence people's behavioural intention to commuting by bicycle.

## 2.3 Methodology to explore research problem

The Literature Review is useful to establish the importance of the problem, whether in other contexts this issue is found and which methods were used by other researchers to analyse it. By carrying out this, the researcher can establish the relevance of this study, its contribution to the current literature but also its significance solving the research problem.

This research followed an integrative literature to explore the current State of Art of empirical research about perception and attitudes towards commuting cycling. Following as Souza et al. (2010), the review was integrative to include qualitative and quantitative studies available. The review aims to present a critical analysis of the literature until 2017.

The review follows a four-phase method as suggested by Souza et al. (2010). In Figure 3 there is a description of the four stages of the process.

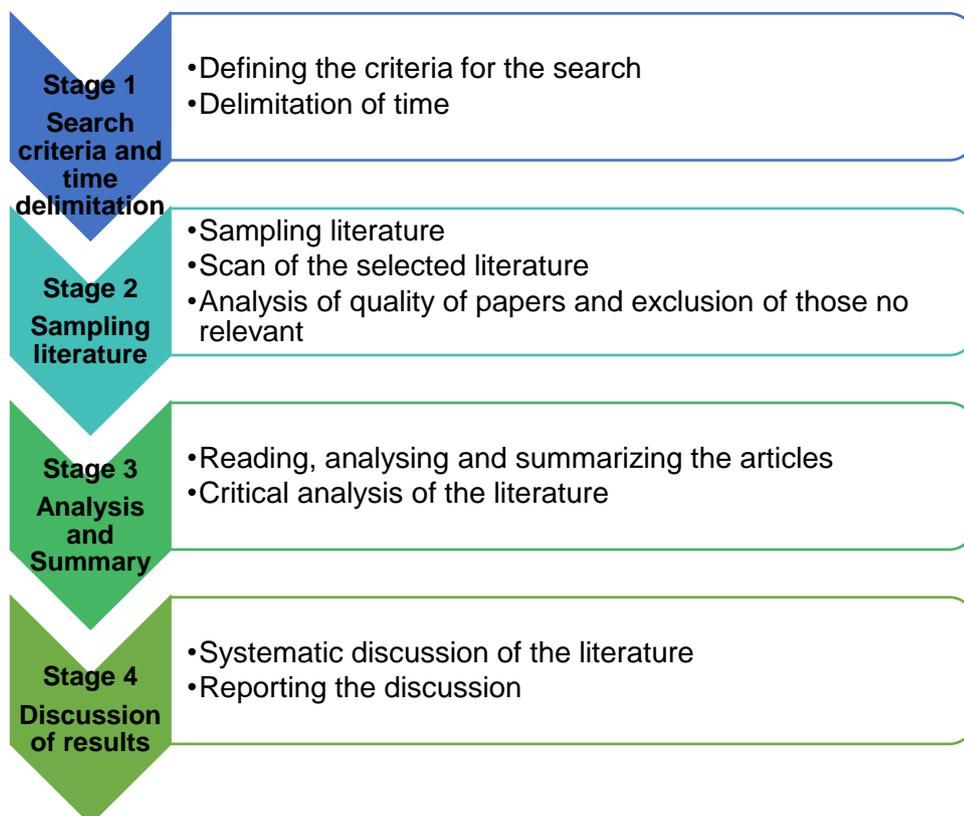


Figure 3 Flow diagram of stages of the Literature Review

### **2.3.1 Stage 1: Search Criteria and Time Delimitation**

This stage comprises the search strategy. The strategy is based on the overview of the social and psychological barriers for cycling with combination of the constructs and keywords. The first search focuses on the theoretical frameworks used to analyse the link between attitudes and behaviour. This part explored the theoretical approaches used in transport studies and particularly for cycling studies. It also examines why the TPB is considered the most appropriate theoretical approach for the research problem based on empirical evidence and how other studies have previously used additional constructs from other theories to improve the ability of TPB to understand different phenomena.

The second search was carried out to investigate empirical evidence about the role of perceived image or identity attached to cyclists and attitudes influencing intention to cycle. The search was based on the research question one (What are the attitudes towards cycling in Mexico City?) and research question two (What is the perceived image or identity attached to cycling and cyclists in Mexico City?).

A third search was targeted to explore empirical evidence about other socio-psychological factors influencing behavioural intention to cycle. It also investigated the link between socio-economic status and cycling commuting. Using keywords such as psychological factors/motivators and intention to cycle, and socioeconomic status/position and bicycle use. Search three was based upon research question three (What other socio-psychological factors influence intention to cycle in Mexico City?). A final search focuses on transport segments. This search was aimed to describe the state of art of the use of social marketing and segmentation techniques in transport studies, particularly for bicycle use. This search was based on the fourth research question about transport segments in Mexico City (Which are the main transport segments identified from the sample of the population?).

The sample characteristics were adults in a range of age from 18-60 and no commuting cyclists (or very occasional cyclists). The time

delimitation focuses on academic material published from 1997 to April 2017. The delimitation of time was fixed in consideration of the report for the Department of Transport carried out by Davies et al. (1997). In this report, the authors stressed that until then, research about attitudes influencing cycling was 'relatively sparse' and the existing literature was characterized for being descriptive instead of adopting a more scientific approach (Davies et al., 1997).

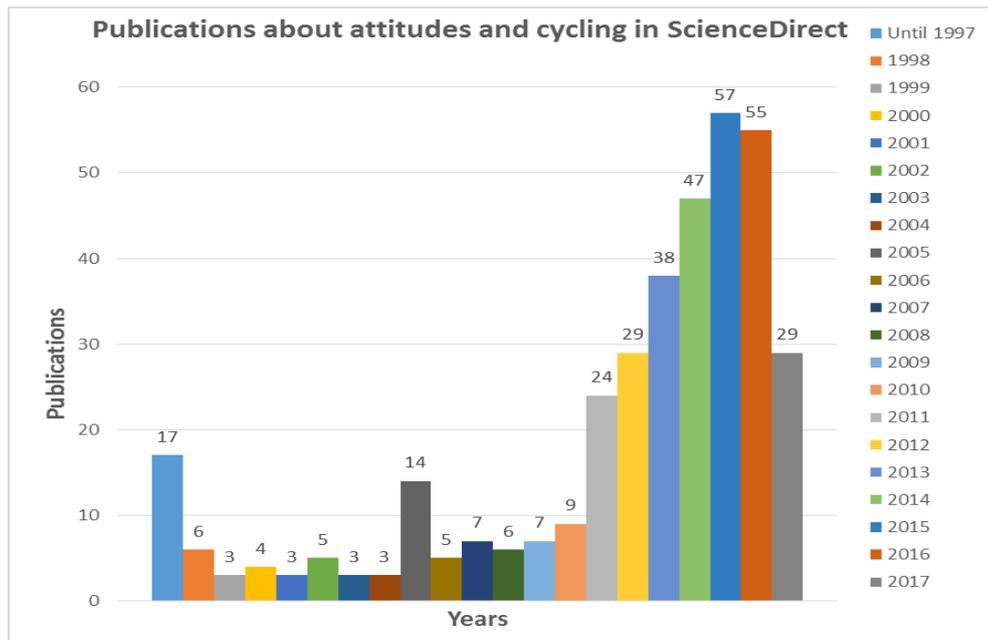
### **2.3.2 Stage 2: Sampling Literature**

In this stage, the literature is scanned in more detail. It is analysed the quality of the material and selected the most appropriate literature to be examined. The academic search engines used were Web of Science, Dialnet and Google Scholar. The search in the three engines included books, thesis, and articles (including citations). All sources were scanned to select only the studies to fit the criteria mentioned in stage one. Otherwise, the studies were excluded.

This stage was divided into three steps. Step one was a search in electronic databases. The search was in articles and other references (books, reports, and thesis) in any language by using three different search strings as explained in stage one and explored the title, keywords and the abstract. The step one search yielded 167 results in total, but only seven documents were relevant to this study. A substantial number of papers were excluded since most of them were not related to the behavioural intention to cycle. Other articles focused on different topics such as perception of risk or perception of performance. Besides, the samples used did not meet the criteria described before. Consequently, the initial search yielded a very small sample of articles.

The step two of the stage two consisted of a manual search in journals. Using the academic database ScienceDirect the researcher identified the relevant literature and the years were more articles on the topic "perception and attitudes to cycle commuting" were published. Therefore, the search was narrowed by selecting only publications title in Transport Research part A, F and D; Journal of Transport Geography; Transport Policy; Procedia Transport

Research; Social and Behavioural Sciences and Travel Behaviour and Society for being the most relevant to this study. This search yield 371 results. The Figure 4 below shows the evolution of the papers in this topic by year. In the graph can be seen that in 2005 there was a peak in the publications with 14, but then the number of the publications decrease until 2011 where the number increase to 24, and from there, the research produced increases steadily.



**Figure 4 Evolution of publications of journal articles about perception and attitudes to cycling**

Based on these results, the search was narrowed in the same database limiting the time for the publications to be from 2005 to 2017, having as results 327 articles. These results were analysed in more detail from the abstract, and after deleting the articles that did not match the initial criteria, the final sample from Science Direct was of 10 articles. The step three in the searching phase was reviewing references described in the selected studies (snowballing search). This process allowed the researcher to choose other 12 articles and two book chapters to add to the sample to be retrieved and analysed in more detail. At this step it was gathered a sample of 24 documents in total, but from the final detailed review the final sample included in

this review is 20 documents in total including articles and book chapters (see Appendix A).

### **2.3.3 Stage 3: Analysis and Summary**

The third stage of the method followed in the literature review consisted of reading, analysing and summarizing the articles. The full matrix with the details of each article reviewed it is found in Appendix A, at the end of the Thesis.

### **2.3.4 Stage 4: Discussion of Results**

This stage consists of reporting the discussion of the results. Here there is the critical analysis and systematic discussion of the literature. It was reviewed the validity of the methods and results from the sample and summarized the empirical research. The summary is divided into six different themes. The first theme is the theoretical approaches to investigate the link between attitudes and behaviour and the presentation of the proposed model of the extended version of TPB as the main approach to investigate our research problem. The second theme is about the role of attitudes towards cycling and the factors influencing attitudes. The third theme is the perceived image of cycling and identity attached to cyclists. The fourth theme is the existence of other socio-psychological factors influencing behavioural intention to cycle. The fifth theme identified from the review is the socio-economic status attached to the image of cycling and cyclists and whether this might influence people's intention to cycle. The sixth and final theme is about the use of social marketing and segmentation techniques for studying cycling.

## **2.4 Results and Discussion**

### **2.4.1 Theoretical Framework**

Synthesising the results of the literature review, it can be concluded that researchers used different theoretical frameworks to investigate transport behaviour. However, research findings suggest that developing a conceptual model based on the extension of the TPB incorporating additional social psychological constructs was useful

investigating the complexity of the link between attitudes and behaviour towards cycling. The strength of the effects of some of the other factors on intention is still subject to further research. In the particular case of Mexico City, to the best knowledge of the researcher, no studies were found focusing on cycling behaviour and the use of TPB neither in its original form or incorporating additional constructs. However, Lastra et al. (2016) produced a report proposing a methodology to assess and plan cycling infrastructure. One chapter is focusing on the analysis of the social perception of bicycle use in Mexico City. In this chapter Lastra et al. (2016) crosscheck information from a mobility survey carried out in 2008 with socioeconomic information. Although the analysis is focused on the variables influencing choice of cycling routes, parking for the bicycle and the connection with other transport alternatives, the study also highlighted that in general the attitudes towards bicycle are positive but social status play a role as deterrent.

Following there are the summary and discussion of the literature reviewed about the theoretical frameworks and the discussion of selecting the TPB in this study.

#### **2.4.1.1 Different Approaches to the Analysis of Behaviour**

In the literature, many different approaches from the social psychology and sociology had been used to explore the link between attitudes and behaviour most of them used previously in transport studies. Based on previous literature (Van Lange et al., 2012, Tapp and Parkin, 2015), the following Tables 1, 2 and 3 briefly present an overview of the relevant approaches.

**Table 1 Theories using Injunctive and Descriptive Social Norm for understanding attitudes-behaviour**

Theory	Author (year)	Description
The Focus Theory of Normative Conduct Social Norm Theory	Cialdini et al. (1991)	Social norms are factors influencing behaviour Social norm is the estimated behaviour of a group of people of which the individual feel part of. There are three types of Social Norms (SN): a) Descriptive norm: based on the perception of how others behave b) Injunctive norm: based on the perception of the approval or otherwise of an individual's conduct by others. c) Personal Norm: based on how an individual would assess his or her own conduct.
Theory of Planned Behaviour (TPB)	Ajzen (1985, 1991)	Any behaviour is preceded by intention. Intention is in turns, influence by attitudes, subjective norm and perceived behavioural control. 1. Attitudes are the sum of beliefs about an outcome. 2. Subjective norm is the sum of belief of 'significant' other people 3. Perceived behavioural control is the sum of individual measures of control over the behaviour.

Table 1 shows that the Social Norm Theory (SNT) and the Theory of Planned Behaviour (TPB) have in common that both analyse social norm. The SN theory explains that SN could have three different categories. The descriptive and the injunctive, whereas the TPB address the same by using the concept of subjective norm which is composed by the sum of the individuals' beliefs about how others behave and their opinions. However, the TPB takes a step further by considering also attitudes and perception of control as precedents for intention and as results in any behaviour.

**Table 2 Theories using stages of change for understanding attitudes-behaviour**

<b>Theory</b>	<b>Author (year)</b>	<b>Description</b>
Trans-Theoretical Model (TTM) of behaviour change	Prochaska et al., (1994); Prochaska and DiClemente (1986)	There are five different stages of change: <ol style="list-style-type: none"> <li>1. Pre-contemplation (no intended action)</li> <li>2. Contemplation (awareness that change may be necessary)</li> <li>3. Preparation (intention to take action is created)</li> <li>4. Action (behaviour is changed)</li> <li>5. Maintenance (work to prevent return to initial stage)</li> </ol>
Stage model of self-regulated behaviour change. Mixed model of Theory of Planned Behaviour (TPB) with models of the stage-of-change type (a model of the social change type).	Bamberg (2014) (2012)	The theory comprises four stages: <ol style="list-style-type: none"> <li>1. Pre-decision</li> <li>2. Pre-action</li> <li>3. Action</li> <li>4. Post-action</li> </ol> Any behaviour pro environmental it is pro-social or altruistic, and the theory assumes that personal moral norm precede the behaviour.

Table 2 shows the TTM analyse behavioural change by breaking dawn any behaviour into five stages including pre and post stages. This theory has been successfully used in health related behaviours and also in transport, in fact Bamberg (2012) and (2014) used it together with TPB. The TTM and its use could bring issues in particular to explore the factors influencing intention to cycle for instance, when it is necessary to define each of the stages. If individuals have negative attitudes towards cycling it could be difficult to specify when there is a stage of pre-contemplation and in fact, this approach is not useful to understand the factor influencing the stages of change. Another limitation from the TTM are the limits of each stage which are not clear to be set due to several different factors influencing intention to cycle. On the other hand, not all individuals pass the five stages.

**Table 3 Theories using observation of others' behaviour for understanding attitudes-behaviour**

<b>Theory</b>	<b>Author (year)</b>	<b>Description</b>
Social Identity Theory (SIT)	Tajfel (1981)	Theory that explains intergroup behaviour, stating that behaviour is based on the observation of members of the same group.
Social Learning Theory (SLT)	Bandura (1969)	All actions carried out are learn from observing the individual's significant ones. Possibility of learning a new behaviour by social reinforcement and approval post-actions.
Social Comparison Theory (SCT)	Festinger (1954)	Comparison against other is the drive for self-evaluation and self-enhancement. Such evaluation can be carried out in upward or downward comparisons.

The SIT possess limitations to investigate the phenomena that this study is aimed to explore, because this theory only helps to explain intergroup behaviour. This theory would be helpful to understand the differences between cyclists among the different types or only drivers, however, it is not addressing issues from intergroup such as cyclist-driver. The second approach is the SLT is useful to understand how individuals shape their opinion by observing people important for them, however, this is addressed in the TPB (subjective norm) but this study is focusing on the influence of other people that individuals observe on the street and not only the individuals' important ones. The third theory in the Table 3 described the SCT, explains the role of personal norm (and therefore overlapping with SNT) and it points at comparisons at two levels (upward and downward) and that can be carried out with people that are or are not the individuals' important ones.

In summary, the review showed that seven main approaches had been useful to explain the link between attitudes and behaviour. However, some of the approaches limit the analysis to only one variable (SNT, SIT, SLT) and sometimes overlapping with the constructs in the TPB. The TTM offers a more broad analysis by

providing 5 stages to analyse the route for carrying out a behaviour, however, this theory presents diverse challenges particularly to analyse intention to cycle. Not all infrequent cyclists pass through all the stages of change, for instance, pre-contemplation and contemplation and the limits from one stage to the other stages is not clear to establish for cycling behaviour. Therefore it could be concluded that the TPB presents a more applicable framework to explore the phenomena of attitudes towards cycling in Mexico City. Adding the SCT, it could be helpful to understand more about the influence of others, however, there is still the need for adding another theory that helps to explain the role of the emotional factors and the behaviour. In the following section there are further details of the chosen framework.

#### **2.4.1.2 Choosing Theoretical Framework**

Finding a theoretical framework that systematically guides this study is essential to be able to understand the research problem in a coordinated and coherent way. The theory helps as well “to identify the variables and possible relationships to be studied” (Robson, 2002, p. 156). Besides, establishing a theoretical framework, it is essential because once the research problem is explored and the research questions are answered, suggestions for the design of transport policy measures will be included in chapter eight. These recommendations aim to inform transport planners and policymakers in the design of policy measures and interventions. The theoretical framework is useful to understanding the policy interventions and assessing whether transport interventions are successful or not (Bamberg et al., 2011) because it is possible to carry out analysis based on the variables and measure the extent of the success of the measures.

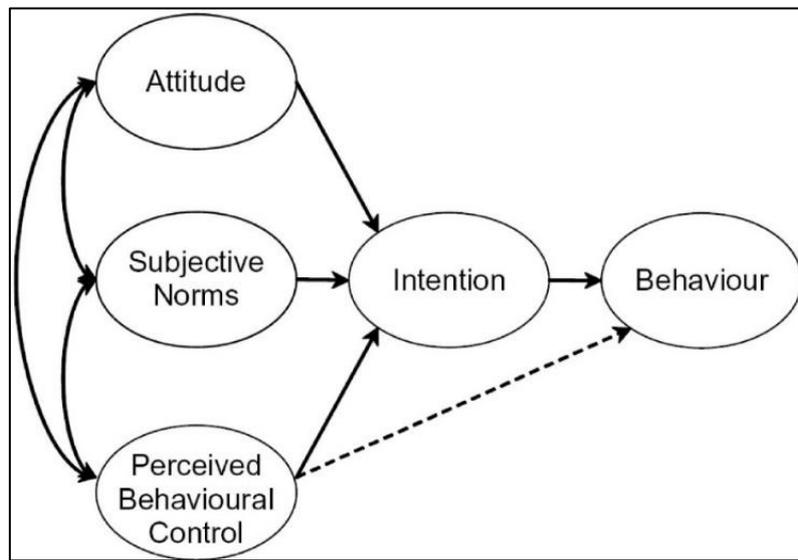
Someone’s behaviour is an individual response to a series of beliefs that result from a cognitive process (Ajzen, 1991). These assumptions can be incorrect, irrational or based on prejudices (Ajzen and Fishbein, 2005). Understand this cognitive process, and the different predictors of the behaviour have been historically difficult

and challenging for the social psychology (Fazio and Olson, 2007). An additional challenge understanding behaviour result from individual characteristics such as gender, age, cultural, situational and educational differences and even from the social and physical environment and the information accessed (Ajzen and Fishbein, 2005). To understand this cognitive process in different fields, social psychology once called the study of attitudes, had explored the role of attitudes influencing subsequent behaviour (Fazio and Olson, 2007). In transport studies, psychological theories have been pointed out as the essential framework to explore attitudes and transport behaviour (Davies et al., 1997, Heinen et al., 2010, Heinen et al., 2011), because these theories are helpful explaining the link between attitudes and behaviour.

According to researchers, not only attitudes are linked to individual's behaviour. The Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980) established that intention, precedes any behaviour and that the intention is influenced by other factors such as attitudes and subjective norms. This theory was improved by adding the concept of perceived behavioural control as a construct resulting in the Theory of Planned Behaviour (TPB) (Ajzen, 1991). Although this approach has been applied mainly to analyse behaviours in relation with health, it has been considered in transport studies as one of the most influential theories to explain the link between attitudes and behaviour (Basford and Britain, 2002, Anable, 2003, Bamberg et al., 2011, Anable et al., 2006a).

For instance, analysing particularly factors deterring and motivating cycling, Parkin et al., (2007c) argued that understanding and measuring the factors influencing the choice to cycle is difficult, thus measuring those factors carefully is essential. But the TPB with the additional variables it could help to explore the factors preceding intention to perform a behaviour. Control factors and social norm explained in the TPB had been already used in European studies to understand bicycle use.

The TPB is a theory considered essential in transport studies (Basford and Britain, 2002, Anable, 2005a, Bamberg et al., 2011). Because it incorporates notions of moral norm and it has been useful to understand the gap in attitude and behaviour in transport studies (Anable, 2003, Anable et al., 2006a). The TPB which states that intention precedes any behaviour is turn influenced by the interaction of these three elements: attitudes, subjective norm and perceived control. According to Ajzen (1991), Attitudes are determined by positive or negative **behavioural beliefs** about the outcome of the behaviour. Subjective norm is defined by **normative beliefs** about that behaviour. These beliefs are the perceived individuals' expectations from the important people (the referent group). Individuals' **control belief** determines perceived behavioural control. This is the individual's perception of their ability to perform the behaviour. The behavioural, normative and control beliefs are also influenced by personal and demographic characteristics, individual, social, and information "background factors" (Ajzen, 2002). Figure 5 contains the model of the TPB.



**Figure 5 Theory of Planned Behaviour (Ajzen, 1991)**

Ajzen (1991) defined behaviour as 'the observable response in a given situation with respect to a given target', in the context of this study, the target is to use the bicycle over other transport modes.

Intentions that precede any behaviour are understood as the promptness to perform a determined behaviour. This promptness 'capture the motivational factors that influence a behaviour' (Ajzen, 1991).

A definition of attitudes in the context of cycling was given by Basford and Britain (2002):

"Attitude encompasses a range of factors but may be summarised as a general orientation towards, in this case cyclists and the degree to which they are viewed as legitimate road users. Attitude also encompasses the subjective assessment of the characteristics of cyclists as sharers of road space" (Basford and Britain, 2002, p. 3).

Basford (2002) used the TPB and highlighted that perceived behavioural control is an essential part of the framework since it has implications for inappropriate behaviour when this is not necessarily reflecting negative attitudes for choosing a transport mode. He concluded that the TPB was useful to detect how drivers consider themselves as an in-group while cyclists are an out group.

The influence of other people are explained by Avineri (2011)

"Individuals are influenced by 'significant others', people in their social networks, and people who have geographical and social proximity (neighbours, work colleagues, class colleagues)" (Avineri, 2011, p. 3).

To understand the impact of others' opinions on peoples' behaviour the TPB considers the subjective norm. Regarding cycling, this is a concept important to consider in studies where cycling is not a traditional practice. Heinen (2011) evidenced that the perceived opinion of others only affects the mode choice over short distances, but the study case was based only on cyclists' sample.

The perceived image of cycling (and the self-image of the cyclist) can be influenced by how the individuals' referent group, expect that person to behave, as explained by subjective norm of the TPB

(Ajzen, 1991). The subjective norm assesses the strength of the Injunctive Normative Beliefs and the Descriptive Normative Belief using injunctive and descriptive referent groups. In contrast with the Social Norm Theory which states that there are norms that are related to the group, the individual feel is belonging to. So there is not necessarily a relationship but identification with a certain group. Social Norms as explained by Cialdini et.al. (1991) can be of three kinds. Descriptive (based on the individual's perception of how the group he belongs to behave); injunctive (based on the individuals perception of the approval or disapproval by the group he belongs to) and personal (based on how the individual assesses his or her own behaviour).

#### **2.4.1.3 Extended Version of the Theory of Planned Behaviour (TPB)**

Although the use of TPB is useful and had been used in previous research, an approach based on the reasoned action have its limitations (Ajzen and Fishbein, 2005) mainly to explain more complex behaviours. To date, empirical evidence of the use of an extended version of the TPB is increasingly growing. Some studies had focused on applying this extended version to study health-related behaviours (Rise et al., 2008) and some more research had focus on other behaviours such as cheating in exams (Harding et al., 2007, Mayhew et al., 2009).

In the transport field, Heath and Gifford (2002) carried out a study in Canada with a sample of university students. The authors aimed to predict intention to use public transportation. The authors incorporated as additional constructs descriptive and moral norm, awareness of and perceived responsibility for the problems caused by car use, and environmental values. They concluded that the additional factors influence intention to use the public transport.

Anable (2005a) undertook a study using a sample of visitors to leisure destinations in the UK and developing an extended version of TPB to identify the characteristics of different groups and explore them as travel behaviours segments with different propensity to use

alternatives to the car. The additional constructs were moral norm (a feeling of personal obligation or commitment); environmental attitudes, efficacy (perceived belief about what can be achieved), identity /behavioural norm (the behavioural norm is more acceptable than subjective norm to explain social pressure impact on behaviour) and habits. Her study concluded that the conceptual model of the TPB with the additions helped to interpret behavioural intentions in the segments identified.

Those previous studies showed the importance of the use of additional factors to explain complex behaviour. Choosing to cycle over other modes requires understanding the rationed action behind but also other factors of affective and symbolic dimension. Choosing to commute by bicycle can also be influenced by other individual cognitive processes such as individual's self-opinion. Self-opinion can be formed in the process of upward or downward comparison with users of other transport modes. Theory of Social Comparison (Festinger, 1954) is helpful to explore the influence of individuals engaging in social comparison. Other important factors, such as instrumental, symbolic and affective motives were explored explained by the Material Possession Model (MPM) (Dittmar, 2008). Previous research had used this model for understanding the meaning people attribute to personal possessions (Stokes and Hallett, 1992, Steg, 2005). This approach can be useful to understand whether the use of the bicycle is associated with an object that fulfils other needs and desires other than the instrumental. To provide a better explanation of the factors influencing attitudes towards the use of bicycle and answer the research questions stated in Chapter One it is necessary the use of the TPB in an expanded version. As explained previously, the SCT and the MPM provide constructs that can be helpful to understand the underlying motivations or barriers for cycling in Mexico City.

### **Social Comparison Theory (SCT)**

Transport mode choice also depends upon not only rational, driven analysis, but also in the factors influencing people's opinions. To understand how people evaluate and inform their opinion about cycling this study draws upon the Social Comparison Theory (SCT) (Festinger, 1954). The TSC was developed by Leon Festinger (1954) to explain how individuals evaluate their opinions and abilities by comparing themselves to others. Thornton D. and Arrowood J. (1966) years later stated that those evaluations depend on people's individual goals.

The framework proposed by Festinger (1954) states that self-evaluation is exclusively expressed in the process of comparison with others. Self-evaluation is related with self-opinion and abilities concerning the belonging group (in-group), the formation of other groups, as well as the changing across groups (for instance from the out-group to the in-group in the context of this study would be the changing from being a cyclist to be the driver). The author stated as well that social influence and competitive behaviour results from that process of self-evaluation based on the comparison with others. Later Thornton D. and Arrowood J. (1966) added the concept of self-enhancement (comparison with someone better off) to the framework, which together with the concept of self-evaluation provided a better understanding of the process of social comparison.

### **Material Possessions Model (MPM)**

Anable (2005a) stated that exploring travel mode choice requires considering attachment to the car. Previous research used the MPM suggested by Dittmar (1994) for this objective and to examine the underlying motivations for public transport use (Steg, 2005, Steg, 2003). The MPM explains that material possessions fulfil instrumental, affective and symbolic functions. This approach can be helpful explaining the factors deterring people from cycling by exploring the whether the bicycle, as a material possession, also

fulfils the same motivations, as it has been shown for other transport alternatives previously.

In more detail, Dittmar's model (1994) explains the role of material objects and how these material possessions shape a social and economic perception. He stated that material goods could be 'stereotypical descriptors of different socio-economic groups.' Material objects have three different functions. The instrumental function, which enables the person to make use of the object. The symbolic, in which by using the object, there is a way to express self-identity or particular social position. And the affective in charge of more profound, non-instrumental needs, desires or emotions (Anable and Gatersleben, 2005b). For instance, pleasure, excitement or stress experienced by driving or cycling to work.

In the study carried out by Steg (2005), it was examined the extent to which symbolic, affective and instrumental motives play a role in car usage with a sample of drivers in The Netherlands. The author concluded that Dittmar's model could provide useful measures of instrumental, symbolic and affective motives for car use.

The importance of instrumental and affective attributes of different transport modes when traveling for work or pleasure were also investigated by Anable and Gatersleben (2005b). The author aimed to examine the importance that people provide to different commuting trips for work or leisure. Using a sample of staff, academics and postgraduate students from the UK, the authors concluded that car users confer inferior attributes to alternatives transport modes. They stressed as well that little is known about non-instrumental factors of car use and cycling and that analysing attributes other than instrumental are useful and relevant to influence people's perception about using another transport mode such as the bicycle.

In the literature review it is possible to see that other additional factors influence intention. For instance, past behaviour and habits

were mentioned as important to consider additionally in TPB.

Following it is explained the difference between both in more detail.

### **Habits versus Past Behaviour**

Habits are characterized for being cognitive goal-directed behaviour whereas past behaviour is an individual's response to past external or internal stimulus (Sommer, 2011). According to Bamberg et al. (2003), past behaviours or habits are important factors to be taken into consideration for an extended version of TPB:

Frequency of past behaviour is an indicator of habit strength, and it can be used as an independent predictor of later action [...] Investigating the role of habit requires a measure that is independent of past behaviour. (Bamberg et al., 2003, p. 176, 185).

Habits, in particular, had been defined to be a "response disposition that can be activated automatically by the context" (Neal, Wood, & Quinn, 2006, p. 198). Thus, when performing a behaviour, the element of automaticity is characterized by minimal attention and unintentionality (Bargh, 1994) which prevents the individual from considering alternative actions (Bamberg, 2014). In consequence, rather than evaluating cycling habits, this study states that the evaluation of past behaviour is more accurate because cycling in the context of Mexico City, this means in a low cycling level city, is an activity that cannot be performed without minimal attention. Besides that, previous research found that past behaviour is a direct indicator of intention (Ouellette and Wood, 1998). Following Ajzen and Fishbein (2005) habit involves past behaviour because "the frequency of a behaviour has been found to predict its re-occurrence" (Ajzen & Fishbein, 2005). Heinen (2011) also reflected about the role of past behaviour as the characteristics of cycling commuting in the Netherlands and stated that:

The inclusion of this factor implies that we assume that not all decisions to commute by bicycle are made after a rational evaluation of alternatives, but that past behaviour and

behaviour in other situations affects the bicycle commute mode choice". (Heinen et al., 2011, p. 103).

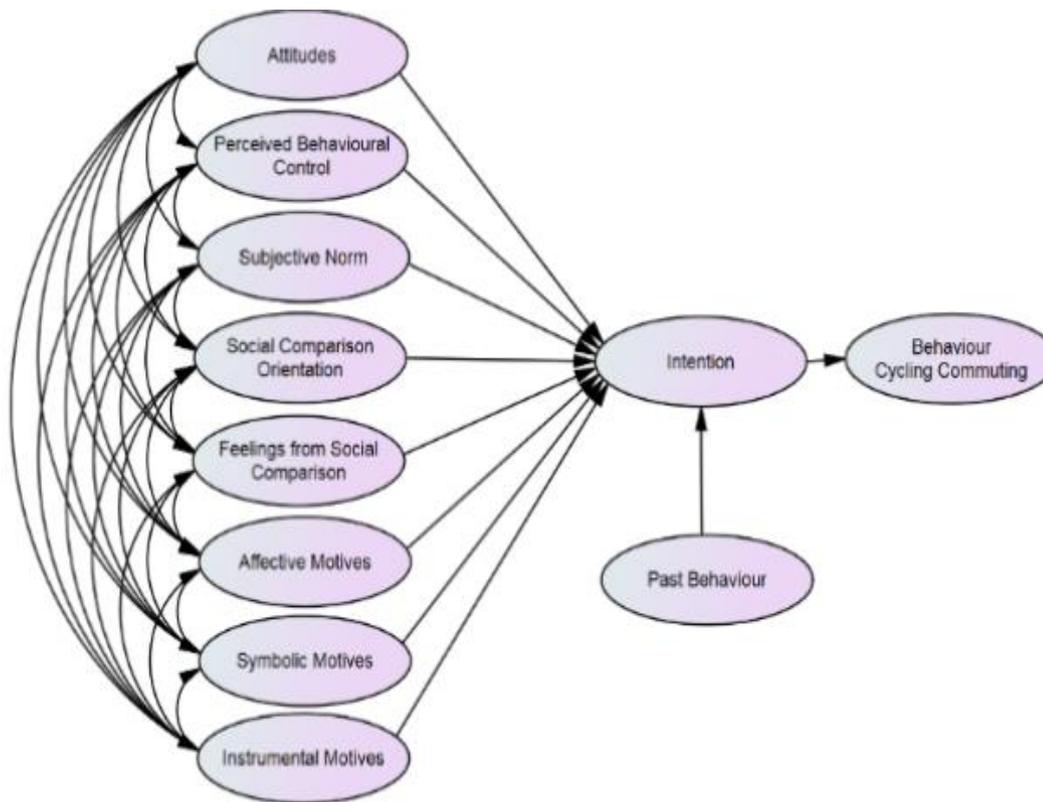
#### 2.4.1.4 Interrelation Between All Constructs

After reviewing the literature, this study is proposing a theoretical model with ten latent constructs for the conceptual framework to predict behavioural intention to cycle in Mexico City. Four constructs are from the TPB (Intention, Attitudes, perceived behavioural control and subjective norm); two constructs are from the SCT (social comparison orientation and feelings from the social comparison); and three constructs are from the MPM (affective motives, symbolic motives and instrumental motives). And past behaviour is an additional factor. See Table 4 for the constructs by Theory.

**Table 4 Theories and constructs used in the model**

<b>TPB</b>	<b>SCT</b>	<b>MPM</b>	<b>Additional factor</b>
<ul style="list-style-type: none"><li>• Intention</li><li>• Attitudes</li><li>• PBC</li><li>• Subjective Norm</li></ul>	<ul style="list-style-type: none"><li>• Social Comparison Orientation</li><li>• Feelings from the Social Comparison</li></ul>	<ul style="list-style-type: none"><li>• Affective motives</li><li>• Symbolic motives</li><li>• Instrumental motives</li></ul>	Past behaviour

The intention is the endogenous variable all the rest latent variables are exogenous. Figure 6 shows that the exogenous latent variables are correlated, except for past behaviour that is independent latent construct in our model and has a direct effect on the intention to perform the behaviour. All other latent constructs are correlated among them and cycling commuting, the target behaviour is preceded by intention.



**Figure 6 Conceptual Framework**

### **2.4.2 Research about Attitudes towards Cycling and Cyclists**

Attitude is an individual characteristic that changes from person to person and from place to place. The study of attitudes has been considered by the Social Psychology who have tried to measure and study them from a long time ago (Fazio and Olson, 2007). However, it is a construct difficult to investigate particularly regarding cycling, since holding a negative attitude towards cyclists might be considered incorrect, and there is a risk of people not expressing their underlying attitudes. For instance, Basford and Britain (2002) in their qualitative and quantitative study in the UK, they asked questions about attitudes and intention in face to face interviews. The authors claimed that drivers might have negative attitudes towards cyclists, but they do not express it openly. The authors argued that:

Throughout the research it was observed that drivers do not have particularly strong feelings towards cyclists compared to their level of feelings towards other groups of road users.

However, when prompted, it is clear that motorists hold negative views of cyclists and tend to classify them as an 'out-group' with significantly different characteristics from most other road users (Basford and Britain, 2002, p.1)

Nevertheless, researchers try to find methods to explore attitudes in the transport field because there is evidence that attitudes influence travel mode choice (Gärling et al., 1998). To date, there is research about car users' attitudes towards driving (Steg et al., 2001, Anable, 2005a, Steg, 2005, Jakovcevic and Steg, 2013). The study of attitudes towards private cars and public transport have also been carried out before. López- Sáez et al. (2014) in a study in Spain. In the study, the researchers asked people to rank the importance of cars and public transport according to some attributes. Later, Fruhen and Flin (2015) carried out a study in the UK with a sample of students who drive to analyse the influence of attitudes and social norms in car drivers' aggressive behaviour. The authors found that negative attitudes and negative social norm perception towards cyclists were associated with aggressive behaviour from the drivers.

There is also a growing literature about perception and attitudes from both cyclists and non-cyclists towards cycling. One of the pioneer's studies was carried out in the nineteen eighties by Finch and Morgan (1985). The authors conducted a qualitative study to explore drivers' attitudes towards cycling in the UK. The authors found that cycling was linked to a childhood activity. They also reported that for young adults, peer pressure was the main deterrent from cycling once they grew up, whereas, for the older participants, among other barriers, they mentioned discomfort and lack of social acceptability.

In the nineties, two other studies were identified as important precedents of the study of attitudes towards cyclists. One was carried out by Mayes et al. (1996) and the second by Davies et al.; (1997) both commissioned by the Transport Research Laboratory on behalf of the Department for Transport in the UK. Mayes et al. (1996) carried out a quantitative (with stated preference exercises) and qualitative study using in-depth interviews and groups discussions

with cyclists and non-cyclists to assess attitudes towards cycling. The authors concluded that attitudes were very diverse and linked to life stage, lifestyle, and car culture. Meanwhile, Davies et al. (1997) conducted focus groups among cyclists and non-cyclists and found that although generally, attitudes to cycling are positive, it is not considered an ordinary everyday activity. And among an important number of respondent's, the authors argued, cycling's lack of status and personal image were considered deterrents for cycling.

Analysing the research of Lorenc et al. (2008) in their systematic review about attitudes towards walking and cycling among children, young and adults (the parents) in the UK, both activities were considered less convenient than driving. The authors argued this might be indirectly linked to walking and cycling to be considered the transport mode for low-income travellers. The authors identified cultural factors and peer pressure/status as part of the factors influencing attitudes towards walking and cycling at the community level. And at the individual level, car use, acceptability, comfort, and embarrassment. In the studies, car use as a normal mode of transportation and social status associated with it were considered important, influential factors. And the authors concluded that the transport interventions are not targeting the issues related to car culture.

Research has shown that the more frequently a mode of transport used, the more favourable the attitudes are towards that transport. For instance, Molin et al. (2016) from a study carried out in Netherlands, found that those participants who drive as their main mode of transportation, held most negative attitudes towards public transport and cycling. This finding is comparable with those found by Fruhen and Flin (2015). Regarding cycling, Gatersleben and Appleton (2007) stated in their study in the UK that the more people cycle, the more positive attitude they have towards cycling. However, it is important to be aware that studies should not underlie in the assumption that people are not multimodal, and additionally that other studies have shown that this principle not always holds true.

For instance, in highly motorized cities where commuting to and from work is usually by car (sometimes for lack of efficient public transport) and where commuting can take up to 3 hours, drivers not necessarily have positive attitudes towards car use. Such is the case of people in Mexico City who due to lack of more efficient transport options or due to issues related to safety some people prefer to drive to avoid public transport<sup>5</sup>. These people meet the profile of the segment called Malcontented motorists described in section six in the present chapter about attitudinal transport segments.

Similarly happens with people that depend upon public transport for lack of other options or economic reasons. In this regard, Molin et al., (2016) argued that people more dependent on public transport more often have positive attitudes towards the car. The authors suggest that people who use more public transport are usually young and from a lower income thus, there is a potential number of them that once that can afford to have a car, they start using it to commute. Another example of bicycle use is the study carried out by Curto et al. (2016). In their study in Spain with a random sample of commuters, the authors aimed to explore attitudes and perceived control towards own bicycles and the bike share system use. The authors defined the sample according to the most common one-way commute trip mode. They further identified four groups of commuters. Two groups were the cyclist commuters using the public bike share system and those using their own bicycle, and two groups of non-bicycle commuters, those willing to cycle, and those not willing to cycle. The results indicated that the two non-bicycle commuters held stronger favourable views of the bike share system.

Other studies have found that attitudes towards cycling influence behaviour. With a sample of college students in Brazil, de Souza et

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<sup>5</sup> In the pilot study carried out for this study, which is described in Chapter Four, semi-structured interviews were conducted. People interviewed argued that the public transport was not safe and very uncomfortable. And that was an important reason to prefer commuting by car.

al. (2014) examined the extent to which the students' attitude towards cycle commuting influenced their perception of barriers to cycling. Although the sample is not representative of the population, it is of interest for this research that the authors found positive attitudes in connection with the feeling of independence provided by cycling. However, negative attitudes were reported about prestige. And both attributes, independence, and prestige, are usually linked to driving.

Attitudes and perception are two constructs that increasingly are considered significant predictors of cycling (Piatkowski and Marshall, 2015). Attitudes, norms, and habits are found to influence bicycle use according to Gatersleben and Appleton (2007) and Heinen et al. (2010) but other factors such as gender, age, ethnic group, and social class shape cycling levels and road users' attitudes (Horton et al., 2007a).

#### **2.4.3 Studying the Role of Perceived Image and Identity Influencing Individuals' Choice to or not to Cycle**

There is a social meaning associated to cycling and an identity linked to cyclists. The identity and social meaning is contextual and depends in several factors. In the literature review it was pointed that a negative perceived image might have a negative effect on the intention. For instance, research has showed that using public transport to commute is seen as inferior compared with commuting in a private car (Mann and Abraham, 2006, Ibraeva and Sousa, 2014), although authors agreed that the distinction between utilitarian and affective benefits is not clear. Another example from cycling is the use of bicycle in the Latin American context, where cycling is associated with low income travellers (Bauman et al., 2013) and where levels of cycling are very low.

In synthesising a study on this topic, Basford and Britain (2002) conducted a research combining quantitative and qualitative methods. With a sample of drivers in UK, the authors used as framework the TPB (Ajzen, 1991) and additional constructs from the Social Identity Theory. Although the results focus more on the

interaction between drivers and cyclists in the shared space and the perceived drivers' annoyance, the study revealed that drivers perceive cyclists as an 'outside' group. In later research, Fincham (2007) examined data from Cardiff and London and confirmed the same, that messenger cyclists were considered outsiders, and that this perception could be extended to other type of cyclists. Tajfel (1981) explained that is a common trait when people interact, they tend to categorize people in terms of in-groups and out-groups but this leads to prejudice and stereotypes. That is what Finchman (2007) argued when the author stated that cycling messengers are marginalised by the work they do, the clothes they use and their riding style and in consequence on their status as cyclists. One influencing factor of this *outsider* image, he argued, it that bicycle messengers' image preserved by the media is contradictory which has consequences in the social meaning.

Gatersleben and Appleton (2007) carried out a study in UK using a questionnaire, diaries and interviews based on the Model of Stages of Change of Prochaska and DiClemente (1986). Their aim was to explore people's barriers to cycle for commuting purposes. The sample was composed from students and staff of a university. About the perceived image of cycling, the authors concluded that cyclists and non-cyclists are different, thus the policies to increase cycling levels should consider this and produced more targeted interventions to improve the image of cycling. Although the sample is not representative of the population, of which the authors are aware, the study brought attention to issues related to the perceived image of cycling. However, the use of the Model of Stages of Change prompt questions about each stage limits. This means, how to determine when someone pass from one stage to another and how to deal with the behaviour that do not pass through all the five stages.

Handy et al. (2010) in a cross-sectional study explored the factors associated with cycling in six cities in USA. The sample were residents of Davis, Boulder, Eugene and three other communities that made them comparable and that differ solely with respect to their

physical and social environment. One relevant finding from the study is that people who perceive cycling as an activity for children or for people that cannot afford to have a car, the authors argued, were less likely to cycle. However, due to sample possible bias these results cannot be generalized to other cities in USA and much less to other contexts. But the perceived idea of cycling as not being a normal activity is again highlighted.

Steinbach et al. (2011) carried out a qualitative research in UK to explore the meaning of cycling as a healthy transport choices across cyclists with diverse urban, gendered, ethnic and class identities. The author found that people with differences in gender, ethnic group and social class perceived different the benefits of cycling. Changing the cultural association with cycling, making it less linked to sport might have a positive impact in cycling. More recently, and also using an extended version of the TPB, Lois et al. (2015) focused on developing a model to explain behavioural intention to cycle in Spain with a non-cyclists sample. Adding social identity in the TPB, the authors found that barriers for cycling are diverse and concluded that identity plays a role in modal choice as other researchers have pointed out before.

Different studies argue that the perception of cycling as an abnormal activity may act as barrier that impedes increases in the levels of cycling in cities (Horton et al., 2007b, Pooley et al., 2011, Aldred, 2013a, Lugo, 2013). Horton et al., (2007b) and Lugo, (2012) argue that apart from being considered as an abnormal activity, cycling is also considered an irrational choice since cyclists are exposed to a high risk of accidents, and additionally, cyclists do not contribute improving this image of risk takers (Basford and Britain, 2002).<sup>6</sup> This is part of the social context or circumstances as it was found by

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<sup>6</sup> In social networks cyclists make comments reinforcing these views. As an example, it was extracted from twitter that the following groups @bicibusdf, @ccastilian, @yobicidf, @mejorenbici stated the 25<sup>th</sup> of April, 2014 : 'is alright the excitement of knowing how you are going to die, but not knowing when is better'.

Olekszechen and Kuhnen (2016) in their qualitative study about barriers and facilitators for cycling in Brazil using a sample of students. The authors found that one barrier faced by the students was the social situation which the authors argued, defines the status of the bicycle as part of the whole transport system. And which has given historical preference in the urban space to the private cars. Limiting the streets to cars, the corridor for motorbikes and the pavement for walking. In consequence making the bicycle less visible and delegitimizing its use.

It is being stated that 'most motorised societies face a constant struggle to restrain car use' (Aldred, 2013a) to date mostly because of the urban environment and lack of consideration of the bicycle as part of the transport system, such as described before. This have turn out to present the use of bicycle as unusual and even as a rare activity (Horton et al., 2007b, Pooley et al., 2011, Lugo, 2013, Aldred, 2013a); cyclists as an out-side group (Basford and Britain, 2002, Fincham, 2007), and marginalizing cycling in very diverse ways, such as in the space provided; the resource allocation by the transport authorities with consequences in terms of the social meaning of cycling (Aldred, 2013a, Aldred, 2013c, Jones and Novo de Azevedo, 2013).

The social meaning of cycling can be different everywhere. As mentioned before, the meaning of cycling and its perceived image change according to time and context, thus, the type of cyclists are not the same everywhere (Aldred, 2013b). As Cox (2015a, p. 14) stated "the single term 'cycling' covers a huge variety of activities, by different groups of people, in different places and for different purposes".

Davies (1997) for instance, categorizing cyclists in the UK developed a typology based on their attitudes to cycle. The typology was: the fair weather cyclist, the lifestyle, the practical and the idealist cyclist. Jensen (2013) developed a different categorization in Copenhagen. The author produced three groups of cyclists: the users of heart, users of convenience and users of necessity. In Canada, Damant-

Sirois et al.,(2014) using information about cycling frequency, categorized cyclists in: dedicated cyclists, path-using cyclists, fair-weather utilitarians and leisure cyclists. Whilst in the City of Portland in USA, Dill and McNeil (2013) suggested four categories of cyclists based on their interest and ability in cycling. The typology developed was: the strong and the fearless; the enthused and confident; the interested but concerned; and no way no how cyclist.

Lugo (2012) found that in Los Angeles, USA, there are three groups of cyclists: the eccentric enthusiasts; the status sport; and the group that cycle because is unable to drive for reasons of income or age. This usually being from Latin or African ethnic group named as 'invisible rider' (Lugo, 2013). In Mexico City, although there are not studies to define the types of cyclists, López (2013) highlighted the presence of three type of users of the bike share system: the cyclists for leisure; cyclist for sport and as Lugo stated before, the 'invisible rider' which use the bike for economic reasons.

Exploring the types of cyclists and the attitudes towards them would be an important step to understand whether there is a relationship between the use of bicycle and the perceived image of cyclists, since it is considered that the construction of self-image in relation with the type of transport mode choice and lifestyle influence behaviour (Anable et al., 2006a).

It is important to establish the distinction between the image of cycling and the identity associated to cyclists. This study adopts the concept of identity and suggests to understand it in its broad definition as to linked to a specific ethnicity or ethnical group as mentioned by Heinen (2016). The author argued that social identity indicates the belonging to a specific group or social category like being a cyclist or being a driver. But also, "identity will be considered as by the self-concept" (Heinen, 2016, p. 240).

In this sense, Murtagh et al. (2012) demonstrated that identity have a role influencing travel behaviour. The author stated that:

Multiple identities are related to travel mode choice on regular journeys. As such, the influence of identities should be included in the complex mix of factors affecting travel behaviour. The influence of identities may vary across type of journey. (Murtagh et al., 2012, p. 522)

The link between identity and travel mode choice had been pointed out before. For instance, Schwanen and Lucas (2011) cited Gilroy (2001) to exemplify how differences in race and ethnicity were shown in car use. Regarding specifically bicycle use, Pojani et al. (2017) carried out a qualitative study to explore the beliefs about the decision to commute by bicycle. The authors used three samples from The Netherlands (Gouda), Albania (Shkodra), and Kosovo (Peja) composed by adults working with all levels of cycling (elder people was excluded). The authors identified several themes influencing beliefs about cycling, but of particular interest for this study, Pojani et al., found that status and image also emerged.

In this theme, the authors found that the respondents from Albania and Kosovo the car was a luxury item that provide status. Some respondents held negative image about public transport and the bicycle was considered a cheap transport alternative for the more disadvantaged people. Contrastingly, the authors found that in The Netherlands, the car was not associated to any particular social status. For respondents in Gouda, the car is seen more by its instrumental function. The authors pointed that this differences might be due to the historical prohibition of car during socialism. The authors concluded that the social status associated with car use in the cities of Shkodra and Peja have some effect in the image of cycling.

#### **2.4.4 Other Socio-Psychological Factors**

Besides attitudes and perceived image of transport, other social psychological factors might play a role influencing transport mode choice. To date there are several studies focusing on other social psychological factors influencing public transport use (Heath and Gifford, 2002, Bamberg et al., 2003, Beirão and Sarsfield Cabral,

2007) but little research have been conducted to explore the influence of these other social psychological factors influencing cycling intention.

In a systematic review of literature carried out by Jakovcevic et al., (2015), the authors explored specifically the studies about the psychological factors influencing bicycle use. Summarising their findings, among all studies reviewed, there was a great variance in the categories used to measure the psychological variables to analyse cycling behaviour, thus the authors stated that evaluation of cycling behaviour is vague and limited to one journey of the cycling trip. The authors highlighted that 80% of the papers examined, studied cases of European cities, therefore there is still the question about the likelihood of the same variables explaining bicycle intention in other contexts, such the present study, focusing in a City in Latin-American. Another systematic review carried out by Willis et al. (2015) in Canada, also supports the role of social psychological factors influencing intention to cycle. For instance, factors such as attitudes, habits and social environment (referred in the literature review as subjective and descriptive norm, parents and community opinion on cycling and work place environment) were found influential.

#### **2.4.5 Investigating Socio-Economic Status Attached to the Image of Cycling and Cyclists**

Horton (2007a, p. 7) highlighted 'the bicycle and the act of riding a bicycle unavoidably convey status'. This perceived status might act as barrier towards cycling regarding belonging to certain social class (Horton et al., 2007b, Aldred, 2013a, Aldred and Jungnickel, 2014), stigma that is also attached to public transport users (Stokes and Hallett, 1992). However, little research has been conducted about whether cycling might be associated with low income groups. Aldred (2013b) suggested that a negative connotation of cycling is the attachment to low income groups, which suggest the idea that people riding bicycle are those who cannot afford a car.

To date there is an important body of literature focusing on the link social class and the practice of sports (Bourdieu, 1978, Wilson, 2002). Particularly about cycling as a healthy option and its association to some groups of people more than others, Steinbach et al.,(2011) carried out a study in UK. The authors aimed to explore the symbolic meanings of cycling across different urban, gendered, ethnic and class identities. The authors, argued that cycling in London being uncommon, provides the opportunity to cycle only a certain group of people (“bourgeois”) to use the bicycle without being linked to a lower income traveller. The author suggested that changing the current cycling cultural association of cycling as a healthy choice, cycling levels could be improved.

Heinen et al. (2010) carried out a literature review to explore the factors influencing commuting cycling in order to identify the policies that help to promote bicycle use. It is of particular importance for our research, the findings from the socio-economic variables (particularly income and its relationship with cycling behaviour) and the psychological factors. About socioeconomic factors, the authors concluded that there is a relationship between these factors and cycling levels but the relationship is not clear in terms of direction and causality. The authors stated that the link between income and cycling levels it is imprecise. For instance, in the review, some evidence supports that the higher the income is, the more that people use the bicycle, but other evidence showed opposite results. Also, evidence was found about the negative effect on cycling levels from car ownership, and opposite to that, the author also found that bike ownership increases probability of cycling more.

Goetzke and Rave (2011) carried out a study in Germany to investigate the factors influencing bicycle use with a sample of households trips records. The authors concluded that traveling by bicycle is not related with household income there, however, it was found out that in the case of recreational trips people with lower income more generally choose to use their bikes. In Mexico City, Lopez (2013) carried out a discussion about the impact of the public

bike-sharing system in several areas of Mexico City in relation with the local environment and the lifestyles of the users. The analysis was carried out based on the results of a survey with a sample of only bike share system users and the results from a different survey with a sample of cyclists but no users of the share system. The author, also access to data from meetings between the Local Government and the residents from the neighbourhood where more stations from the bike share system were planned to be installed. Lopez (2013) found that low income households that still cannot afford a vehicle use bikes as a daily based mode of transport.

The perceived socio-economic status attached to bicycle users may differ from the type of cyclists. For instance, the image reflected by a cyclist in the Tour of France compared with a cyclists messenger or a student riding a bike will not be perceived in the same way. This shows how not all cyclists are perceived in the same and how some cyclists can be more marginal than others (Lugo, 2012). In this respect Lugo also stated that the image of cycling differ across contexts and can vary according to social forces and cultural practices and 'stigma' may become attached to particular types of cyclists and associated with socio-economic conditions (Aldred, 2013b).

More recently, Singleton and Goddard (2016) carried out a study to understand the gap in gender for cyclists and non-cyclists in the USA. The authors found that male and females had differences in their likelihood of choosing cycling regarding variables such as education, occupation and income. For instance, women with less education and with low income were less likely to use the bicycle for commuting opposite to this, men in same conditions were more likely to use the bicycle. The authors suggest that women face more constraints and have less tendency to see the bicycle as a mode of transportation.

In summary, from the literature reviewed it is possible conclude that perceived image and attitudes play a role influencing peoples' intention to cycle. But also other factors of social psychological

dimension. Thus, changing peoples' behaviour to achieve modal shift towards cycling requires explore the role of other influential factors linked to concerns about personal image and social status. And these factors affect every road user in different manner, because research has shown that cyclists and no-cyclists are different. To be able to create groups according to their attitudes can help policy makers to tailor the measures to the groups more willing to change their behaviour and this could be a first step to achieve modal shift. Research has pointed that market segmentation techniques could be helpful to create these groups. In the following section, there is an introduction to the attitudinal market segmentation and a brief review of the literature of segmentation and cycling.

## **2.4.6 Market Segmentation Techniques and Applicability in Cycling**

### **2.4.6.1 Marketing and Social Marketing in Transport Studies**

The American Marketing Association<sup>7</sup> defined Marketing as “the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large”. Tapp and Parking (2015) summarized it as the “management process involving customer research, segmentation of the markets, product and services development, creation of the brands, consideration of issues around location and accessibility, and finally, communication designed to maximize their motivational and persuasive potential” (Tapp and Parkin, 2015, p. 183-184). When this process is aim to influence people's behaviour to improve certain aspect of some individuals or the society as a whole then it refers to social marketing according to Andreasen (1994) who defined social marketing as “the adaptation of commercial marketing technologies to programs designed to influence the voluntary behaviour of target audiences to

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<sup>7</sup> American Marketing Association, Definition of Marketing, Available at: <https://www.ama.org/AboutAMA/Pages/Definition-of-Marketing.aspx>

improve their personal welfare and that of the society of which they are a part” (Andreasen, 1994, p. 110).

Social marketing is an approach with a set of tools that can help to achieve social change (Andreasen, 2006). According with the definitions provided before, in the context of transport and particularly promoting modal shift, social marketing is understood as a management process that using market segmentation techniques help us to persuade and influence people who commute driving to engage into more sustainable modes of transportation such as public transport, walking and cycling. Tools such as incentives and other measures of socio-psychological dimension help to persuade people to change their behaviour (Haq et al., 2013). Although considered a limitation for some researchers, social marketing empowers and foster change at the individual level (Haq et al., 2013), but in case of modal shift this can be considered an strength, since modal choice is individual and encouraging any change should be done at this level.

Social marketing have been used to change different health related behaviours (Andreasen, 2006) and also to explore pro-environmental behaviour (Haq et al., 2013). In the transport field there is research focusing on public transport and how to attract users (Beirão and Sarsfield Cabral, 2007, Ibraeva and Sousa, 2014) and for bicycle use too (Li et al., 2013, Damant-Sirois and El-Geneidy, 2015, Tapp and Parkin, 2015).

#### **2.4.6.2 Segmentation to Increase Cycling Levels**

Segmentation is a key tool in marketing that helps to identify individuals that are clustered in the same group, creating artificial groups to be target by developing the most appropriate marketing strategies such as communication messages, information and incentives (Wedel and Kamakura, 2012, Haq et al., 2013). In transport research it has been stressed the need to segment the population according to attitudes and behaviour (Beirão and Sarsfield Cabral, 2007) . However, in the UK there is still very little literature regarding the definition of different mobility segments in a systematic and meaningful way (Anable, 2005a). And this type of studies in Latin

American cities, to the knowledge of the author are null. Anable (2006a) have stressed that a large scale segmentation study needs to be carried out to understand the most important factors fostering travel behaviour in different groups for different behaviours and in different contexts.

There are very different types of segmentation used in business, for instance, psychographic and behavioural segmentation.

Psychographic divides the costumers according to their interests, activities, opinions, values and attitudes. The behavioural is based on actual customer behaviour towards products for instance dividing customers based on benefits sought, usage rate, brand loyalty, user status, readiness to buy, etc. (Goyat, 2011). Another subdivision of the behavioural segmentation is the purchase/usage occasion and the needs-based segmentation. The former being relatively simple and of low cost to implement. This, used in transport can provide information about the frequent, infrequent and riders. (Elmore-Yalch, 1998). The needs-based segmentation as the name indicates, consists on segmenting the population according to their needs. This is mainly used business to develop products and brand strategy (Greengrove, 2002). Other type of segmentation use four main bases: Geographic, Demographic, Channel and Psychographic (McDonald and Dunbar, 2004).

Nevertheless, in the literature review the socio-demographic and the attitudinal segmentation are the most used in transport and particularly in cycling research, both are reviewed in the next section.

#### **2.4.6.3 Socio-Demographic Segmentation**

Traditionally, research about bicycle use had focused on dividing the road users according to socio-demographic characteristics (Nkurunziza et al., 2012b) usually defined by life cycle, age, household size or employment status (Hunecke et al., 2010) rather than using a different approach. This method is being the traditional since data is relatively easy and less expensive to obtain and it provides a quick indication of the market (Elmore-Yalch, 1998). However, Anable (2005a) stated that segmenting populations only

considering socio-demographic characteristics do not take into consideration the complexities of the different groups of people. And, as stated by Tapp and Parking (2015), behavioural change interventions are more effective when targeted to different segments based on marketing techniques such as attitudinal segmentation.

#### **2.4.6.4 Attitudinal Segmentation**

In transport studies, there is a growing literature about attitudinal transport segments. For instance, some research has used market segments to explore public transport (Shiftan et al., 2008, Ibraeva and Sousa, 2014). Regarding cycling, research showed that neither all cyclists nor all non-cyclists are the same (Gatersleben and Appleton, 2007) and understanding this, can have important implications to target cycling policies and make them more efficient. Using the approach of attitudinal market segmentation Li et al. (2013) studied bicycle commuting in China. The authors concluded that using attitudinal market segmentation techniques was useful to identify different submarkets and also potential bicycle commuters.

The use of segmentation helps creating groups and subgroups according with their key attitudes (Anable, 2003, Anable, 2005a, Shiftan et al., 2008) which provide better understanding of the audience and detecting the groups with more potential to change their behaviour (Li et al., 2013, Tapp and Parkin, 2015), leading to more efficiently targeted governmental interventions and optimize transport measures (Anable, 2010, Jakovcevic et al., 2015). For instance, Hunecke (2010, p.7) found that “attitude-based segments had the highest predictive power for travel mode choice”. Although it is still not clear which social marketing campaigns are the most appropriate to influence bicycle use understanding the attitudinal differences in the population is a very important first step towards changing behaviour (Tapp and Parkin, 2015).

Anable (2010) proposed the use of a methodology to segment the population according to their attitudes towards transport focusing on the “life change” moments in their lives (Anable, 2010). The methodology was adopted and used in the EU project Segmented

Marketing for Energy Efficient Transport (SEGMENT Project). Which was a three-year project funded by the EU Intelligent Energy Europe's Energy in Transport programme (IEE STEER). The author produce a set of questions (Anable, 2014) aim to divide the population in eight different segments. The questions were derived from factor analysis and the first question to explore car ownership. The factors were divided as follows.

#### *Attitudes Towards Car Use*

- Moral responsibility to use the car less
- Attachment to the car for leisure
- General car-dependency
- Affects of congestion on travel
- Enjoyment of travelling by car
- Efficacy of reducing travel behaviour

#### *Attitudes Towards Alternatives to the Car*

- Perceived Behavioural Control
- Willingness to sacrifice for the environment
- Concern for negative effects of car use
- Social and personal normative beliefs
- Attitude towards road building
- Attitudes towards cycling

#### *Attitudes Towards the Environment*

- Green Identity
- Romantic views of nature
- Anthropocentric view of nature

#### *Green Behaviour*

- Green purchasing
- Political activity

Seven European cities participated to test the methodology of the segment project. The cities were: Almada (Portugal), Athens (Greece), Gdynia (Poland), Hounslow (London, UK), Munich

(Germany), Sofia (Bulgaria) and Utrecht (Netherlands). One of the major findings from the member cities was that, from the campaigns implemented in the seven cities after segmenting their population, a 10% overall modal shift was found in each city. Additionally, the cities reported that over 200 transport practitioners in Europe used this approach as part of mobility management training.

Carrying out cluster analysis different eight different groups were found. Knowing this segments and the characteristics of profile is useful to tailor transport interventions and measures. The following eight tables provide the description of the eight attitudinal segments.

**Table 5 Characteristics of the Devoted Drivers**

<b>Segment</b>	<b>Description</b>
Devoted Drivers	<ul style="list-style-type: none"><li>• Would rather use the car and have no intention of reducing car use</li><li>• Think successful people use the car</li><li>• Not the kind of person to use the bus or to cycle, and finds bus use stressful</li><li>• See no benefit to cycling and think walking is too slow</li><li>• Do not like to walk. Although they know it can provide flexibility, they find it too slow.</li><li>• Are not motivated by fitness and have a very low moral obligation to the environment</li></ul>

**Table 6 Characteristics of the Image Improvers**

<b>Segment</b>	<b>Description</b>
Image Improvers	<ul style="list-style-type: none"><li>• Like to drive and see the car as a way of expressing themselves</li><li>• Do not want driving restricted and do not want to cut down car use</li><li>• Not the kind of people to use the bus</li><li>• Think cycling can be a form of self-expression and a good way to keep fit</li><li>• Would like to walk for fitness, but are worried about the time it takes</li><li>• Have neutral or moderate environmental attitudes</li><li>• Are motivated by fitness – especially cycling</li><li>• Would like to increase cycling and maybe walking, rather than use the bus</li></ul>

**Table 7 Characteristics of the Malcontented Motorists**

<b>Segment</b>	<b>Description</b>
Malcontented Motorists	<ul style="list-style-type: none"><li>• Do not like driving – find it stressful</li><li>• Want to reduce driving but still prefer the car</li><li>• Would rather use the bus than cycle, but see problems with using the bus</li><li>• Do not identify as cyclists, and see no benefit to cycling other than fitness</li><li>• Walk, but do not see any advantage to walking, except for fitness</li><li>• Have a small level of environmental consciousness</li><li>• Have a moderately strong intention to reduce car use, but not to increase use of public transport</li></ul>

**Table 8 Characteristics of the Active Aspirers**

Segment	Description
Active Aspirers	<ul style="list-style-type: none"> <li>• Feel guilty using their car on short journeys, so would like to cut down on car use</li> <li>• Agree that using the bus can be quicker, but are not bus users and see lots of problems with using the bus</li> <li>• See themselves as cyclists and believe that cycling is quick and provides freedom and fitness</li> <li>• Regard walking as healthy, do walk, and would like to walk more for fitness</li> <li>• Have a high moral obligation to the environment, therefore do not believe that more roads are necessary</li> <li>• Believe reducing their own car use will make a difference and intend to reduce car use</li> <li>• Are highly motivated to use active transport modes, and to walk and cycle for fitness</li> <li>• Have above-average levels of part-time employment</li> </ul>

**Table 9 Characteristics of the Practical Travellers**

Segment	Description
Practical Travellers	<ul style="list-style-type: none"> <li>• Use the car only for getting from point A to point B</li> <li>• Only use the car when necessary. Think that cars reduce our quality of life</li> <li>• Would much rather cycle than use the bus as it is much quicker</li> <li>• Identify themselves as cyclists but do not see it as a form of self-expression</li> <li>• See the benefits of cycling – for example, it is not stressful</li> <li>• See walking as moderately healthy. Will walk when it seems more practical than cycling</li> <li>• Are not motivated by climate change</li> <li>• See local pollution and congestion as issues</li> <li>• Claim to not be motivated by fitness, but could be as they believe they are already fit</li> <li>• Have no intention of reducing car use and have no intention of using the bus more. But intend to cycle</li> <li>• They probably think they are using a balanced amount of each transport mode</li> </ul>

**Table 10 Characteristics of the Car Contemplators**

<b>Segment</b>	<b>Description</b>
Car Contemplators	<ul style="list-style-type: none"><li>• See cars as status symbols, and believe that people should be allowed unrestricted car use</li><li>• Would like to increase car travel</li><li>• Would rather use the bus than cycle, but see lots of problems with the bus and find bus travel stressful</li><li>• Are neutral about cycling</li><li>• Do not identify with cycling and see it as a bit stressful</li><li>• Regard walking as not very flexible, but might want to walk a bit more for fitness</li><li>• Have a neutral or moderate attitude towards the environment and cycling</li><li>• Are not motivated by fitness but believe walking is healthy</li><li>• Intend to use other transport modes but are most likely to say they will start driving</li></ul>

**Table 11 Characteristics of the Public Transport Dependents**

<b>Segment</b>	<b>Description</b>
Public Transport Dependents	<ul style="list-style-type: none"><li>• Do not like driving and would like to see less congestion</li><li>• Believe that more roads are needed to relieve congestion</li><li>• Think people should be allowed to use cars and would like to travel more by car</li><li>• Use public transport, although think that the bus is not the quickest method</li><li>• Believe that the bus is better than cycling, but that walking is often better</li><li>• Definitely do not see themselves as cyclists, and see no benefits to cycling, believing it to be stressful</li><li>• Walk and would like to walk more for fitness</li><li>• Are not motivated by the environment</li><li>• Are keen to walk more and least likely to start driving</li></ul>

**Table 12 Characteristics of the Car-free Choosers**

<b>Segment</b>	<b>Description</b>
Car-free Choosers	<ul style="list-style-type: none"><li>• Do not like driving and think that cars lead to unhealthy lifestyles</li><li>• Believe car use should be reduced</li><li>• Do not think the bus is stressful or problematic</li><li>• Would rather cycle than take the bus</li><li>• See cycling as beneficial for many reasons and as a route to self-expression</li><li>• Do not believe that cycling is stressful</li><li>• Regard walking as healthy and would like to walk more for fitness</li><li>• Feel a high moral obligation to the environment, and believe that reducing their own car use will make a difference</li><li>• Are keen to use active modes of transport</li><li>• Regard walking and cycling as healthy and good for fitness</li></ul>

Source: The Segmentation Toolkit (Anable, 2010).

## 2.5 Conclusions

The conclusions from this chapter are divided into four parts. First part is conclusion about the barriers for cycling. The second part contains the conclusions of the methodology section. Part three are the conclusions from the theoretical framework. Finally part four, contains the conclusions from the review of empirical evidence studying attitudes, perceived image of cycling and other socio psychological factors as deterrents from cycling.

Conclusions about the barriers towards cycling. The barriers were divided in three categories. External barriers, individual and social-psychological. From this section can be concluded that there are several barriers people face when choosing cycling over other transport options. Weather and topography might act as barrier for instance. Hot weather and heavy rain showed impact in cycling levels according to research. Air pollution also have impact, due to the risks linked to breathing in cycling in bad quality air due to traffic and congestion. The role of car ownership as an external barrier is not clear established, since according to research in some places it seems to play a role whereas in others there is no correlation between car ownership and bicycle use. Car-focus infrastructure represents a barrier not only for the perception of risk of an accident but also reinforcing the lack of normality in cycling. Among the individual barriers there are, the ability to afford to have a bicycle or access to one; individual 's age and gender, level of fitness, lack of cycling skills and disabilities and also the distance travelled or length of the trip. Finally, research have also pointed at the social and psychological barriers that individuals' might face such as perceived image or social status attached to cycling; or linking cycling with an activity for children, where also culture and social practices play an important role.

Part two of the conclusions about the methodology carried out for the search. In this section it was identified that although there has been a growing literature about the topic, until 1997 the existing literature was mainly descriptive. After this time, the publications growth, but it

was not until 2005 that it was possible to notice an important progress on research about this topic, therefore, the search was established from 2005 until 2017, however, a couple of papers from before this time were included due to its importance.

Part three of the conclusions from the selection of the theoretical framework. In this Chapter it was presented the most influential approaches used to explore the link between attitudes and behaviour. It was presented a brief overview of some of the frameworks used to study attitude and behaviour in the transport field, but it was highlighted that the TPB is one of the most influential theoretical frameworks and that this was selected to guide this research. It was also stated the need for using other approaches due to the characteristics of the research problem.

The TPB states that any behaviour is preceded by intention which in turn is influenced by attitudes, subjective norm and perceived control. However, the main limitation for this theory is that it overlooks affective and emotional factors involved in the intention to perform certain behaviour. Hence, the literature pointed at the role of affective and symbolic motivations involved choosing to cycle as well as considerations about self-evaluation and comparison, and that this would add explanatory power to the TPB in the research problem to investigate. Therefore, it was developed a framework with the TPB extended drawing upon other two theories, the TSC and the MPM. The SCT was selected because it is helpful to understand how through social comparison, people evaluate their opinions and abilities. From the MPM because this theory incorporates the idea that material objects as symbols of social identity. The interrelation between all the constructs provide a better understanding of a complex phenomenon such the behavioural intention to commute by bicycle.

Part four of the conclusions drawn from the review of empirical evidence studying attitudes, perceived image of cycling and other socio psychological factors as deterrents from cycling. It can be concluded that attitudes is a construct difficult to measure because

as some research showed regarding certain behaviours, people do not always openly express what they think. Investigating attitudes towards transport, there is research about driving and public transport use. A growing research in attitudes towards cycling from cyclists and non-cyclists showed that attitudes influence behaviour, however, the samples used in most of the studies are not representative of the population, showing that there is a gap of knowledge.

In the literature it was highlighted the existence of a perceived image and identity associated to cyclists, but this is contextual and change from place to place. In UK research has shown that cyclists are considered an outside group. There has been identified a variety of types of cyclists in Europe, USA and Mexico. The review of literature pointed that the perceived image and identity might influence intention to cycle.

The link between socio-economic status and cycling and cyclists was also found in the literature. In Latin America for instance, the literature highlighted that cycling is linked to a low income traveller. Research have found a link between socio-economic factors and cycling however, this link is imprecise and further research is required.

But not only attitudes and perceived image influence intention to cycle. In systematic reviews it was highlighted that habits, subjective and descriptive norm, for instance also play a role, however, little research has been conducted. And in particular there is a gap of knowledge from studies focusing in studying areas outside Europe.

After the literature review it was identified as well that to achieve behavioural change some researchers suggest targeting policy measures to the individuals. Thus, creating meaningful segments of the population according to their attitudes towards transport can be useful to tailor the transport interventions and measures to the audience and this in consequence can help optimizing them.

Therefore the literature review also included a section to explore the

state of art of the use of social marketing techniques to create transport segments and to promote behavioural change towards cycling. From the review about social marketing and attitudinal transport segments it can be concluded that segmenting the population according to their attitudes towards transport segments is helpful. It can be useful to detect the segments more willing to change and then to produce tailored policy measures. Using Social Marketing techniques ensures that the measures are optimized and that the budget for cycling is efficiently applied.

## **2.6 Research Questions and Sub-Questions**

After carrying out the review of the literature, it is possible to conclude that there is a real gap in the knowledge about the social psychological factors influencing intention to cycle and particularly in Mexico City. It was also found from the literature review, that that there is not previous study in Mexico that attempt to create groups or segments of the population according to their attitudes towards transport. Based upon this, following there is a description of the research questions (and sub questions) that guide this research and which will help determining the methodology to follow.

Research question 1: What are the attitudes towards cycling in Mexico City and do they influence intention to cycle?

1. Can road users' attitudes towards cycling be measured?
2. Are attitudes influencing individuals' intention to cycle or not to cycle?

Research question 2: What is the perceived image or identity attached to cycling and cyclists in Mexico City does it influence intention?

1. Can the perceived image of cycling be measured?
2. To what extent does the perceived image of cycling influence individuals' choice to cycle or not to cycle in Mexico City?

Research question 3: What other socio-psychological factors influence intention to cycle in Mexico City?

1. Is there a socio-economic status attached to the image of cycling and cyclists?
2. What other affective and symbolic factors might influence commuting by bicycle in Mexico City?

Research question 4: Which are the main transport segments identified from the sample of the population?

1. Can systematic and meaningful transport segments be created for Mexico City?
2. Can the same transport segments identified in Europe be found in Mexico City?

## **Chapter 3 Research Design and Method**

### **3.1 Introduction**

Before carrying out the data collection it is paramount to define the approach and the strategy to follow. This chapter presents the research design and discusses the strategy selected for the data collection. The overarching aim of this study was defined in Chapter One as exploring the social psychological barriers to cycling and whether the perceived socio-economic status attached to the image of cycling and cyclists in Mexico City is a key determinant of the choice to cycle commute. In Chapter Two it was decided that the most appropriate theoretical framework for studying the link between attitudes and behaviour is the TPB. Because of the complexity of the phenomena and in order to be able to analyse the research problem in-depth it is important to add additional constructs to the theory. It was explained that the proposed theoretical framework is drawing upon the SCT and the MPM. It was argued as well that using social marketing techniques such as market segmentation to explore attitudinal transport segments can have positive effects on the implementation of policy measures and interventions aimed at changing people's behaviour. Now, having stated this, in this Chapter the research design will be described, along with the method used to explore perceptions of and attitudes towards cycling, and the methodology adopted to segment the population according to their attitudes towards transport. The chapter is organized as follows. Section two contains the research aim and objectives. Section three comprises the description of the research design. The following section contains the rationale of the research method. In this section is explained the justification for following a positivists approach to the research problem. Section five contains the description of the survey. This section explains first the method used to segment the population and after, it is explained the process to develop the Theory-based questions. This section is followed by the description of the pilot study, the sampling method, the data collection and data analysis method. The final section discusses the key methodological issues.

### 3.2 Research Aim and Objectives

The overarching aim of this study is to explore the social psychological barriers towards cycling and whether the perceived socio-economic status attached to the image of cycling and cyclists in Mexico City influence intention to commute by bicycle.

Simultaneously to the study's aim, the existence of attitudinal transport segments was also explored, following the methodology from the Segmentation Project<sup>8</sup> (Anable, 2010). Investigating attitudinal segments is very important as this research aims also to inform policy makers and practitioners in the design of transport interventions and measures.

Following there is the description of the research objectives which are essential to achieve the research aims, and are will answer the research questions posed in the Chapter Two.

The research objectives are as follows:

- To explore road users' perception of and attitudes towards cycling
- To identify the extent to which the perceived image of cycling and attitudes towards cycling influences individuals' intention to cycle
- To explore whether there is a socio-economic status attached to the image of cycling and the extent to which this may act as a barrier to choosing to cycle or not.
- To develop a structural model to predict behavioural intention to cycle commute in Mexico City
- To identify the existence of attitudinal transport segments in Mexico City
- To draw attention to the social and psychological factors influencing intention to cycle in Mexico City
- To propose changes in the current policy measures focused on cycling and to recommend new strategies to address issues related with the social and psychological barriers for cycling

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<sup>8</sup> For general information about the project see: <http://www.segmentproject.eu/> .

### **3.3 Research Design**

Research design is a process adopted to collect and analyse data and answer the research questions (Kumar, 2011). For this study, a non-experimental, theory-driven, fixed research design was selected to be implemented. To give a general overview, a fixed research design typically relies on quantitative data; it includes variables in the survey that are essential to answer the research questions; to check that the design is correct a pilot is run; and its findings are discussed with scientific rigor. This means that the findings of a fixed research design are based upon results that are reliable, valid and generalizable (Robson, 2002).

A non-experimental design was chosen because the aim of the study is to understand factors influencing intention to cycle, as explained in Chapter One, and since it was found from the literature review in Chapter Two that perception of and attitudes towards cycling can be influential constructs, the study aims to explore those variables, rather than changing or controlling any of them. A theory-driven approach was adopted also because of the literature review in Chapter Two, which concluded that the TPB provided the best model to explain attitudes and behaviour, and moreover that the inclusion of other constructs from SCT and MPM could add explanatory value to predicting intention to cycle. Hence the measures used in the survey were elaborated based on the theories mentioned above.

The cross-sectional studies – also called one-shot studies – are useful for collecting as much information as possible in a single survey so that the population only needs to be contacted once. Cross-sectional studies are recommended for investigating attitudes because they are good at exploring the frequency of a certain situation or issue (Kumar, 2011). In the present study, all the data was collected over a relatively short period of time (three months) using a survey to measure the frequency and strength of the underlying factors influencing intention to cycle. It can be considered

a relational design (Robson, 2002) because in the analysis of the scores relationships and correlation will be explored across all variables.

In the Table 13 there is a description of the research objectives and the research questions posed in the section before; the method used to answer the research questions and finally the section in this study where the results will be reported.

**Table 13 Matrix for research design**

Research objective	Research Question	Method	Section for Results
<p>-To explore road users' perception of and attitudes towards cycling</p> <p>-To identify the extent to which the perceived image of cycling and attitudes towards cycling influences individuals' intention to cycle</p>	<p>1. What are the attitudes towards cycling in Mexico City and do they influence intention to cycle?</p> <p>2. What is the perceived image or identity attached to cycling and cyclists in Mexico City does it influence intention?</p>	Theory-based survey	<p>Analysis: Chapter 5</p> <p>Discussion: Chapter 6</p>
<p>-To explore whether there is a socio-economic status attached to the image of cycling and the extent to which this may act as a barrier to choosing to cycle or not.</p>	<p>3. What other socio-psychological factors influence intention to cycle in Mexico City?</p>	Theory-based survey	<p>Analysis: Chapter 5</p> <p>Discussion: Chapter 6</p>
<p>-To identify the existence of attitudinal transport segments in Mexico City</p>	<p>4. Which are the main segments identified from the sample of the population?</p>	Survey based on the Segment Project EU to segment the population.	<p>Analysis: Chapter 5</p> <p>Discussion: Chapter 7</p>
<p>-To develop a structural model to predict behavioural intention to cycle commute in Mexico City</p>	<p>Answer research question 1, 2, 3</p>		Chapter 5

<p>-To draw attention for policy makers to the social and psychological factors influencing intention to cycle in Mexico City</p> <p>-To propose changes in the current policy measures focused on cycling and to recommend new strategies to address issues related with the social and psychological barriers for cycling</p>	<p>Results from the analysis of the research question 1, 2, 3, and 4.</p>		<p>Chapter 8</p>
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### 3.4 Positivist Paradigm

Two main paradigms are the foundations of the social sciences: the qualitative or naturalistic approach, and the quantitative or positivist approach (Kumar, 2011). The first approach, the qualitative one, is based more on collecting data by observation, interviews and focus groups. Specific analysis techniques have been developed to deal with such data, such as thematic or content analysis. The quantitative or positivist approach is present in almost all fixed research design. It is an approach that is characterized by selecting the appropriate theory, establishing formal hypotheses, and following the necessary strategies to test those hypotheses (Robson, 2002). The quantitative or positivist approach is important for this study because, as was explained in Chapter One, it is the best approach for measuring the hypothesized factors, and also for measuring the strength and direction of their effect in the dependent variable intention.

Guba and Lincoln (1994) stress that historically there has been a discussion about the importance of quantifying the findings from social science studies to make the results credible, proving 'scientific maturity'. Kothari (2004) stated that this approach is "especially important in the behavioural sciences where the aim is to discover

the underlying motives of human behaviour". Research has also shown that the quantitative can be helpful in understanding the underlying factors influencing intention to cycle. For instance, Parkin et al. (2007c) argued that understanding and measuring the less tangible factors influencing the choice to cycle (such as self-image, perceived ability and social norms) is very complex, and thus developing adequate measures is essential. Quantitative methods can help achieve this.

It is important to make a distinction here between the research method and the data used in this study. On the one hand, the nature of the variables used in this study are qualitative or categorical, since they cannot be measured directly through simple observation, but instead need to be measured through other underlying variables, using five-point Likert scales for this measurement. On the other hand, the research methodology is quantitative, because those variables were transformed into intervals by using the average value of the variables and analysing the data with parametric methods. Further details about this will be given in the following sections.

### **3.5 Survey Design**

Selecting the method for data collection should be based upon the information that is required (Robson, 2002). As resulted from the literature review and the research problem, the phenomena we aim to investigate is related with people's beliefs and how these beliefs influence their attitudes towards cycling and perceived image of cycling they hold. Surveys are recommended for studies that aim to explore attitudes because they are helpful for exploring the incidence of certain behaviours. Besides, in non-experimental fixed research designs usually are based on surveys (Robson, 2002).

For this study, using a survey is the best way to collect data because this technique allows the researcher to collect data from a relatively large number of individuals with just one single survey, as explained in section 4.2, which makes contacting the population to follow up on the survey unnecessary (unless the research aims establish

otherwise). However, designing a survey and distributing it successfully depends upon the adequate design of the survey, the sampling and the recruitment strategy.

The survey used in this study consisted of 61 items in total, divided into three sections. Section one contained 18 items designed to explore attitudinal transport segments. These questions are based on the methodology from the Segmentation Project<sup>9</sup> (Anable, 2010) and the questionnaire is known as the 'Segmentation Golden Questionnaire'. This methodology was adopted to answer research question four, posed in Chapter One. The particular objectives were to explore the existence of attitudinal transport segments in Mexico City, to investigate the existence in Mexico City of the same segment groups as are found in European cities, and to test the transferability of the methodology. More details about these questions are in section 4.4.1.

Section two of the survey contained 32 items, the design of which was based on the Theoretical Framework explained in Chapter Two. In section 4.2 it was explained that the measures used in the survey were elaborated based on the TPB, the SCT and the MPM. The variables to measure are named intention, attitudes, subjective norm, perceived behavioural control, social comparison orientation, feelings from social comparison, affective motives, symbolic motives, instrumental motives, and past behaviour. These ten variables are relevant to answering the research questions described in Chapter One.

Section three consisted of 11 items aimed at gathering socio-demographic information, and contained questions to explore age, gender, education, occupation, marital status, income, residence, principal transport mode used, travel time, location, and a final question asking for any contact details the person surveyed wished

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<sup>9</sup> For general information about the project see: <http://www.segmentproject.eu/>.

to provide for further research. These items were included because part of the analysis of perception and attitudes consisted of analysis of whether socio-economic and demographic characteristics exerted a statistically significant difference on the mean of the answers. On the other hand, for the questions about segmentation, this information was useful for better understanding the profile of each segment.

### **3.5.1 Segmentation Questionnaire**

#### **Methodology**

In order to answer research question four, and identify which are the main attitudinal transport segments identified from the sample in Mexico City, this study used the methodology that was previously used in the EU project Segmented Marketing for Energy Efficient Transport (SEGMENT Project). In Chapter Two, section 2.4.6 it was explained that this methodology is aimed to test the use of the market segmentation technique to cluster people into different groups according to their attitudes, focusing on the “life change” moments in their lives (Anable, 2010). The project also aimed to produce targeted policy measures and change people’s travel behaviour in favour of more environmentally sustainable options. The eight attitudinal segments proposed by the methodology, were developed based upon a number of surveys with over a hundred questions, which then were analysed to identify the smaller number of questions necessary to be able to automatically assign the respondents into the most adequate attitudinal segment. The eighteen questions that were selected are called the ‘Golden Questions’. These can be found online for free access in the Segmentation EU Project website. The eight attitudinal segments developed are: devoted drivers (DD), image improvers (II), malcontented motorists (MM), active aspirers (AA), practical travellers (PT), car contemplators (CC), public transport dependents (PTD), and car-free choosers (CF). A full description of each segment is given in Chapter Two.

To the best of the knowledge of the researcher, there is no other current study in Mexico exploring attitudinal transport segments.

Therefore, by using this methodology this study aims to explore the existence of attitudinal transport segments in Mexico City and to explore the differences and similarities between the segment groups identified in Europe and those identified in Mexico City, in order to evaluate the transferability of the methodology. The analysis can be found in Chapter Five and the discussion in Chapter Seven in which taking a step further, policy recommendations based on the results are presented.

### **Measures**

The first question (“Have you driven a car or van in the past 12 months?”) was dichotomous. For the other seventeen questions, responses were measured on a five-point Likert scale from 1 = strongly disagree to 5 = strongly agree, and 3 = neither disagree nor agree; except for question six, which was measured with Likert scale from 1 = very unlikely to 5 = very likely. The eighteen questions are given in English below. They can be also found in both Spanish and English in the full copy of the survey in Appendix Two.

Golden Questions used to segment the population:

1. Have you driven a car or van in the past 12 months?
2. For most journeys, I would rather use the car than any other form of transport
3. I like to drive just for the fun of it
4. I am not interested in reducing my car use
5. Driving gives me a way to express myself
6. How likely are you to drive in the next 12 months?
7. I am not the kind of person who rides a bicycle
8. I feel I should cycle more to keep fit
9. I find cycling stressful
10. Cycling can be the quickest way to travel around
11. I like travelling by bicycle
12. I am not the kind of person that likes to walk a lot
13. I feel I should walk more to keep fit
14. I like travelling by walking
15. I am not the kind of person to use the bus

16. In general, I would rather cycle than use the bus
17. I feel a moral obligation to reduce my emissions of greenhouse gases
18. People should be allowed to use their cars as much as they like

### **3.5.2 Theory-Based Questionnaire**

#### **3.5.2.1 Intention, Attitudes, Subjective Norm, Perceived Behavioural Control, and Past Behaviour**

##### **Methodology**

These constructs are based on Theory of Planned Behaviour (TPB) (Ajzen, 1991). Intention relates to the individual's willingness or perceived likelihood to perform the behaviour. Attitude is the individual's positive or negative evaluation of the consequences of a behaviour. A positive attitude leads to a higher likelihood of performing the behaviour. Subjective Norm can be defined as the individual's concern about other people's expectations (people important to the person) about the person engaging in a behaviour. This means the individual's perception of whether their significant others think they should or should not perform the behaviour. Perceived Behavioural Control (PBC) is the individual's perception of their confidence and ability to perform the behaviour. Past behaviour is an additional construct utilized, and its importance was stated in the literature review in Chapter Two. For instance, Bamberg et al. (2003) highlighted that analysing past behaviour may improve predictions of later behaviour and can express habit strength.

Statements were used based on the suggestions in Ajzen's (2002) work and on items used in previous research. To measure intention, social norms, and PBC, participants were asked to indicate their degree of agreement with the statements on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Attitudes were measured with semantic differentials using 5-point bipolar adjective scales. The last construct of past behaviour was measured with a Likert scale ranging from 1 (never) to 5 (always).

To measure behavioural intention three items were used to evaluate the generalized intention as suggested by Francis et al. (2004). The authors demonstrated that using three items adequate internal consistency was achieved. Based on them, this study used three items utilizing three different words (expect, want and intend) that could function as general indication of intention. Because it is the general intention that is measured, the three questions have the same structure. It was set the time frame to measure intention as “cycling next week” because we are referring at a behaviour (cycling commuting) to be carried out in the short term.

According to Ajzen (2002), attitudes are composed by the beliefs and the evaluation of the behaviour. Because in this study, the researcher was interested in predict intention to commute by bicycle, as Ajzen (2002) suggested, there were used only direct measures for the evaluation of attitudes. The direct measures were built with evaluative semantic differentials (SD) that may reflect the different possible evaluations of performing that behaviour. The stem or the behaviour to evaluate was ‘*For someone that travels for less than 8 km, to choose commute by bicycle is*’, and the extreme positive was at the left side and the extreme negative was on the right side. In the pilot study there were tested different adjectives, however, when these were analysed for internal consistency, some of these items were not helpful, thus deleting some of them improved the consistency of attitudes as a construct. The final number of adjectives to evaluate attitudes were four.

Subjective norm, was measured with two kind of statements. First, the statements formulated to explore Injunctive Normative Beliefs and Motivation to Comply. The statements were formulated using “Other people in general expect” and “social pressure” because these items measure the strength of the Injunctive Normative Beliefs using as injunctive normative referent group other people, in this case, people that the individual observes, over the individuals’ decision to cycle commute or for not using the bicycle. Second, the statements formulated to explore Descriptive Normative Belief and

Identification with Referent Group. This statement was formulated using “People that are important to me” because this item measures the strength of the Descriptive Normative Belief using as descriptive normative referent group people that matters for the individual.

PBC is formed by the Control beliefs. And refers to the individual’s beliefs about the capability of cycle commuting. Therefore this item was measured by asking a question to evaluate the individual’s perception of control over engaging into cycling. It was used one item because in the pilot study it was identified that more items did not improve the internal consistency, thus to make PBC less ambiguous for the respondents the measure was narrowed to a single-item (Wanous et al., 1997). In section 4.5 in this chapter, there are further details about the Pilot Study.

Past behaviour was used to improve predictions of future behaviour and as measure of habit strength as argued by Bamberg et al. (2003). Similarly that with PBC, it was measured by a single-item to reduce ambiguity in the survey.

## Measures

**Table 14 Theory of Planned Behaviour Constructs and Their Associated Question Number**

<b>Construct</b>	<b>Question</b>	<b>Description</b>
<b>Intention</b>	Q21a.	I expect to use my bike for my daily commute in the next week
	Q21b.	I want to use my bike for my daily commute in the next week
	Q21c.	I intend to use my bike for my daily commute in the next week
<b>Subjective norm</b>	Q21d.	Other people in general expect me not to commute by bicycle

	Q21e.	I feel under social pressure to use a certain mode of transport to commute
	Q21f.	People who are important to me want me to commute by bicycle
<b>PBC</b>	Q21g.	I am confident that I can use my bicycle to commute
<b>Attitudes</b>	Q22	For an individual who daily covers a distance of less than 8 km, to choose to use the bicycle to commute is:
	Q22a.	Important – Not important
	Q22b.	Beneficial – Harmful
	Q22c	Enjoyable – Unenjoyable
	Q22d	Good – Bad
<b>Past behaviour</b>	Q24	How frequently you have used a bicycle to commute in the last six months

### 3.5.2.2 Social Comparison Orientation and Feelings from Social Comparison

#### Methodology

Social Comparison Orientation (SCO) (Gibbons and Buunk, 1999, Buunk et al., 2005) and Feeling from Social Comparison (Thornton and Arrowood, 1966) are the constructs based on the Social Comparison Theory (Festinger, 1954). This is explained in the literature review in Chapter Two. SCO can be defined as how much people tend to pay attention and behave according to others' behaviour (Gibbons and Buunk, 1999). The statements used to measure SCO are based on a modified version of the questions used by Buunk et al. (2005) and the statements used to measure feelings from social comparison are based on the statements used by Buunk

et al. (2005) and Lee (2014). These constructs aim to analyse people's tendency to compare themselves with others regarding transport mode choice and the feelings evoked as consequence of the social comparison when choosing to cycle over other options of transport. Participants were asked to indicate their degree of agreement on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) with the following statements:

### Measures

**Table 15 Social Comparison Constructs and Their Associated Question Number**

<b>Construct</b>	<b>Question</b>	<b>Description</b>
<b>Social Comparison Orientation</b>	Q19a.	I often compare myself with others
	Q19b.	I often compare myself with others with respect to the transport I use to commute
	Q19c.	If I want to assess what I have achieved in life, I compare the way I commute with how other people do it
<b>Feeling from Social Comparison</b>	Q19d	I often feel good when I see other cycle commuters
	Q19e	If I commute by bicycle I often feel that other people will think that I am poor

### 3.5.2.3 Affective Motives, Instrumental Motives, and Symbolic Motives

#### Methodology

Affective, instrumental, and symbolic motives are constructs based on the Material Possessions Model of Dittmar (1994). Affective

motives are needs and desires linked to emotions that individuals use as reasons to perform behaviours. Instrumental motives are the individual's reasons related to the extent to which the object's function allows the individual to perform a certain behaviour. Instrumental motives can be defined as the individual's reasons to perform a behaviour that are based on their self-identity or social position (Dittmar, 1994, Dittmar, 2008).

To measure these constructs, modified versions of the statements used by other researchers were employed. Affective motives were measured using modified statements from Lois and López-Sáez (2009) and Steg et al. (2001). Instrumental motives were measured with modified statements from Lois and López-Sáez (2009), Steg et al. (2001), and van Vugt et al. (1996). Symbolic motives statements were modified from those used by Lois and López-Sáez (2009), Jensen (1999), and Steg et al. (2001). Participants were asked to indicate their degree of agreement on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

## Measures

**Table 16 Material Possessions Model Constructs and Their Associated Question Number**

<b>Construct</b>	<b>Question</b>	<b>Description</b>
<b>Affective motives</b>	Q20a	I enjoy riding a good bicycle
	Q20b	Riding a bicycle can be an exciting adventure
	Q20c.	For me, my bicycle is, above all, an object of pleasure
	Q20d.	Riding my bicycle gives me freedom and independence
	Q20e.	Riding my bicycle is relaxing

<b>Instrumental motives</b>	Q20f.	Cycling commuting is comfortable
	Q20g	Cycling commuting is beneficial for the local environment
	Q20h.	Cycling commuting is flexible
	Q20i	Cycling commuting means a low cost of travelling
	Q20j.	Cycling is safe
<b>Symbolic motives</b>	Q20k.	If I could choose, I would prefer a classy bicycle
	Q20l	Your bike can distinguish you from other people
	Q20m	A bicycle is an object with which you can sometimes show other people in general the way you are and your tastes
	Q20n	The bicycle you ride can give you prestige among friends and acquaintances
	Q20o	The better your bike is, the more successful you are in life

### 3.6 Pilot Study and Practicalities

Before distributing the survey, some practicalities had to be considered and a pilot study had to be conducted. 'Practicalities' refer to the language used in the survey. The full questionnaire was prepared in English and then translated into Spanish, the official language of the case study. A copy of both questionnaires can be found in Appendix Two. A process of forward-backward translation was carried out by the researcher to avoid cross-cultural, conceptual

and linguistic issues. The researcher has proficient knowledge of English-speaking culture, but the researcher's primary language is that of the target population (Mexican Spanish). So the researcher prepared the English version and then translated it into Spanish, considering the conceptual equivalence of words and phrases. After this, the Spanish version was translated into English by an English native speaker. Both English versions were compared to ensure the quality of the questions. After this, it was then possible to proceed with the pilot study. According to Robson (2002), a pilot study is "a mini version of the study", and it has to be carried out before the actual study in order to identify and sort out any problems to do with the survey. This means that the pilot study also helped to ensure that the questions in the survey were clear for the participants.

The pilot study was carried out in March 2015, aiming to test and improve the survey. The pilot study was composed of two parts: one small-scale, theory-based survey and cognitive testing by semi-structured interviews. The interviews were analysed and used to improve the questionnaire. The small-scale survey was used to refine the belief items, to check comprehension of the questions, the ergonomics of the survey and the language. As a result of the pilot study no new belief items were added to the survey, but changes were made to refine the number of questions used to measure the variables as well as the wording of the questions.

There were two changes made in the survey. The first change was in the use of only one item to measure PBC. The construct was piloted using three items, but on examination the Cronbach Alpha was found to be very low (below 0.5). The Cronbach Alpha is a measure of the internal consistency within questions in a survey. The values can range from 0.7-0.8 to be considered acceptable. The consensus is that 0.8 is appropriate, however some researchers have pointed out that having values of 0.7 could be expected in psychological constructs, but this needs to be taken with caution (Field, 2013).

Exploration of each item found that the internal consistency was not significantly improved by the use of more than one item. Thus, one

item was chosen, and this reduced the ambiguity in the question wording for the respondent, so that the item was less confusing for the respondent (see Wanous et al. (1997) citing Sackett and Larson and Lois et al. (2015)). The second change was regarding the item to measure past behaviour. Bamberg et al. (2003) highlighted that analysing past behaviour may improve predictions of later behaviour and can express habit strength. In order to gather this information and, as in the case of PBC, to make the item less ambiguous for the respondent, the measure was narrowed to a single item (Wanous et al., 1997).

### **3.7 Sampling Method**

The sample is the link between the study population and its generalization to the wider population (Bloor and Wood, 2006). The sampling method selected for this study was a probability sample. This type of sample allows the researcher to make statistical inferences about the population based upon the responses. Moreover, in this sampling method the probability of selecting each participant from the population is known (Robson, 2002). This sample method was the most adequate for the aim of this study because it allows the researcher to explore the perception of and attitudes towards cycling from people working and living in Mexico City. The sample characteristics were non-cyclists or occasional cyclists living and working in Mexico City who regularly commute. Respondents had to be between 18 and 60 years old. The age range was chosen based on a review of existing statistics on cycle use for Mexico City, which showed that only 3% of cyclists using the bike share system are 60 years old or over and that currently in Mexico City 79% of the cyclists are under 40 years old.

According to official data from the National Institute of Statistics and Geography (INEGI), the population in the capital of Mexico is 8,802,665 inhabitants and the population with an age between 15 and more (population in working age) is 4,142,159 (INEGI, 2013) . However, with an actual occupation, (with paid and unpaid jobs) the

total is 4,136,468 (Secretaria del Trabajo y Prevision Social [STPS], 2018). At a 95% confidence interval and a 5% margin of error the minimum sample size required was 384 respondents. To select the subjects, this study followed a simple random sampling of the required number of the responses.

### **3.8 Data Collection Procedure**

The recruitment strategy followed was online and on-street. The online recruitment was done using advertisement on social media platforms, LinkedIn, Facebook (using a page designed specifically for the survey), and Twitter for a period of three months (October-December 2015). The online survey contained a description of the study and the required characteristics of the respondents, as is explained in the next paragraph. The online survey was also distributed among the employees of the Department for Support to Victims of Crime (DGAVD) of the General Attorney of Mexico City through its email distribution list, thanks to the support of the General Director. In addition to the distribution online and through the networks of the DGAVD, a street-based recruitment strategy was carried out in Mexico City from November to December 2015. The total number of surveys responded to online was 101.

On-street recruitment was done at four specific public places in four municipalities of the city: Miguel Hidalgo, Benito Juárez, Coyoacán, and Cuauhtémoc. These places were selected because the four of them combine residential zones with upper, medium, and lower socio-economic levels; these zones also have a considerable number of business and offices; and, finally and most importantly, because in these zones there is a large number of transport options, thus there is a large number of individuals commuting through the day. Therefore, distributing the survey at these points allowed the researcher to reach people from different socio-economic backgrounds who were commuting to work.

The surveys were handed out and collected back by the researcher and four assistants. The main role of the people handing the surveys

out on the street was to provide the survey exclusively to the respondent, explain the instructions of the survey and the incentive, and wait for the respondent to hand it back once it was answered. Regarding the incentive, participants were informed that by answering the survey (both online and in hard copy) they would be entered into a lottery for 40 memberships of the bike share system (Ecobici) and 40 memberships of the car sharing system (Carrot). To filter exclusively people with the characteristics of the sample mentioned before in section 4.6, the facilitators were also instructed to ask the potential respondents whether they live in Mexico City and their frequency of cycle commuting. Those individuals not filling in the profile were excluded from answering the survey. From the distribution on-street, a total of 427 surveys were distributed and collected. Surveys with non-items responses and with unengaged responses were excluded. The sample from the on-street distribution was 301. And the final sample was 401 complete surveys.

### **3.9 Data Processing and Analytical Strategy**

The primary statistical software package to test the validity of the model was IBM SPSS Amos, but Microsoft Excel was also used for data visualization and organization. Before proceeding with the analysis all data was coded, input into the software, and then it was cleaned. Each step is described below.

#### **3.9.1 Coding**

Before carrying out any analysis it is necessary to code and carry out data entry. "Codes are symbols, usually numbers, which are used to identify particular responses, or types of response, in questionnaires [...] they help organizing, quantifying and analysing data" (Robson, 2002, p. 461). The coding was carried out by creating a coding book using numerical symbols for all answers. For instance, 1 = yes and 2 = no. In the case of the answers on the Likert scale, the numerical symbols ranged from 1 to 5, being 1 for strongly disagree and 5 for strongly agree, with number 3 as the neutral response. There was only one open question, but this was at the end of the survey to

request contact details if the respondent eventually wanted to take part in further research.

### 3.9.2 Data Entry and First Approach to the Data

An Excel file was created by directly keying in all the survey results, and subsequently this file was exported into SPSS for analysis. With the files ready it was possible to proceed to analysis.

### 3.9.3 Cleaning the Dataset

The first stage of the data processing was dealing with the missing responses. The observations with 10% or more of answers missing were deleted. These are listed in table 15.

**Table 17 List of Observations with More than 10% of Answers Missing**

<b>Collection Method</b>	<b>Blanks</b>	<b>ID</b>
Hard copy	58	313
Hard copy	46	300
Hard copy	37	254
Hard copy	26	378
Hard copy	23	307
Hard copy	21	281
Hard copy	20	395
Hard copy	18	319
Hard copy	17	331
Hard copy	15	311

#### 3.9.3.1 Dealing with Missing Data

There were missing answers in the segmentation questions. In table 18 for instance, for question 1 (sgc1: "Have you driven a car or van in the past 12 months?") 21 responses were missing. And the rest of the segmentation questions did not have more than 3 responses

missing. These missing answers were not replaced. After dealing with the missing and unengaged answers from the rest of the questions, we proceed to calculate the distribution of the segments and the missing answers did not affect the analysis.

**Table 18 Total Answers from Segmentation and Missing Answers (in pink)**

sgc1	sgc2	sgc4	sgc5	sgc6	sgc7	sgc9	sgc11	sgc12	sgc13	sgc14	sgc15	sgc17	sgc18	Segment
414	434	434	433	433	432	432	433	432	434	434	434	434	433	414
21	1	1	2	2	3	3	2	3	1	1	1	1	2	21
1.00	3.00	2.00	2.00	5.00	2.00	2.00	4.00	2.00	4.00	4.00	3.00	4.00	3.00	4.00
1	5	1	1	5	1	1	4	1	4	4	1	5	1	4
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	5	5	5	5	5	5	5	5	5	5	5	5	5	8

From the Social Comparison Theory (SCT), there were only two responses missing. For the responses missing in this case, because they are in five-point Likert scale, the missing responses were replaced with the median, which was 2 and 4. This process was carried out with SPSS, using 'Replace missing values' with the method 'median of nearby points'. For replaced responses, see table 19 below.

**Table 19 Total Answers from Social Comparison Theory and Missing Answers (in Pink)**

scomp_ori1	feeling_sc1
434	434
1	1
2.00	4.00
2	4
1	1
5	5

From the Material Possessions Model (MPM), instrument1 and symbolic1 had the largest number of missing responses, with 4 and 6 missing responses respectively. Considering the sample size was big enough (n=429 and n=431) missing answers were calculated through the same process as the SCT missing responses. For replaced responses, see Table 20 below.

**Table 20 Total Answers from Material Possessions Model and Missing Answers (in pink)**

affectivem4	instrumentm1	instrumentm2	instrumentm3	instrumentm4	instrumentm5	symbolicm1	symbolicm2	symbolicm3	symbolicm4	symbolicm5
434	431	434	433	432	434	429	433	433	434	433
1	4	1	2	3	1	6	2	2	1	2
4.00	3.00	5.00	4.00	5.00	2.00	3.00	3.00	3.00	3.00	1.00
4	4	5	4	5	2	3	3	4	3	1
1	1	1	1	1	1	1	1	1	1	1
5	5	5	5	5	5	5	5	5	5	5

Regarding the observations of items from the Theory of Planned Behaviour (TPB), all items have missing responses, but only 3 responses or less, except for the items measuring attitudes, which had on average 29 missing responses. These items are semantic differentials that were placed together in a table and people were asked to select the option which best represented their opinion from the extreme positive to the extreme negative. From the surveys handed out by the researcher in the on-street process, it was detected that the instructions to answer that specific question seemed to be confusing for the respondents. Respondents needed clarification on how to answer it, since they had to fill in the four rows with their answer for each item, but 29 respondents only answered the first row. Thus it could be that the missing responses were not intentional, but were rather a mistake. Therefore these missing answers were calculated through the same process as the SCT missing responses. For the responses replaced, see table 21.

**Table 21 Total Answers from Theory of Planned Behaviour and Missing Answers (in pink)**

intention1	intention2	intention3	subjenorm1	subjenorm2	subjenorm3	percibecontrol	attitud1	attitud2	attitud3	attitud4
434	434	434	434	433	433	432	407	408	404	405
1	1	1	1	2	2	3	28	27	31	30
3.00	3.00	3.00	2.00	2.00	2.00	3.00	2.00	1.00	2.00	2.00
3	4	3	1	1	1	4	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
5	5	5	5	5	5	5	5	5	5	5

Finally, in the case of socio-demographics, the largest number of missing responses were in the question for age, income and average

travel time. However, no answers were replaced, except for the variable income, in which, the 11 observations with missing responses were deleted because some analysis like SEM cannot be run with missing observations. In table 22, we can see the total items replaced.

**Table 22 Total Answers from Socio-Demographics and Missing Answers (in pink)**

bikeowners hip	age group recoded	Are you male or female?	What is your occupation?	income merged 2	Average travel time from home to work or to school (with return)
433	413	432	432	424	421
2	22	3	3	11	14
1.00	2.00	1.00	1.00	3.00	3.00
1	1	1	1	2	3
1	1	1	1	1	1
2	6	2	7	9	10

**Table 23 List of Replaced Values for Missing Responses**

Result Variables						
	Result Variable	Replaced Missing	Missing Values		N of Valid Cases	Creating Function
			First	Last		
1	Q19a	1	1	435	435	MEDIAN(Q19a,ALL)
2	Q19d	1	1	435	435	MEDIAN(Q19d,ALL)
3	Q20d	1	1	435	435	MEDIAN(Q20d,ALL)
4	Q20f	4	1	435	435	MEDIAN(Q20f,ALL)
5	Q20g	1	1	435	435	MEDIAN(Q20g,ALL)
6	Q20h	2	1	435	435	MEDIAN(Q20h,ALL)
7	Q20i	3	1	435	435	MEDIAN(Q20i,ALL)
8	Q20j	1	1	435	435	MEDIAN(Q20j,ALL)
9	Q20k	6	1	435	435	MEDIAN(Q20k,ALL)
10	Q20l	2	1	435	435	MEDIAN(Q20l,ALL)
11	Q20m	2	1	435	435	MEDIAN(Q20m,ALL)
12	Q20n	1	1	435	435	MEDIAN(Q20n,ALL)
13	Q20o	2	1	435	435	MEDIAN(Q20o,ALL)
14	Q21a	1	1	435	435	MEDIAN(Q21a,ALL)
15	Q21b	1	1	435	435	MEDIAN(Q21b,ALL)
16	Q21c	1	1	435	435	MEDIAN(Q21c,ALL)
17	Q21d	1	1	435	435	MEDIAN(Q21d,ALL)
18	Q21e	2	1	435	435	MEDIAN(Q21e,ALL)
19	Q21f	2	1	435	435	MEDIAN(Q21f,ALL)
20	Q21g	3	1	435	435	MEDIAN(Q21g,ALL)
21	Q22a	28	1	435	435	MEDIAN(Q22a,ALL)
22	Q22b	27	1	435	435	MEDIAN(Q22b,ALL)
23	Q22c	31	1	435	435	MEDIAN(Q22c,ALL)
24	Q22d	30	1	435	435	MEDIAN(Q22d,ALL)

### 3.9.3.2 Unengaged Responses

The other observations had between 0-9 missing answers, thus the degree of unengaged responses was calculated according to the standard deviation of the answers in the Excel file and these were deleted from the file. Neither in the answers about the socio-demographic information nor the Segmentation Questions had unengaged responses. Below is the table for the missing answers to theory-based questions.

**Table 24 List of Observations and the Unengaged Responses**

<b>Blank answers</b>	<b>Count (observations)</b>
0	309
1	61
2	20
3	21
4	12
5	7
6	3
7	1
8	1
9	1

### 3.9.3.3 Outliers

An outlier is an observation that is very different from the rest of the observations (Field, 2013). From the inspection of the box plots, some outliers were identified in the items from feelings from social comparison (2 items), affective motives (3 items), instrumental motives (3 items), symbolic motives (3 items) and attitudes (2 items). The outliers were visually inspected and it was determined that they were not data entry errors nether measurement errors. They were

genuinely unusual values, but looking at the Tukey's Hinges (see table 25) it is determined that those were mild outliers. Thus those observations were kept, however in further analysis they would be treated with caution.

**Table 25 Tukey's Hinges results**

Weighted Average (Definition 1)	Percentiles						
	5	10	25	50	75	90	95
scomp_ori1	1.00	1.00	1.00	2.00	3.00	4.00	4.00
scomp_ori2	1.00	1.00	1.00	2.00	3.00	4.00	4.00
scomp_ori3	1.00	1.00	1.00	2.00	3.00	4.00	4.00
feeling_sc1	1.00	1.00	3.00	4.00	4.00	5.00	5.00
feeling_sc2	2.00	3.00	4.00	5.00	5.00	5.00	5.00
affectivem1	1.00	2.00	3.00	4.00	5.00	5.00	5.00
affectivem2	2.00	3.00	4.00	4.00	5.00	5.00	5.00
affectivem3	1.00	2.00	3.00	3.00	4.00	5.00	5.00
affectivem4	1.00	2.00	3.00	4.00	5.00	5.00	5.00
affectivem5	1.00	2.00	3.00	4.00	4.00	5.00	5.00
instrumentm1	1.00	2.00	3.00	3.00	4.00	5.00	5.00
instrumentm2	2.00	3.00	4.00	5.00	5.00	5.00	5.00
instrumentm3	2.00	2.00	3.00	4.00	5.00	5.00	5.00
instrumentm4	2.00	3.00	4.00	5.00	5.00	5.00	5.00
instrumentm5	1.00	1.00	1.00	2.00	3.00	4.00	5.00
symbolicm1	1.00	2.00	3.00	3.00	4.00	5.00	5.00
symbolicm2	1.00	1.00	2.00	3.00	4.00	4.80	5.00
symbolicm3	1.00	1.00	3.00	3.00	4.00	5.00	5.00

symbolicm4	1.00	1.00	2.00	3.00	3.00	4.00	5.00
symbolicm5	1.00	1.00	1.00	1.00	3.00	3.00	4.00
intention1	1.00	1.00	2.00	3.00	4.00	5.00	5.00
intention2	1.00	1.00	2.00	3.00	4.00	5.00	5.00
intention3	1.00	1.00	2.00	3.00	4.00	5.00	5.00
subjenorm1	1.00	1.00	1.00	2.00	3.00	4.00	5.00
subjenorm2	1.00	1.00	1.00	2.00	3.00	4.00	4.00
subjenorm3	1.00	1.00	1.00	2.00	3.00	4.00	4.00
perceivedcontrol	1.00	1.00	2.00	3.00	4.00	5.00	5.00
attitud1	1.00	1.00	1.00	2.00	3.00	4.00	4.00
attitud2	1.00	1.00	1.00	1.00	2.00	3.00	4.00
attitud3	1.00	1.00	1.00	2.00	3.00	3.00	4.00
attitud4	1.00	1.00	1.00	2.00	2.00	3.00	4.00
pastbehaviour	1.00	1.00	1.00	2.00	3.00	4.00	4.00
Tukey's Hinges							
scomp_ori1			1.00	2.00	3.00		
scomp_ori2			1.00	2.00	3.00		
scomp_ori3			1.00	2.00	3.00		
feeling_sc1			3.00	4.00	4.00		
feeling_sc2			4.00	5.00	5.00		
affectivem1			3.00	4.00	5.00		
affectivem2			4.00	4.00	5.00		
affectivem3			3.00	3.00	4.00		
affectivem4			3.00	4.00	5.00		

affectivem5			3.00	4.00	4.00		
instrumentm1			3.00	3.00	4.00		
instrumentm2			4.00	5.00	5.00		
instrumentm3			3.00	4.00	5.00		
instrumentm4			4.00	5.00	5.00		
instrumentm5			1.00	2.00	3.00		
symbolicm1			3.00	3.00	4.00		
symbolicm2			2.00	3.00	4.00		
symbolicm3			3.00	3.00	4.00		
symbolicm4			2.00	3.00	3.00		
symbolicm5			1.00	1.00	3.00		
intention1			2.00	3.00	4.00		
intention2			2.00	3.00	4.00		
intention3			2.00	3.00	4.00		
subjenorm1			1.00	2.00	3.00		
subjenorm2			1.00	2.00	3.00		
subjenorm3			1.00	2.00	3.00		
perceivedcontrol			2.00	3.00	4.00		
attitud1			1.00	2.00	3.00		
attitud2			1.00	1.00	2.00		
attitud3			1.00	2.00	3.00		
attitud4			1.00	2.00	2.00		
pastbehaviour			1.00	2.00	3.00		

In summary, after the data was cleaned a final sample of 401 observations remained. These observations were analysed in Chapter Five with descriptive and inferential statistics, and subsequently a Factor Analysis was conducted and a Structural Model was created to explore the relationships between the variables. To conclude, the next section, contains a description of the key methodological issues found.

### **3.10 Key Methodological Issues**

The researcher is aware of the limitations of the selection of a fixed design, since, as stated by Robson (2002), fixed designs 'cannot capture the subtleties and complexities of individual human behaviour'. However, it was the most adequate design to avoid the influence of the researcher in the study, and because such design helps to identify patterns in the data that can be related to specific social representations (Robson, 2002), in this case about the perceived image of cycling. An additional issue as mentioned in Robson (2002), is that individual characteristics of the respondents could have affected the answers. For instance, the respondent's educational background and knowledge could affect the understanding of the questions. As an example, although there were people taking 10 minutes to answer the survey, other respondents took up to 16 minutes.

The level of susceptibility to social desirability response bias is another issue to take into account. This means that the respondents do not accurately report their beliefs and attitudes because they try to project a better image of themselves. The data collection procedure described that in order to not influence the responses and to allow respondents to feel free to express their opinions the survey was conducted by self-completion, which means that respondents filled in the answers by themselves. However, the accuracy of the answers provided cannot be checked.

## **Chapter 4 Mexico City as the Case Study**

### **4.1 Introduction**

Mexico City, being a highly motorized city, is facing different challenges in the social and environmental sphere. Research about bicycle use had pointed that cycling at least 30 minutes daily can provide varied potential benefits in health and in the environment. In Mexico City in particular, cycling could help to overcome issues related with traffic and air pollution as well as improving health by helping people to adopt more active lifestyles. In Mexico City, there has been a general impulse to the use of bicycle through policy measures and there has been an increase in the participation of the civil society and pro-cycling organizations, and there are more cyclists on the streets.

Despite this, in the environment still lingers some negative attitudes towards cycling as described in Chapter One. The extent to which these negative attitudes have effect on the cycling levels Mexico are still unknown. In Chapter Two of the Literature Review it was emphasized that to the best knowledge of the researcher, currently there is not any study focusing on investigating how road users perceived cycling and what are the attitudes towards cycle commuting. And this was the motivation for targeting Mexico City as case study. Another motivation is that, although the results are only about the case study they could point directions for research in other cities in Latin America who are facing similar problems and that have a similar context. Mexico City cannot implement measures based on the experiences of other cities or conversely, however, highlighting problematic areas where little research has been conducted can be potentially beneficial. An additional reason why this research is also carried out in the capital of Mexico is because the researcher originally comes from there so has existent contacts as well as good knowledge of the culture and transport context, which make slightly easier to collect the data.

This chapter aims to describe Mexico City as case study for the research. The second part contains the background information about Mexico City. Information such as the location, weather and topography and socio-demographic characteristics. Section three described the urban mobility. Next section explains briefly the background of the use of bicycle in Mexico. This section makes emphasis of who used the bicycle before and who uses it currently. In this section a typology of the existing cyclists is presented, based on previous research. Section five presents the current cycling environment and the policy measures adopted to promote cycling, to understand how policies in some cases are contradictories and in other cases are not tackling the origin of the barriers for cycling. Section six presents the individual and societal benefits from cycling and how despite the benefits from modal shift that can be achieved such as improving mobility, reducing pollution and enhancing people's health, the total percentage of trips remain very low. Section seven describes the current facilitators and barriers that people experiment to cycle in Mexico City. Last section eight, contains a summary of the chapter and the conclusions.

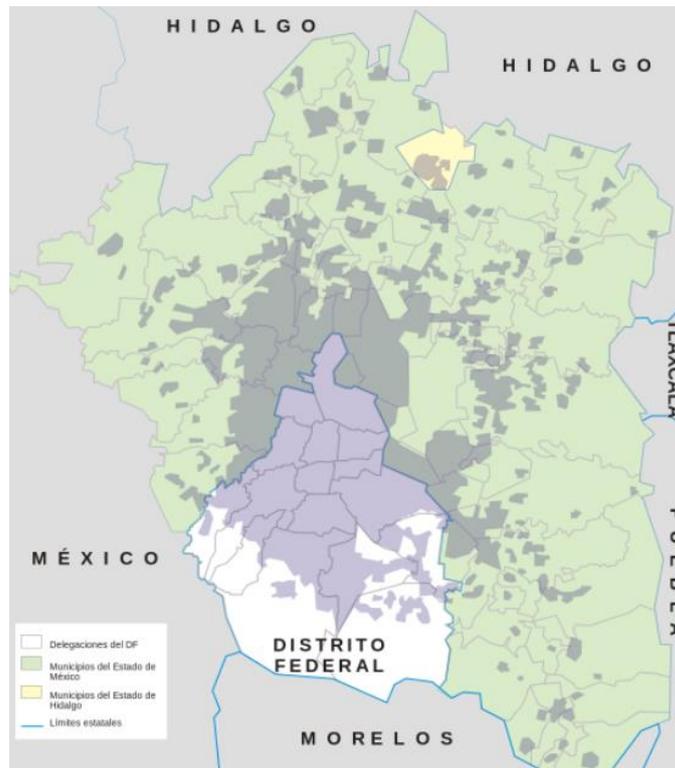
## **4.2 Mexico City Background**

Mexico is a country in the north of the American Continent and Mexico City is its capital (Figure 1). Mexico City is considered a megacity. When talking about Mexico City, it is usual than analysis and figures refer to Mexico City Metropolitan Area (MCMA) because this includes part or the totality of territory from other municipalities of the State of Mexico (17 municipalities) that spread in the capital making almost just one area with a total of 4,250 km<sup>2</sup> at 2,240 meters above the sea level and a population estimated of 21.2 million (World Bank, 2010). In figure 7, there is the map of the full MCMA.



**Figure 7 Map of Mexico and location of Mexico City**

Source: (Organisation for Economic Cooperation and Development, 2015)

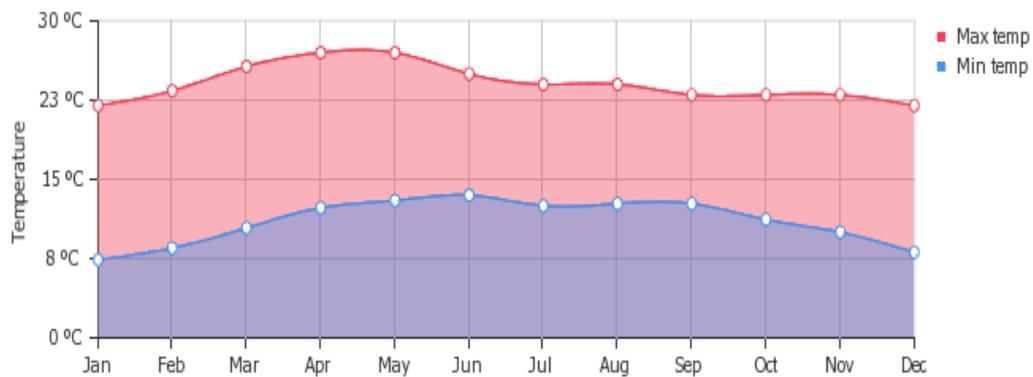


**Figure 8 Map of the MCMA**

Source: Public Domain,  
<https://commons.wikimedia.org/w/index.php?curid=864948>

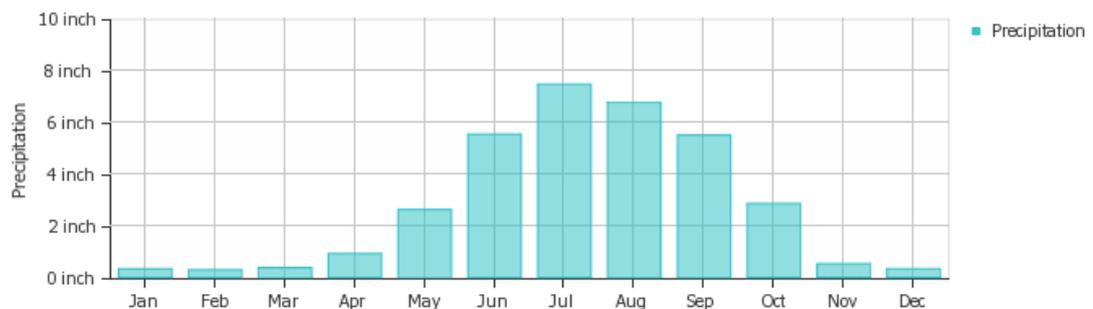
Mexico City (until 2016 also known as the Federal District) with the Metropolitan Zone of the Valle de México is the economic, financial, political and cultural centre of Mexico (Organisation for Economic Cooperation and Development, 2015) and it is the place selected for study case. Mexico City has 1500 km<sup>2</sup> and a total population of 8.8 million of inhabitants (7.5% of the total of the Country), of which 53% are female and 47% male (Consejo Nacional de Población, 2014). Its territory is divided by 16 municipalities. Two municipalities, Gustavo A. Madero and Iztapalapa have the largest population (over a million). See Figure 8 for location.

The average temperature throughout the year is 16 degrees. Figure 9 shows the monthly average temperature. The average annual precipitation is between 600 mm and 800 mm (Universidad Nacional Autonoma de Mexico-SMA, 2008), for monthly precipitation average see Figure 10.



**Figure 9 Mexico City average min and max temperatures**

Source: (World Weather and Climate Information, 2018)



**Figure 10 Mean monthly precipitation over the year (includes rain, snow, hail etc.)**

Source: (World Weather and Climate Information, 2018)

In table 26 we can see the distribution of the budget per capita and the population with motor vehicles. This table help us to understand the economic potential from each municipality to invest in infrastructure and implement measures to foster bicycle use and the municipalities highly motorized. The municipalities with higher budget per capita (higher than 4800.00, except for Milpa Alta) have also a population with high level of car ownership. And the three first in the table count also with bike share system. However, other such as Alvaro Obregon, Tlalpan, Coyoacan, Iztacalco, Iztapalapa and Gustavo A. Madero, have smaller budget per capita but over 40% of population owning a car.

**Table 26 Economic characteristics of each Municipality in Mexico City**

<b>Municipality</b>	<b>Total gross production per capita</b>	<b>Budget per capita</b>	<b>Remuneration per capita</b>	<b>Population with motor vehicles in 2014</b>
Miguel Hidalgo	2092775.5	4961.60	272509.3	119.7%
Cuauhtémoc	1487774.9	4923.90	228557.5	80.8%
Benito Juárez	805290.2	3491.70	53498.2	100.9%
Cuajimalpa de Morelos	679456.3	4818.70	51961.6	62.6%
Álvaro Obregón	464284.5	2738.10	50230.5	45.1%
Azcapotzalco	427887.8	3598.90	71911.1	65.2%
Tlalpan	131359.4	2793.20	17892.4	50.2%
Venustiano Carranza	123216.8	4461.7	21741..3	56.4%

Coyoacán	120674.7	2977.80	16210.9	66.6%
Iztacalco	107980.6	3570.10	12885.9	54.7%
Iztapalapa	78734.9	2139.20	6710.6	33.5%
Xochimilco	56744.7	3516.50	6068.30	36.1%
Gustavo A. Madero	51924.6	2848.90	6257.7	42.9%
Tláhuac	28305.3	3385.0	3614.6	29.5%
La Magdalena Contreras	24454.0	3784.60	4010.1	45.6%
Milpa Alta	10056.2	7120.40	862.8	34.4%

\*All data is given in Mexican pesos (1 MXN = 0.0538616 USD)

Source: (Meléndez, 2016)

Data for this study was collected in Mexico City from a sample of 401 respondents, based on the population with an occupation or job (paid or unpaid) further details are found in Chapter Four. In Table 27 it possible to see the comparison between the population of each municipality and the sample size. Although the sample is not representative, it was explained that the sample was based on the population living and working in Mexico City.

**Table 27 Municipalities in Mexico City**

	<b>Municipality</b>	<b>Population</b>	<b>Sample</b>
1	Álvaro Obregón	301,416	43
2	Azcapotzalco	185,090	11
3	Benito Juárez	211,256	51
4	Coyoacán	305,055	30
5	Cuajimalpa de Morelos	95,851	36
6	Cuauhtémoc	294,243	33
7	Gustavo A. Madero	527,934	22
8	Iztacalco	187,636	17
9	Iztapalapa	858,482	16
10	La Magdalena Contreras	116,316	11
11	Miguel Hidalgo	146,795	41

12	Milpa Alta	45,687	1
13	Tláhuac	164,768	2
14	Tlalpan	348,259	19
15	Venustiano Carranza	174,267	5
16	Xochimilco	179,289	9
17	Other	-----	54
	Total	4,142,343*	

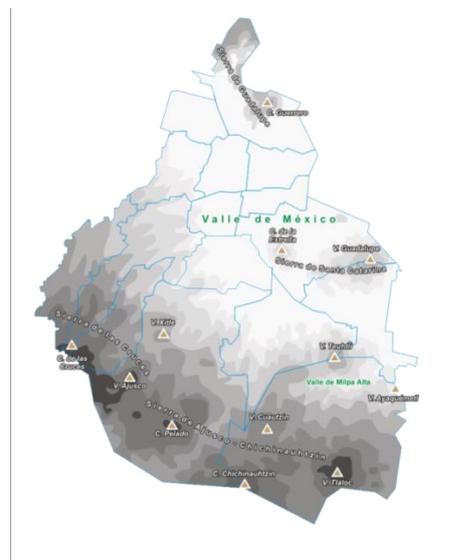
\*Average of 2013

Source: (INEGI, 2013)



**Figure 11 Map of the Municipalities in Mexico City**

Source:  
<http://www.gifex.com/detail/2011-09-18-14574/Delegaciones-de-la-Ciudad-de-Mxico-DF.html>



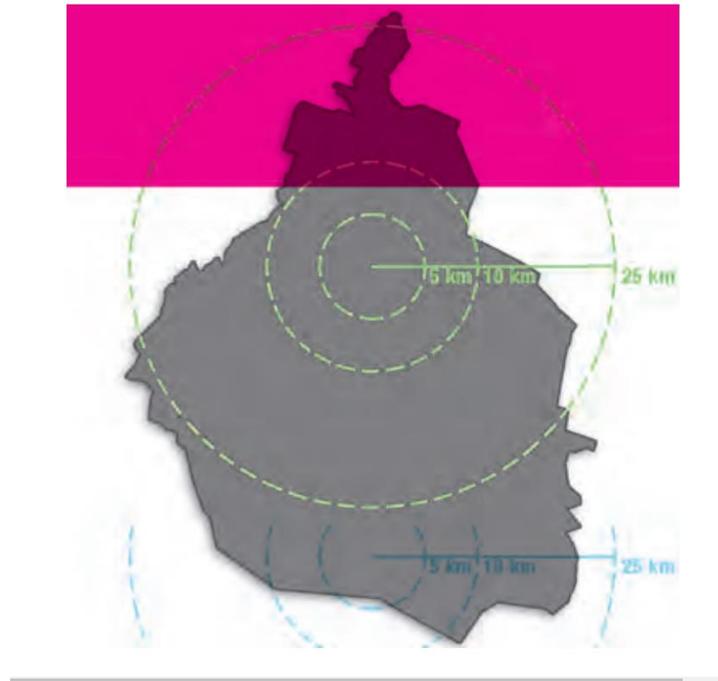
**Figure 12 Map of the Topography of Mexico City**

Source:  
<https://commons.wikimedia.org/wiki/File:MX-DF-Relieve.png>

The City has a great potential for cycling for diverse reasons according to the strategy for mobility (Universidad Nacional Autónoma de México-SMA, 2008):

1. Topography: As showed in the Figure 4, approximately 37.7% of the city is flat. Which makes it a terrain that can be cycled for having less than 6% slope.

2. Distance travelled: 40% of the total of trips do not exceed 8 km, which means that the route can be travelled in 30 minutes in average (see Figure 11).
3. Weather: as mentioned before, the average temperature throughout the year is 16 degrees.



**Figure 13 Travel distance mapped**

Source:(Universidad Nacional Autonoma de Mexico-SMA, 2008)

### **4.3 Urban Mobility**

In the MCMA there are about 4 million vehicles consuming more than 40 million liters of petroleum fuels per day (Molina et al., 2010) and with an occupancy rate of 1.3 according to (United Nations Human Settlements Programme, 2015). Only in Mexico City there are 2.9 millions of cars (Universidad Nacional Autonoma de Mexico-SMA, 2008). Car use is linked to environmental problems such as the high concentration of air pollutants. The MCMA is in a high altitude with tropical insolation which contributed to the production of ozone throughout the year but in winter air quality is worsened (Molina et al., 2010).

Urban mobility is essential of every city. According to the Household survey for Origin-Destination carried out by the Government (INEGI, 2007). In the MCMA everyday individuals do 21.9 million of trips. 58.4% are in Mexico City and 41.3% in the rest of the municipalities of the MCMA. (INEGI, 2007).

According to the same survey, residents of the MCMA of these trips, almost 2 million are made in different modes. Of which 14.8% million are carried out in public transport, 6.8 million in private transport, and some trips multimodal or with other options. Breaking dawn the trips, from the trips in public transport, a little bit more than 8 million of the trips are only made by one transport option whereas more than 6 million combine two or more public transport options (INEGI, 2007)

The public transport is composed by different modes such as the subway, buses, BRT, Tram, Trolley which count upon official figures. However, another massive mode of transportation is the mini bus (a.k.a. microbus) which have informal stops and do not count with any official ticket or timetable.

According with figures from 2016, the subway, which in 2017 celebrated 48 years since its launch, has 275 trains in service across 12 lines with a total of 195 stations (INEGI, 2016). Providing service to 130 million passengers monthly. There are 1289 buses of which, 867 provide general service; 100 are the 'Atenea' buses exclusively for women; 72 Ecobuses; 145 Express Service and 105 transport to schools. In total the buses have 94 different routes providing service to approximately 8 million passengers monthly. The BRT (Metrobus) has 468 units and by 2016 provide service in 6 different lines and 208 stations. The Metrobus provides service to 20837 passengers monthly. The tram, has only 20 trains in operation in one line with 18 stations in just one line, providing service to 2711.70 people monthly. The Trolley (Trolebus) have 340 buses operating in 6 lines providing service to approximately 5954 passengers monthly (INEGI, 2016)

From the trips in public transport, those 6 million trips in just one mode the minibus concentrates more than 60% followed by taxi

(16.4%); the subway (8.2%) and the rest of the percentages are divided by the buses, trolley, BRT and the tram. Regarding trips in private transport, the 92.3% are made by car and the remaining percentages are divided by the bicycle and motorbike (INEGI, 2007).

The City counts also with share economy options for mobility. The car share system is called Carrot and it was launched in 2012<sup>10</sup>, whereas the bike share system's name Ecobici was launched in 2010. Currently the trips in bicycle accounts for only 2% of the total trips in the MCMA and 0.9% for Mexico City (López, 2013) and data from Carrot was not available online.

#### **4.4 Cyclist Profile in Mexico City**

To understand more about the perceived image cycling and the cultural practices surrounding it, it is important to look at the beginning of the use of the bicycle in Mexico. The bicycle was exported to Mexico from North America and Europe. In Europe it was the most affordable means for mobility of the masses and by the 1950s was the most numerous means of individual transport however it uses experimented a transformation, passing from mean of transport to a leisure item (Cox, 2015b). It is important to notice that the use of bicycle as a massive means of transport didn't reach the society in United States and it did reach for longer time other societies and diverse factors were very influential for this (see Cox, 2015).

“In the UK the bicycle boom did not fundamentally transform the cycle industry, which rely on high-price and high-margin sales but in France and Germany ‘stimulated the expansion of the indigenous cycle trades’. Canada, Australia and New Zealand were directly linked by their positions within the British Empire, and as in the mother country, the bicycle provided not only an important means for demonstrating fashionable status, but also

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<sup>10</sup> See: <http://www.carrot.mx/>

began to provide more utilitarian transport. For the European socialist, what made the bicycle such a desirable commodity during the growth years was its clear potential for more universal distribution of social goods through the access granted by increased mobility. [...] The success of Danish workers political organization at the turn of the century was also paralleled in the rise of socialist cycling organizations.” (Cox, 2015b, p. 54)

In North America, adopting the bicycle was not easy and it was rejected by some groups of the society sometimes even from the religious or medical vision in the latest eighteenth hundred (Aronson, 1952). But over there, the bicycle changed people’s idea of the “countryside” (Norcliffe, 2001) since the bicycle allowed the population to engage into a new dynamic of mobility by being able to travel more (Aronson, 1952).

In Mexico, the use of bicycle became popular between the 1950s and 1980s, although it was imported from the United States and Europe since the latest 1850s. In fact, cycling was adopted around 1900 by the affluent people as a leisure activity (Félix Zavala, 2015) back then bicycles were expensive, however, with the development of the industry to produce them, the prices dropped (Norcliffe, 2001). But nevertheless, that industrial development also reduce the price of cars making them more popular neglecting the idea of bicycle to commute by the 1960s. This resulted on giving priority to roads to accommodate motor vehicles, but purchasing a car was not at hand for all social classes.

Thus, in the capital of Mexico, public transport was the predominant mode of transport for the middle class from the 1940s and 1979 although car also became dominant (Benítez, 1984). This showed as mentioned by Guerra (2015) a relationship between high income and car ownership, limiting the use of the bicycle to the most disadvantaged social classes. These lower social classes used the bicycle as a transport mode to reach their jobs and their homes, originating a link between social position and transport mode in the

social imaginary of upper social classes (Herrera Miranda et al., 2014).

Analysing diverse reports and studies about cycling (López, 2015, Institute for Transportation and Development Policy [ITDP], 2014, López, 2013) and the use of bicycle has been characterized by two types of cyclists in Mexico City, the cyclists that use their own bicycle and cycle for economic reasons (to save money in transport) and those who use the bike share system (to commute to work or trips in working hours, such as having lunch).

From a small review the current images of cycling and cyclists in Mexican newspapers, there are mainly two types of cyclists depicted: the cyclists for sport, who could be categorized as the sport cyclists and the user of the bike-share system (Ecobici). However, ordinary people cycling to commute are not shown. This images lead to the idea that cycling for commuting purposes is not a conventional activity and an uncommon activity. Horton et al. (2007b) and Granville et al. (2001) argue that images like these has the effect of affecting the perception of cycling, and thus the intention to cycle in general. Davies (1997) stated that images of sport cyclists make cycling look like an activity to be practised only by fit and sporty people. Aldred (2013b) supported this when she concluded that presenting cycling as a sport will not necessarily increase cycle commuting.

But the perceived image of cycling in Mexico City is not only considered uncommon or linked to sports. Cycling as a mode of transport can be also be linked to a specific socio-economic status. The perceived image associated with a cyclist as an individual can play an important role as a barrier or motivator to cycle. The perceived socio-economic status attached to bicycle users may differ according to the type of cyclists and the context. Lugo (2012) also stated that this differentiation and marginalization results from social forces and cultural practices.

## **4.5 Cycling Environment and Policy**

One of Mexico City's first actions to promote bicycle was in 2004 when the local Government launch the "Ciclovía de la Ciudad de México" or Cycle Path. This cycle path followed a trajectory of 90 km crossing the municipalities of Miguel Hidalgo, Álvaro Obregón, Magdalena Contreras and Tlalpan. This was an initiative that was thought to impulse the use of bicycle for fitness and leisure. From 2004 until 2006, the local government started an awareness campaign and promotion of the bicycle by different programs such as "Programa de Educación Ambiental Itinerante"; the setting up of cycling racks on buses in the zone of the cycle path; the allowance of bicycles in public transport such as subway and BRT on Sundays and some spaces for bicycle parking. By 2007, the local Government launch the "Plan Verde de la Ciudad de México" or Green Plan to guide the governmental actions towards sustainability.

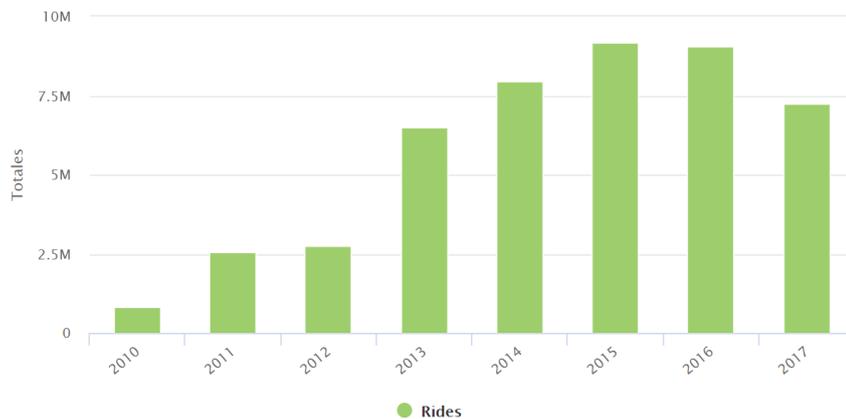
Plan Verde which was a strategy planned for 15 years with the purpose of establishing policies and rout of actions to move into a more sustainable mobility. The strategy was divided in seven lines: land conservation, public space, mobility, water, climate change, energy and management of solid wastes. With the cooperation of Mexican academics and a Danish Urban and Design consulting firm it was designed the Mexico City's Bicycle Mobility Strategy. The strategy was based on three pillars: Socialization and bicycle culture; Public bicycle system and infrastructure and bicycle parking (Secretaria de Medio Ambiente (SMA), 2011).

In this plan, in the mobility section, incentivized the use of bicycle for leisure but also as part of the transport system. And actions such as "Muévete en Bici", "Ciclotón" and the plan of creating a bike share system. The governmental goal was to increase the bicycle trips from 1% in 2007, to 2% in 2010 and in 2012 reach the 5% according to the SMA (2012).

In July 2015 it was launched the "Ley of Movilidad" or Mobility Law, where it is stabilised that mobility is a right and there is a legal

establishment of the hierarchy of the road users in terms of space and financial resources. Placing cyclists just below the pedestrians and before the public transport (Organisation for Economic Cooperation and Development, 2015). In fact, there were even modifications the Traffic Regulations, before the cyclists' role in the transport and mobility system was unclear.

The bike share system is popular Ecobici is relatively popular and had steadily increased the number of users and the trips (see Figure 12). But although the attitudes in general are positive (Lastra et al., 2016) when it was required to use space to increase the perimeter of the system and enlarge it, some residents from one of the richest areas in Mexico City, opposed to it, arguing that it will increase crime and would decrease the residential value of the houses in the zone (López, 2013). In Chapter One it was also described the recent rise in verbal and physical aggressions towards cyclists on the streets. And these were the motivations to carry out this study in which it is argued that the perceived image towards cycling might influence intention.



**Figure 14 Historic Use of Ecobici**

Source: <https://www.ecobici.cdmx.gob.mx/en/stats>

## **4.6 Benefits of Cycling in Mexico**

Mexico City being a highly motorized city have several problems associated to this. First, air pollution and congestion (United Nations Human Settlements Programme, 2015). Secondly, a population with health problems that have been to the lack of physical activity (Secretaria de Salud, 2014) which is leading to an increase in obesity in people over 20 years old, which is linked to other health problems such as diabetes (Secretaria de Salud, 2014, Secretaría de Salud, 2016). Diabetes and other cardiovascular illnesses are among the main causes of mortality in the country, representing a public health burden (Instituto Mexicano de la Competitividad, 2015). And finally, long travel journeys from work at rush hour, for instance, is estimated to take up to 3.5 hours (United Nations Human Settlements Programme, 2015).

Therefore, a modal shift from driving to cycling can help to tackle some of this problem. In the literature it is evidenced that the bicycle is the most efficient mode of individual transportation and the most favourable alternative to cars (Wilson, 1973). Cycling for commuting purposes, for instance, allows people that do not have time for physical activity to engage in exercise whilst traveling from and to places (Garrad, 2012). There is strong evidence supporting the individual benefits from cycling such as cardiorespiratory endurance as well as the reduction in obesity (Oja et al., 2011). But benefits from cycling go beyond fitness. Cycling at least 30 minutes daily as a physical activity has a significant positive impact on people's mental wellbeing, for instance, reducing symptoms of depression and anxiety (Carek et al., 2011).

Modal shift from driving to cycling, have also a positive impact on the environment such reducing greenhouse gasses and other pollutants, noise levels as well as in promoting more liveable cities (Garrad, 2012). Although sometimes is argued that cyclists are more exposed to pollutants and face higher risk of accidents, De Hartog et al. (2010) in a study about the health benefits derived from modal shift from driving to cycling, found that the benefits from cycling are

greater than the negative effects and risk comparing driving and cycling. Rojas-Rueda *et.al.* (2011) concluded from a study in Barcelona, that the benefits of cycling to commute have greater benefits in health than the risk of exposure to air pollutants and road traffic accidents.

Modal shift's benefits from driving to cycling can lead to several positive environmental and social benefits (Mueller *et al.*, 2015, Bauman *et al.*, 2013, Garrard *et al.*, 2012, Oja *et al.*, 2011) even in polluted cities (Tainio *et al.*, 2016). However, travel modal choice is complex (Davies *et al.*, 1997, Beirão and Sarsfield Cabral, 2007) and choosing to cycle over other transport options is even more complex because as Parking (2007c) argued, individual factors with socio-psychological or cultural dimension play an important role.

#### **4.7. Barriers and Facilitators of Cycling**

Cycling levels around the world are very different and contrasting (Tin *et al.*, 2009) this might be linked to the fact that cycling can be easier or more difficult from one place to another (Horton *et al.*, 2007a). For instance, the highest cycling modal share in European cities is distributed as follows: Copenhagen 35%, Amsterdam 32%, Berlin 13%, Ljubljana 12%, Helsinki 11%, Zagreb 10.1% and Stockholm 9%. The lowest levels are in Lisbon 1%, London 2%, Brussels 3.5%, just to name a few (European Cyclist Federation, 2016). In the United States, cycling commuting accounts only 1% of the total trips (Dill and Voros, 2007) which is similar to levels in the UK (Steinbach *et al.*, 2011).

These contrasting levels can be related to barriers such as adverse weather (e.g. rain, extreme hot or cold) and topography (e.g. very hilly) (Gatersleben and Appleton, 2007). Safety linked to lack of infrastructure in the urban environment (Gatersleben and Appleton, 2007, Horton *et al.*, 2007b) and safety that can be linked to the number of incidents, or linked with perception of safety (Heinen *et al.*, 2010). It has been discussed also that psychological barriers such as intention, perceived image and attitudes (Milakis, 2015, Fernández-

Heredia et al., 2014, Heinen et al., 2011, Gatersleben and Appleton, 2007, Davies et al., 1997) as well as cycling history and culture (Fruhen and Flin, 2015, Aldred and Junnickel, 2014, Bamberg et al., 2003, Parkin et al., 2007c) play an important role as deterrents for cycling.

Understanding these factors is very important in highly motorized cities like Mexico City with very low cycling levels and where transport authorities are facing big challenges such as traffic congestion, pollution and a growing population with obesity problems (United Nations Human Settlements Programme, 2015). Particularly for Mexico City, a modal shift would help to improve air quality and health. Currently, more than 80% of the air pollutants in this city originate from motor vehicles, and exposure to this is leading to respiratory problems (Escamilla-Nuñez et al., 2008). Traffic congestion is worsening and traveling from and to work in peak hour is estimated to take up to 3.5 hours (United Nations Human Settlements Programme, 2015) placing Mexico City as one of the most congested cities in the world (International Business Machines Corporation [IBM], 2011). On the other side, the population's lack of physical activity together with an inadequate nutrition is leading to an increase in obesity in people older than 20 years old which it is linked to other health problems such as diabetes (Secretaria de Salud, 2014, Salud, 2016). Tendency that it is expected to increase for all age groups (Rtveladze et al., 2014). Diabetes and other cardiovascular illnesses are among the main causes of mortality at the country level, representing a public health burden (Instituto Mexicano de la Competitividad, 2015).

In Mexico City, multiple factors such as built environment, centralization of economic activities, disperse dwellings in the peripheries, is leading to an increase in car ownership (Guerra, 2015) and this might be a deterrent for cycling since there is much less infrastructure for cycling than for cars.

Regarding public transport, there is a permanent crisis (Figueroa, 2005) such as demand exceeding the offer and lack of maintenance

leading to a reduction in the quality of public transport and lack of attractiveness. But also the insecurity and crime in the public transport might lead to an increase in car use and car ownership. McCarthy et al. (McCarthy et al., 2016) in their study about how transport users perceive personal safety apps stated that fear of crime potentially affects people choice to use public transport (McCarthy et al., 2016). The United Nations have stressed the increase in problems associated with gender violence in public transport, for instance, in Mexico City at least 65% of women had experimented episodes of violence (United Nations Human Settlements Programme, 2015). According to the Road Safety Annual Report produced by the (Organisation for Economic Co-operation and Development (2016) in the country, 'between 2010 and 2014, the number of registered vehicles increased by 20%'. In the pilot study described in the Chapter Four, there were carried out some semi structured interviews, and people interviewed commented on their preference for car use for safety reasons.

Promoting cycling for commuting purposes would contribute to improve mobility, reduce pollution and enhance people's health. Therefore, the use the bicycle can be a potential remedy to tackle the problems in Mexico City. That is why the vision of Mexican Government, following the example of the growing bike sharing schemes around the world (Shaheen, 2012, Pucher et al., 2011) and inspired by the European programs in Paris and Barcelona (Dieleman, 2013) in 2009 launched the system called 'Ecobici', which by 2016 generated 433.981 trips per day, only under Bogota (Colombia) with 611.472 trips and Santiago de Chile (Chile) with 510.569 trips (Ríos Flores et al., 2015).

To date, the Ecobici has 480 stations covering 55 neighbourhoods of Mexico City (an extension of 38 km<sup>2</sup>) with a total of 6800 bicycles. However it can be argued that the infrastructure is lacking of connectivity and that it only benefits the users of Ecobici since the perimeter where the facilities are installed are where middle class mainly commute. According to previous studies (INEGI 2007 and

Lopez 2013) the municipalities where most of the bicycle trips are travelled are Iztapalapa, Cuauhtemoc and Gustavo A. Madero. Only Cuauhtemoc is the municipality where the system have stations, whereas the in Iztapalapa and Gustavo A. Madero there are not stations neither connectivity with the Ecobici perimeter.

## **Chapter 5 Introduction to the Analysis of Findings**

### **5.1 Introduction**

In the Chapter Three, it was described the approach and strategy followed throughout this study. It was also explained the methodology used and the specific strategy followed to collect and create the dataset. This chapter, presents the analysis of the data. Section two starts with the description of the background of the respondents. Section three contains the analysis of the transport segments in Mexico City. In this section, first data is checked for normality and then there is the analysis of each of the attitudinal transport segment. After this, the attitudes towards driving, bus use, cycling and walking is examined for each of the segments. The final part of this section contains the comparison between the segments in Mexico City and those found in Europe to test the transferability of the methodology. The section four in this chapter, comprises the analysis of the perception and attitudes towards cycling in Mexico City. In this section, the data is also assessed for normality followed by a description of the observed variables. In this section, the analysis of the differences across the groups are the correlation between the variables is explored. Section five contains the model development. This section consists of the steps previous to the development of the structural model. The first part includes the analysis of reliability and validity of the items, followed by the exploratory and confirmatory factor analysis and subsequently there is presented the test for invariance. After meeting all the requirements of reliability and validity, the Structural model to predict intention to cycle is presented and it also contains the interpretation of the results. This section finish with the hierachical multiple regression model to investigate the effect of each variable in the variance in intention to cycle. The section six contains the description of the limitations faced in carrying out this study. And finally section seven, contains a summary of the chapter and the conclusions.

## 5.2 Sample Background and Description

All the socio-demographic characteristics of the sample are in the Table 28. The sample was composed by 55.1 % males and 44.9% female respondents. The largest age group was people from 18-31 years old (30% respondents), followed by the group aged 25-31 (24.2%), 32-38 (16.2%), 39-45 (13.3%) and the least represented groups are those from 46-52 years old (7.6%) and >53 years old (7.6%). Half of the respondents have at least one university degree (52.1%), which shows that the sample is an educated group and this might bias the answers. More than 80% of the sample work or combine work with studies.

It is important to notice that another possible source of bias can be found from the average time travelled. Although more than 50% of the sample travel for 60 min or less (with the return, meaning that each trip last up to 30 minutes), 38.9% of the sample commute for longer than one hour. This indicates that the latter group face other barriers for cycling not only not related with socio-psychological factors. For example, travelling distances longer than 30 minutes is challenging for a non-regular cyclist in terms of physical endurance.

Additionally, the lack in facilities (such as showers at offices) and infrastructure (e.g. segregated cycling paths) make more difficult to cycle for long distances in the city. In the Figure 15 it is possible to see that a variety of different modes of transportation to commute are used, and although some of them are combined to travel, private car is the most used by almost 60% of the individuals. This is followed by using subway (30.9%), gasoline powered bus or microbus (26.4%), walking (25.2%) and cycling (20.7%). It is not surprising that tram is only used by 2% of the respondents. The tram travels only for 13,04 km, communicating only three municipalities (Coyoacán, Tlalpan y Xochimilco).<sup>11</sup>

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<sup>11</sup> See <http://www.trenligero.com.mx/recorrido.php>, consulted 02 May 2017.

**Table 28 Descriptive statistics of the sample and population**

Variable	Category	Percentage sample	Percentage population
Gender <sup>12</sup>	Male	55.1	54
	Female	44.9	46
Age <sup>13</sup>	18-24	30	21 (20-29)
	25-31	24.2	
	32-38	16.2	47 (30-49)
	39-45	13.3	
	46-52	7.6	29 (>50)
	>53	7.6	
Education	Post degree	15.5	34.2 (superior)
	University	52.1	
	Technical or commercial education	10	50.1 (secondary and next)
	High school	18.2	
	Secondary education or less	5.9	15.5 (primary or less)
Occupation	Work or work and Study	81.3	***
	Only Study	9.7	
	Other	9.1	
Income* <sup>14</sup>	3000 or < MXN	14.5	12.78
	4000 to 9000 MXN	29.7	41.4
	10000-15000 MXN	17.2	13.14
	16000 to 27000 MXN	18	6.50
	28000 or > MXN	20.7	
Average commuting travel time**	Up to 30 min	22.4	53.9
	From 31 min to 59 min	35.4	20.3
	Up to 1.5 hrs	21.9	8.4
	Up to 2 hrs	11	
	Up to 2.5 hrs	2.5	2.5
	Up to 3.5 hrs	2.5	
	More than 3.5 hrs	1	
	N/A and missing answers	3.2	8.7

\*Income is monthly and the currency used was Mexican pesos (MXN), 1 Mexican peso = 0.052 US Dollar and the classification is based on the deciles used by the National Survey of Household Income and Expenditure 2014(INEGI, 2014). \*\*This question had 7 missing responses (total sample 394) and six respondents choose 'Not applicable'.

\*\*\* This data was not available for the population.

<sup>12</sup> This includes the Metropolitan Area (STPS, 2018).

<sup>13</sup> Based in the same source this includes the metropolitan area and it was not found equivalent age, that is why the categories were merged (STPS, 2018).

<sup>14</sup> For data of Mexico City as a whole, it was used the minimum wage (80.04 Mexican pesos daily) reported by 2017. See for further details

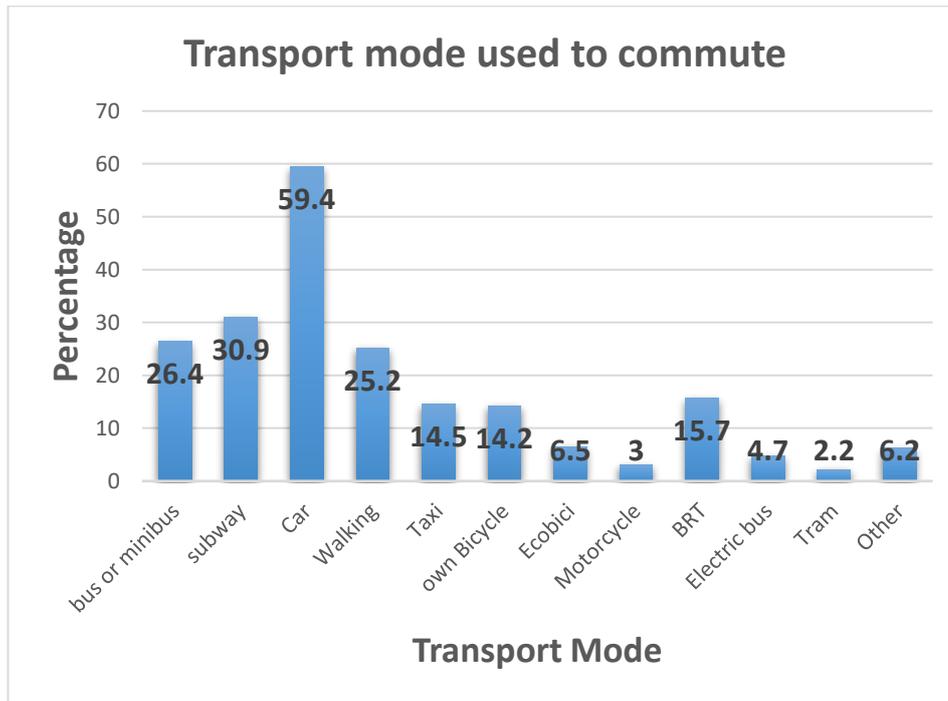
<http://reporteeconomico.sedecodf.gob.mx/index.php/site/main/114>

Regarding car use, as showed in Figure 15, more than half of the respondents use motor vehicles to commute. This could be linked to the regular environmental contingencies due to the poor urban air quality in the city. For instance, “of the precursors to ozone, 71.5 percent by weight of the NOx was originated by transport vehicles” (World Bank, 2010). However this is one factor, but there are others causes of the poor air quality in Mexico City too. For example, a balance between pollutant emissions together with atmospheric chemical reactions between primary pollutants and the capacity of the valley to eliminate, disperse or concentrate those air pollutants (Calderón-Garcidueñas et al., 2015). Data about transport mode use to commute by the population and the sample in Mexico City is in the following table 29.

**Table 29 Transport mode used to commute to work by sample and population.**

<b>Transport mode use</b>	<b>Percentage Sample</b>	<b>Percentage Population</b>
Taxi, Bus or minibus	40.9	34.7
Private car	59.4	27.7
Walking	25.2	22.6
Transportation of staff	0	6.9
Subway, BRT, Tram, Electric bus	17.9	3.3
Bicycle (personal or Ecobici)	20.7	5.4
Other	1.6	9.2

Source: (INEGI, 2015)



**Figure 15 Transport mode most commonly used to commute daily by sample**

### **5.3 Analysis of Attitudinal Transport Segments in Mexico City**

#### **5.3.1 Assessing Normality of the Data**

As explained in Chapter Three, the survey was distributed online and on-street. Thus, the next step before carrying out the analysis of the segments is to assess whether the distribution tool might affect the responses and if the data is normally distributed. To assess for normality for the two different method for distributing the survey. It was used the Shapiro-Wilk test for normality. The results in table 30 show that all the p values are  $<0.05$ , thus the null hypothesis is rejected and it is accepted that the population is not normally distributed. In large samples a significant result could have been obtained even with a small deviation from the normal distribution (Ghasemi and Zahediasl, 2012). With a sample of 401 respondents, based on Pallant (2013), it was proceed with the analysis.

**Table 30 Normality T-test for Segmentation questions in both data collection tools**

Method of collecting data		Shapiro-Wilk		
		Statistic	df	Sig.
sgc1	Online	0.555	96	0.000
	hard copy	0.483	289	0.000
sgc2	Online	0.833	96	0.000
	hard copy	0.881	289	0.000
sgc3	Online	0.839	96	0.000
	hard copy	0.898	289	0.000
sgc4	Online	0.788	96	0.000
	hard copy	0.884	289	0.000
sgc5	Online	0.605	96	0.000
	hard copy	0.827	289	0.000
sgc6	Online	0.760	96	0.000
	hard copy	0.705	289	0.000
sgc7	Online	0.706	96	0.000
	hard copy	0.872	289	0.000
sgc8	online	0.777	96	0.000
	hard copy	0.857	289	0.000
sgc9	online	0.843	96	0.000
	hard copy	0.863	289	0.000
sgc10	online	0.844	96	0.000
	hard copy	0.913	289	0.000
sgc11	online	0.753	96	0.000
	hard copy	0.891	289	0.000
sgc12	online	0.757	96	0.000
	hard copy	0.840	289	0.000
sgc13	online	0.852	96	0.000
	hard copy	0.867	289	0.000
sgc14	online	0.844	96	0.000
	hard copy	0.897	289	0.000
sgc15	online	0.809	96	0.000
	hard copy	0.882	289	0.000
sgc16	online	0.836	96	0.000
	hard copy	0.903	289	0.000
sgc17	online	0.807	96	0.000
	hard copy	0.835	289	0.000
sgc18	online	0.850	96	0.000
	hard copy	0.882	289	0.000

a. Lilliefors Significance Correction

Following is explored the Skewness and Kurtosis of the data. These are two measures to evaluate the distribution of the data. Skewness is a condition of the distribution where the data is not symmetric. This means that instead of the bars on a graph being centred (like in a normal distribution with a bell shape) the bars are clustered on the

left or on the right side. If the bars cluster on the right side where the positive values are, it is called positive skewed. Whereas if the bars grow towards the left side (or the negative values) it is called negative skewed. Kurtosis, on the other hand, is a condition where the scores are clustered at the end or the tail of the distribution. If the tail clusters on the right side it is known as a positive kurtosis, and if the tail clusters on the left side it is called negative kurtosis (Field, 2013). Thus a perfectly normal distribution should have a score of zero. Searching the dataset using these two measures it was noticed that there were issues of skewness and kurtosis since some values lied outside -1 and 1. As we can see from table 26, in general the values of the answers for each item vary in the response, this is that respondents answered the items in a diverse way. Nevertheless, because of the sample size, it was proceed with further analysis assuming normal distribution (Ghasemi and Zahediasl, 2012).

The descriptive information of the questionnaire in table 18 shows that the scores are almost symmetrical since the kurtosis and skewness are close to zero, except for some questions, however none of the questions have values  $>1.5$  or  $>-1.5$ . Following that with “relatively large samples” skewness and kurtosis detected will have no effect in the analysis (Pallant, 2013), it was continued with the analysis.

**Table 31 Descriptive information from Segmentation Questionnaire**

Question	Valid	Miss.	Skew.	SE of S	Kurt.	SE of K
Have you driven a ban or car in the last 6 months?	401	0	1.397	0.122	-0.050	0.243
For most journeys, I would rather use the car than any other form of transport	400	1	-0.056	0.122	-1.356	0.243

I like to drive just for the fun of it	401	0	0.342	0.122	-1.026	0.243
I am not interested in reducing my car use	400	1	0.386	0.122	-1.142	0.243
Driving gives me a way to express myself	399	2	1.046	0.122	-0.007	0.244
How likely are you to drive in the next 12 months?	400	1	-1.124	0.122	-0.182	0.243
I am not the kind of person who rides a bicycle	398	3	0.579	0.122	-0.963	0.244
I feel I should cycle more to keep fit	401	0	-0.939	0.122	0.249	0.243
I find cycling stressful	398	3	0.473	0.122	-1.060	0.244
Cycling can be the quickest way to travel around	401	0	-0.271	0.122	-0.973	0.243
I like travelling by bicycle	400	1	-0.645	0.122	-0.503	0.243
I am not the kind of person that likes to walk a lot	399	2	0.798	0.122	-0.556	0.244
I feel I should walk more to keep fit	400	1	-0.787	0.122	-0.036	0.243
I like travelling by walking	401	0	-0.542	0.122	-0.595	0.243
I am not the kind of person to use the bus	400	1	0.316	0.122	-1.226	0.243

In general, I would rather cycle than use the bus	401	0	-0.346	0.122	-1.000	0.243
I feel a moral obligation to reduce my emissions of greenhouse gases	400	1	-0.872	0.122	-0.200	0.243
People should be allowed to use their cars as much as they like	399	2	0.328	0.122	-1.157	0.244

### 5.3.2 Assessing Differences from Distribution Tool

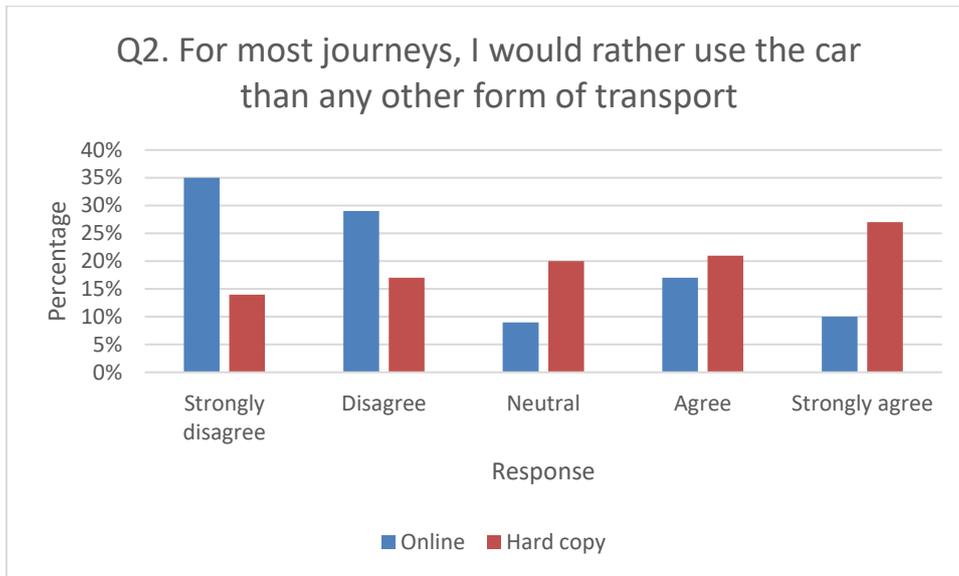
Next step was to determine whether there is a statistically significant difference between the population means as we have data collected online and in a hard copy of the survey distributed face to face. An independent sample t-test was run for each of the questions to determine if there were differences in the answers that might be influenced by the survey distribution tool. It was checked first that no assumptions were violated. The assumptions met by the data were to have a random sample data normally distributed; to have a continuous dependent variable and a categorical independent variable (two groups are online and hard copy); and independence of the observations. After this, the analysis was carried out. In the table 5 there is the t- test results for all the questions.

**Table 32 T-Test for population mean of sample online and sample in hard copy**

Method of collecting data	N	Mean	Std. Dev.	Std. E. Mean	t	df	Sig. (2-tailed)	Mean Diff.	Std. E. Diff.	
1	O	100	1.27	0.446	0.045	1.475	155	<b>0.142</b>	0.074	0.050
	HC	301	1.20	0.398	0.023					
2	O	99	2.39	1.376	0.138	-5.640	398	0.000	-0.908	0.161
	HC	301	3.30	1.395	0.080					
3	O	100	2.07	1.103	0.110	-5.007	200.397	0.000	-0.671	0.134
	HC	301	2.74	1.319	0.076					
4	O	100	1.96	1.171	0.117	-5.959	202.065	0.000	-0.850	0.143
	HC	300	2.81	1.410	0.081					
5	O	100	1.44	0.795	0.080	-7.092	281.458	0.000	-0.777	0.110
	HC	299	2.22	1.304	0.075					
6	O	99	3.93	1.365	0.137	-0.502	398	<b>0.616</b>	-0.081	0.161
	HC	301	4.01	1.394	0.080					
7	O	99	1.88	1.272	0.128	-5.034	181.380	0.000	-0.760	0.151
	HC	299	2.64	1.389	0.080					
8	O	100	4.08	1.041	0.104	3.052	183.640	0.003	0.376	0.123
	HC	301	3.70	1.138	0.066					
9	O	100	2.34	1.265	0.127	-1.126	396	<b>0.261</b>	-0.177	0.157
	HC	298	2.52	1.388	0.080					
10	O	100	3.86	1.146	0.115	4.980	399	0.000	0.697	0.140
	HC	301	3.16	1.234	0.071					
11	O	100	4.10	1.193	0.119	4.601	398	0.000	0.630	0.137
	HC	300	3.47	1.183	0.068					
12	O	100	1.90	1.193	0.119	-2.767	397	0.006	-0.414	0.150
	HC	299	2.31	1.329	0.077					
13	O	100	3.95	0.857	0.086	2.182	235.646	0.030	0.240	0.110
	HC	300	3.71	1.193	0.069					
14	O	100	3.89	1.100	0.110	3.119	182.744	0.002	0.405	0.130
	HC	301	3.49	1.196	0.069					

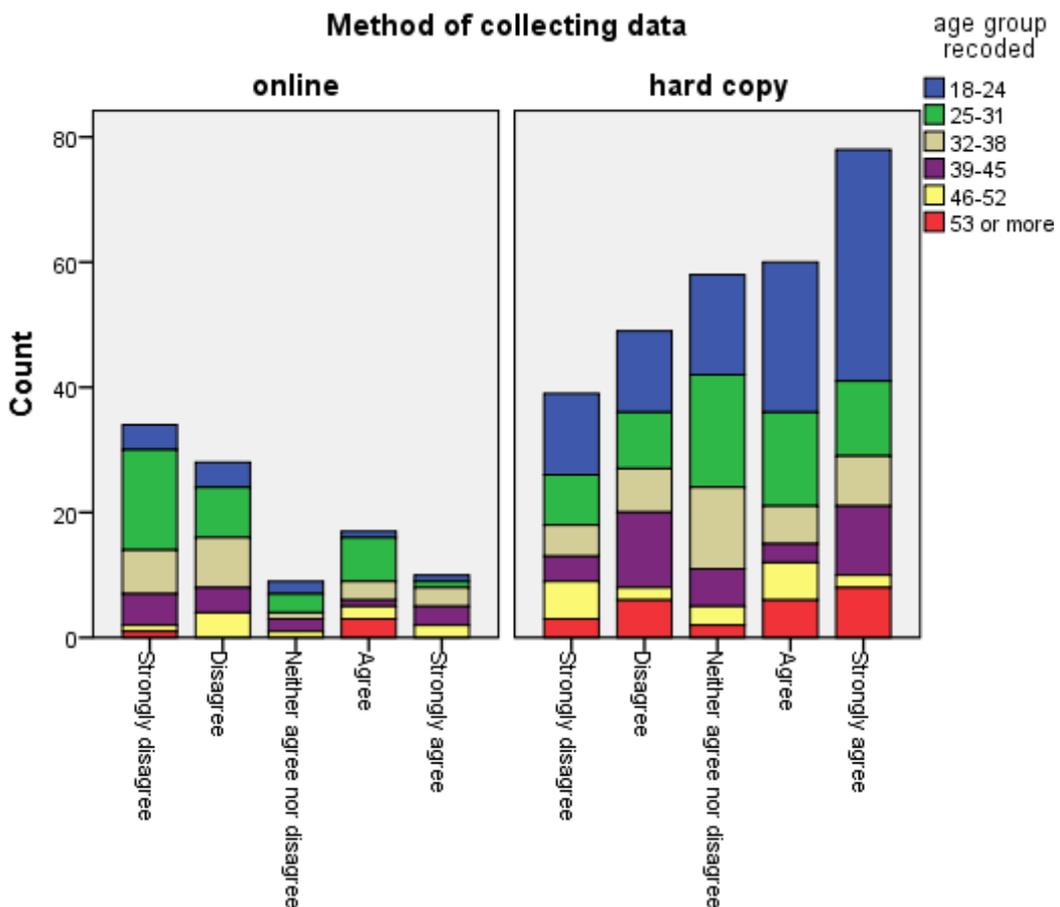
15	O	99	2.13	1.242	0.125	- 5.066	191.095	0.000	-0.759	0.150
	HC	301	2.89	1.437	0.083					
16	O	100	3.67	1.319	0.132	2.605	399	0.010	0.391	0.150
	HC	301	3.28	1.294	0.075					
17	O	100	4.06	1.099	0.110	1.660	186.283	<b>0.099</b>	0.217	0.131
	HC	300	3.84	1.218	0.070					
18	O	100	2.19	1.152	0.115	- 4.442	208.337	0.000	-0.629	0.142
	HC	299	2.82	1.426	0.082					

There was statistically significant difference in the mean of all the responses when collected by a different method as showed in Table 32, except for four items, the item one (Have you driven a ban or car in the last 6 months?) item six (How likely are you to drive in the next 12 months?), item nine (I find cycling stressful) and item seventeen (I feel a moral obligation to reduce my emissions of greenhouse gases). Next we carried out further analysis of the responses of the questions with statistically significant difference to explore the nature of the difference in the mean. For each of the questions, following there is the distribution of the percentage of responses for the sample online and the hard copy. First, there is the bar chart with the distribution of the answers. After that, there is a comparison stacked chart with the distribution of the answers split by age group. The final chart show the comparison of the answers split by gender. At the end of the charts there is a comment about the differences found in the samples.



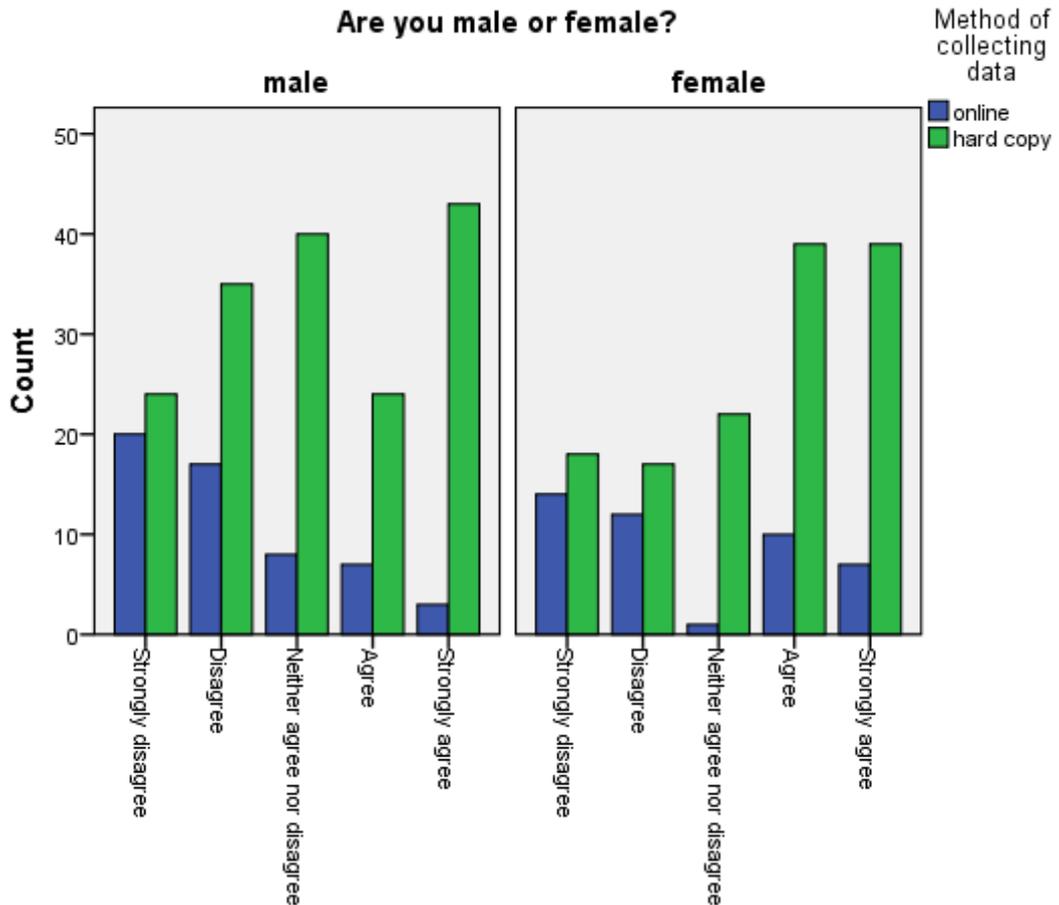
\*Sample size Online=99 and Hard Copy= 301

**Figure 16 Distribution of the responses for Q2 by sample**



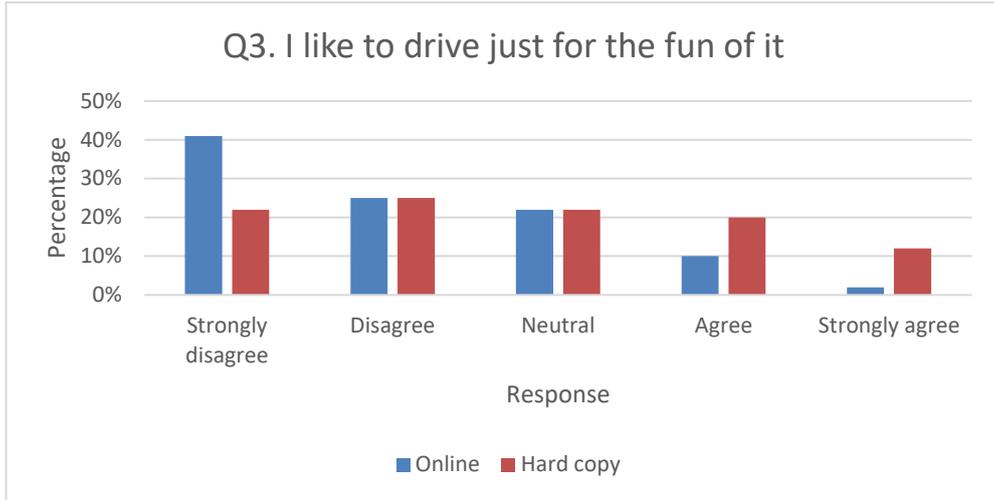
\*Bars represent number of cases

**Figure 17 Distribution of responses Q2 split by age groups**



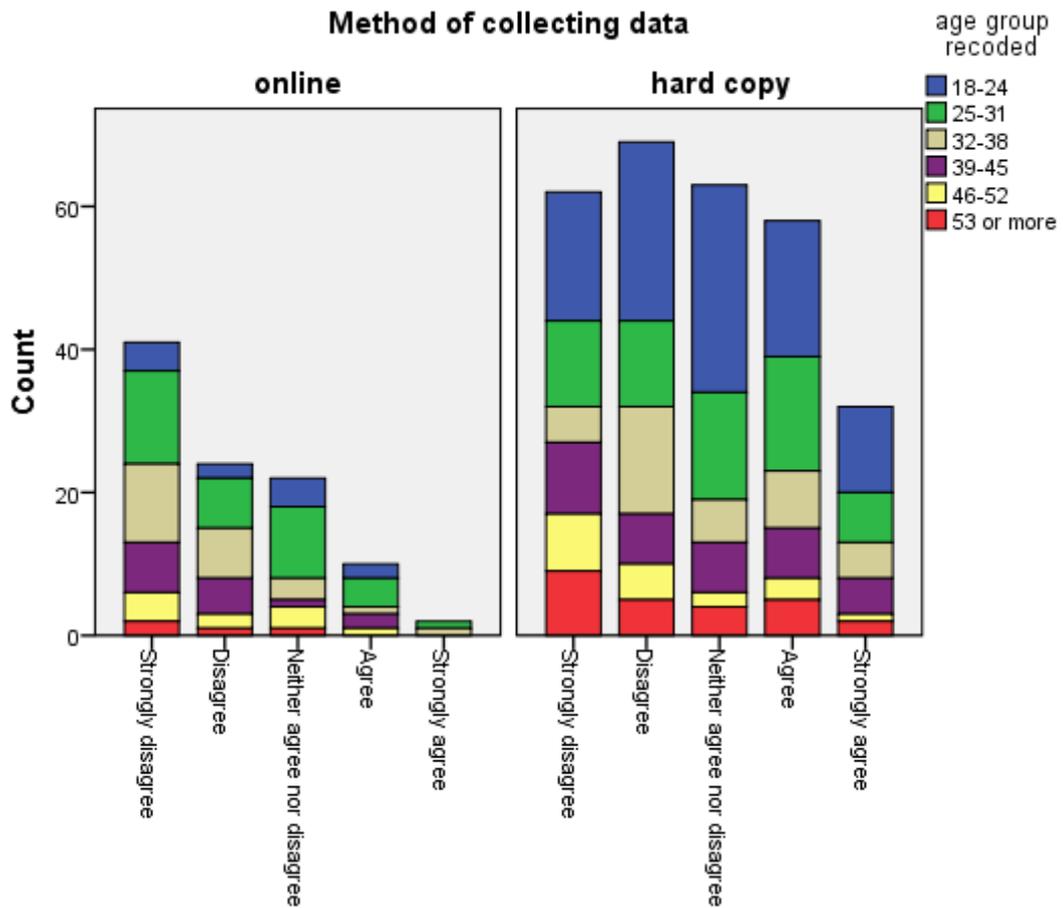
**Figure 18 Distribution of responses Q2 split by gender**

It could be noted Figure 16 that the online sample (n=100) have a higher percentage of people who disagree about using the car rather than any other transport mode whereas sample in hard copy (301) it is more distributed between the responses. Particularly, there is a higher percentage of respondents in the hard copy sample who were neutral about the statement. Looking at the Figure 17, the distribution of responses split by age showed that the sample in hard copy, have a higher proportion of young people (18-24 and 25-31) and people over 53 that prefer car over other mode of transport. Regarding gender, Figure 18 shows that in hard copy sample women tend to agree more with the statements. Men have a higher number of respondents in the hard copy sample who disagree or were neutral about the statement.



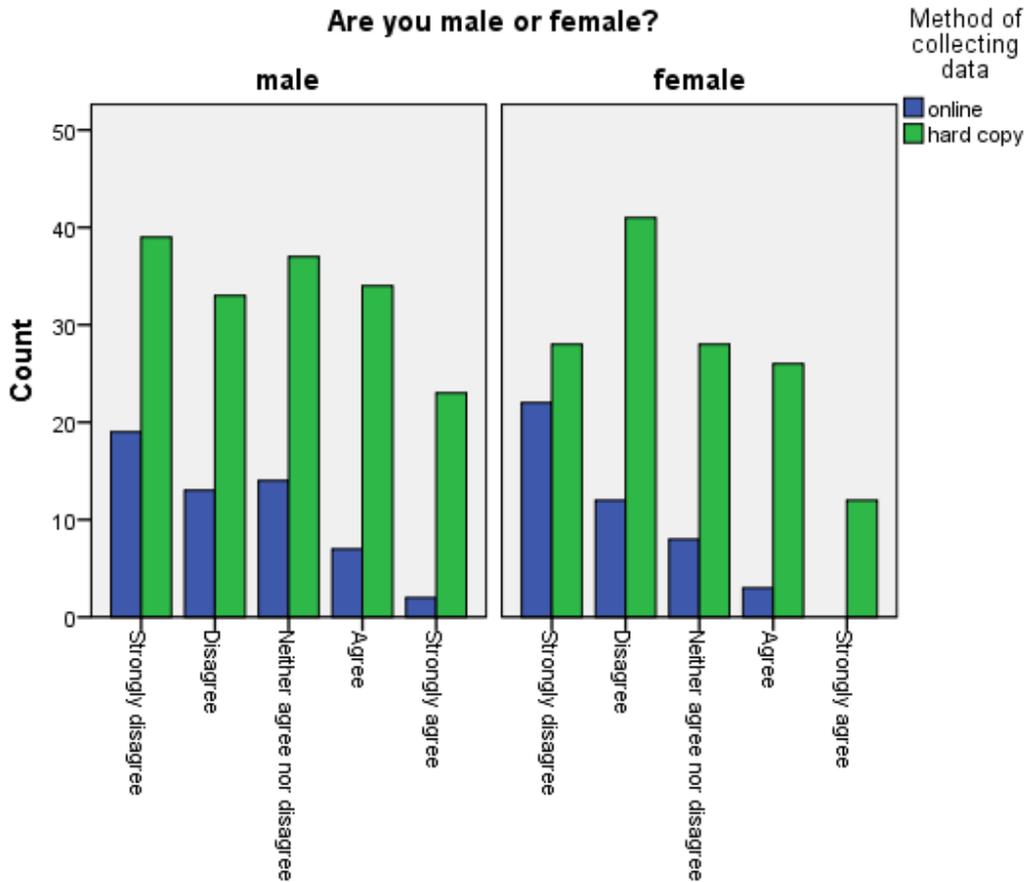
\*Sample size Online=100 and Hard Copy= 301

**Figure 19 Distribution of the responses for Q3 by sample**



\*Bars represent number of cases

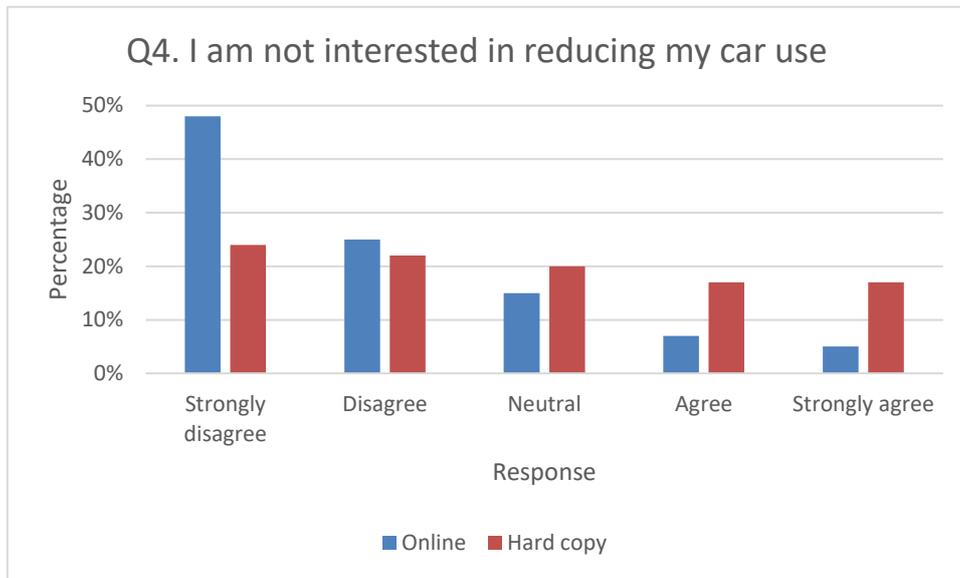
**Figure 20 Distribution of responses Q3 split by age groups**



**Figure 21 Distribution of responses Q3 split by gender**

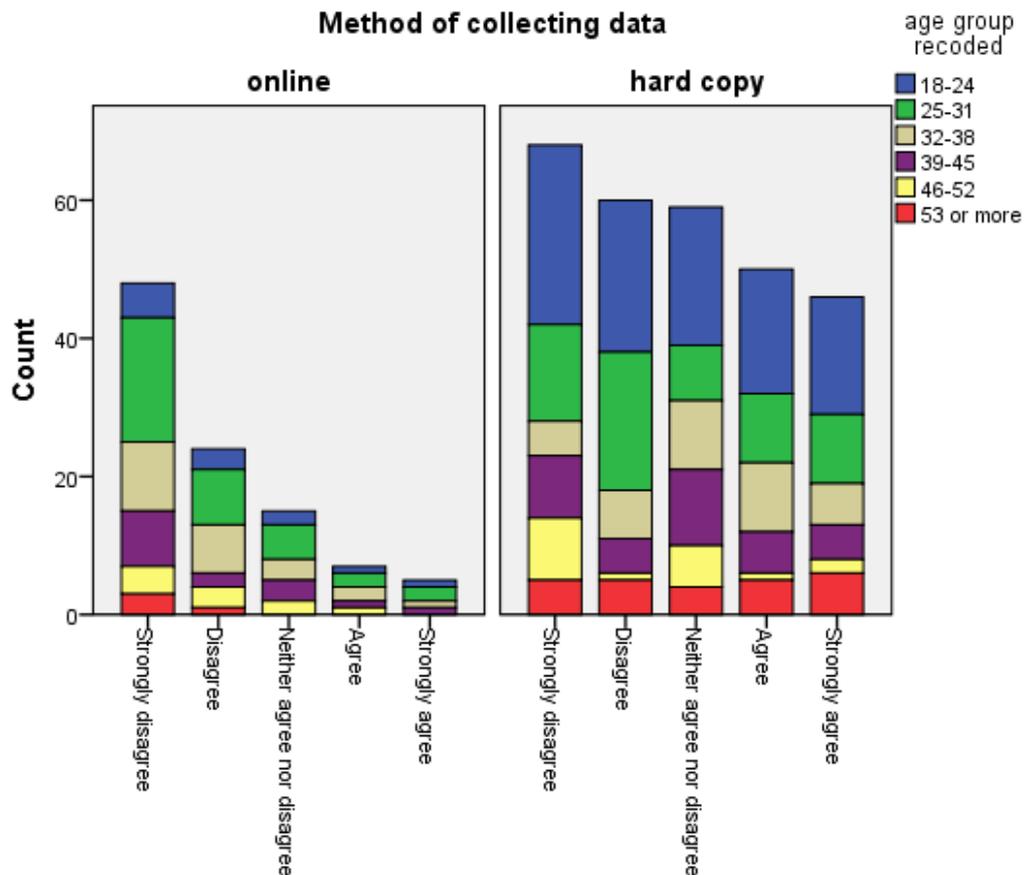
Figure 19 shows that the sample online (n=100) have a higher proportion of respondents who disagree a high proportion of neutral responses with the statement about driving just for fun. The responses in hard copy (n=301) have responses distributed across all responses. Figure 20 shows that respondents >53 in the online sample disagree more about driving for the fun of it. However, the hard copy sample this age group had more distributed the answers between disagree and agree. The group aged 39-45 in the online sample also disagree more about driving for the fun of it. In the hard copy, this age group had more distributed the answers. For the younger age groups (18-31) although mostly the responses were distributed across agree and disagree in both samples. In the sample online none of the respondents strongly agree with driving for fun whereas in the hard copy sample, small proportion strongly agreed. In Figure 21 there is a fairly distribution of the answers by male and

female in both samples, except for the online sample, where any female strongly agreed.



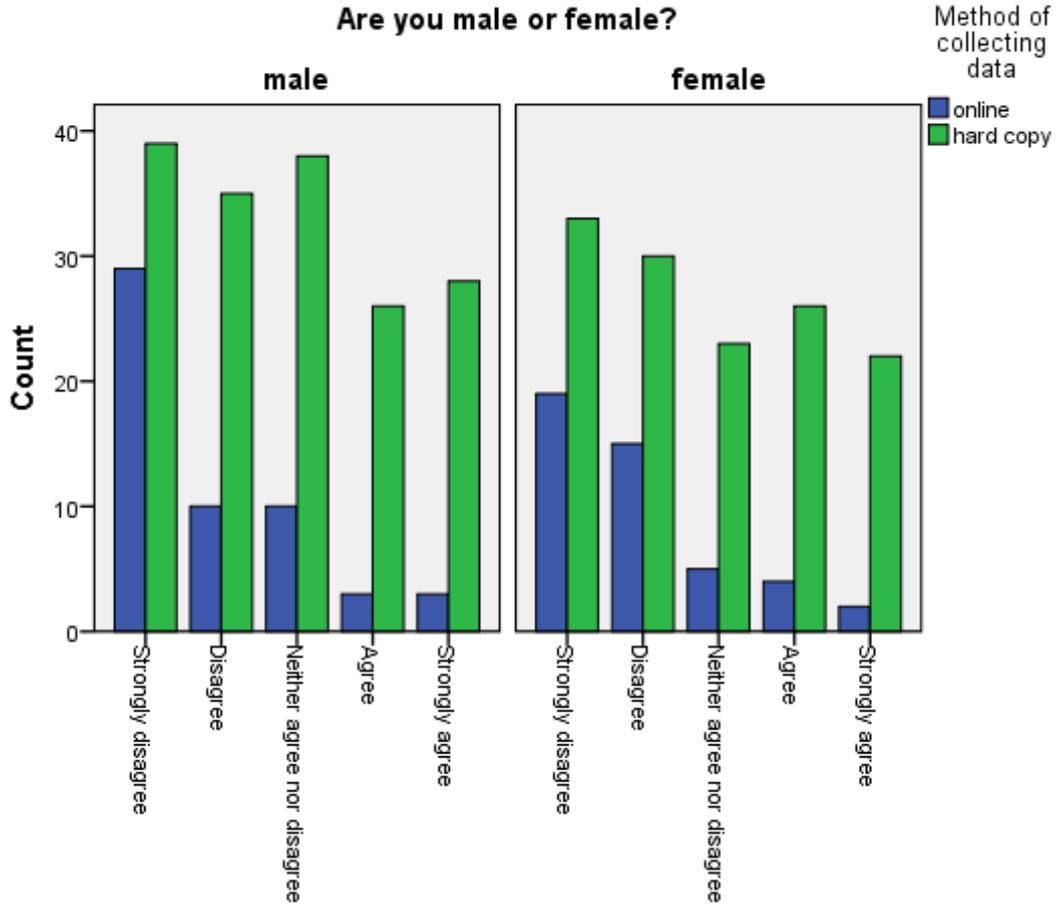
\*Sample size Online=100 and Hard copy=300

**Figure 22 Distribution of the responses for Q4 by sample**



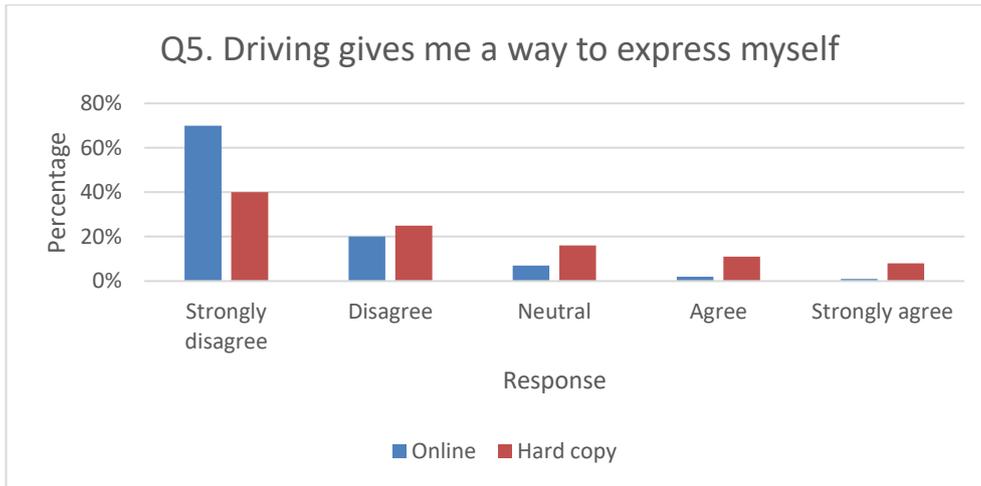
\*Bars represent number of cases

**Figure 23 Distribution of the responses Q4 split by age groups**



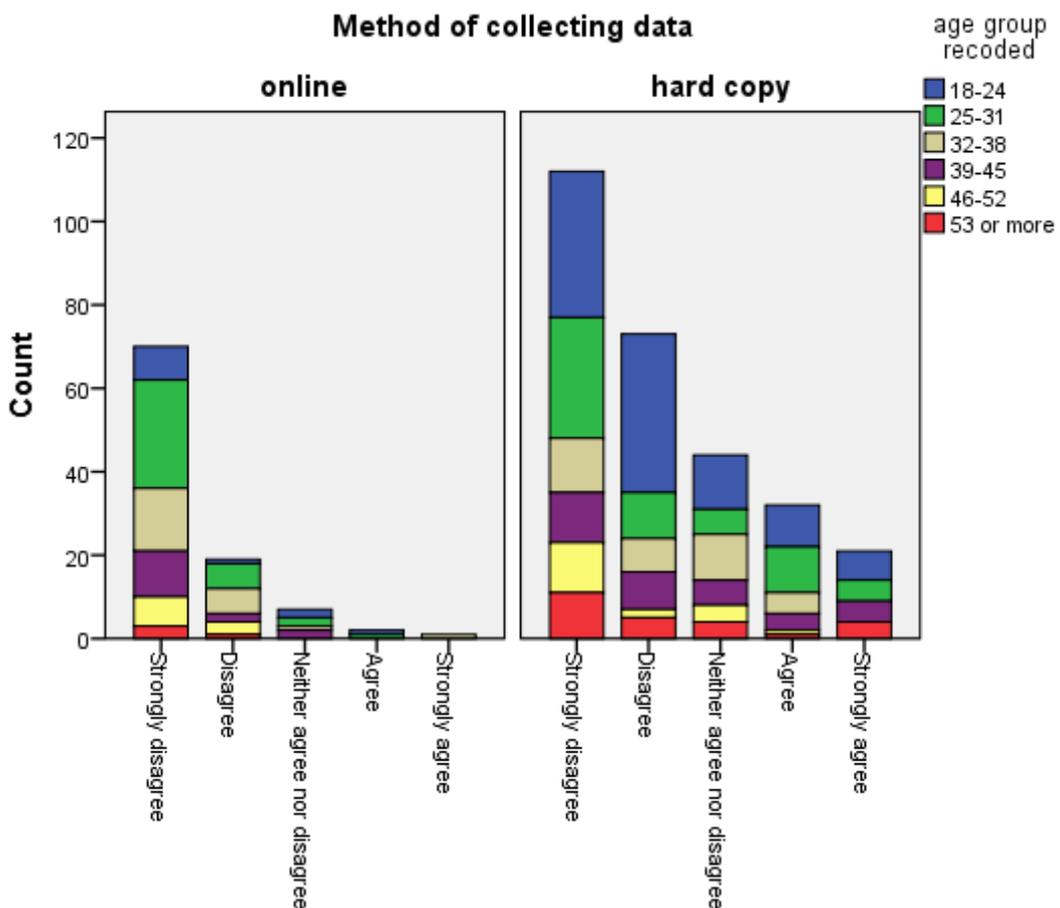
**Figure 24 Distribution of the responses Q4 split by gender**

Figure 22 show that more people disagree online sample than in hard copy about their interest in reducing their car use. In the hard copy, there is a proportion of respondents that agree of not interest of reducing car use. About age, the sample online, the respondents >53 disagree in reducing car use whereas in hard copy, the responses of this age group tend to be more distributed between strongly agree and strongly disagree, same than the rest of the groups. More male than woman online disagree whereas in the hard copy responses are more equally distributed among both genders.



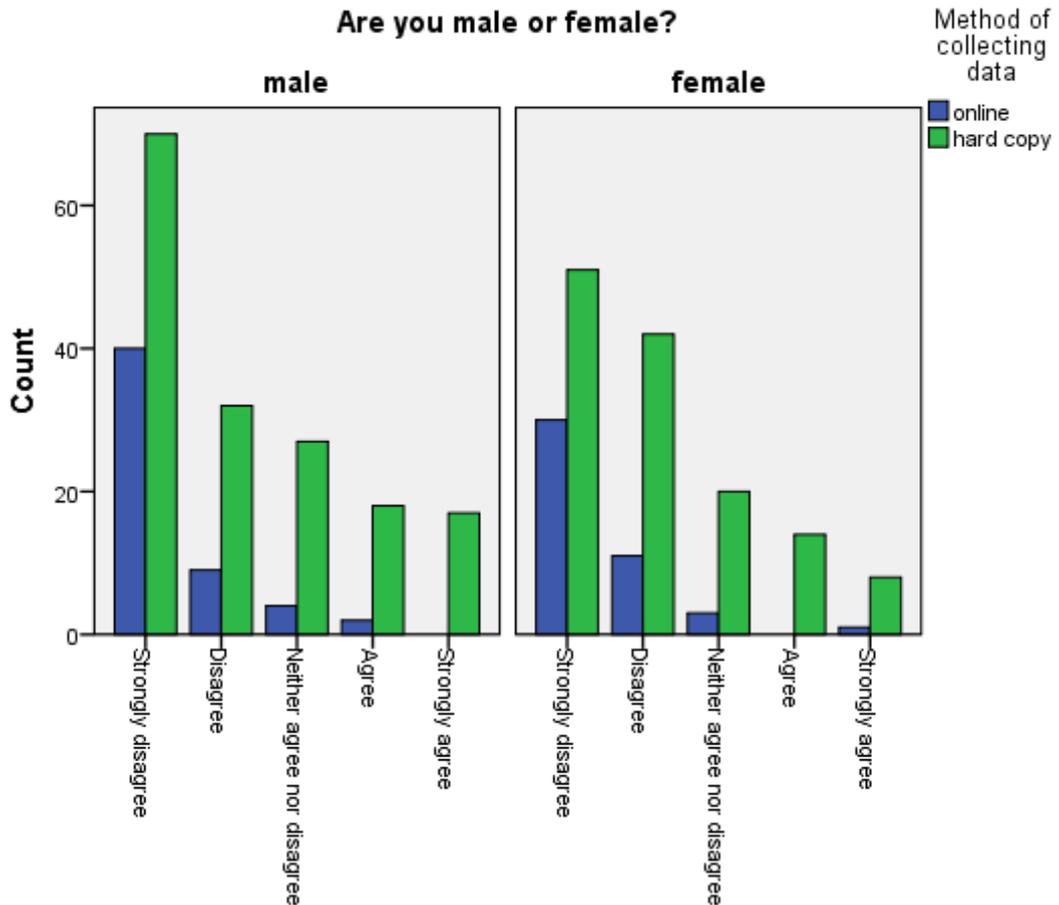
\*Sample size Online=100 and Hard copy=121

**Figure 25 Distribution of the responses for Q5 by sample**



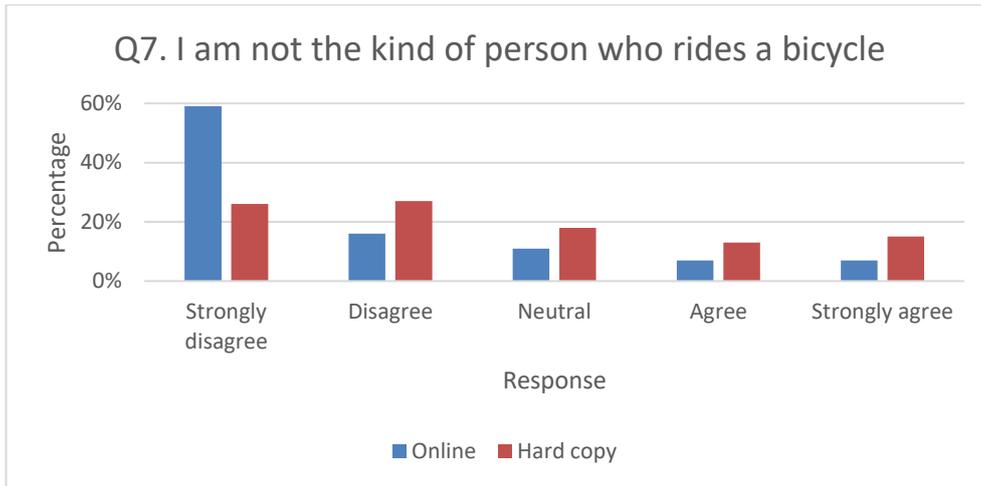
\*Bars represent number of cases

**Figure 26 Distribution of the responses Q5 split by age groups**



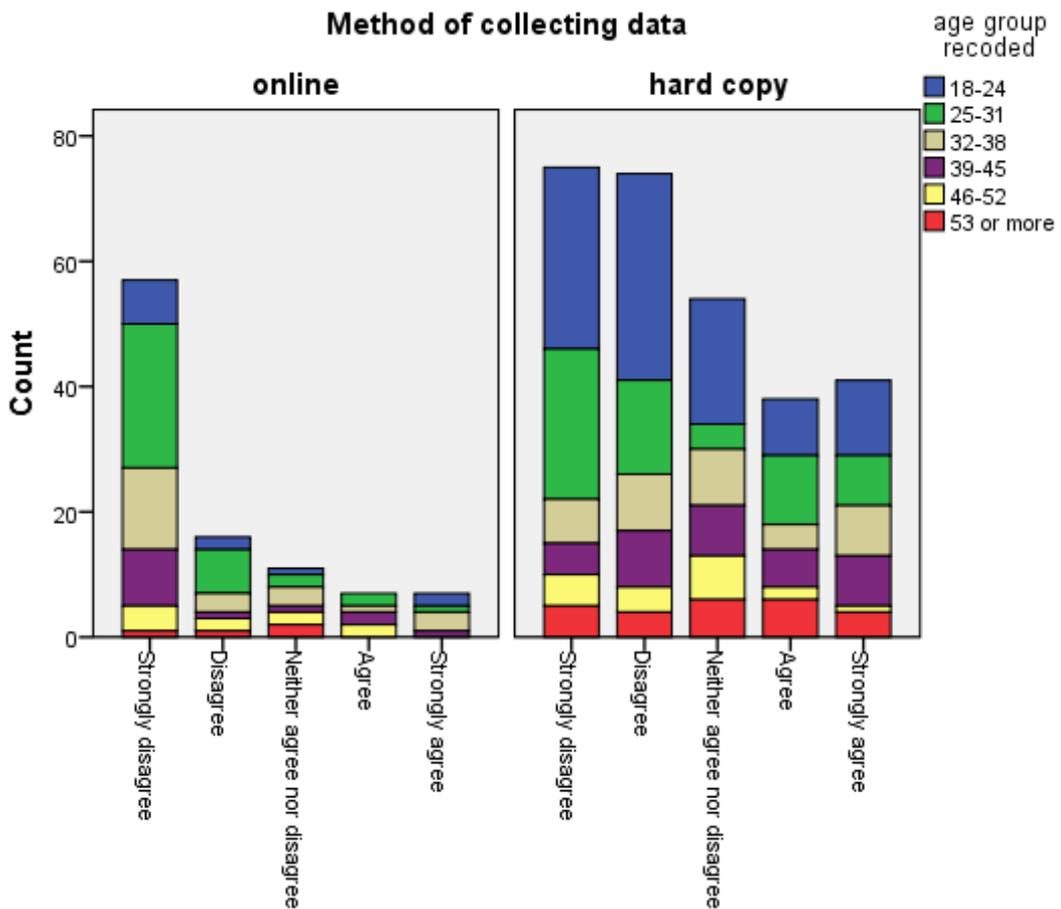
**Figure 27 Distribution of the responses Q5 split by gender**

It can be noted from Figure 25 that both samples have a similar distribution of the responses online and in the hard copy sample. Figure 26 show that hard copy sample represented all age groups with the answers distributed across all the responses, however, the sample online is not representative of all age groups and the respondents in high proportion disagree about that driving is way to express themselves. The hard copy sample on the contrary had respondents particularly from 18-31 and 39-45 who agree with the statement. Male and female online, disagree more that driving is a way for self-expression.



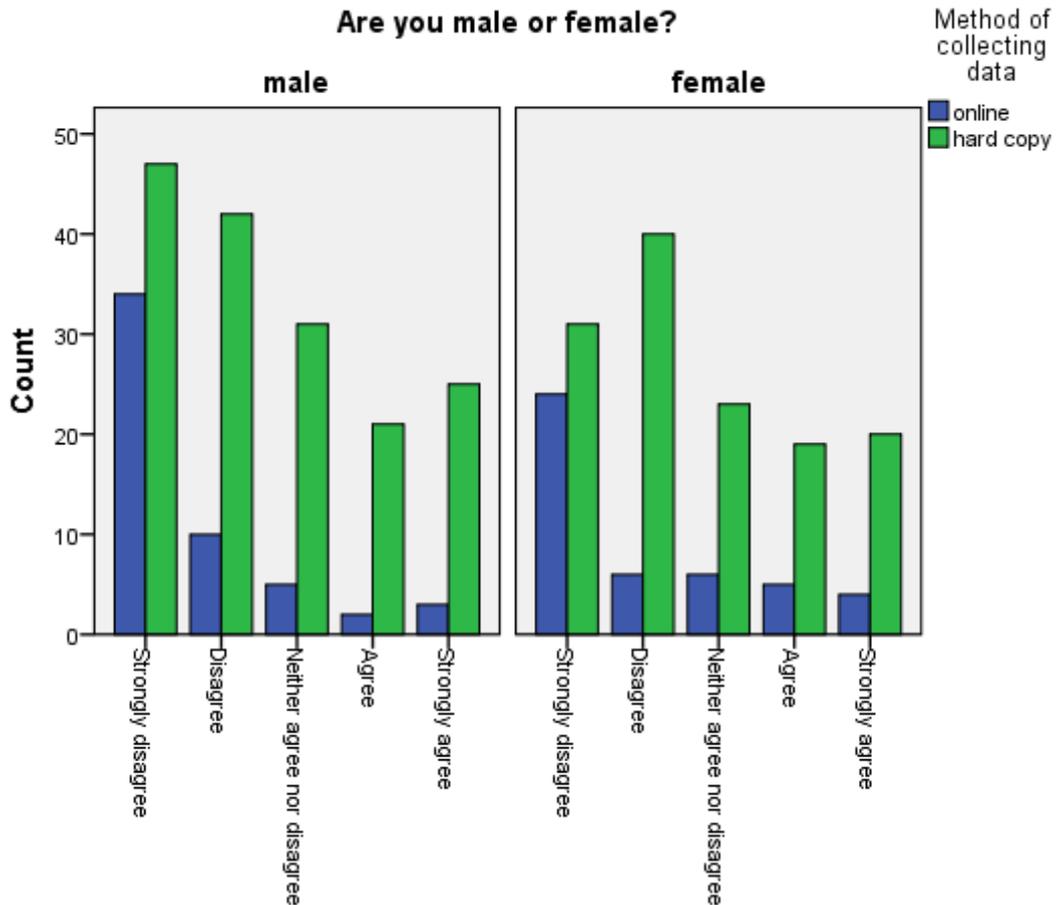
\*Sample size Online=99 and Hard copy=299

**Figure 28 Distribution of the responses for Q7 by sample**



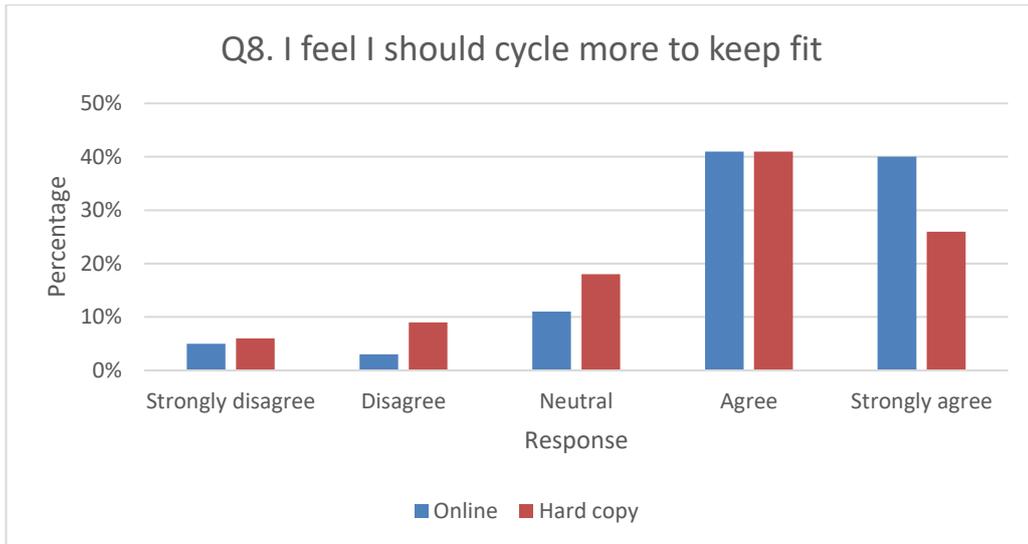
\*Bars represent number of cases

**Figure 29 Distribution of the responses Q7 split by age groups**



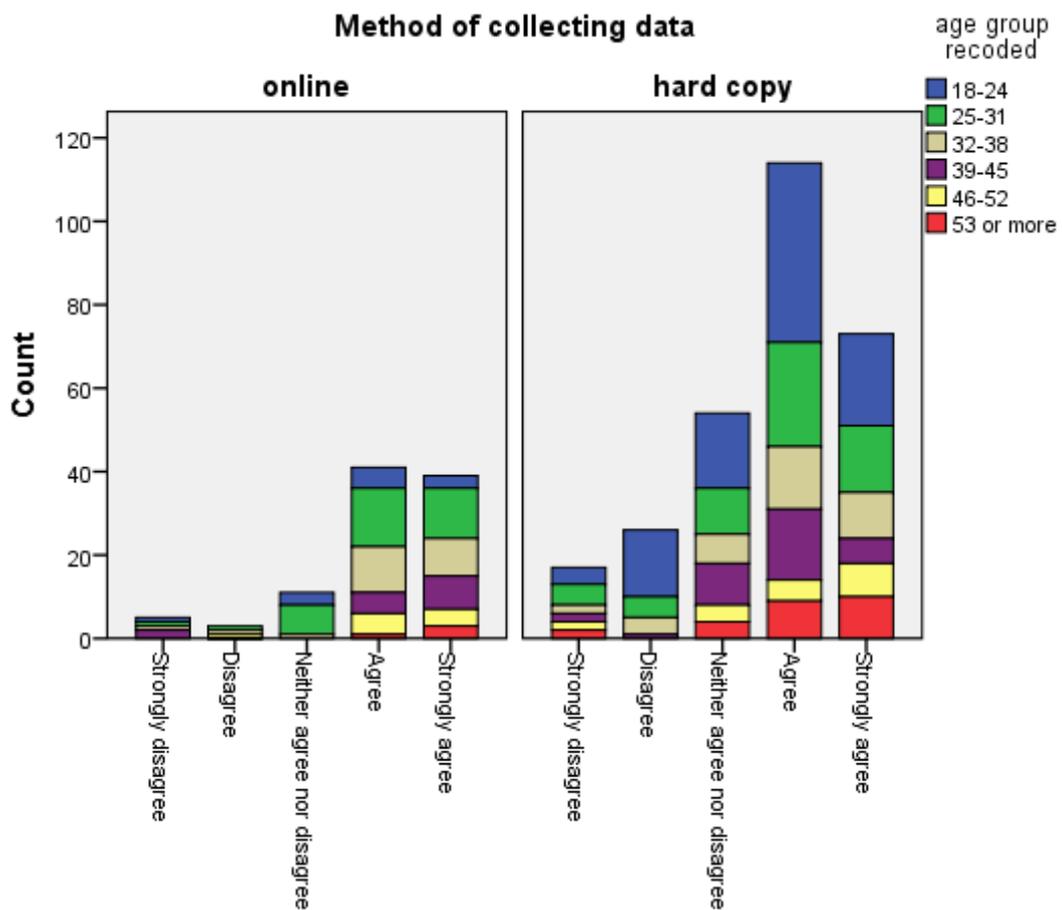
**Figure 30 Distribution of the responses Q7 split by gender**

Online sample had the highest proportion of respondents who disagree. The Figure 29 show that online sample people aged 25-38 had the highest proportion who disagree with not being the kind of people who rides a bicycle. In the hard copy, respondents >53 agree with the statement. Female, had differences in the distribution of the answers online and in the hard copy according to Figure 30. For instance, it suggest that female responses online disagree with the statement, however, in the hard copy sample female expressed more diverse opinion.



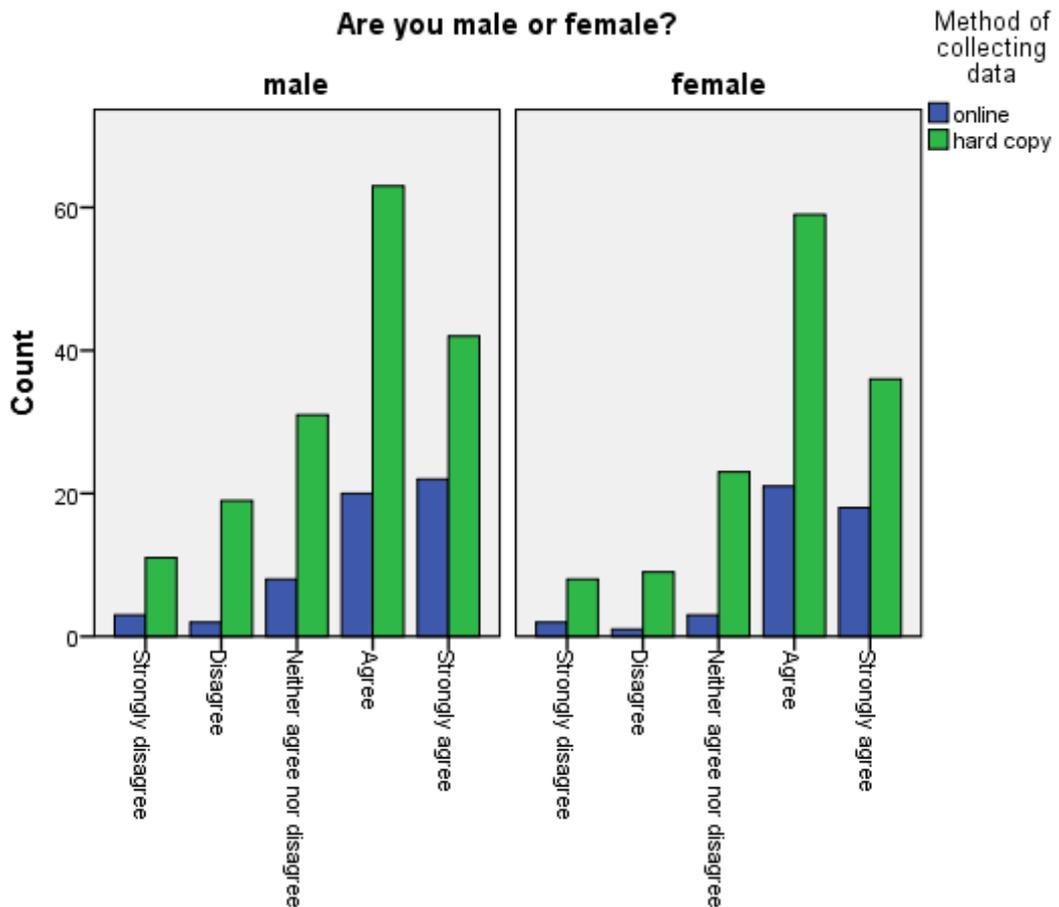
\*Sample size Online=100 and Hard copy=301

**Figure 31 Distribution of the responses for Q8 by sample**



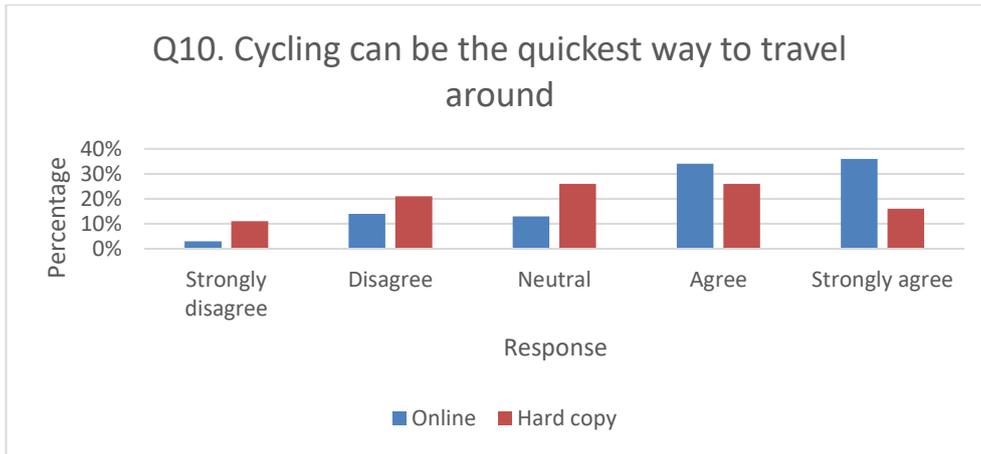
\*Bars represent number of cases

**Figure 32 Distribution of the responses Q8 split by age groups**



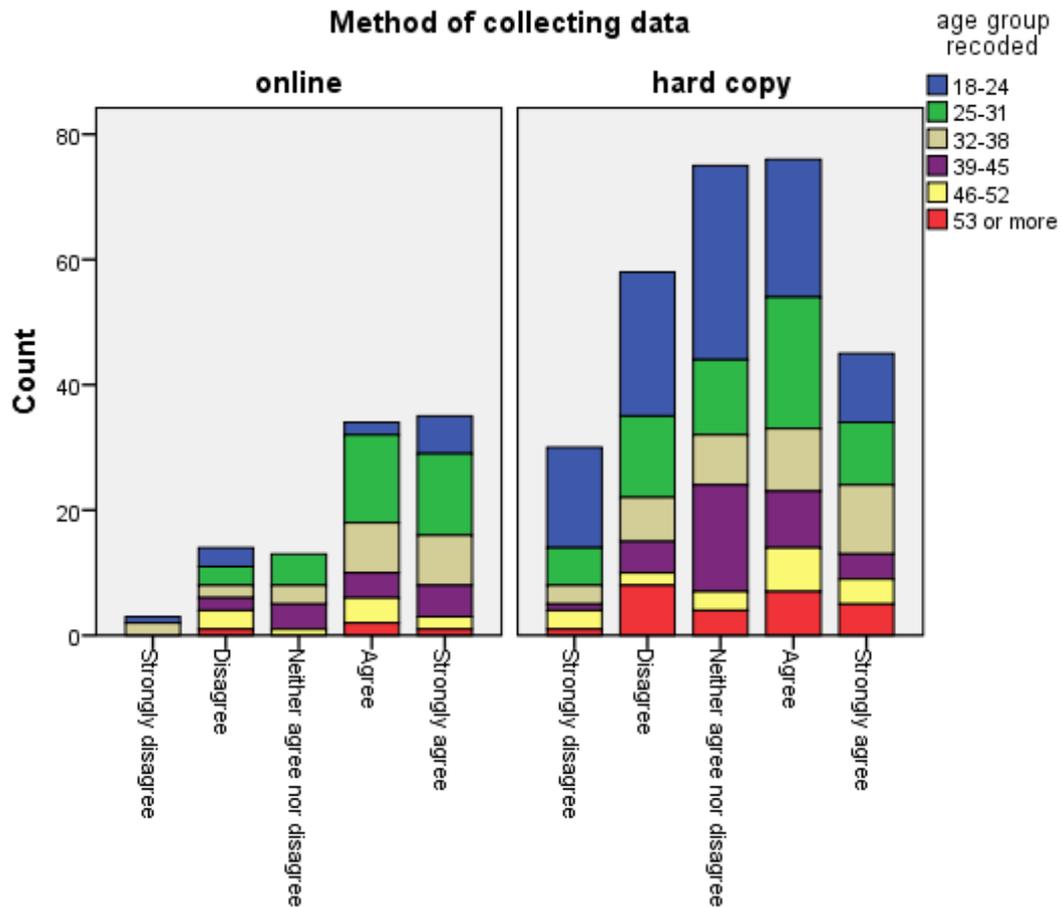
**Figure 33 Distribution of the responses Q8 split by gender**

Figure 31 shows that in comparing online and the hard copy sample, respondents in the hard copy disagreed more with the feeling that they should cycle more for fitness. Whereas online showed a higher proportion of respondents who strongly agreed. Regarding age, in the online copy showed that most age groups agree with the statement whereas, in the hard copy a proportion of respondents from the younger age group (18-24) disagree about cycling as a way to keep fit. However, overall the highest proportion of young people (18-31) agrees. Regarding gender, Figure 33 shows that male and female respondents follow a similar distribution of the responses in both samples.



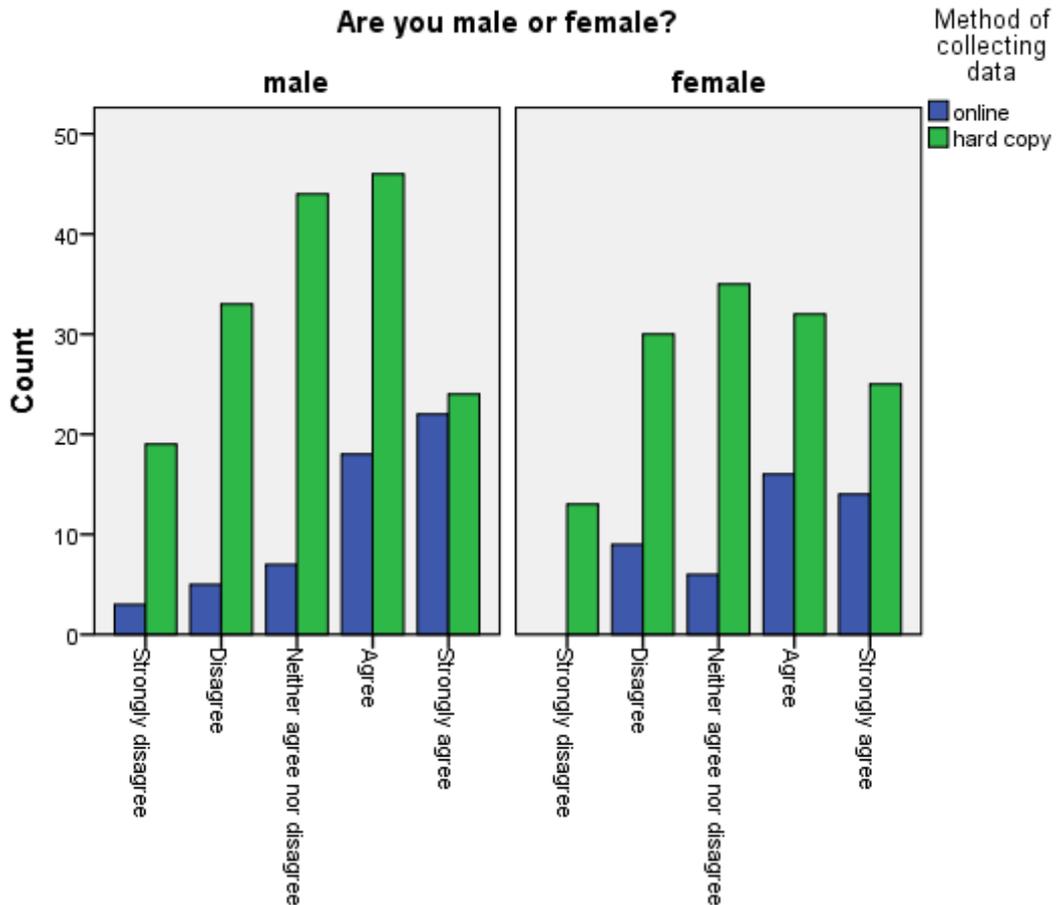
\*Sample size Online=100 and Hard copy=301

**Figure 34 Distribution of the responses for Q10 by sample**



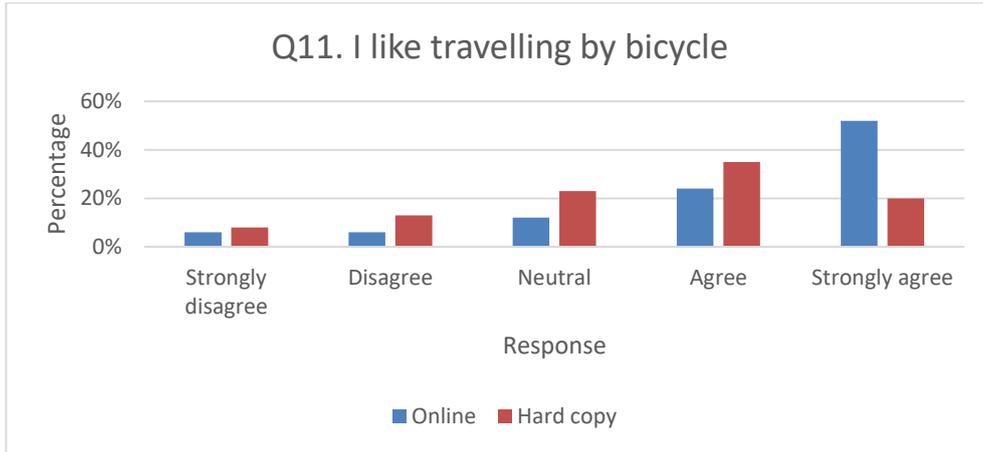
\*Bars represent number of cases

**Figure 35 Distribution of the responses Q10 split by age groups**



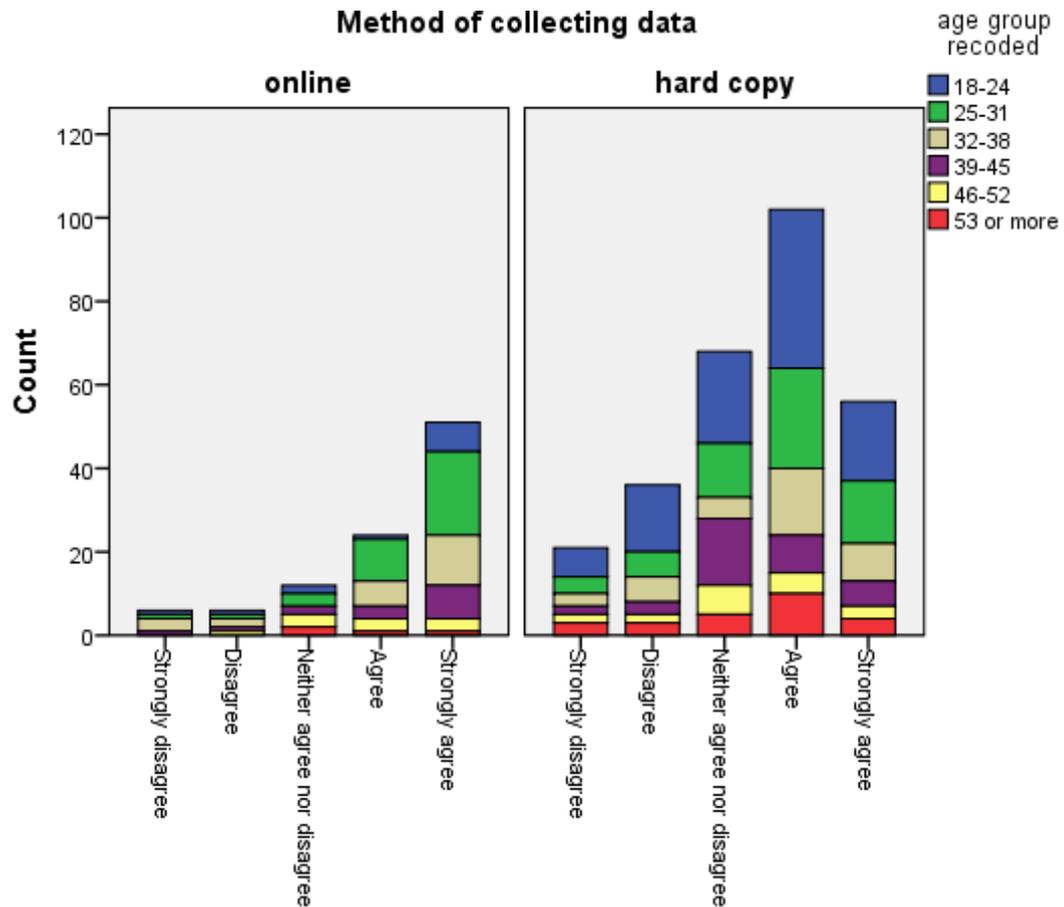
**Figure 36 Distribution of the responses Q10 split by gender**

Figure 34 shows that online people agreed more that cycling can be the quickest way to travel around, whereas in the hard copy people disagree more. The distribution of the answers by age group showed in Figure 35 suggest that the answers in the hard copy are more equally distributed in comparison with the online sample which has the highest proportion of answers between being neutral or agreeing with the statement. Regarding gender, Figure 36 shows that both samples for female and male followed a different distribution of the answers. For instance, for the female group, online respondents agreed more that bicycle is quickest way to travel around whereas in the hard copy sample, respondents have the answers distributed across strongly disagree and strongly disagree. The male group have a completely different distribution of the answers. The online sample agreed in higher proportion with the statement whereas the hard copy sample disagreed more.



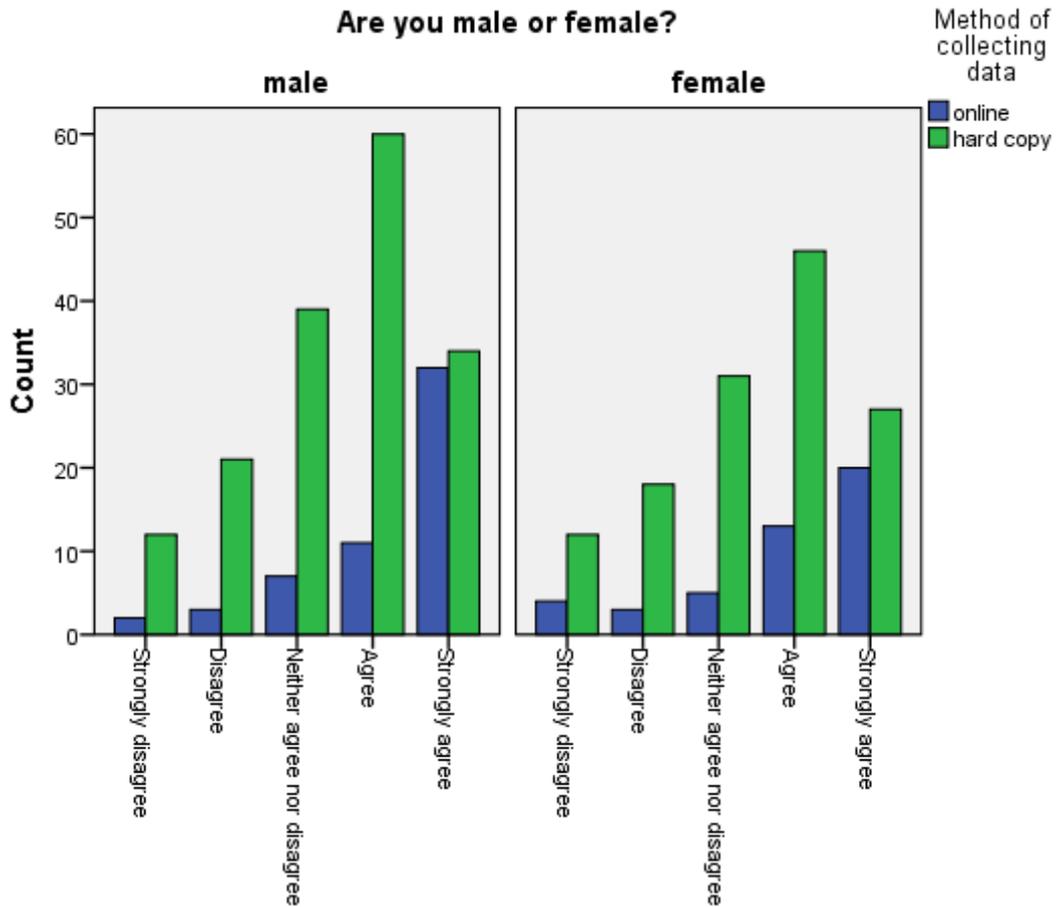
\*Sample size Online=100 and Hard copy=300

**Figure 37 Distribution of the responses for Q11 by sample**



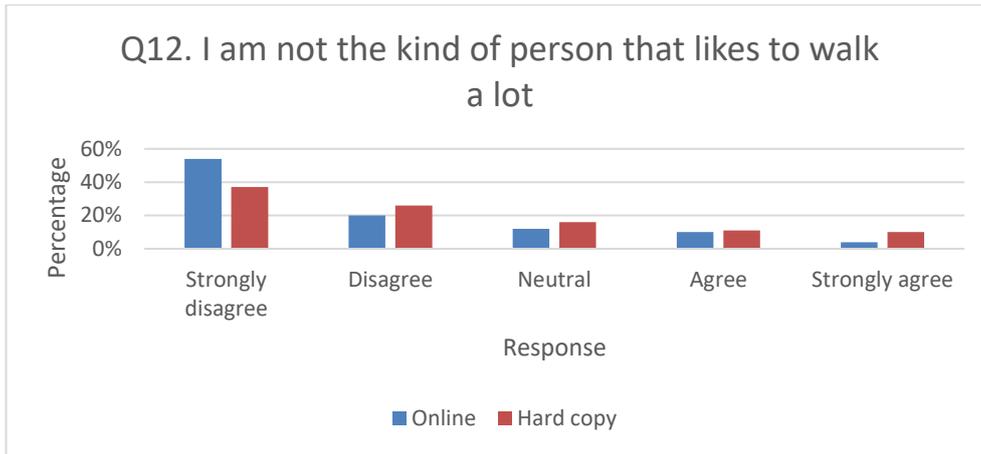
\*Bars represent number of cases

**Figure 38 Distribution of the responses Q11 split by age groups**



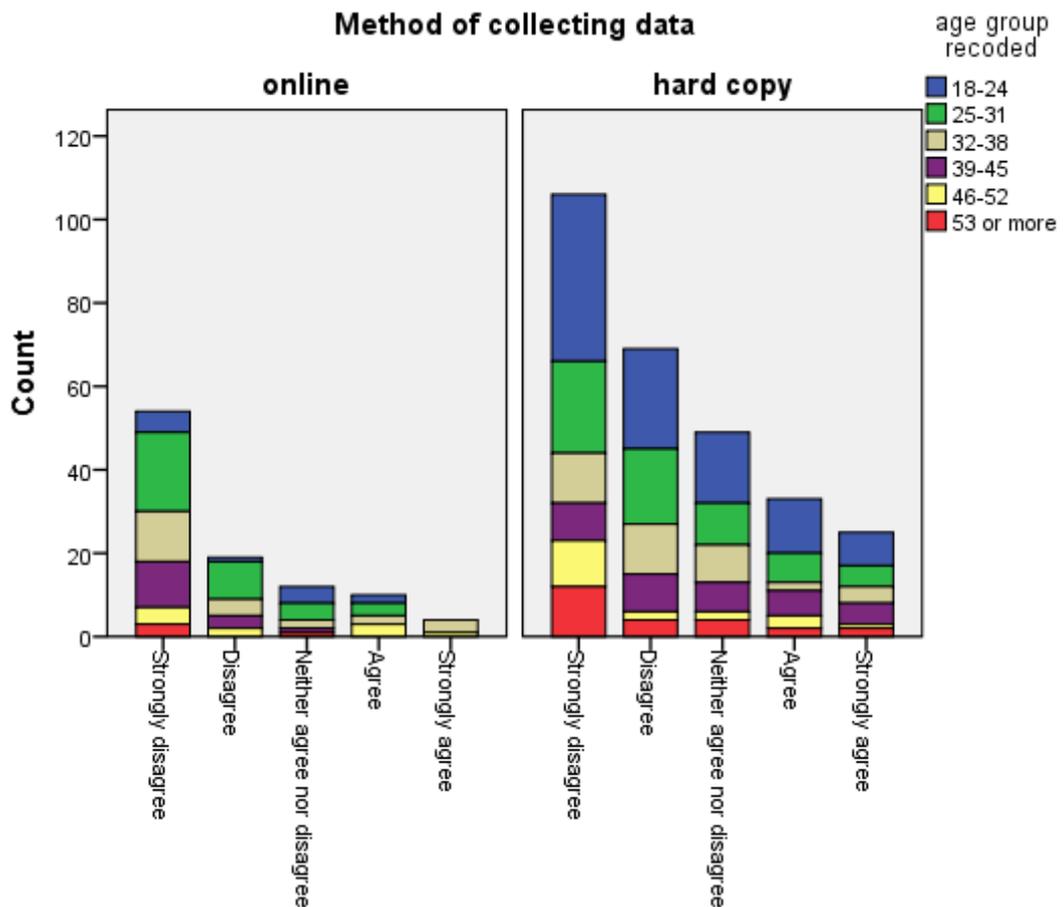
**Figure 39 Distribution of the responses Q11 split by gender**

Overall from Figure 37 it can be noticed that both samples followed the same distribution. However, when looking at the responses by age, the online sample shows that younger people (18-24) is more represented in the hard copy than in the online sample. In general people between 25-31 and 39-45 tend to agree more that they like travelling by bicycle. The age group between 32-38 years old showed also disagreeing with the statement. The age group >53 years old is almost not represented online and in the hard copy have fairly equal distribution of the answers between strongly disagree and strongly agree. Figure 39 showed that both samples male and female followed a very similar distribution of the responses. With the higher proportion of respondents agreeing that they like travelling by bicycle.



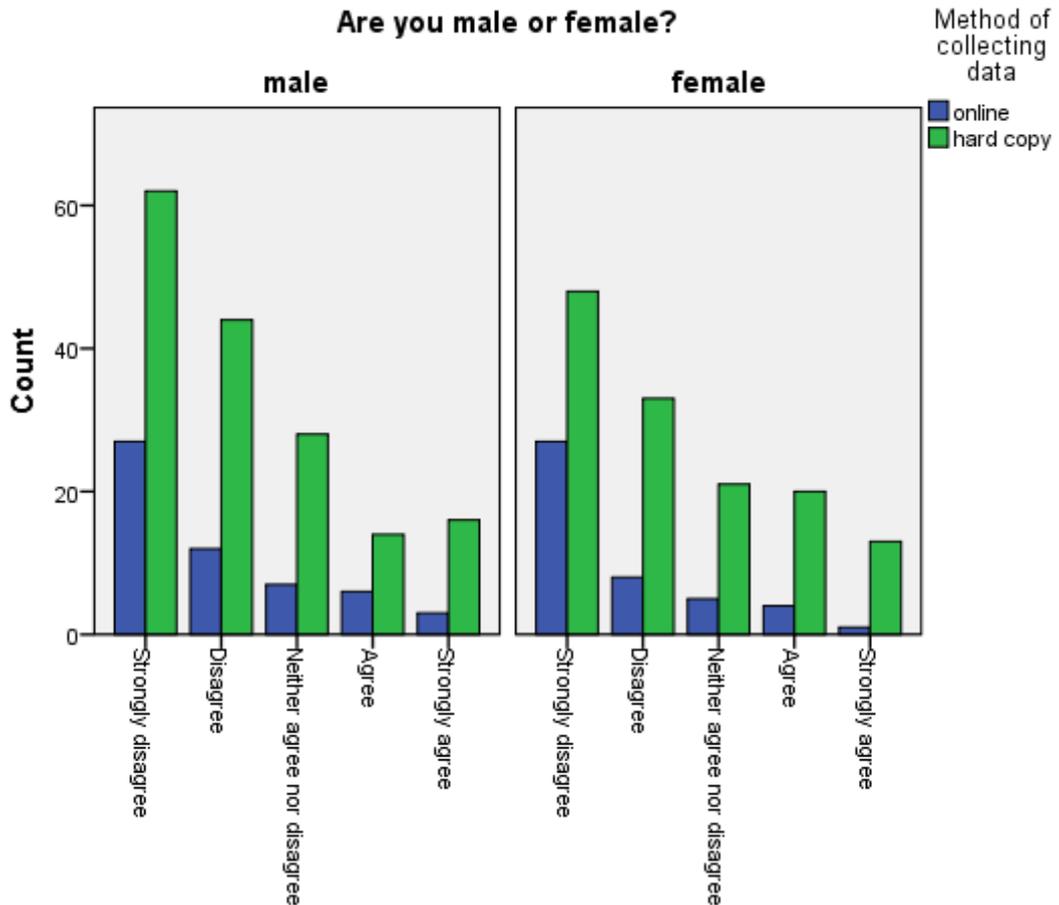
\*Sample size Online=100 and Hard copy=299

**Figure 40 Distribution of the responses for Q12 by sample**



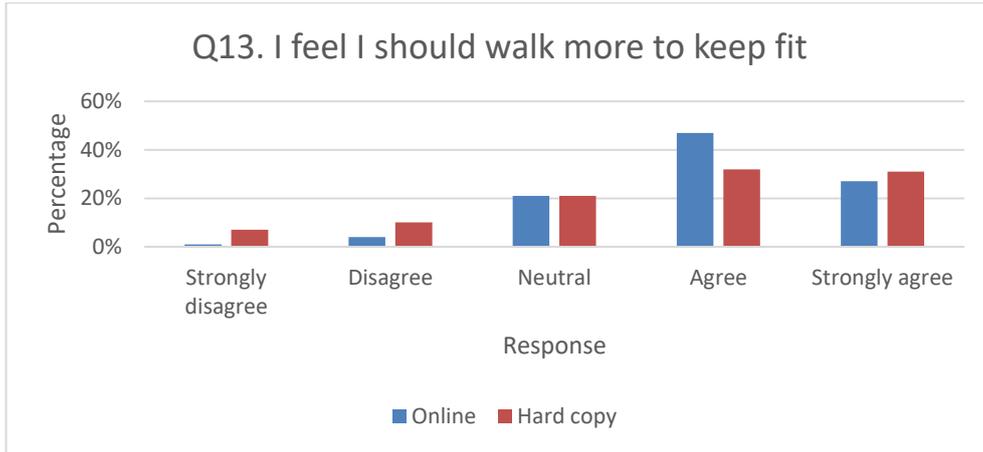
\*Bars represent number of cases

**Figure 41 Distribution of the responses Q12 split by age groups**



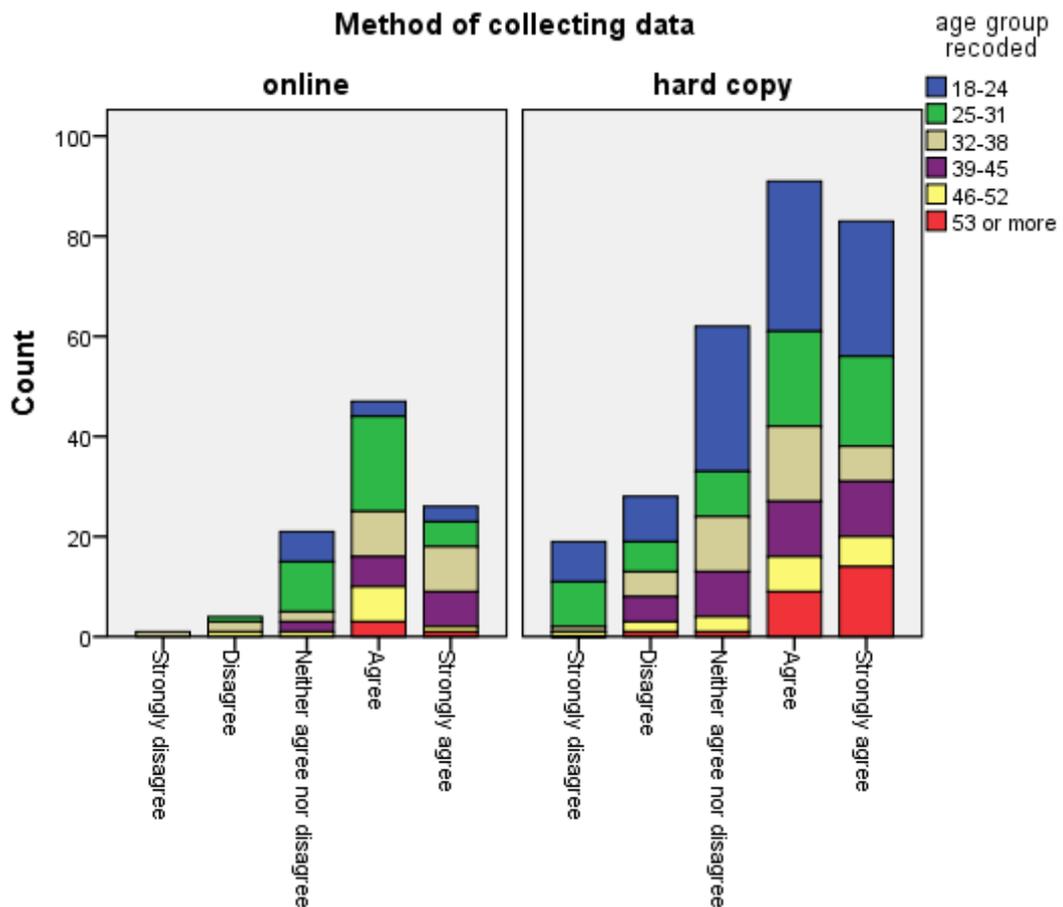
**Figure 42 Distribution of the responses Q12 split by gender**

About walking, overall, both samples have a higher proportion of respondents that disagree about not being the kind of person that likes to walk a lot. Regarding age, Figure 41 shows that in both samples, the highest proportion of respondents disagrees with the statement and only a small proportion does not like to walk a lot. The sample online is not representative of the people >53, and they disagree with the statement. From Figure 42 it can be noticed that both samples have fairly equal distribution of the answers (disagree more about not being the kind of person that likes to walk a lot. Suggesting that gender does not play a role in the difference in the responses from the two different samples.



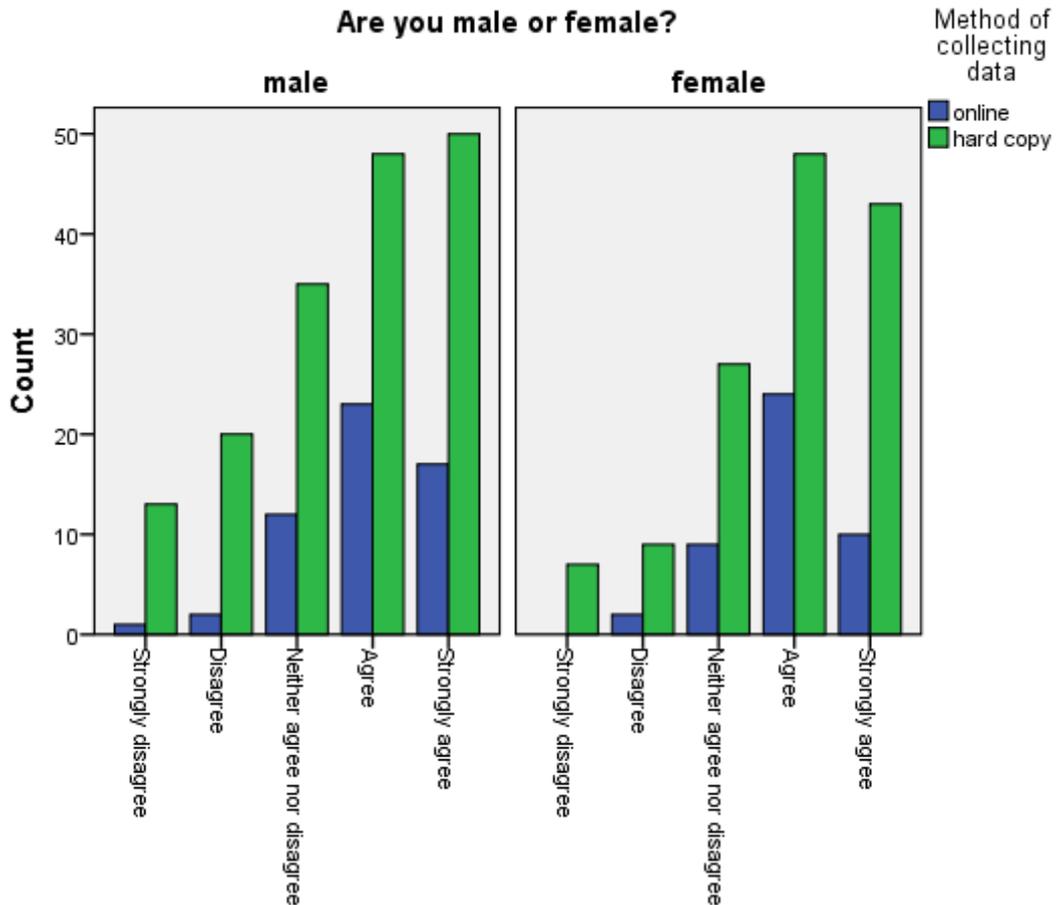
\*Sample size Online=100 and Hard copy=300

**Figure 43 Distribution of the responses for Q13 by sample**



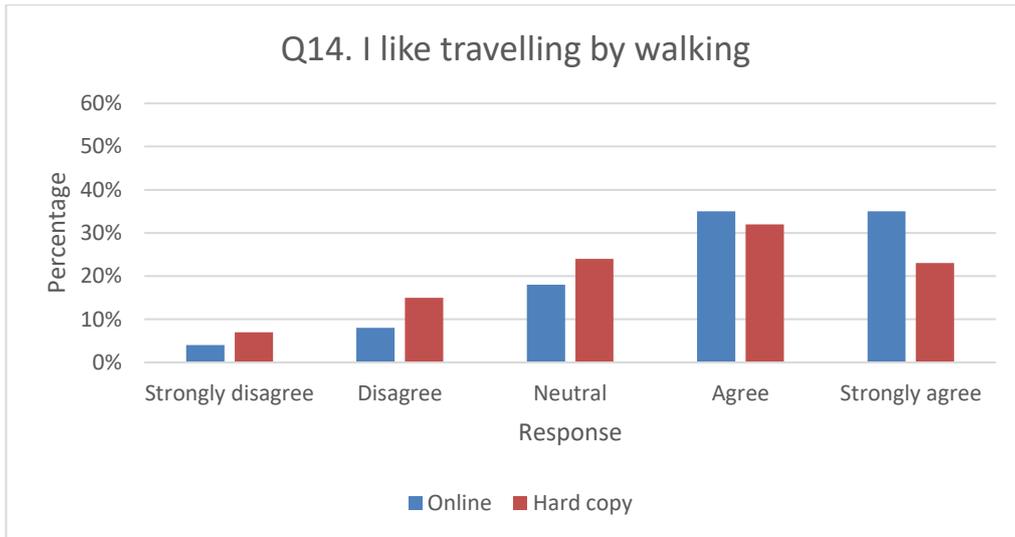
\*Bars represent number of cases

**Figure 44 Distribution of the responses Q13 split by age groups**



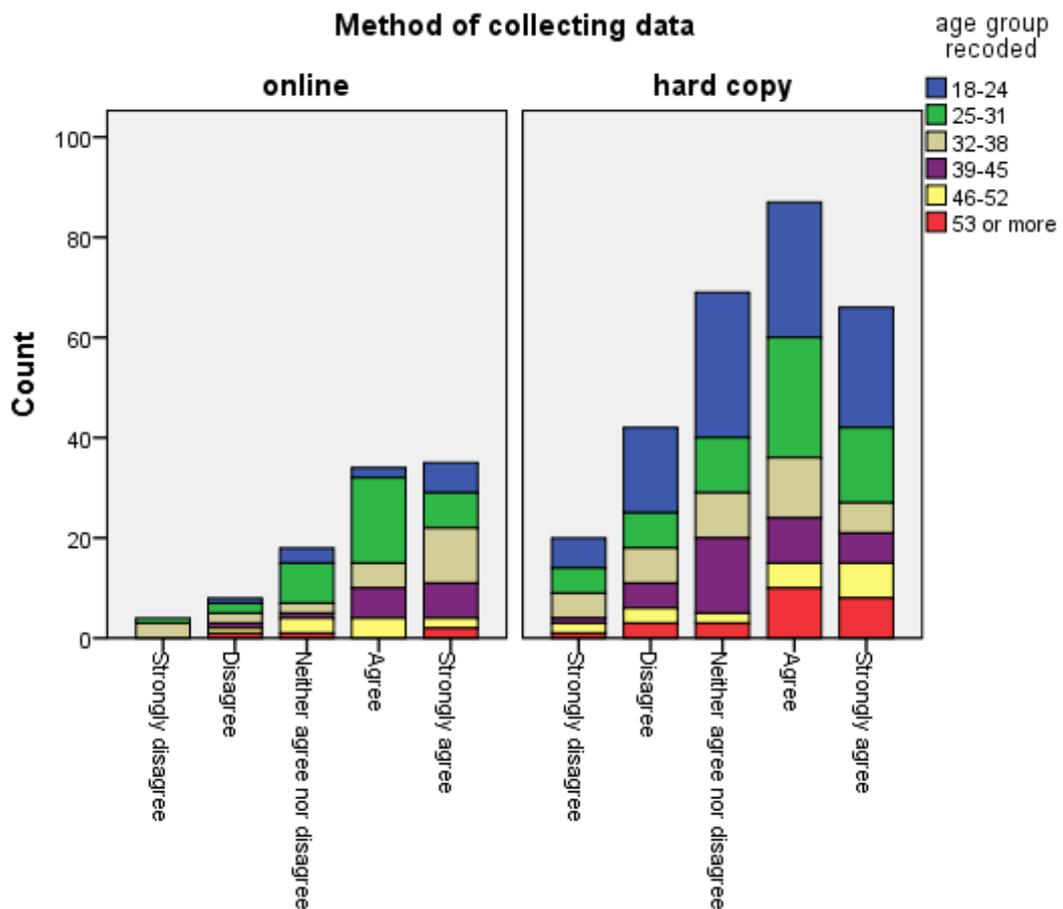
**Figure 45 Distribution of the responses Q13 split by gender**

Figure 43 shows that the online sample agreed more that they should walk more to keep fit, whereas in the hard copy, the responses are distributed across strongly disagree and strongly agree. Looking at the Figure 44, there are differences in the age groups. For instance, the younger groups (18-24 and 25-31) in the sample online were neutral or agreed with the statement, whereas in the hard copy, the same age groups have also a proportion of respondents who disagree. In the Figure 45, that in both samples male and female has a similar distribution of the responses. It can be noticed that the female group have a higher proportion were neutral or agreed more with the statement.



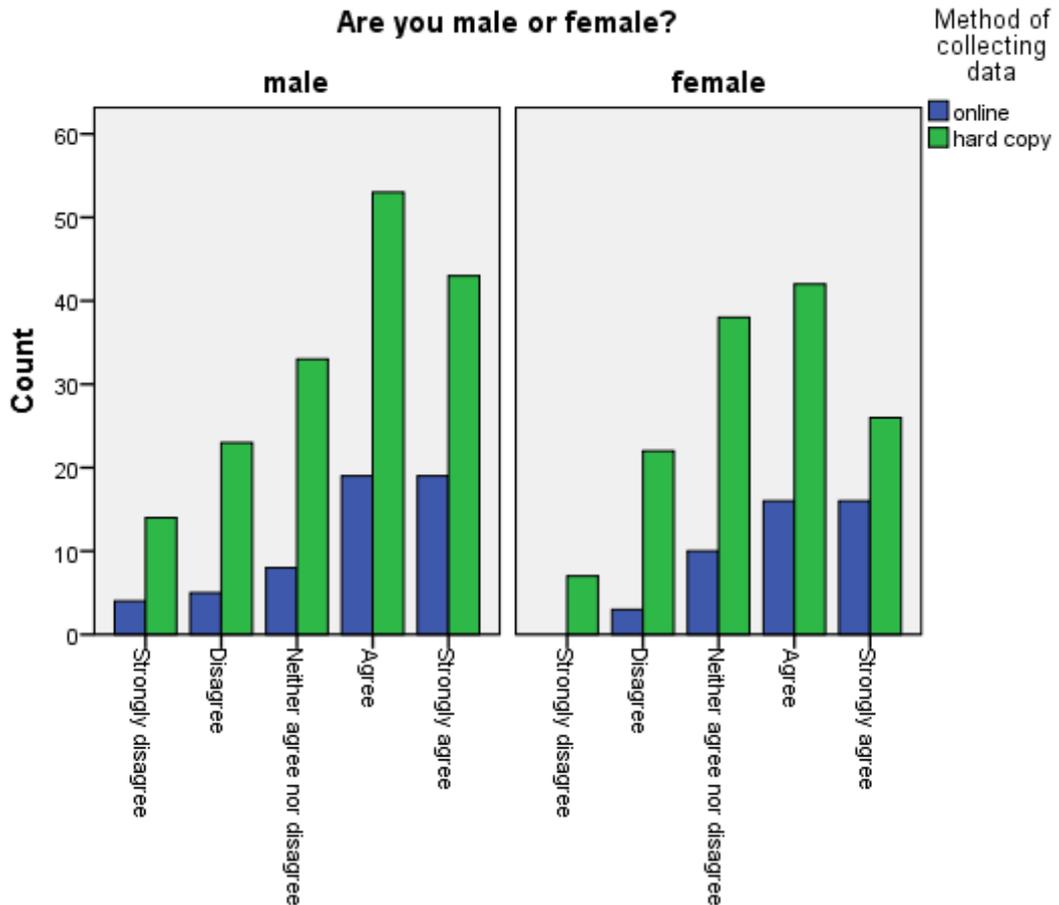
\*Sample size Online=100 and Hard copy=301

**Figure 46 Distribution of the responses for Q14 by sample**



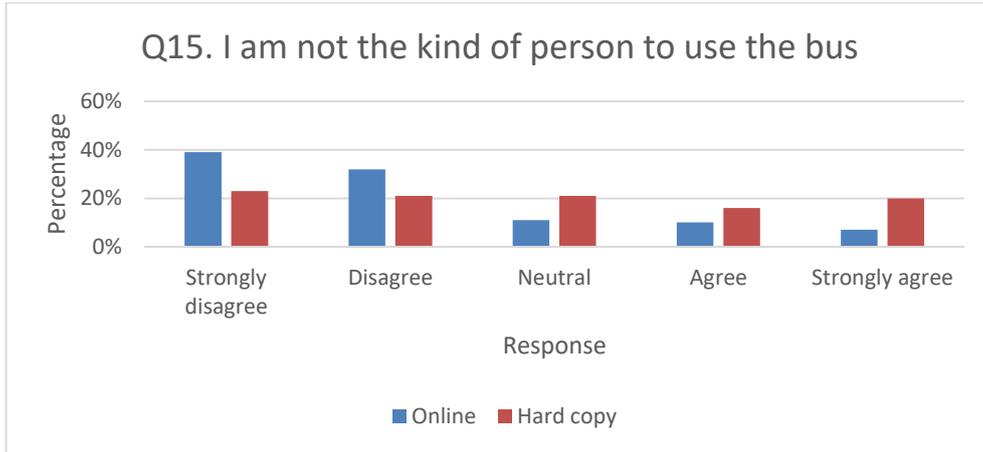
\*Bars represent number of cases

**Figure 47 Distribution of the responses Q14 split by age groups**



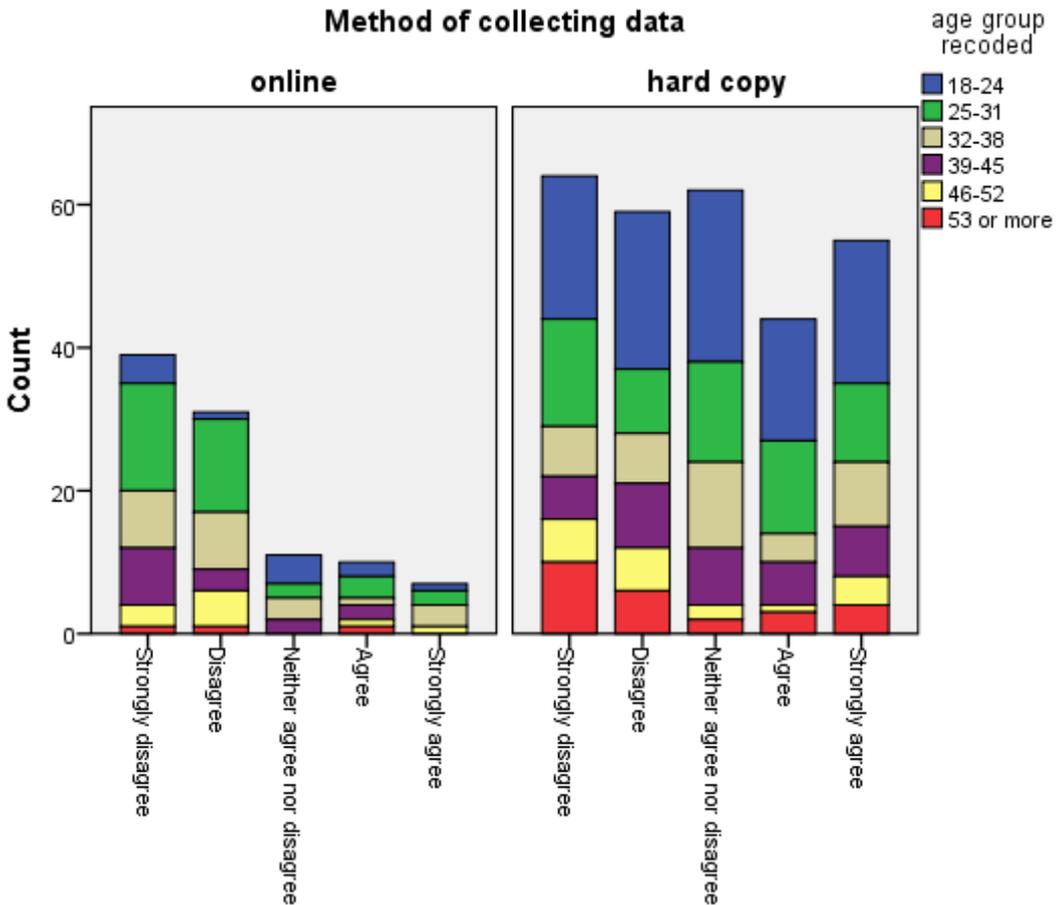
**Figure 48 Distribution of the responses Q14 split by gender**

Figure 46 shows that the distribution of the responses in both samples is very similar. Both samples have the higher proportion agreeing that they like traveling by walking. From the Figure 47 it can be noticed that the age group from 39-45 years old have the higher proportion of neutral responses in the hard copy sample, and the rest distributed between agree and disagree, whereas in the online sample, the responses were in higher proportion positive towards the statement. The Figure 48 comparing both samples by gender, shows that the female group agreed with the statement in a higher proportion in the hard copy than online.



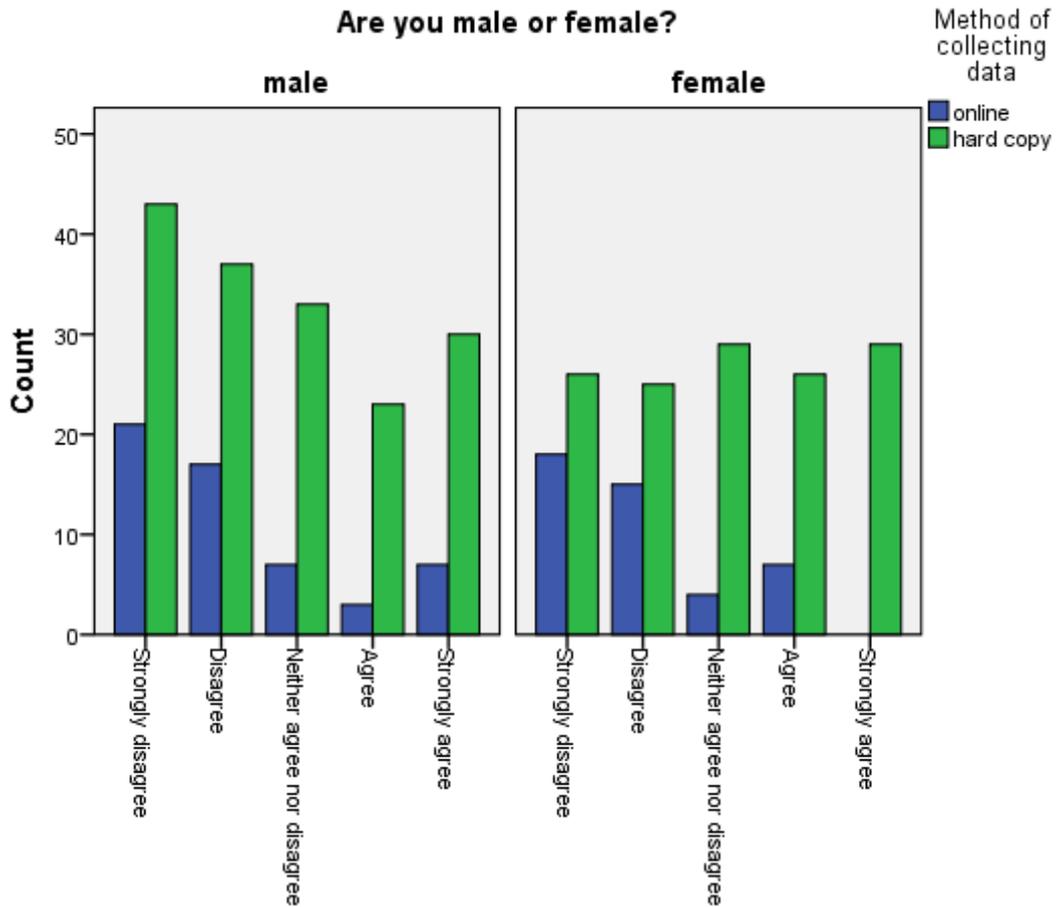
\*Sample size Online=99 and Hard copy=301

**Figure 49 Distribution of the responses for Q15 by sample**



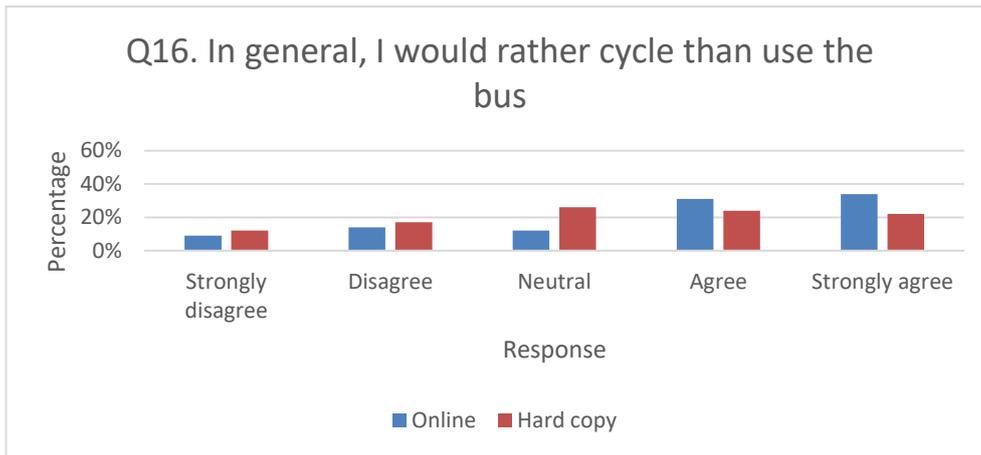
\*Bars represent number of cases

**Figure 50 Distribution of the responses Q15 split by age groups**



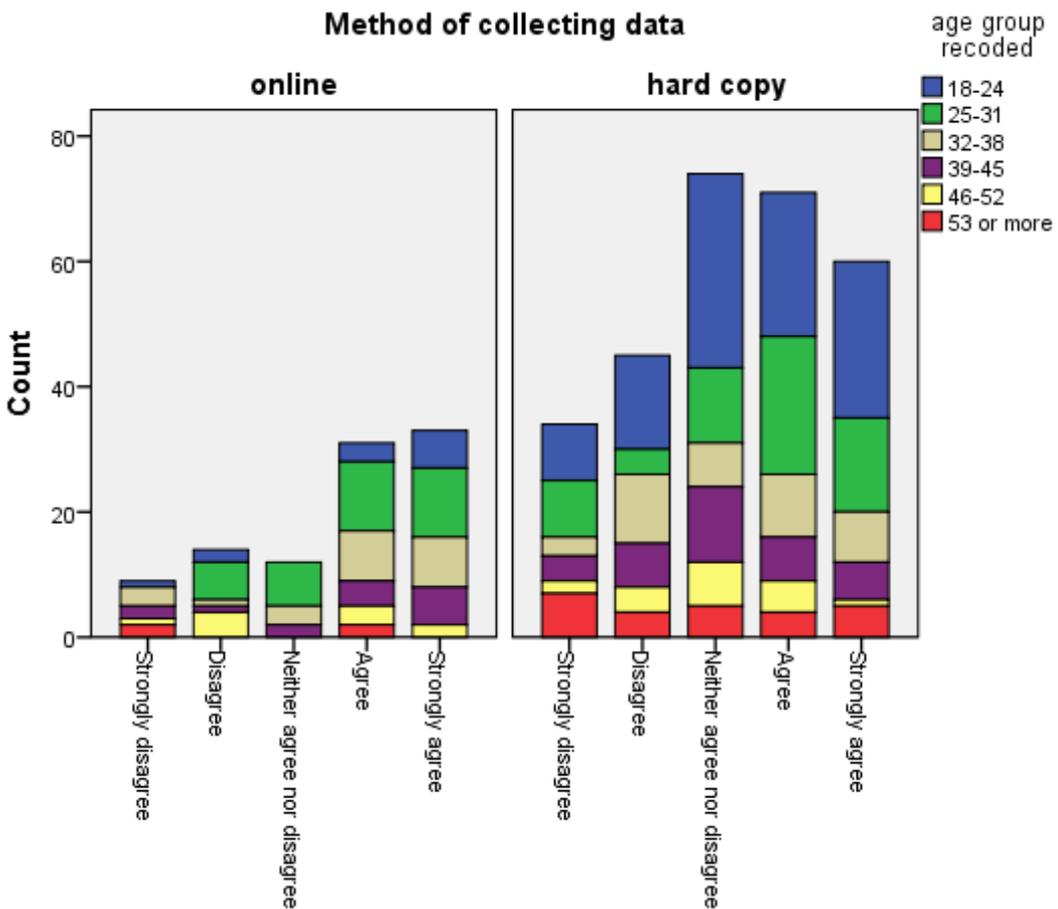
**Figure 51 Distribution of the responses Q15 split by gender**

Figure 49 shows that there was difference in the answers of the respondents from the two different samples. Hard copy sample agree more with not being the kind of person who uses the bus, whereas in the online sample respondents disagree more. Analysing the difference across the age groups, Figure 50 shows that the higher proportion of the 18-24 age group online was more neutral about the statement and that the rest of the groups tend to disagree more online, whereas in the hard copy the answers are more distributed across the responses. In both samples people over 53 have a higher proportion of respondents who disagree. The Figure 51 show that for the male group, both samples follow a similar distribution, however, the female group disagree more about being the type of person who uses the bus in higher proportion online than in the hard copy.



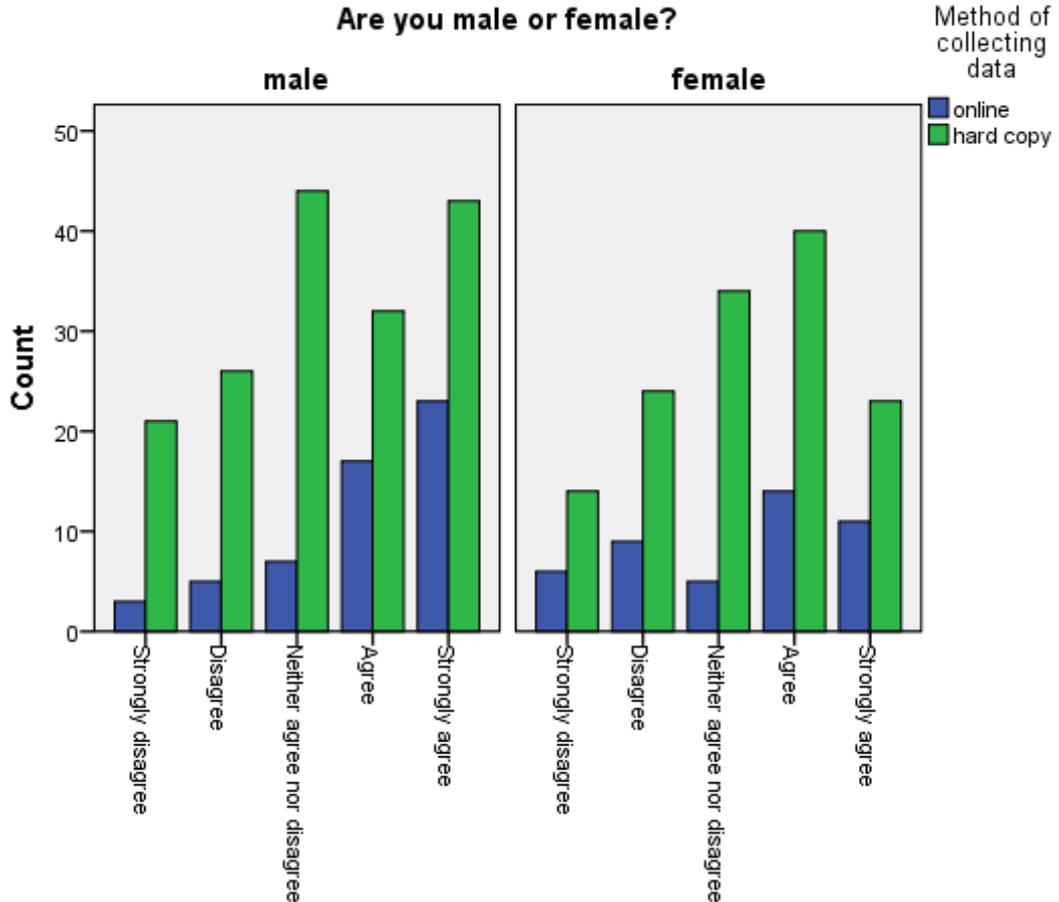
\*Sample size Online=100 and Hard copy=301

**Figure 52 Distribution of the responses for Q16 by sample**



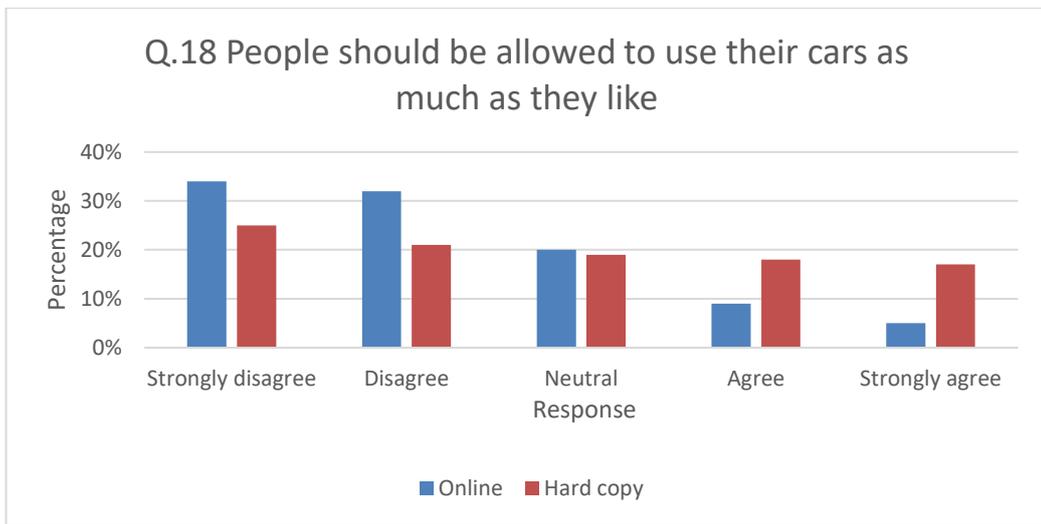
\*Bars represent number of cases

**Figure 53 Distribution of the responses Q16 split by age groups**



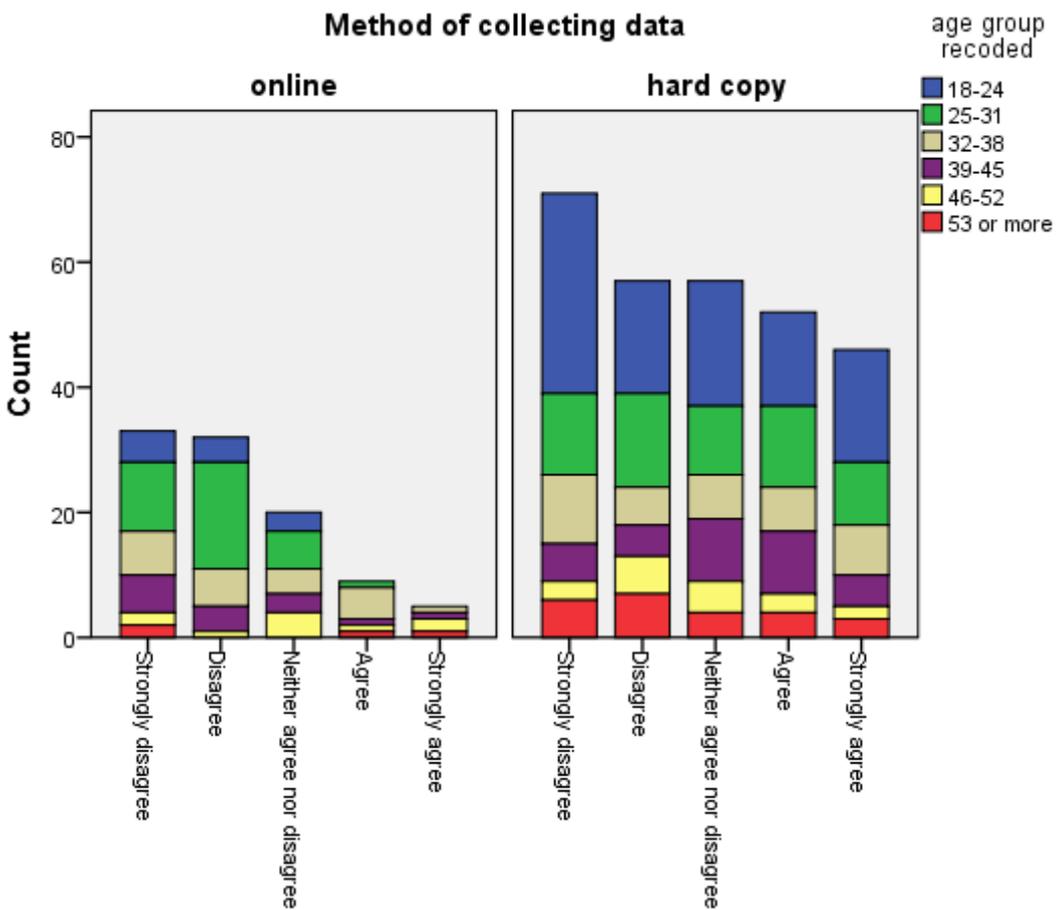
**Figure 54 Distribution of the responses Q16 split by gender**

About the preference for cycling over other transport options, Figure 52 shows that as in the previous questions, the online sample have higher proportion of respondents who agree with the statement. The responses in the hard copy, suggest that bicycle is preferred over the bus. Analysis the responses by age, Figure 53 shows that most of the age groups have more preference for the bicycle rather than using bus for this was showed in both samples. Except for the group over 53, that in the sample online only a small proportion agree or disagree, whereas in the sample in hard copy they had a more distributed responses between strongly disagree and strongly agree. Both samples analysed by gender, showed that male and female followed a similar distribution of the answers online and in the hard copy. However, the responses from the female group in hard copy, are more in the extreme with a very small proportion of respondents neutral about the statement.



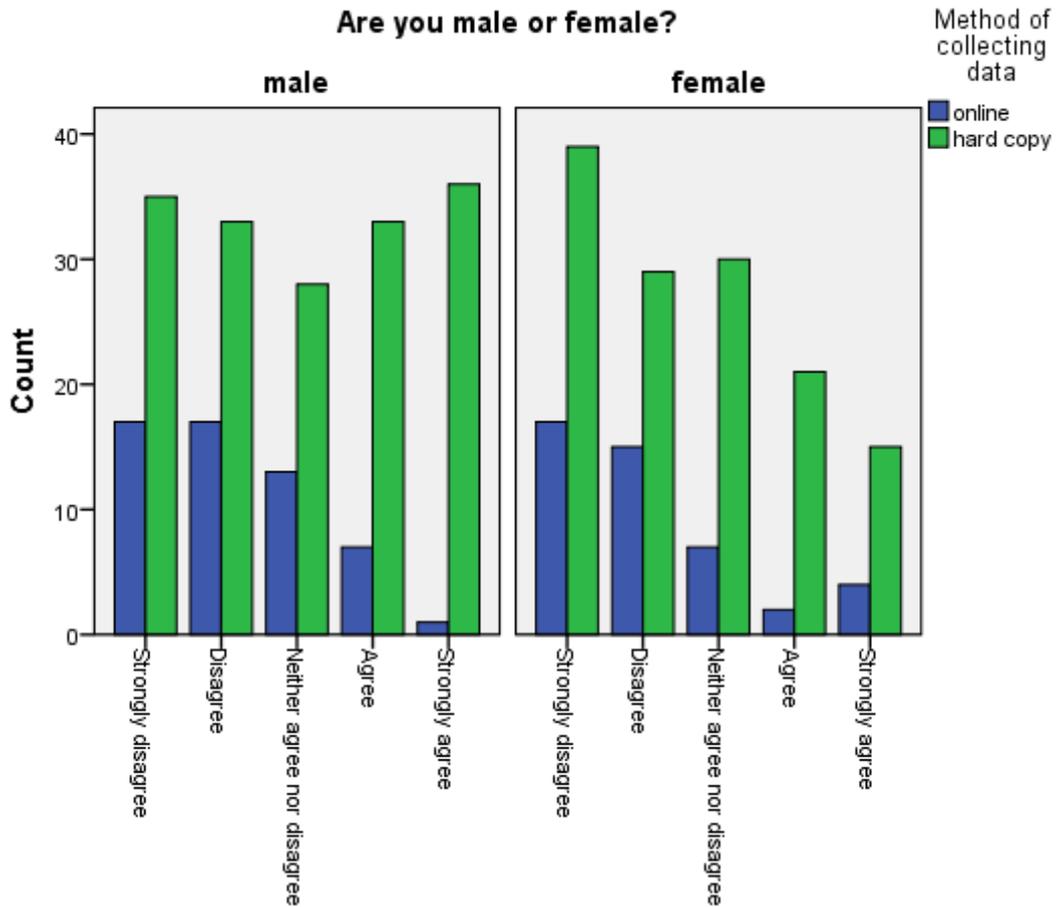
\*Sample size Online=100 and Hard copy=299

**Figure 55 Distribution of the responses for Q18 by sample**



\*Bars represent number of cases

**Figure 56 Distribution of the responses Q18 split by age groups**



**Figure 57 Distribution of the responses Q18 split by gender**

Overall, in Figure 55 we can see that the online sample disagree in higher proportion about people being allowed to use their cars as much as they like in contrast with the sample in hard copy. The analysis of the responses split by gender in Figure 56 show that in the online sample respondents most of the respondents disagree with the statement, whereas in the hard copy sample responses are distributed across all responses, this means that there was also a proportion of respondents that agree with having not restriction to their car use or at least being neutral about it. Carrying out the analysis of the responses by gender, this is confirmed because in the sample online both male and female tend to disagree more with the statement than in the hard copy sample for both genders.

Overall the analysis of the responses in both samples showed that Online sample seemed to be more positive about active

transportation and reduction of car use than the respondents in the hard copy sample.

From the inspection of the distribution of the responses and the graphs the sample collected online was almost three times smaller than the hard copy sample. The distribution of the responses vary regarding gender and age. From the analysis of the responses it is possible to conclude in the hard copy sample the respondents seemed to show preference towards car. For instance, hard copy more people agree in their preference for using car and they are mainly young (18-31) or older than 53” This could be related with the aspirational view of the car as an indicator of progress for young people. For adults, as mentioned before the public transport is usually overcrowded, thus people with less mobility due to age might feel scared by using it, thus car represent a more convenient way to commute. In the hard copy women agreed more than online. Men and women showed different responses, men disagree more than women in the hard copy than online.

The statement of “driving for the fun of it” showed that online people tend to disagree more regardless of age and gender. Whereas in the hard copy responses tend to be more distributed across strongly disagree to strongly agree. Only the people >53 showed more attachment to car by not agreeing with being interested in reducing car use.

Male and female online, disagree more that driving is a way for self expression. No gender differences in both samples in considering cycling as a way to keep fit neither in age, although it is clear that people between 18-31 overall consider cycling for fitness. Suggest that sometimes hard copy have less positive attitude towards cycling. Hard copy for male considered cycling is not always the quickest way to get around. Not gender differences about liking travelling by bicycle whereas young people prefer the bicycle than the bus. Hard copy are less prone to use public transport overall and particularly for the female group.

### 5.3.3 Data Processing

The Segment project provided an Excel Workbook file as a tool for the analysis of the answers (which calculates the distribution of different Segment types) (Anable, 2014). This was used to explore the distribution of the segments. See Figure 14 for a screenshot of the Excel Tool. Although Microsoft Excel was used for data visualization and organization, the primary statistical software package used to carry out the analysis was IBM SPSS and AMOS.

ID	Have you driven a car or van in the past 12 months?	Please indicate the extent to which you agree with the following statements... [For most journeys, I would rather use the car than any other form of transport]	Please indicate the extent to which you agree with the following statements... [I like to drive just for the fun of it]	Please indicate the extent to which you agree with the following statements... [I am not interested in reducing my car use]	Please indicate the extent to which you agree with the following statements... [Driving gives me a way to express myself]	Please indicate the extent to which you agree with the following statements... [How likely are you to drive in the next 12 months?]	Please indicate the extent to which you agree with the following statements... [I am not the kind of person who rides a bicycle]	Please indicate the extent to which you agree with the following statements... [I feel I should cycle more to keep fit]
1	1 YES	5	2	4	2	5	5	3
2	2 YES	2	4	5	1	5	1	4
3	3 YES	2	3	2	1	5	2	4
4	4 NO	5	3	1	3	3	3	4
5	5 YES	5	3	1	4	5	2	4
6	6 YES	2	2	4	2	5	5	4
7	7 YES	5	4	2	2	5	3	4
8	8 YES	5	4	4	2	5	3	3
9	9 YES	5	4	2	1	5	3	3
10	10 YES	5	2	5	2	5	5	4
11	11 YES	5	3	5	2	5	2	4
12	12 YES	4	4	2	4	4	2	4
13	13 YES	5	5	4	3	5	2	2
14	14 YES	5	5	3	2	5	3	4
15	15 NO	3	2	5	1	3	2	4
16	16 YES	5	2	3	2	5	1	4
17	17 YES	5	4	2	1	5	3	3
18	18 YES	3	4	1	1	5	1	4
19	19 YES	5	3	5	2	5	3	5
20	20 YES	5	3	2	3	5	5	2
21	21 YES	5	5	4	5	5	5	4
22	22 NO	1	5	1	1	4	5	4
23	23 YES	2	3	2	1	4	2	4
24	24 YES	3	1	1	1	4	4	5
25	25 YES	4	4	3	2	5	5	4
26	26 YES	4	3	3	2	5	2	3
27	27 NO	2	2	1	1	4	1	5
28	28 YES	5	3	2	2	5	1	3
29	29 YES	3	4	4	5	1	5	4
30	30 YES	5	4	1	2	5	3	5
31	31 YES	2	1	3	4	5	2	4
32	32 YES	4	3	2	1	5	2	3
33	33 YES	3	3	4	2	5	3	4
34	34 YES	4	4	3	2	5	4	3
35	35 NO	1	1	1	1	2	1	2
36	36 YES	3	2	3	4	4	4	3

Figure 58 Screenshot of the Excel Tool

### 5.3.4 Distribution of the Scores of the Segmentation Questions

The final sample was 401 responses in total, Table 33 presents the description of the answers using the mean and median. Question 1 asked whether the respondent drove in the last 6 months and the answers were coded as 1 for yes and 2 for not. In this question the median showed that the average of the sample drove in the last six months. Rest of the questions were measured in a five-point Likert scale (1=strongly disagree or very unlikely to 5= strongly agree or very likely). The median shows that although in general respondents feel moral obligation to reduce their GHG emissions is very likely they will still be driving in the next 12 months. Another observation is that people agree in having preference for cycling rather than using the bus. In overall people have a positive attitude towards travelling by bicycle or by walking.

**Table 33 Descriptives for the Segmentation Questions**

Q	Description	N	Mean	SE. Mean	Median	Std. Dev.	Var
1	Have you driven a ban or car in the last 6 months?	401	1.21	0.021	1.00	0.411	0.169
2	For most journeys, I would rather use the car than any other form of transport	400	3.08	0.072	3.00	1.443	2.082
3	I like to drive just for the fun of it	401	2.57	0.065	2.00	1.300	1.690
4	I am not interested in reducing my car use	400	2.60	0.070	2.00	1.402	1.965

5	Driving gives me a way to express myself	399	2.02	0.062	2.00	1.243	1.545
6	How likely are you to drive in the next 12 months?	400	3.99	0.069	5.00	1.386	1.920
7	I am not the kind of person who rides a bicycle	398	2.45	0.070	2.00	1.399	1.956
8	I feel I should cycle more to keep fit	401	3.80	0.056	4.00	1.125	1.267
9	I find cycling stressful	398	2.47	0.068	2.00	1.359	1.847
10	Cycling can be the quickest way to travel around	401	3.34	0.062	3.00	1.249	1.559
11	I like travelling by bicycle	400	3.63	0.061	4.00	1.215	1.477
12	I am not the kind of person that likes to walk a lot	399	2.21	0.065	2.00	1.307	1.709
13	I feel I should walk more to keep fit	400	3.77	0.056	4.00	1.123	1.260
14	I like travelling by walking	401	3.59	0.059	4.00	1.185	1.403
15	I am not the kind of person to use the bus	400	2.70	0.071	2.00	1.428	2.039
16	In general, I would rather	401	3.38	0.065	4.00	1.310	1.715

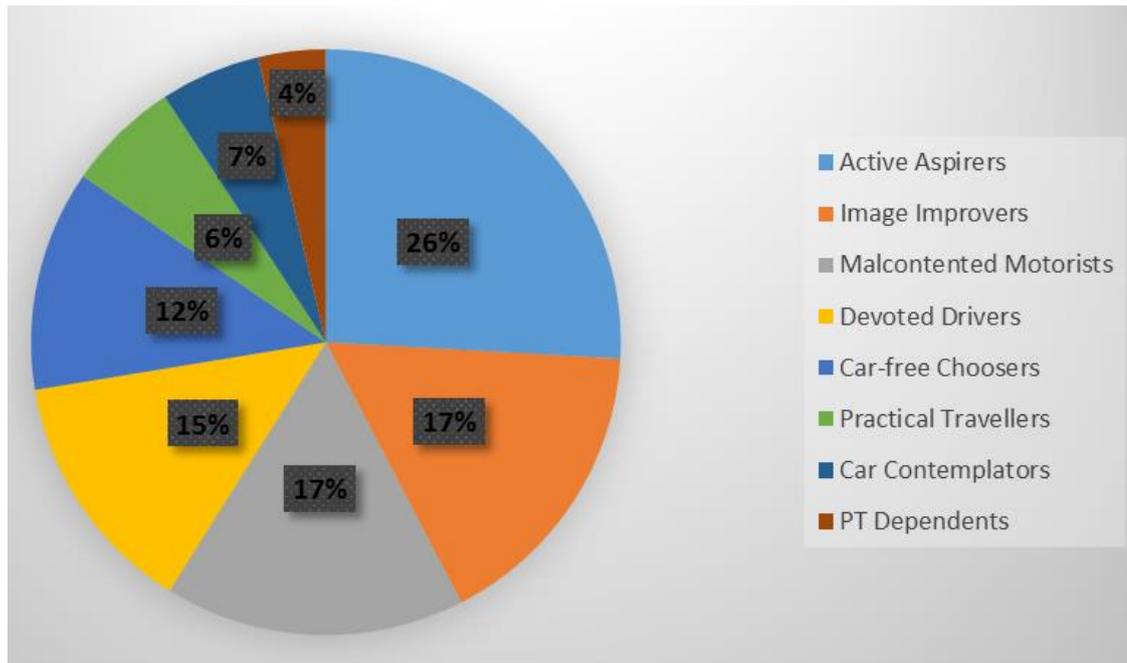
	cycle than use the bus						
17	I feel a moral obligation to reduce my emissions of greenhouse gases	400	3.90	0.060	4.00	1.192	1.421
18	People should be allowed to use their cars as much as they like	399	2.66	0.070	2.00	1.389	1.928

### 5.3.5 Characteristics of the Segments

Table 34 contains the distribution of the segments and Figure 59 show it graphically. The biggest group was the active aspirers being the 25% of the total, followed by the image improvers and malcontented motorists (each one with 16.5%), devoted drivers (13.5%) and car-free choosers (12.2%). The three smallest groups were practical travellers (6.2%), car contemplators (5.5%) and public transport dependents (3.7%).

**Table 34 Distribution of the Segments**

No.	Segment	Frequency	Percentage
1.	Active Aspirers	104	25.9
2.	Image Improvers	66	16.5
3.	Malcontented Motorists	66	16.5
4.	Devoted Drivers	54	13.5
5.	Car-free Choosers	49	12.2
6.	Practical Travellers	25	6.2
7.	Car Contemplators	22	5.5
8.	PT Dependents	15	3.7
	Total	401	100.0



**Figure 59 Pie Chart of the distribution of the Segments**

Having found in Mexico City the same eight segments found in Europe supports the conclusion of the researchers of the Segmentation Methodology, who argued that methodology could be transferred to different contexts and that the only difference is that the distribution of the segments is the only thing that will differ. The Transferability Report in fact states that most of the segments were found in all the cities although they differ in the frequency distribution (Anable, 2013).

The Segmentation Methodology stated that socio-demographic information is not necessary to create the segments, the author stressed that collecting this information is useful to understand the characteristics of people that tend to be in each segment and to produce tailored policy measures (Anable, 2013). In table 35 and 36 there are the socio-demographic characteristics of each segment in Mexico City. And analysis between the segments found in Europe and those found in Mexico is in the following sections to understand the differences between them.

**Table 35 Socio-demographic characteristics of each segment**

Variable	Category	Segment (in %)							
		AA	II	MM	DD	CF	PrT	CC	PtD
Gender	Male	63	47	55	52	39	80	64	47
	Female	37	53	45	48	61	20	36	53
Age	18-24	24	39	28	39	29	32	25	20
	25-31	29	20	23	16	35	40	20	13
	32-38	16	11	12	16	21	20	25	20
	39-45	15	13	15	16	6	8	10	20
	46-52	8	9	8	6	4	0	15	13
	>53	7	8	14	6	4	0	5	13
Education	Secondary or less	2	2	3	6	4	4	18	13
	High school	15	17	18	19	20	12	32	27
	Technical or commercial	10	9	11	9	8	12	14	13
	University	51	59	48	54	57	60	32	40
	Postdegree	22	14	20	13	10	12	5	7
Occupation	Only Work	68	55	52	61	63	40	57	60
	Student	10	6	12	11	10	12	5	13
	Not working	2	0	6	4	0	8	10	0
	Work and study	17	33	23	19	22	36	14	7
	Housework	2	3	3	4	2	0	5	7
	Retired	0	2	5	2	0	0	0	7
	Other	1	2	0	0	2	4	10	7
Income*	3000 or < MXN	12	15	11	9	27	16	27	7
	4000 to 9000 MXN	16	27	29	28	45	28	55	60
	10000-15000 MXN	20	20	15	24	8	16	9	13
	16000 to 27000 MXN	24	12	23	17	10	28	5	13
	28000 or > MXN	28	26	23	22	10	12	5	7

\* 1 MXN = 0.0536775 USD Source: <http://www.xe.com/currencyconverter/>

**Table 36 Mobility characteristics by Segment**

		Segment (in %)							
Variable	Category	AA	II	MM	DD	CF	PrT	CC	PtD
Commute by car	Yes	59	88	70	91	6	64	18	7
	No	41	12	30	9	94	36	82	93
Commute by bicycle	Yes	26	3	6	0	37	16	9	0
	No	74	97	94	100	63	84	91	100
Commute by bike-share system	Yes	14	0	3	0	14	8	0	0
	No	86	100	97	100	86	92	100	100
Average commuting travel time*	Up to 10 min	7	11	2	8	8	16	15	7
	From 11-30 min	17	14	13	19	23	12	0	7
	From 31-59 min	36	39	39	38	25	40	35	33
	Up to 1.5 hrs	21	27	23	26	23	8	25	7
	Up to 2 hrs	12	6	14	8	10	8	15	33
	Up to 2.5 hrs	3	2	5	0	4	4	0	0
	Up to 3 hrs	2	2	0	0	4	4	0	0
	Up to 3.5 hrs	2	0	0	0	0	4	5	0
	More than 3.5 hrs	0	0	2	2	2	0	0	7
	N/A	1	0	3	0	0	4	5	7

\*Average travel time from home to work or to school (with return)

Summary of the socio-demographic information and mobility patterns from the previous tables.

1. Active Aspirers (AA)

This is the biggest group found in the sample. The largest proportion are men (63%) the rest female (37%). A little bit more than half of the AA are aged between 18-31 (53%), followed by the age group of 32-38 (16%), 39-45 (15%) and 46-52 (8%) the least represented age group is people with more than 53 years old (7%). This segment is well educated since 73% of this group have university education or

post degrees. The highest proportion of this segment (85%) work full time or combine work and study and a very small proportion are full time students (10%). The income is distributed as follows: 52% of the segment is paid more than 16000 pesos (US\$835) monthly, 20% is paid between 10000-15000 pesos (US\$536-805), 16% is paid between 4000-9000 pesos (US\$209-483), and only 12% perceived less than 3000 pesos (US\$157). Regarding mobility, it is to notice that 60% of the respondents commute for less than 30 minutes in a single trip whereas the rest of the segment (40%) commute for longer time. However, 59% commute by car and only about 26% use their own bicycle and about 14% use Ecobici to commute.

## 2. Image Improvers (II)

This segment has an almost equal distribution of gender. It is composed by 47% male and 53% females. The bigger age group is people aged 18-24 (39%), followed by aged 25-31 (20%); 32-38 (11%); 39-45 (13%); the smallest age groups were 46-52 (9%) and older than 53 (8%). Regarding education, 59% of respondents have University education), the second biggest group completed high school (17%), followed by post degree (14%), technical education (9%) and secondary or less (2%). This group predominantly work (55%) or work and study (33%). The two largest groups of income are in the extremes, this means that 27% of this segment earns between 4000-15000 mx pesos (US\$209-783) monthly, whereas in the second largest group 26% earn more than 28000 mx pesos (US\$1462) at month, third largest group is the individuals earning between 10000-15000 pesos (US\$536-805) (20% of respondents). The 88% of this segment commute by car. Almost no one use the bicycle for commuting. Their travelling time can vary from 31 minutes to up to 1.5 hours.

## 3. Malcontented Motorists (MM)

This segment has an almost equal distribution of gender. It is composed by 55% male and 45% females. Age is distributed as follows: 18-24 (28%); 25-31 (23%); 39-45 (15%); older than 53 (14%); 32-38 (12%) and 46-52 (8%). This group have mainly

University education (48%), followed by post degrees (20%), the rest are divided as follows: high school (18%), technical education (11%) and secondary or less (3%). The majority of them only work (52%) and work and study (23%). The least represented groups are students (12%), not working (6%), retired (5%) and doing housework (3%). Regarding income, the largest group has an income between 4000-9000 pesos (US\$209- 483) (29%); followed by 16000-27000 (US\$835-1409) (23%) and more than 28000 pesos (US\$1462) (23%). The income group receiving less than 3000 pesos (US\$157) was the smallest (11%). 70% commute by car and almost no one use a bicycle private or share system. Regarding travelling time, 39% commutes for up to 60 minutes and only 13% less than 30 minutes. Rest of the respondents commute longer than 1 hour.

#### 4. Devoted Drivers (DD)

This segment has an almost equal distribution of gender. It is composed by 52% male and 48% females. The largest age group was 18-24 (39%), 25-31 , 32-38 and 39-45 have 16% each of them; the least represented are 46-52 (6%) and over 53 years old (6%). This segment is well educated with 54% University education. The respondents predominantly work (61%). Majority of the group (28%) have an income between 4000-9000 mx pesos (US\$209- 483) and the second largest group 10000-15000 pesos (US\$536-805) (24%) followed by those earning more than 28000 mx (US\$1462 (22%). The 90% of this group commute by car and do not use any type of bicycle to travel. The commuting average time is 11 min to up 1.5 hrs for 81% of this group. It is to be noticed that, 19% travel from 11-30 minutes and 38% travel from 31-59 min.

#### 5. Car-free Choosers (CF)

This segment has a bigger group of females (61%) than males (39%). The bigger age group is between 25-31 years old (35%) followed by 18-24 (29%) and 32-38 (21%). The rest of the age groups from were the least represented. Regarding education, the more than half has University education (57%). The respondents mainly work (63%) or work and study (22%). Regarding income, the largest proportion

(45%) earns between 4000-9000 mx pesos (US\$209-483). In this segment, 94% of the respondents do not use their car to commute, 14% use the bike share system and 37% reported to commute with their own bicycle. This might be linked with the fact that 48% of the respondents travel maximum 30 minutes in a single trip whereas the rest reported that they travel more than 1 hour in round trip to commute and only 8% up to ten minutes.

#### 6. Practical Travellers (PrTr)

This segment has highest percentage of me. Of the total segment 80% of the respondents are male and only 20% female. The largest age group is 25-31 years old (40%) followed by 18-24 (32%) and 32-38 (20%). The other age groups, are underrepresented. More than half have University education (60%) and work full time (40%) or combine work and education (36%). The two largest income groups earn between 4000-9000 mx (US\$209-483) (28%) and between 16000-27000 (US\$835-1409) (28%). More than 60% commute by car (private, shared or by taxi) the majority of them do not commute by bicycle. The largest proportion travels from 31-59 minutes (40%), whereas 16% up to ten minutes and 12% 11-30 minutes.

#### 7. Car Contemplators (CC)

This segment was composed by 64% males and 36% females. The age was distributed highly between the following age groups 18-24 (25%); 32-38 (25%); 25-31 (20%). 32% of the respondents have University education and the second largest group was people with only high school (32%). A high proportion of this group work full time (57%). The highest proportion (55%) earns a monthly income between 4000-9000 mx pesos (US\$209-483). They mostly do not commute neither by bike nor by car. And the majority (35%) commute for one hour (with return).

#### 8. Public Transport Dependent (PTD)

This group had almost the same percentage of male (47%) and female (53%) respondents. There was not any age group that was more represented. The age was distributed as follows 18-24 (20%); 25-31 (13%); 32-38 (20%); 39-45 (20%); 46-52 (13%) and older than

53 (13%). 40% of the total have University and 60% work full time. The average monthly salary of this segment is 4000-9000 mx pesos (US\$209-470) (60%). And the main mode of transportation was neither car nor bicycle. This segment commute in journeys of one hour only 33% and up to two hours (including return journey) other 33%.

The eight segments found in the Europe were found in Mexico City. It should be noticed that the cross comparison of the segments based on the sociodemographic characteristics highlight the following.

Regarding gender, AA, PrTr and CC are highly percentage of male, whereas the CfC showed more female representation. Rest of the segments (II, MM, DD, PTD) have more equal distribution of gender across male and female.

With respect to education and occupation, AA, II, DD, CfC and PrTr have more than half of respondents has University as last education level, whereas the MM, CC and PTD have less than half of respondents with this level of education. And in all segments, more than half of respondents work full or part time.

In Table 48 we can see that there are five bands for income distribution. In order to carry out a more illustrative comparison across all the segments, in this paragraph low income will be assigned for those respondents earning monthly less than 3000 pesos (US\$157) and up to 9000 mx pesos (US\$470); middle income will be assigned to respondents earning monthly between 10000-15000 pesos (US\$536-805) and finally high income will be assigned to those respondents earning monthly more than 16000 pesos (US\$835).

CfC, CC and PTD are the segments in the low income band; AA and MM are the segments in the high income band; finally II, DD, PrTr are the segments which showed a more equally distributed income across all the income bands.

About the mobility, all segments commute mainly by car, except for CfC, CC and PTD. Most of the segments do not commute by bicycle (their own or Ecobici) except for AA and CfC. Regarding travel time, AA, II, DD and PrTr commute for less than one hour in a round trip, this means that each trip takes up to 30 minutes. For the rest of the segments, the commuting time varies more.

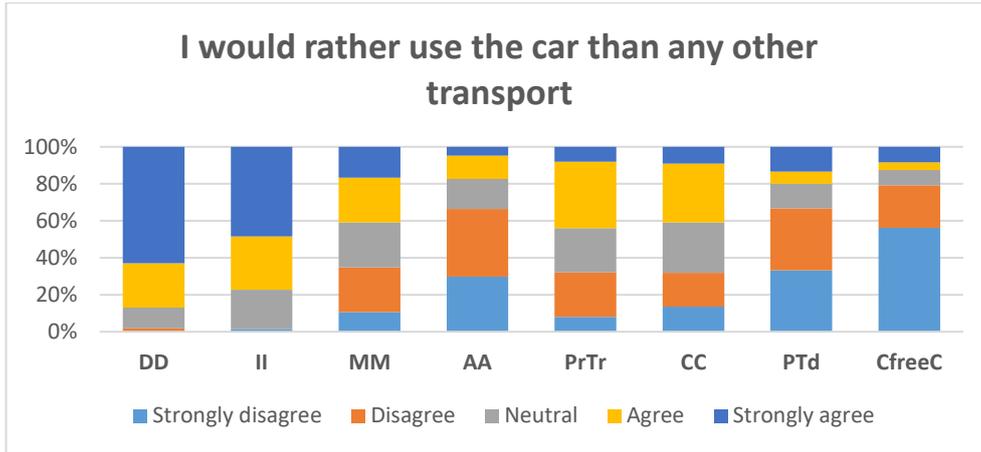
In summary, it is possible to see that car dependency does not seem to be linked to gender, since the segments with more car dependency actually have more equal distribution among male and females. Same is the case of the educational level and occupation. Car dependent segments are distributed among respondents with University degree as well as among those with less education. It should be noticed too that the segments that commute for shorter journeys are actually those who showed higher percentage of car dependency.

In the following section, there is the analysis of each segment and their attitudes towards transport.

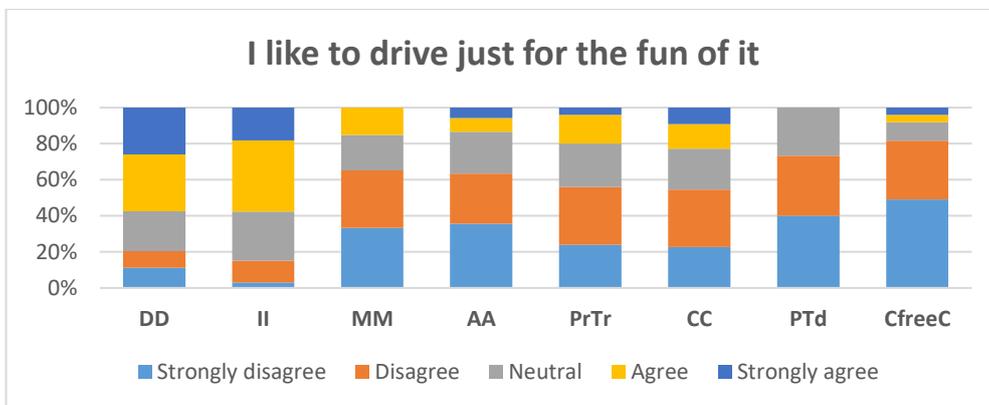
### **5.3.6 Segment Groups and Attitudes towards Transport**

#### **5.3.6.1 Attitudes towards Car Use**

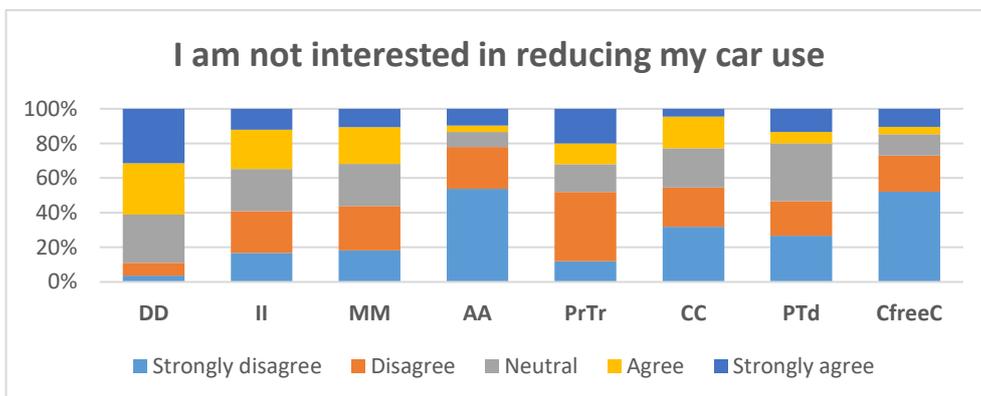
In this section it will be analysed the responses about car use for each of the eight segments. In the first part, there are the graphs with the distribution of the answers by segment. These questions are question two (I would rather use the car than any other transport); question three (I like to drive just for the fun of it); question four (I am not interested in reducing my car use); question five (Driving gives me a way to express myself); question six (How likely are you to drive in the next 12 months); question seventeen (I feel moral obligation to reduce GHG emissions) and question eighteen (People should be allowed to use their cars as much as they like). These questions were measured in a 5-point Likert scale from 1= Strongly disagree to 5= Strongly agree, except for question six that was measure in a 5-point Likert scale from 1= Very unlikely to 5= Very likely. At the end of the graphs there is the analysis of the responses.



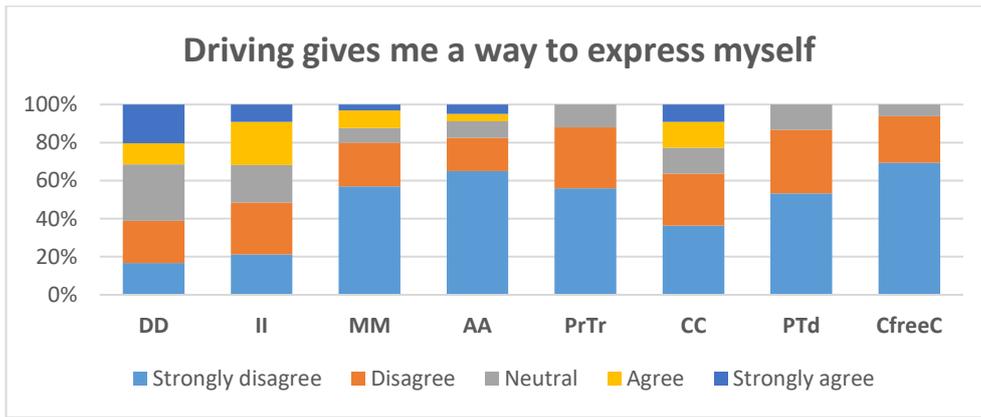
**Figure 60 Question two about car use**



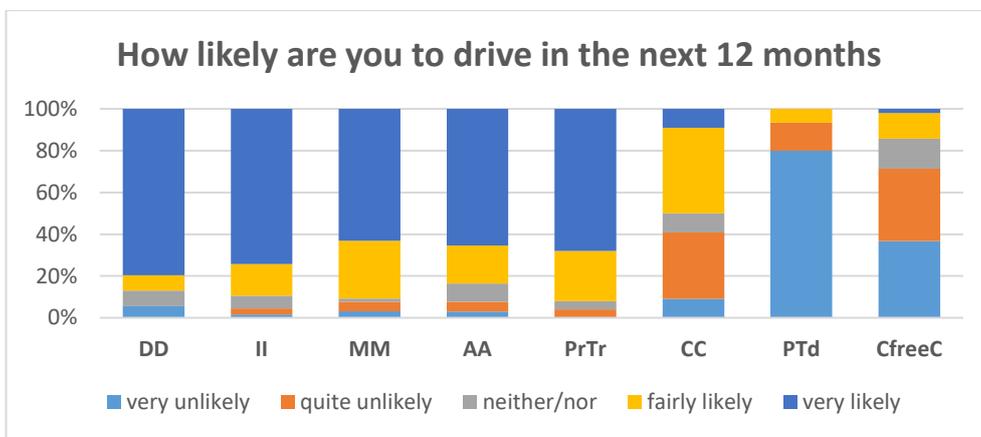
**Figure 61 Question three about car use**



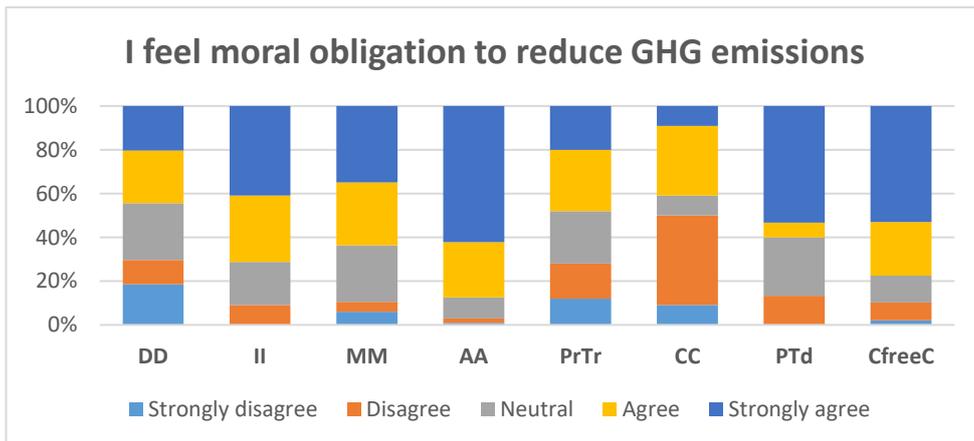
**Figure 62 Question four about car use**



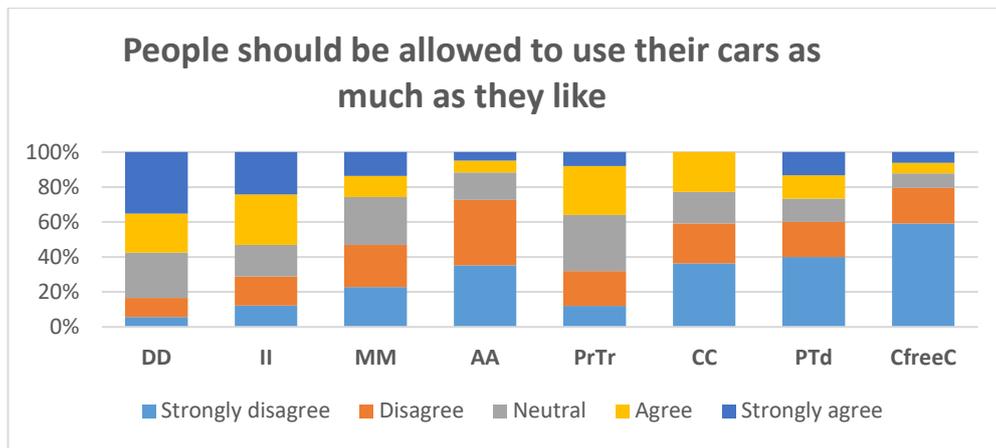
**Figure 63 Question five about car use**



**Figure 64 Question six about car use**



**Figure 65 Question seventeen about car use**



**Figure 66 Question eighteen about car use**

**1. Active Aspirers (AA)**

About their preference for using car over other transport modes, high proportion disagree (69%). More than 60% disagree about driving just for fun and 83% disagree in the statement that driving is a way for self-expression. 87% of the respondents feel a moral obligation for reducing their greenhouse gas emissions (GHG) which is coincident with the 77% of people agreeing that people shouldn't be allowed to use their car as much as they want. Although overall high proportion of this segment have intention to reduce car (78%), only 8% are not likely to drive in the next 12 months.

**2. Image Improvers (II)**

About their preference for using car over other transport modes, high proportion agree (77%). Regarding driving just for fun 15% people disagree, 27% was neutral and 58% agrees. 48% disagree in the statement that driving is a way for self-expression but 32% agrees and 20% was neutral about it. 71% of the respondents feel a moral obligation for reducing their greenhouse gas emissions (GHG) however 53% of people agree that they shouldn't be allowed to use their car as much as they want. This segment has low intention to reduce their car use, since only 35% has the intention to change their behaviour whereas 24% was neutral. A high proportion of them (89%) are likely to drive a car in the next 12 months.

### 3. Malcontented Motorists (MM)

About their preference for using car over other transport modes, this groups is relatively split. 41% agree, 35% disagree and a 24% neither agree nor disagree. About 65% disagree about driving just for fun and 80% disagree in the statement that driving is a way for self-expression. 64% of the respondents feel a moral obligation for reducing their greenhouse gas emissions (GHG) but only 47% of people disagree that people should be allowed to use their car as much as they want. Overall 44% of this segment have intention to reduce car against 32% that has no intention to reduce its use. Finally, 91% are likely to drive in the next 12 months.

### 4. Devoted Drivers (DD)

About their preference for using car over other transport modes, the highest proportion (87%) agrees on rather using the car than other options. About 57% agree about driving just for fun and 22% neither agree nor disagree with the statement. About seeing driving as a way for self-expression, the segment is relatively split. 31% of the respondents agrees and 39% disagree and the rest are neutral about it. 44% agrees on feeling a moral obligation for reducing their greenhouse gas emissions (GHG) but 30% disagrees. However, 57% of people agree that people should be allowed to use their car as much as they want. Overall 61% of this segment have no intention to reduce their car use. Finally, 87% are likely to drive in the next 12 months.

### 5. Car-free Choosers (CF)

A high proportion of CF would use another options rather than car (79%) and the majority do not consider driving just for the fun of it (82%) neither that driving give them as a way for self-expression (94%), thus a high proportion of this segment is interested in reducing their car use (73%). About reducing their GHG emissions, 78% feel the moral obligation, and in fact 71% considers unlikely that they will drive in the next 12 months and 80% considers people should not be allowed to use their cars as much as they like.

#### 6. Practical Travellers (PrTr)

In this segment, 44% of the respondents rather use the car than other options to commute, only 32% would use other modes and 24% was neutral. More than half of the PrTr's do not drive just for the fun of it and a high proportion (88%) disagree about driving being a way for self-expression. Half of the respondents are interested in reducing their car use, 16% was neutral and the rest is not interested in changing their behaviour. 48% feel moral obligation for reducing GHG but 92% consider likely that they will drive in the next 12 months. About whether people should be allowed to use their car as much as they like, the segment is split. 32% agrees about it whereas 36% disagrees and 32% was neutral about this statement.

#### 7. Car Contemplators (CC)

Overall of the CC, 41% prefers the car, 32% disagree about that and 27% are neutral. The highest proportion (55%) do not drive for the fun of it and 23% were neutral, rest of the respondents agreed. About seeing driving as a way for self-expression, 64% of the respondents disagrees. 41% agrees on feeling a moral obligation for reducing their greenhouse gas emissions (GHG) but 50% disagrees. However, 59% of people disagree about people being allowed to use their car as much as they want. Overall 55% of this segment have intention to reduce their car use. Finally, 50% think is likely they will drive in the next 12 months, 41% think it is very unlikely.

#### 8. Public Transport Dependent (PTD)

The highest proportion (67%) disagree on preferring car over other transport modes. No one in this segment drive for the fun of it, although 27% was neutral about it. About reducing their car use, 47% have intention to reduce their use and 33% was neutral and 20% do not have intention to drive less. No one in this segment considers that driving is a way for self-expression, in fact, 87% disagree with this statement. About likelihood of driving in the next 12 months, 93% considers unlikely they will do it. And 60% considers moral obligation for reducing their GHG emissions and the same proportion considers

that people shouldn't be allowed to use their cars as much as they want.

### 5.3.6.2 Attitudes towards Bus Use

In this section it will be analysed the responses about bus use for each of the eight segments. In the first part, there are the graphs for each question with the distribution of the answers by segment group. These questions are question fifteen (I am not the kind of person that use the bus) and sixteen (In general, I would rather cycle than use the bus). These questions were measured in a 5-point Likert scale from 1= Strongly disagree to 5= Strongly agree. At the end of the graphs there is the analysis of the responses.

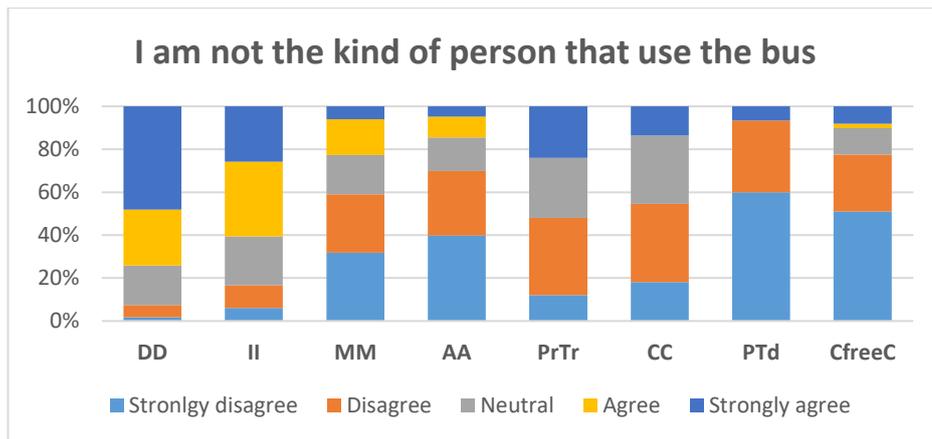


Figure 67 Graph question fifteen about bus use

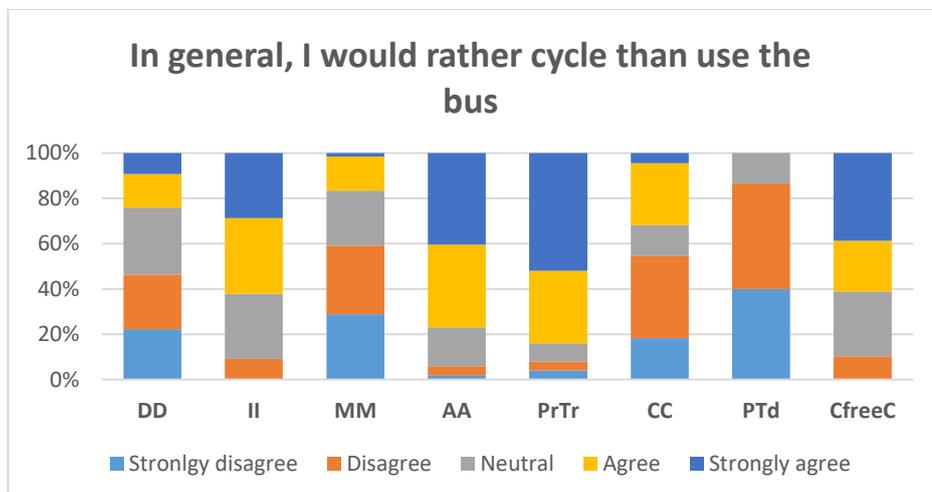


Figure 68 Graph question sixteen about bus use

1. Active Aspirers (AA)

Regarding bus use 15% agree on not being the kind of people that uses the bus and 16% was neutral about it. But 77% would rather cycle than use the bus.

2. Image Improvers (II)

Regarding bus use, 61% of the II do not see themselves as bus users, 62% would rather cycle than use it.

3. Malcontented Motorists (MM)

For the MM, 59% see themselves as the kind of people that uses the bus, 18% was neutral and 23% do not see themselves as bus users. But 59% would rather prefer the bus than using the bicycle.

4. Devoted Drivers (DD)

A high proportion of this segment (74%) do not see themselves as the kind of people that uses the bus and 19% was neutral about it. But 46% would rather prefer the bus than using the bicycle, a 30% was neutral about this statement.

5. Car-free Choosers (CF)

A high proportion of this segment consider themselves as the kind of person that use the bus. However, a 61% would rather use the bicycle to commute instead of the bus.

6. Practical Travellers (PrTr)

This segment, 48% of the PrTr see themselves as bus users but a high proportion (84%) prefer to cycle than using bus.

han use the bus to commute.

7. Car Contemplators (CC)

Regarding bus use 14% do not see themselves as the kind of people that uses the bus and 32% was neutral about it and rest disagree with the statement. But 55% prefer the bus rather than cycling.

8. Public Transport Dependent (PTD)

In this segment, 93% do not consider themselves as the type of person that use the bus. And the high proportion (87%) prefer the bus rather than cycle.

### 5.3.6.3 Attitudes towards Cycling

In this section it will be analysed the responses about cycling for each of the eight segments. In the first part, there are the graphs for each question with the distribution of the answers by segment group. These questions are question seven (I am not the kind of person who rides a bicycle); question eight (I feel I should cycle more to keep fit); question ten (Cycling can be the quickest way to travel around) and question eleven (I like travelling by bicycle). These questions were measured in a 5-point Likert scale from 1= Strongly disagree to 5= Strongly agree. At the end of the graphs there is the analysis of the responses.

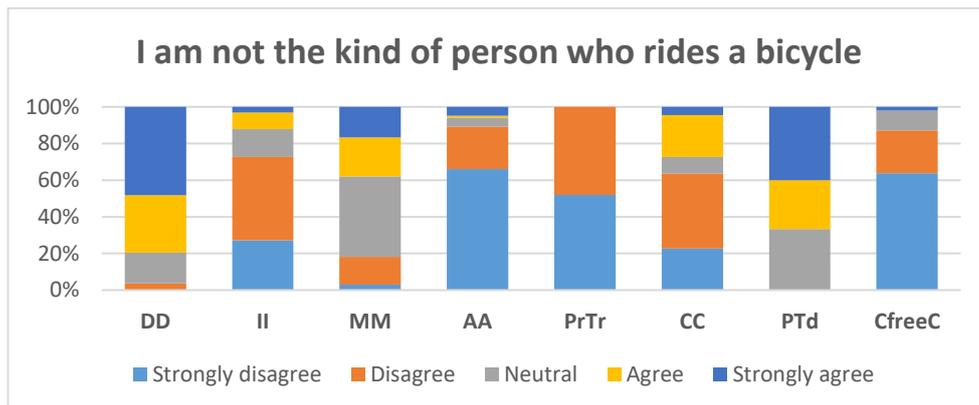


Figure 69 Question seven about cycling

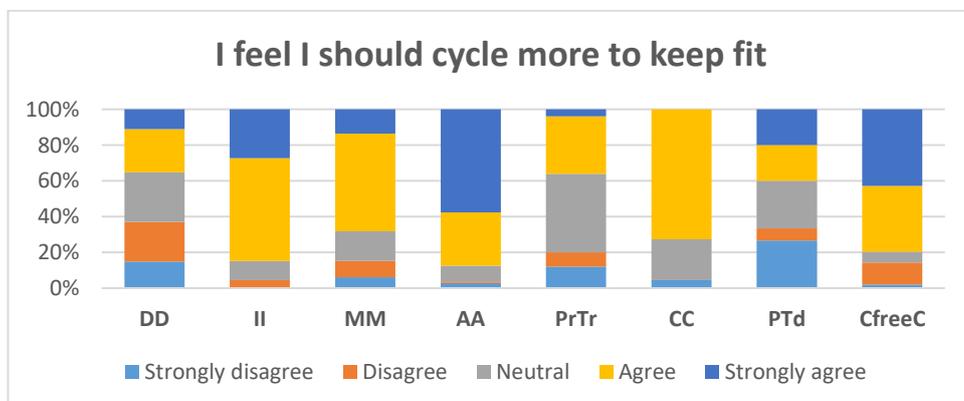
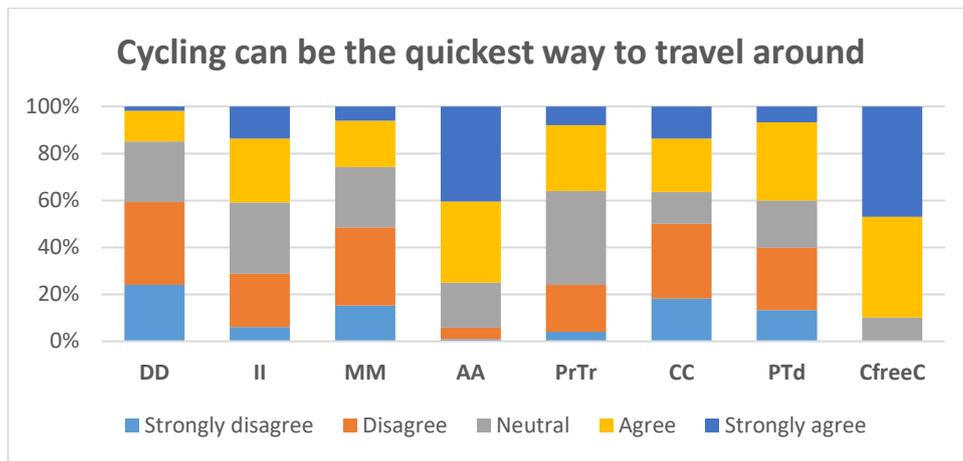
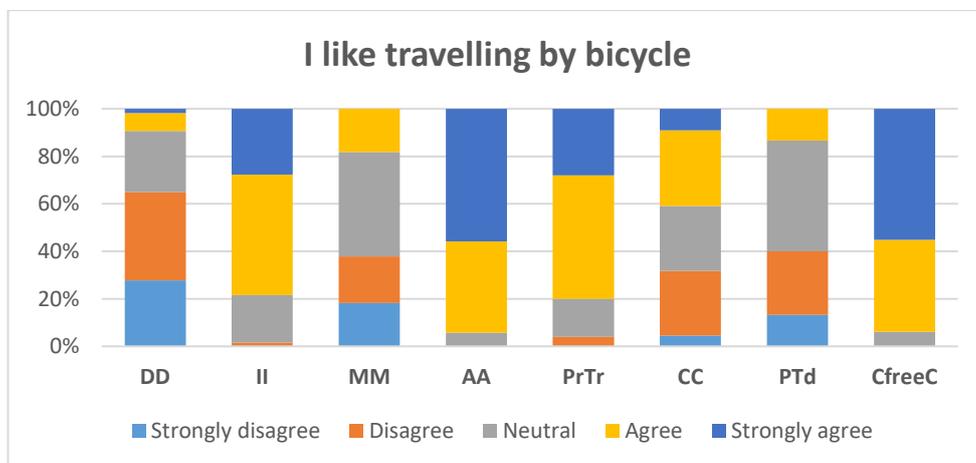


Figure 70 Question eight about cycling



**Figure 71 Question ten about cycling**



**Figure 72 Question eleven about cycling**

**1. Active Aspirers (AA)**

High proportion of this segment (89%), consider themselves as a person who rides a bicycle. 88% considers cycling as a way to keep fit and 75% considers it the quickest way to travel around. Overall 94% like to travel by bicycle.

**2. Image Improvers (II)**

A high proportion of respondents (more than 70%) see themselves as cyclists and like to travel by bicycle. But 85% feel that cycling is a way to keep fit because it is seen more as leisure sport activity more than a mode to commute. This is because only 41% see cycling as the quickest way to travel around.

**3. Malcontented Motorists (MM)**

The highest proportion of respondents (40%) is neutral about being the kind of people that use the bicycle. 38% of the respondents do not see themselves as cyclist. 68% see cycling as an activity to keep fit but find it stressful and not the quickest way to travel around (48%). The highest proportion of respondents (44%) is neutral about liking travelling by bicycle and 38% do not like to use the bike to travel.

#### 4. Devoted Drivers (DD)

The highest proportion of respondents (80%) do not see themselves as cyclist. Regarding cycling as an activity to keep them fit, the segment is split because 37% disagree whereas 35% agrees, and the rest were neutral. 59% do not consider cycling as the quickest way to travel around and 26% were neutral about it. The highest proportion of respondents (65%) do not like travelling by bicycle and 26% was neutral about it, whereas only the remaining percentage agreed.

#### 5. Car-free Choosers (CF)

The highest proportion (87%) of this segment considers themselves as the kind of person who rides a bicycle. 80% of respondents feel they should cycle more to keep fit. The majority of people (90%) considers cycling the quickest way to travel around. Overall, 94% like travelling by bicycle.

#### 6. Practical Travellers (PrTr)

All the respondents in this segment considers themselves as the kind of person who rides a bicycle. The highest proportion (44%) is neutral about linking cycling with being fit, 36% agrees with the statement and only 20% disagrees. About considering cycling the quickest way to travel around, the highest proportion (40%) also was neutral about this statement, 36% agrees and only 24% disagrees. Overall 80% of the segment likes to travel by bicycle.

#### 7. Car Contemplators (CC)

27% of the respondents see themselves as cyclist, 9% was neutral and rest disagree with that. Regarding cycling as an activity to keep

them fit, the highest proportion (73%) agrees 23% were neutral. 50% do not consider cycling as the quickest way to travel around and 14% were neutral about it. 41% like travelling by bicycle and 27% was neutral about it, whereas only the remaining percentage disagreed.

#### 8. Public Transport Dependent (PTD)

67% of this segment do not consider themselves as cyclists, and 33% was neutral about this statement. 40% considers cycling as a way to keep fit, 33% disagrees with this and 27% was neutral. Regarding cycling being the quickest way to travel around, the answers are split. 40% agrees and the other 40% disagrees, and 20% was neutral about it. A high proportion (47%) was neutral when asked whether they like travelling by bicycle, 40% do not like to travel using the bicycle and only 13% like it.

#### 5.3.6.4 Attitudes towards Walking

In this section it will be analysed the responses about walking for each of the eight segments. In the first part, there are the graphs for each question with the distribution of the answers by segment group. These questions are question twelve (I am not the kind of person that likes to walk a lot); question thirteen (I feel I should walk more to keep fit) and question fourteen (I like travelling by walking). These questions were measured in a 5-point Likert scale from 1= Strongly disagree to 5= Strongly agree. At the end of the graphs there is the analysis of the responses.

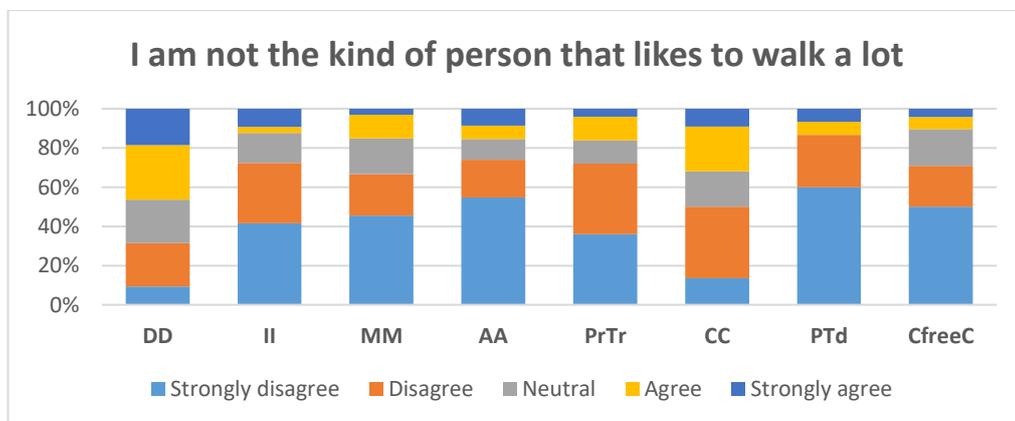
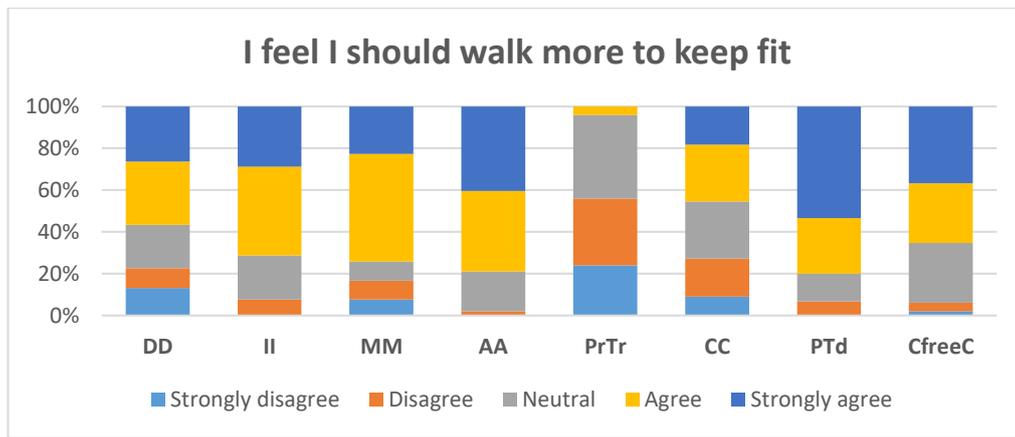
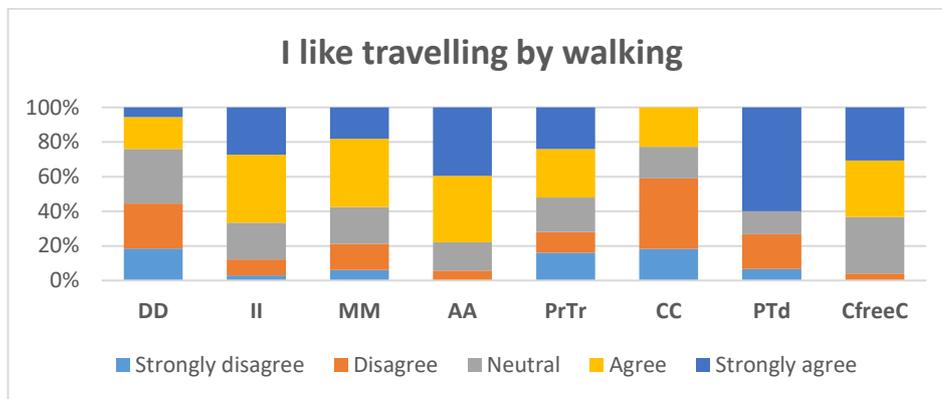


Figure 73 Question twelve about walking



**Figure 74 Question thirteen about walking**



**Figure 75 Question fourteen about walking**

**1. Active Aspirers (AA)**

Regarding walking, 78% likes to travel by walk because a high proportion considers it as a way to keep fit (79%).

**2. Image Improvers (II)**

Regarding walking, 67% likes to travel by walk because a high proportion considers it as a way to keep fit (71%).

**3. Malcontented Motorists (MM)**

Regarding walking, a high proportion consider themselves as someone that likes to walk a lot (67%) likes to travel by walk because considers it as a way to keep fit (74%).

4. Devoted Drivers (DD)

Regarding walking, a high proportion do not like to walk a lot (46%), 31% like it and rest was neutral. 57% likes to walk because they consider it as a way to keep fit.

5. Car-free Choosers (CF)

The highest proportion (71%) likes to walk a lot. 65% of the respondents feel they should walk more to keep fit. Overall 63% like travelling by walking and 33% was neutral about this.

6. Practical Travellers (PrTr)

The highest proportion (72%) consider that they like to walk a lot. However, the majority (56%) do not consider they need to walk more to keep fit, 40% was neutral about this and only 4% agrees. Overall, only 52% like travelling by walking.

7. Car Contemplators (CC)

Regarding walking, 23%travelling by walking 18% was neutral and the rest do not like it. 45% likes to walk because they consider it as a way to keep fit, 27% was neutral and rest disagree.

8. Public Transport Dependent (PTD)

The majority (87%) of this segment consider they are the kind of people that like to walk a lot. The highest proportion (80%) also feel that they should walk mire to keep fit. Overall, 60% like travelling by walking, 27% do not like it and 13% was neutral.

**Table 37 Summary of Attitudes Towards Transport**

AA	II	MM	DD	CF	PrTr	CC	PTD
<b>Walking</b>							
Like it see it for fitness	Like it see it for fitness	like it see it for fitness	Half like it way to keep fit	like it see it for fitness	Like it No for fitness	Do not walk See it for fitness	like it see it for fitness

<b>Cycling</b>							
Like it See themse lves as cyclists For fitness	Like it See themse lves as cyclist s For fitness	Neutral Like it Neutral see themse lves as cyclists For fitness	Don't like it Don't see themsel ves as cyclists Neutral for fitness	Like it See themsel ves as cyclists For fitness	Like it See themsel ves as cyclists Not for fitness	Like it Don't see themsel ves as cyclists For fitness	Don't like it Don't see themsel ves as cyclists For fitness
<b>Bus</b>							
See themse lves as bus user Prefer bicycle over bus	Don't see themse lves as bus user Prefer bicycle over bus	Don't see themse lves as bus user Prefer bus over bicycle	Don't see themsel ves as bus user Prefer bus over bicycle	See themsel ves as bus user Prefer bicycle over bus	See themsel ves as bus user Prefer bicycle over bus	See themsel ves as bus user Prefer bus over bicycle	Don't see themsel ves as bus user Prefer bus over bicycle
<b>Driving</b>							
Don't prefer car over other Don't drive for fun Not way for self-	Prefer car over other Drive for fun No way for self- expres sion	Prefer car over other Don't drive for fun Not way for self- expres sion	Prefer car over other Drive for fun Neutral way for self- express ion	Prefer car over other Don't drive for fun Not way for self- express ion	Prefer car over other Don't drive for fun Not way for self- express ion	Prefer car over other Don't drive for fun Not way for self- express ion	Don't prefer car over other Don't drive for fun Not way for self- express ion

expres sion							
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Table 37 contains the summary of the attitudes towards driving, bus, walking and cycling. This cross segment comparisons showed that in general regarding driving, only AA and PTD do not prefer the car over other transport options. They do not consider driving for fun neither as a way for self-expression. The II and DD prefer the car instead of other options. These segments in fact drive for the fun of it. This suggest that these segments are harder to change in driving behaviour. The rest of the segments (MM, CF, PrTr and CC) prefer the car but do not drive for fun and neither see the car as a way for self-expression. This suggest that these four segments are more easily to be targeted with policy measures focused on more active transportation.

All segments considered walking for fitness, except for practical travellers. Only DD and CC have not positive attitude towards walking. Regarding cycling, AA, II, CF, PrTr and CC like to use the bicycle and see themselves as cyclists and also consider it a way to keep fit except for the PrTr. PTD and DD do not like cycling neither consider themselves as cyclists, although they see it as a way to keep fit. MM showed neutral attitude towards cycling although they see themselves as cyclists and consider it for fitness too.

PrTr do not consider neither cycling nor walking a way to keep fit, this suggest that policy measures such as promotion of active transport for health and fitness would not encourage them to use bicycle or to walk. However, the rest of the segments, could be targeted with policy measures that emphasise active transportation for fitness.

About bus use, AA, CF, PrTr and CC see themselves as bus users but all prefer the bicycle rather than using the bus, except for the segment of CC who prefers the bus. This suggest that for the four first segments, there are some barriers for bus use and that policy

measures to encourage the use of bicycle could be more effective. The II, MM, DD, PTD do not see themselves as bus users, but all except the II, prefer the bus rather than cycle for commuting. This show that targeting these segments with policy measures to improve bus image could be more effective.

### 5.3.7 Comparison of Segments in Europe and Mexico

In order to understand the similarities and differences between the attitudinal transport segments found in the European Cities and the segments found in Mexico City, it was analysed the socio-demographic characteristics of those segments and the attitudes towards driving, bus, cycling and walking. Below there are eight tables (one for each segment group) to help us to see this similarities and differences. Moreover, this is very important to assess the transferability of the methodology and policy recommendations, which will be discussed in the final Chapter.

**Table 38 Comparison of Segment AA in Europe and Mexico**

Characteristic	Active Aspirers (AA)		
	Europe	Mexico	Comment
Gender and age	Twice as many women as men in the segment. Highest proportion of 45-54-year-olds.	More than 60% are male. Highest proportion of 18-31 years old.	AA in Europe are mainly female, in Mexico more than half are male. Regarding age, in Mexico the AA are young people from 18 till 31, whereas in Europe this groups are from 45 to 54.
Education and Occupation	High proportion having undertaken further education. High proportion of individuals in full and part-time employment – low percentage retired	This 73% of this segment group have further education. More than 85% of this segment work or work and study. Mainly are of high income	AA in Europe and Mexico are usually an educated group both working (full or part time).
Attitudes towards driving	Feel guilty using car on short trips. They would like to cut down on car use. Intention to reduce car use.	Prefer other transport mode rather than driving. Intention to reduce car use.	European and Mexican AA are interested in changing their behaviour and reduce their car.

Attitudes towards bus	No bus users although quicker way to commute they see it problematic	Bus users. But prefer Cycling	Europe AA segment although they see bus as a good option for travel time they are not bus users. In Mexico the AA are bus users.
Attitudes towards walking	Would like to walk more for fitness	They like to walk. And consider it as fitness activity	European and Mexican AA like to walk for fitness
Attitudes towards cycling	See themselves as cyclists. Believe cycling is quick.	See themselves as cyclists. Believe cycling is quick	European and Mexican AA see themselves as cyclists.

The differences in gender in the AA segment could be result of the urban safety and gender-based transport harassment that it is reported in Mexico City impact negatively women's mobility (Dunckel, 2016). There was not difference in educational level in both Europe and Mexico AA. Regarding attitudes towards transport, about car use, in both cases they have intention to reduce car use. With regards bus use, in Mexico, they see themselves as bus users, whereas in Europe they are not bus users. This might be because travel distances in Mexico are longer and the infrastructure for cycling is limited to certain zones. Thus, bus is helpful, however, as it was shown in the Chapter One, commuting in public transport can take up to 3 hours in peak hours, which can explain why in Mexico rather than bus respondents prefer bicycle. About walking and cycling AA in Europe and Mexico like to do it.

**Table 39 Comparison of Segment II in Europe and Mexico**

Characteristic	Image Improvers (II)		Comment
	Europe	Mexico	
Gender and age	Highest proportion of 25-34-year-olds – 40.9%	18-24 age, equally men and women	Age differ for the II in Europe and in Mexico. Information about gender from the Europe is not

			provided in the Tool Kit
Education and Occupation	Second highest proportion of employed or self-employed individuals – 70.4%	Well educated, work and work and study, some people high income some low income	Both groups of II mainly employed. Information about education from the European II is not provided in the Tool Kit
Attitudes towards driving	Like to drive. See car is a way of self-expression. Do not want driving restricted or cut down car use. Moderate intention to reduce car use	Like to drive for fun but not as a way of self-expression. Just a small proportion do not want to cut down their car use. Low intention to reduce car use.	European and Mexican II like to drive and see the car as a way for self-expression.
Attitudes towards bus	They rather increase cycling and walking instead of using bus. Low intention to use public transport	No bus user. Prefer cycling than using bus	Both groups of II prefer other modes of transport rather than the bus.
Attitudes towards walking	Like walking for fitness but is time consuming. Moderate intention to walk	Like walking for fitness.	Both groups see cycling more as a way to keep fit.
Attitudes towards cycling	They would like to increase cycling and see it as a way to keep fit.	They like travelling by bicycle. About 70% see themselves as cyclists and agree they should cycle more to keep fit.	Both groups of II like the bicycle.

II had marked differences regarding age between European cities and Mexico City. In Europe, this segment was predominantly 25-34 whereas in Mexico, the highest proportion was people aged 18-24. educated, work and work and study, some people high income some low income, commute by car, no bicycle, majority long travel

time. About attitudes towards transport, both like to drive and both have some intention to reduce car use, however an important difference is that in Mexico, different to Europe, car is not seen as way for self-expression. In both cases, they like to cycle and they like to walk.

**Table 40 Comparison of Segment MM in Europe and Mexico**

Characteristic	Malcontented Motorists (MM)		Comment
	Europe	Mexico	
Gender and age	Highest proportion of women car drivers. 67.6% of this cohort are aged between 25 and 44 years old	Gender distribution almost equal. The only segment with high proportion of >53 years	In Mexico, MM are distributed more equally according to gender whereas in Europe they are mainly females. The older group is in Mexico.
Education and Occupation	Information about Education or occupation from European MM is not provided in the Tool Kit.	Well educated, working, some of the second lowest income but almost half high income.	This category is not compared as data from Europe was not available.
Attitudes towards driving	Do not like driving. It is stressful. Moderately strong intention to reduce car use because they still prefer it. Highest number of people unclear (neither agree nor disagree) about reducing their current level of car use.	They do not see driving as a fun or a way for self-expression. Some prefer driving over other modes but more than half disagree. Almost half have intention to reduce their car use.	Both groups have moderate intention to reduce their car use.
Attitudes towards bus	They see problems with bus but they rather use it than cycling	A little bit more than half see themselves as bus user but the same proportion rather cycle than use bus	Both groups of MM rather use a different mode of transport than the bus
Attitudes towards walking	Walk but do not see advantage to	Like walking for fitness.	Both groups differ on the outcome of

	walking only for fitness		walking. While Mexican MM see it as fitness the European MM do not see it solely for fitness.
Attitudes towards cycling	Do not identify themselves as cyclists. Only benefit of cycling is fitness	Do not identify themselves as cyclists. Cycling is an activity to keep fit but it is stressful	In both cases the MM, they do not identify themselves as cyclists.

MM differs in the distribution of the gender. In Mexico this was distributed fairly equal whereas in Europe, this was a segment with high proportion of women. In both cases, they don't like to drive. In Europe they prefer to use the bus rather than using the cycle, whereas in Mexico is the opposite, they are drivers and they rather cycle than use the bus, regardless they do not see themselves as cyclists. In both cases, they like to walk for fitness. In Mexico, this was the only segment with high proportion of >53 years old. Well educated, working, some of the second lowest income but almost half high income.

**Table 41 Comparison of Segment DD in Europe and Mexico**

Characteristic	Devoted Drivers (DD)		Comment
	Europe	Mexico	
Gender and age	Highest percentage of men of all the segments –46.7%	18-24, Gender equally distributed.	Differences in gender. In Mexico gender among MM is more equally distributed.
Education and Occupation	High level of full-time employment – 73.9%	Well educated. This group predominantly work full time	Both cases of MM in full time work
Attitudes towards driving	Successful people drive. No intention to reduce car use. Showed the least intention to change	They prefer driving than other options. More than half drive for the fun of it. Same proportion do not want to cut down they car use. More	In both cases MM have not intention in reducing car use. This might be because there are symbolic and affective

	their travel behaviour	than half have not intention to reduce car use.	motivations for driving.
Attitudes towards bus	Not the kind of person that use the bus. Bus is stressful	No the kind of person that use the bus. Only almost half of them prefer bus than cycling	No bus users in either case.
Attitudes towards walking	Walking is too slow. They do not like to walk	A little bit more than half consider it good for fitness, but in general they do not like it.	In general both cases do not like walking.
Attitudes towards cycling	Not the kind of person who cycle. See no benefits to cycling	Not the kind of person who cycle. They do not like travel by bicycle.	The MM in both cases do not see themselves as cyclists.

In Mexico the gender is distributed almost equally between male and female. Europe has higher proportion of men. In both cases respondents work full time. This group has the least intention to reduce car also in Mexico because they prefer it over bus, cycling and walking. In Mexico, mainly young people but drivers who do not usually commute for longer than an hour.

**Table 42 Comparison of Segment CF in Europe and Mexico**

Characteristic	Car-free Choosers (CF)		
	Europe	Mexico	Comment
Gender and age	70.7% women make up the vast majority of the segment 74% of segment is under the age of 34 years – one of the youngest groups.	More females, majority between 18-31,	Both with high percentages of females and both age groups similar.
Education and Occupation	16% still involved in studying with 19% full-time student at college or university	The largest group has University education (28). Mainly people that work (31)	Differences in Education. CfC from Mexico are working whereas the group in Europe are mainly students.

Attitudes towards driving	Do not like driving. They think is unhealthy. Use should be reduced. Very likely to have had a plan to reduce car use	They do not like driving. Car use should be reduced. Want to reduce car use.	Both cases of CfC want to reduce car use.
Attitudes towards bus	Do not think the bus is stressful or problematic	They consider themselves the kind of people using bus. More than half prefer using the bike instead.	Both see themselves as bus users. Although in Mexico they rather prefer the bicycle.
Attitudes towards walking	Walking is healthy	Like to walk a lot, that keep them fit.	Walking is a way to keep fit for both groups of CfC
Attitudes towards cycling	Cycling is a way of self-expression. Strongly agree that over the next six months they intend to make sure that they (or their child) cycles to work/school more often.	Consider themselves as cyclists. Cycling is an activity to keep and the quickest way to travel around.	Very positive attitude towards cycling.

High proportion of women in both cases Europe and Mexico. In both cases they do not like to drive and consider car use should be reduced. They see themselves as bus users, they like cycling and walking for in both cases Europe and Mexico.

**Table 43 Comparison of Segment PrTr in Europe and Mexico**

Characteristic	Practical Travelers (PrTr)		Comment
	Europe	Mexico	
Gender and age	81% of the segment are between the ages of 25 and 44 years old	The highest percentage of men (80%). The largest age group 25-31 years old (40%)	Both groups similar in age.
Education and Occupation	Highly educated. Above-average part-time working. Highest proportion	The largest groups have University education and work	Both cases are educated with

	still in further or continuing education at the age of 20 years – 74.9% Highest proportion of part-time workers – 26.1%	full time or combine work and education.	university. And also working.
Attitudes towards driving	Car used only when is necessary. Driving reduce quality of life, but no intention of reducing car use. Least likely to have a plan to reduce car use	Car is not used for fun. However, not strong intention to reduce car use. Low intention to change behaviour	Both cases have not intention to reduce car use, but they use car more for instrumental motivations.
Attitudes towards bus	They rather cycle that use the bus. Intention to cycle but no intention of using the bus more	Half of them see themselves as bus users, however high proportion prefers to cycle instead.	Preference of bicycle over the bus in both cases.
Attitudes towards walking	See walking as moderately healthy	They like to walk a lot but just moderately as a way to keep fit.	Walking is a way to keep fit in Europe and Mexico segments.
Attitudes towards cycling	See themselves as cyclists. Cycling is a quick mode.	See themselves as cyclists. Neutral about cycling being a quick mode to travel.	Positive attitude towards cycling.

The segment in Mexico had similar age than the European description. Car is used for necessity, thus not intention to reduce its use in neither of the cases. See themselves as cyclists and like to walk for fitness.

**Table 44 Comparison of Segment CC in Europe and Mexico**

Characteristic	Car Contemplators (CC)		
	Europe	Mexico	Comment
Gender and age	Youngest segment. More likely to be	Highest proportion males (64%). The age was distributed	Difference in gender in both groups. And in age,

	women. Highest proportion under 24 years old – 36.9%	between all age groups but the least represented group was people over 53 years old.	because in Mexico this segment is distributed among all ages and not only in one as the European CC.
Education and Occupation	Highly proportion of students. Highest proportion unemployed/seeking work – 21.4%	Highest proportion with University education. A high proportion of this group work full time or combine work with education.	Difference in occupation, since in Mexico CC work full time.
Attitudes towards driving	Car is a status symbol. Would like unrestricted use of car. Would like to increase car use	A little bit more than half considers car use should be restricted and that driving is not for fun. Car is not seen as way for self-expression. Moderate intention to reduce car use.	Both groups differ in their attitudes towards driving. For the European CC car is a symbol whereas in Mexico CC don't see car as a way to express themselves.
Attitudes towards bus	They found bus travel stressful but they rather do it than cycling.	Just about half of people see themselves as bus user and only moderate preference for cycling instead of bus use.	Some similarity in the perception of bus, however, in Mexico CC, they rather cycle.
Attitudes towards walking	Walking is not flexible but is good for health	Although 45% consider it as a way to keep fit, only a small proportion like to walk.	Both see walking as a way of keeping fit but not very enthusiastic about doing it.
Attitudes towards cycling	Neutral about cycling but do not identify themselves as cyclists	Do not identify themselves as cyclists. Although some consider a way to keep fit.	Do not identify themselves as cyclists neither case.

This segment differs in gender distribution. In Mexico, highest proportion of men, whereas in Europe is more likely to be women. Mexican respondents do not consider the car as a way for self-expression and have moderate intention to reduce car use whereas in Europe car is a way for self-expression and there is not intention to reduce its use. In both cases they do not identify themselves as cyclists and walking although considered to improve health, it is not clear whether they like it or not neither in Europe nor in Mexico.

**Table 45 Comparison of Segment PTD in Europe and Mexico**

Characteristic	Public Transport Dependents (PTD)		
	Europe	Mexico	Comment
Gender and age	Highest proportion of women (81.1%). Highest proportion of those aged over 55 years.	Gender divided almost equally. There was not any age group that was more represented.	Differences in gender and in age for both PTD groups
Education and Occupation	Highest number of retired people. The least-educated group (13.8%). Most likely to have a disability that affects travel options – 8.9%.	The majority of respondents had University education and work full time	Difference in occupation and education. European PTD is mainly retired people.
Attitudes towards driving	Do not like driving.	Do not like driving. Car use should be reduced. Moderate intention to reduce car use	Both groups of PTD do not like driving.
Attitudes towards bus	Use it but they think is not the quickest mode. It is better than cycling	Are bus users. And prefer it rather than cycling.	Although both groups are bus users, the European PTD would rather cycle.

Attitudes towards walking	Walking is better than cycling. They walk and would like to do it more for fitness.	They walk and would like to do it more for fitness.	Positive attitudes towards walking both groups.
Attitudes towards cycling	Do not identify themselves as cyclists. They believe it is as stressful	Do not identify themselves as cyclists. Very small proportion like to travel using the bicycle.	Neither group of the PTD identify themselves as cyclists.

In Europe this segment had the highest proportion of women whereas in Mexico the gender was divided fairly equally. This was the least educated people in European description however this segment in Mexico had University education. In both cases they do not like to drive, but Mexican respondents prefer cycling over bus use contrary to Europe where they prefer the bus and walking before cycling. In neither case they identify themselves as cyclists.

## 5.4 Analysis of Perception and Attitudes towards Cycling

### 5.4.1 Characteristics of the Sample

All the socio-demographic characteristics of the sample are in the Table 28 and Figure 1 in the section 5.2 of this chapter. As it was distributed just one survey, with the questions for segmentation and the questions to explore attitudes and perception, the characteristics of the sample are the same. As a reminder to the reader the total sample was 401 and it was composed by 55.1 % males and 44.9% female respondents. The largest age group was people from 18-31 years old (30% respondents), followed by the group aged 25-31 (24.2%), 32-38 (16.2%), 39-45 (13.3%) and the least represented groups are those from 46-52 years old (7.6%) and >53 years old (7.6%). Half of the respondents have at least one university degree (52.1%). Although more than 50% of the sample travel for 60 min or

less (with the return, meaning that each trip last up to 30 minutes), 38.9% of the sample commute for longer than one hour. A variety of different modes of transportation to commute are used, and although some of them are combined to travel, private car is the most used by almost 60% of the individuals. This is followed by using subway (30.9%), gasoline powered bus or microbus (26.4%), walking (25.2%) and cycling (20.7%).

#### 5.4.2 Assessing Normality of the Data

Before proceeding with the model development data from the Theory-based Questionnaire was checked for normality. But to proceed with this, first it was computed mean scale scores for each of the constructs to treated them as the dependent variables The normal distribution was checked using different methods as suggested by Ghasemi and Zahedias (2012). The Shapiro-Wilk normality test was used and the Table 46. The results show that the null hypothesis can be rejected and accept that the population is not normally distributed.

**Table 46 Normality test for the Theory-based questionnaire**

Variable	Method	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Stat.	df	Sig.	Stat.	df	Sig.
SubjectiveNorm	online	0.124	100	0.001	0.943	100	0.000
	hard copy	0.117	301	0.000	0.942	301	0.000
Attitudes	online	0.200	100	0.000	0.862	100	0.000
	hard copy	0.140	301	0.000	0.917	301	0.000
Intention	online	0.153	100	0.000	0.887	100	0.000
	hard copy	0.102	301	0.000	0.942	301	0.000
SocialComp	online	0.109	100	0.005	0.940	100	0.000
	hard copy	0.104	301	0.000	0.945	301	0.000
FeelingsSCom	online	0.224	100	0.000	0.865	100	0.000

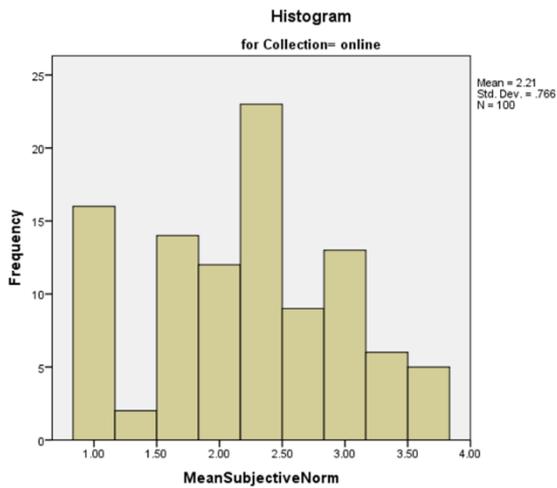
	hard copy	0.165	301	0.000	0.931	301	0.000
AffectiveM	online	0.106	100	0.007	0.937	100	0.000
	hard copy	0.071	301	0.001	0.977	301	0.000
InstrumentalM	online	0.077	100	0.150	0.974	100	<b>0.046</b>
	hard copy	0.074	301	0.000	0.965	301	0.000
SymbolicM	online	0.088	100	0.057	0.983	100	<b>0.222</b>
	hard copy	0.089	301	0.000	0.983	301	0.001
pastbehaviour	online	0.246	100	0.000	0.842	100	0.000
	hard copy	0.255	301	0.000	0.824	301	0.000
perceivedcontrol	online	0.237	100	0.000	0.846	100	0.000
	hard copy	0.153	301	0.000	0.892	301	0.000
a. Lilliefors Significance Correction							

From the visual inspection of the frequency distribution it was noted that some of the variables are skewed to the right or the left.

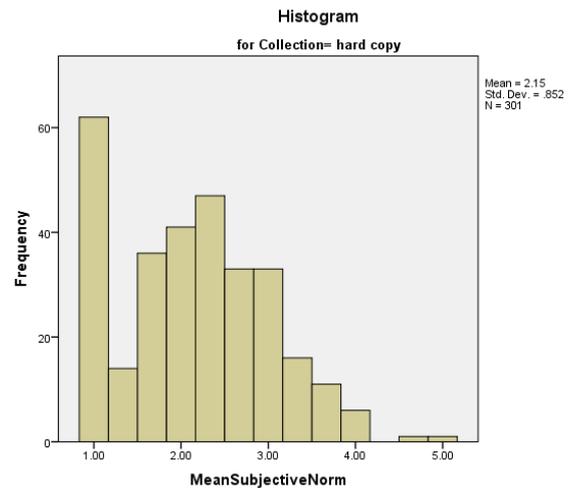
Following there is the histogram to analyse the frequency density for the sample online and the hard copy for each of the variables.

#### 1. Subjective norm (Figure 76 and 77).

The distribution of the answers online is roughly symmetric whereas the distribution of the hard copy are slightly skewed to the right. There is a concentration of data among disagreeing or being neutral about the statements. The data for the online copy suggest that the mean is centred to disagree whereas the hard copy positive skewed suggest the mean is greater than the median. More of the data is towards the left side of the distribution. The hard copy sample, there seem to be two probable outliers to the far right, where the strongly agree response lies.



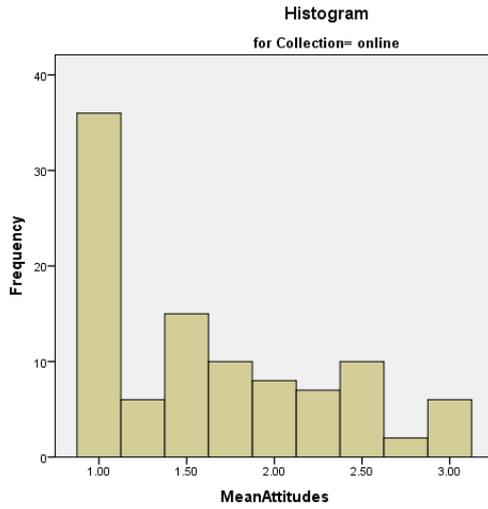
**Figure 76 Histogram data online Subjective Norm**



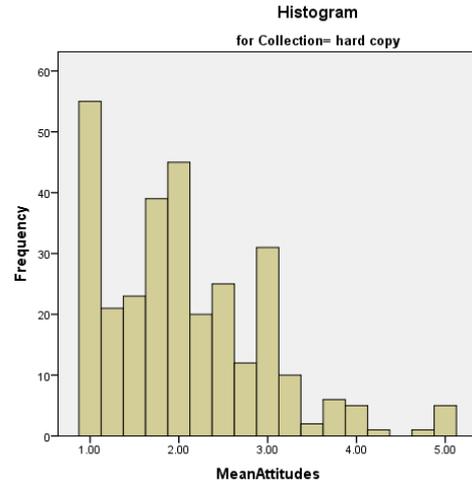
**Figure 77 Histogram data hard copy Subjective Norm**

## 2. Attitudes (Figure 78 and 79)

The distribution of the answers online is roughly symmetric whereas the distribution of the hard copy are slightly skewed to the right. The most common value in both samples occur in the number 1 which represent the strongly disagree response. For both samples, there is a concentration of data among disagreeing or being neutral about the statements. The data for the online copy and the hard copy is centred in the value 2 (disagree) a bit more towards the neutral response. As for subjective norm, the data from attitudes showed in the sample in hard copy, the existence of two probable outliers to the far right, where the strongly agree response lies.



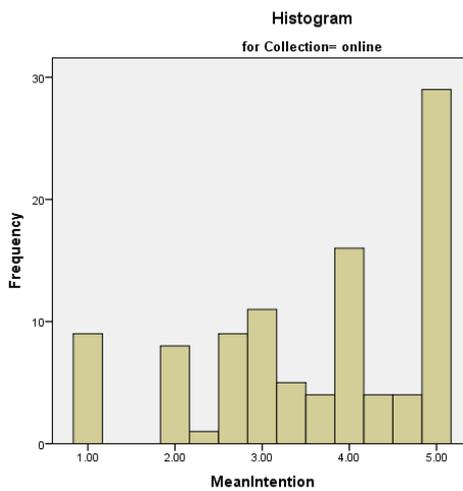
**Figure 78 Histogram data online Attitudes**



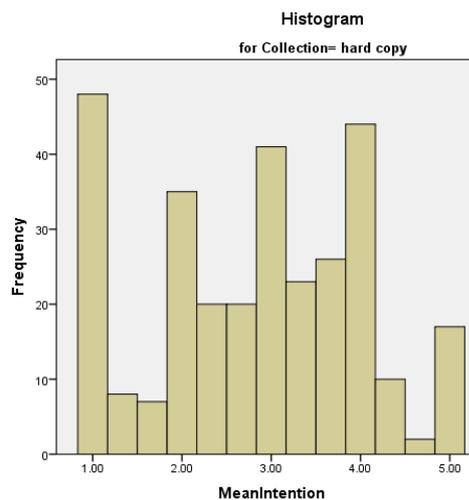
**Figure 79 Histogram data hard copy Attitudes**

### 3. Intention (Figure 80 and 81)

The distribution of the answers online is slightly skewed to the left whereas the distribution of the hard copy is roughly symmetric. For both samples, there is a concentration of data among disagreeing or being neutral about the statements. The data for the online copy seem to be centred to value 4 (agree) whereas the hard copy is a bit more towards value 3 (the neutral response).



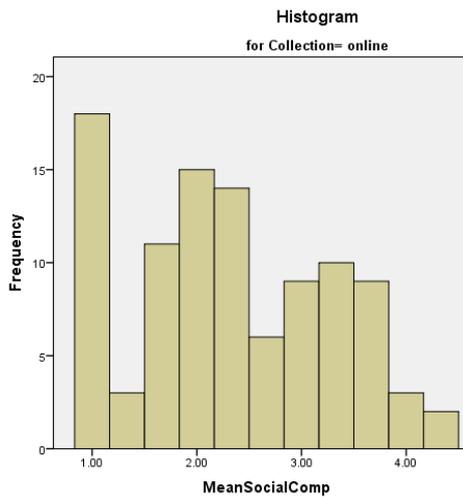
**Figure 80 Histogram data online Intention**



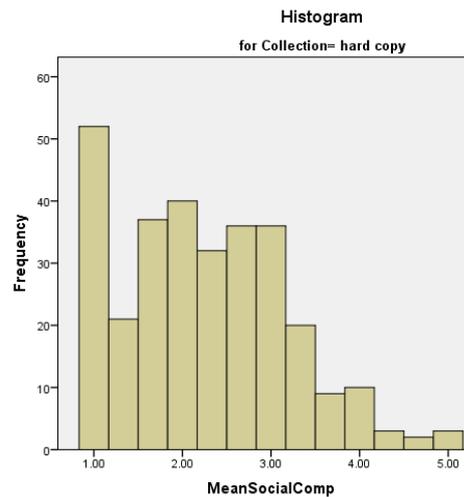
**Figure 81 Histogram data hard copy Intention**

#### 4. Social Comparison (Figure 82 and 83)

Both histograms are slightly skewed to the right, particularly the hard copy sample. In both cases it is possible to see that the middle point is approximately 2.5 which corresponds to the middle point between disagree and neutral. The most common value in both samples occur in the number 1 which represent the strongly disagree response.



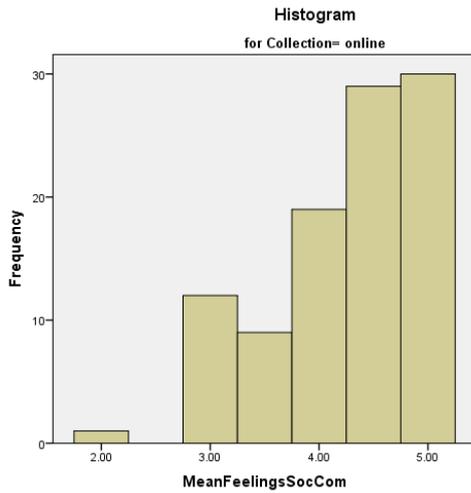
**Figure 82 Histogram data online Social Comparison**



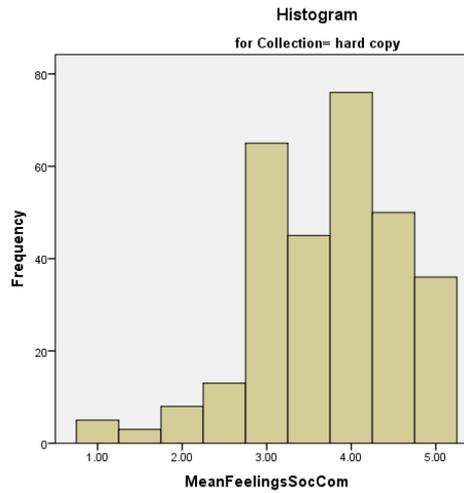
**Figure 83 Histogram data hard copy Social Comparison**

#### 5. Feelings from Social Comparison (Figure 84 and 85)

The histograms of the variable Feelings from social comparison show that both samples are skewed to the left. The data for the online sample seem to be centred to value 4 (agree) whereas de hard copy is a bit more towards value 3 (the neutral response). The most common value in the online sample is 5 (strongly agree) whereas in the hard copy sample occur in the number 4 which represent the agree response.



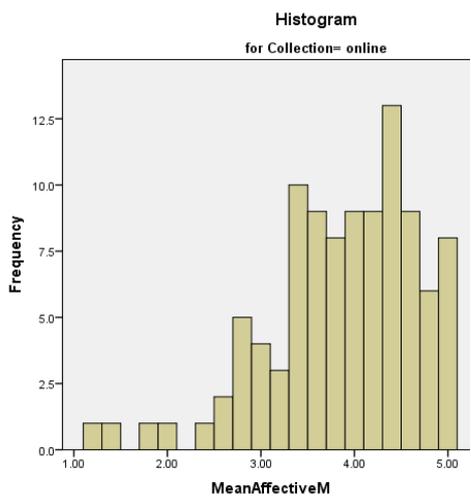
**Figure 84 Histogram data online Feelings Social Comparison**



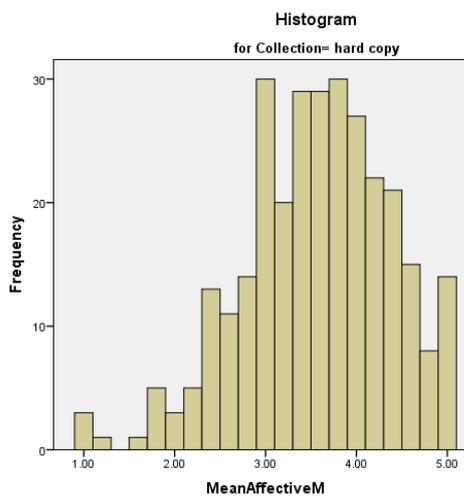
**Figure 85 Histogram data hard copy Feelings Social Comparison**

6. Affective Motives (Figure 86 and 87)

The histograms of the Affective Motives variable show that both samples are skewed to the left. In the online sample the most common value occurs between 4 and 5 (agree and strongly agree) whereas in the hard copy occurs in the number 3 (neutral). For both samples, there is a concentration of data between being neutral or agree about the statements.



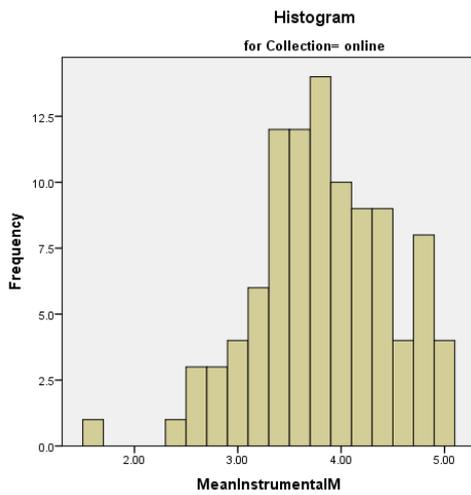
**Figure 86 Histogram data online Affective motives**



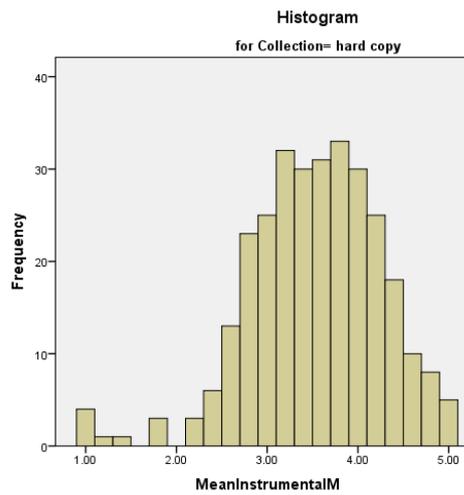
**Figure 87 Histogram data hard copy Affective motives**

7. Instrumental motives (Figure 88 and 89)

For instrumental motives, it can be noted from the histograms that both samples followed a roughly symmetric shape. In both cases all data is concentrate mainly between the values of 3 and 5 (neutral and strongly agree). In the online sample the most common value occurs between 3 and 4 (neutral and agree) whereas in the hard copy occurs in the number 4 (agree).



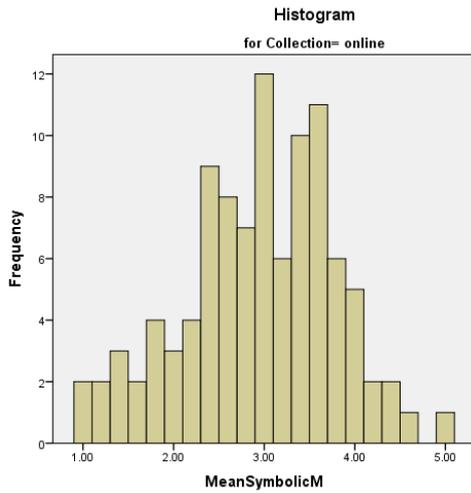
**Figure 88 Histogram data online Instrumental motives**



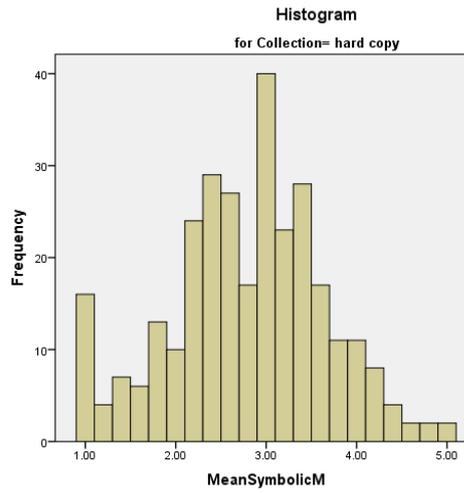
**Figure 89 Histogram data hard copy Instrumental motives**

8. Symbolic motives (Figure 90 and 91)

For symbolic motives, it can be noted from the histograms that both samples followed a roughly symmetric shape. Both samples have the most common value occurring in the value 3 (neutral). In both cases all data is concentrate mainly between all the values of strongly disagree and strongly agree.



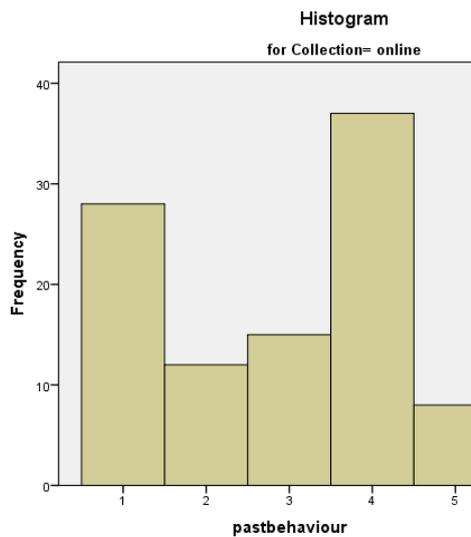
**Figure 90 Histogram data online Symbolic motives**



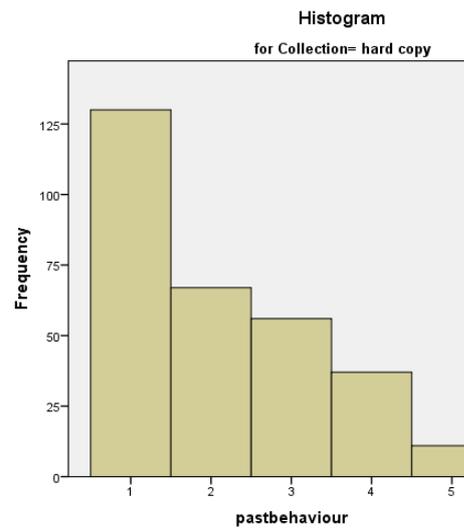
**Figure 91 Histogram data hard copy Symbolic motives**

9. Past behaviour (Figure 92 and 93)

For this variable the sample distributed in hard copy is slightly skewed to the left, whereas the online sample is roughly symmetric. For the online sample, the most common value occurs in the value of 4 (agree) and all data is distributed across the 5 responses from strongly disagree to strongly agree. The hard copy sample however, follows a different distribution. The most common value occurs in the number 1 (strongly disagree) and all data is concentrated between value 1 (strongly disagree) and 3 (neutral).



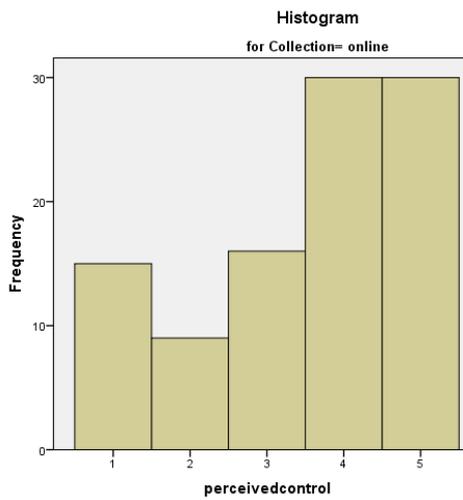
**Figure 92 Histogram data online past behaviour**



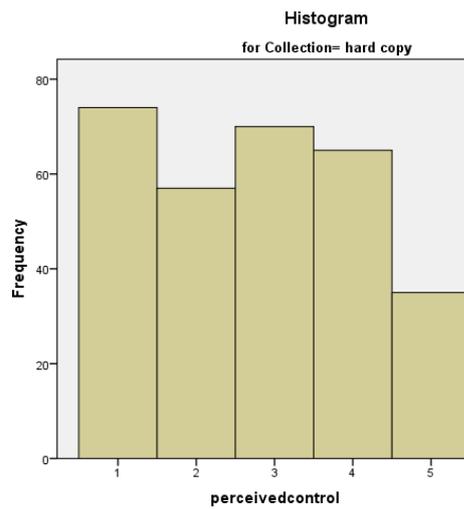
**Figure 93 Histogram data hard copy past behaviour**

10. Perceived behavioural control (Figure 94 and 95)

The distribution of the answers online is slightly skewed to the left whereas the sample in hard copy is roughly symmetric. The most common value in the sample online occurs in value 4 and 5 (agree and strongly agree) whereas in the hard copy sample occurs in the number 1 which represent the strongly disagree response. Sample online has a concentration of data between 3 and 5 (neutral and strongly agree) and for the hard copy sample there is not clear concentration of data the responses since all data is distributed across strongly agree to strongly disagree. The data in the online sample is centred in the value 4 (agree) whereas the hard copy sample is centred in the value 3 (neutral).



**Figure 94 Histogram data online perceived behavioural control**



**Figure 95 Histogram data hard copy perceived behavioural control**

As explained before in section 5.3.2 normality can be checked also by exploring the Skewness and Kurtosis of the data. In the following table 47 there are the values for skewness and kurtosis for each observed variable.

**Table 47 Skewness and Kurtosis of the observed variables**

Construct	Item	Scale	Skew.	Std. Error	Kurt.	Std. Error
Social Comparison Orientation	scomp_ori1	5-Likert	0.497	0.122	-0.794	0.243
	scomp_ori2	5-Likert	0.416	0.122	-0.886	0.243
	scomp_ori3	5-Likert	0.665	0.122	-0.583	0.243
Feelings from Social Comparison	feeling_sc1	5-Likert	-0.509	0.122	-0.651	0.243
	feeling_sc2	5-Likert	<b>-1.532</b>	0.122	<b>1.638</b>	0.243
Affective motives	affectivem1	5-Likert	-0.768	0.122	-0.073	0.243
	affectivem2	5-Likert	-1.149	0.122	1.044	0.243
	affectivem3	5-Likert	-0.159	0.122	-0.525	0.243
	affectivem4	5-Likert	-0.605	0.122	-0.404	0.243
	affectivem5	5-Likert	-0.535	0.122	-0.562	0.243
Instrumental motives	instrumtm1	5-Likert	-0.377	0.122	-0.523	0.243
	instrumtm2	5-Likert	<b>-1.847</b>	0.122	<b>3.327</b>	0.243
	instrumtm3	5-Likert	-0.488	0.122	-0.413	0.243
	instrumtm4	5-Likert	-1.469	0.122	<b>1.854</b>	0.243

	instrumen tm5	5- Liker t	0.617	0.122	-0.528	0.243
Symbolic motives	symbolic m1	5- Liker t	-0.463	0.122	-0.463	0.243
	symbolic m2	5- Liker t	-0.088	0.122	-0.720	0.243
	symbolic m3	5- Liker t	-0.411	0.122	-0.581	0.243
	symbolic m4	5- Liker t	0.224	0.122	-0.749	0.243
	symbolic m5	5- Liker t	0.978	0.122	0.039	0.243
Intention	intention1	5- Liker t	0.012	0.122	-1.112	0.243
	intention2	5- Liker t	-0.282	0.122	-1.122	0.243
	intention3	5- Liker t	-0.003	0.122	-1.156	0.243
Subjective norm	subjenor m1	5- Liker t	0.505	0.122	-0.718	0.243
	subjenor m2	5- Liker t	0.746	0.122	-0.424	0.243
	subjenor m3	5- Liker t	0.664	0.122	-0.349	0.243
PBC	percibeco ntrol	5- Liker t	-0.049	0.122	-1.267	0.243
Attitudes	attitud1	Sem Diff	0.704	0.122	-0.293	0.243
	attitud2	Sem Diff	1.425	0.122	1.727	0.243
	attitud3	Sem Diff	0.790	0.122	0.152	0.243

	attitud4	Sem Diff	1.136	0.122	0.989	0.243
Past behaviour	Past-behaviour	5-Likert	0.501	0.122	-1.067	0.243

Searching the dataset using these two measures it was noticed that there were issues of skewness and kurtosis since some values lay outside -1 and 1. As we can see from table 55, in general the values of the answers for each item vary in the response, this is that respondents answered the items in a diverse way. Nevertheless, because of the sample size, it was proceed with further analysis (Ghasemi and Zahediasl, 2012).

### 5.4.3 Assessing Differences from Distribution Tool

In order to compare the mean scores of the data distributed online and the one distributed in the hard copy and determine whether there is a significant difference in the scores as result of the distribution tool we carried out a T-test. An independent sample T-test is used to compare mean scores and check whether there is a statistically significant difference (Field, 2013).

The data met the assumptions that the T-test require. The assumptions are to have a dependent variable measured at continue level (for this is used the constructs with mean scores); a categorical independent variable (the distribution tool was measured by 1=online and 2= hard copy), independence of observations, data approximately normally distributed and no outliers (although in Chapter Three some were detected they were not extreme outliers). The null hypothesis for this t-test is that the population means of the data distributed online and in hard copy are equal. The alternative hypothesis is that the means are not equal. The T-test showed significant difference in the mean of feelings from social comparison (2 items), affective motives (2 items), instrumental motives (4 items),

symbolic motives (2 items), intention (3 items), perceived control (1 item), attitudes (4 items) and past behaviour (1 item).

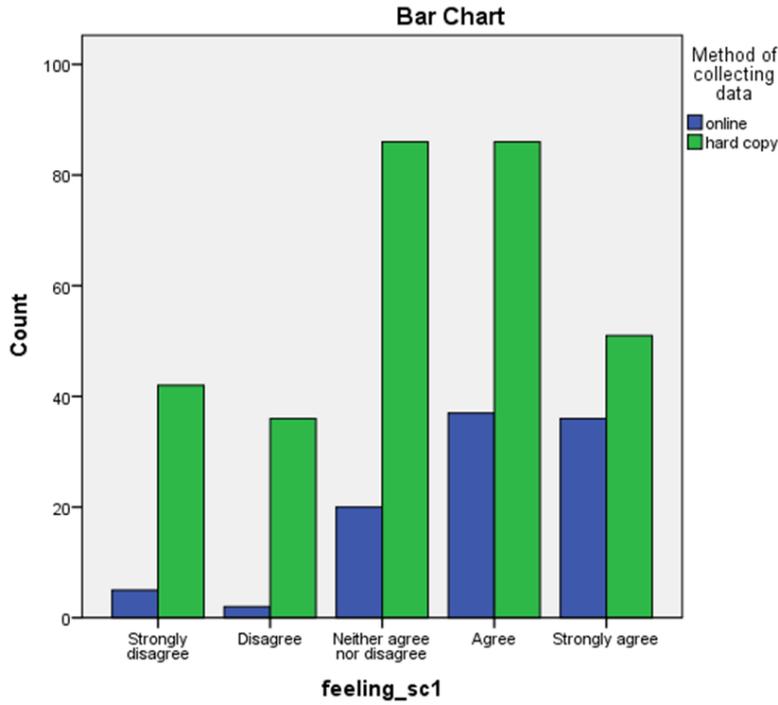
We proceed to analyse the distribution of the scores for each questions.

Following there is the analysis of each item detected with difference in the mean.

1. Feelings from Social Comparison

**Table 48 Frequency distribution of the scores for item feeling\_sc1**

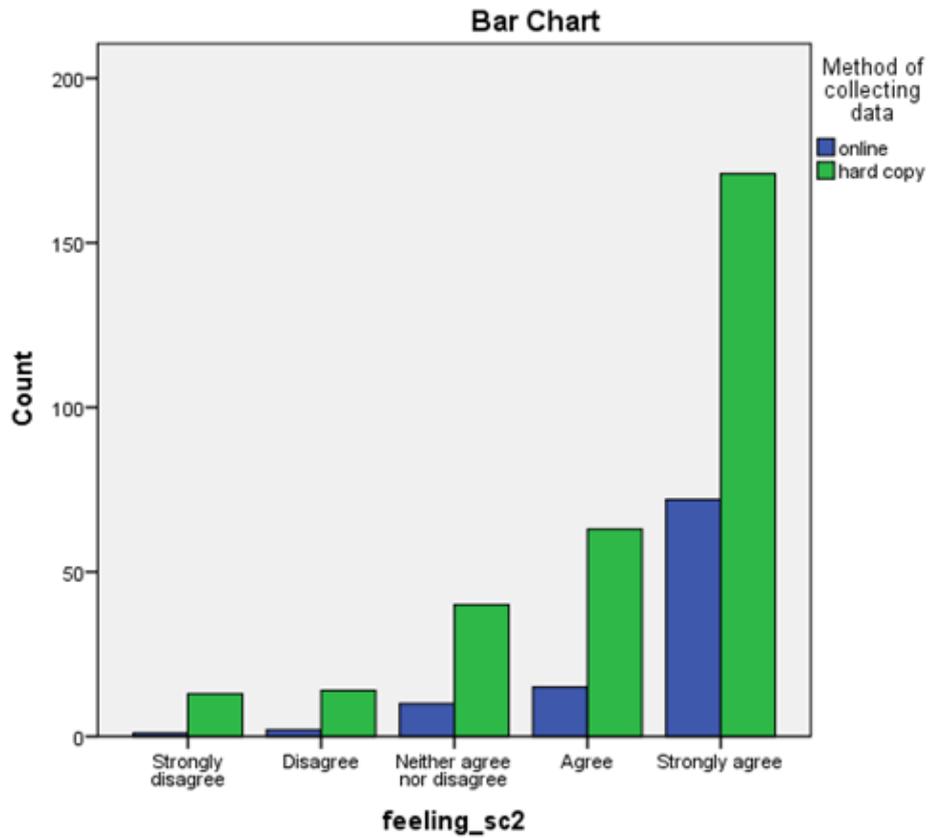
		Method of collecting data		Total
		online	hard copy	
feeling_sc1	Strongly disagree	5	42	47
	Disagree	2	36	38
	Neither agree nor disagree	20	86	106
	Agree	37	86	123
	Strongly agree	36	51	87
Total		100	301	401



**Figure 96 Bar Chart distribution of the scores for item feeling\_sc1 online and hard copy**

**Table 49 Frequency distribution of the scores for item feeling\_sc2**

		Method of collecting data		Total
		online	hard copy	
feeling_sc2	Strongly disagree	1	13	14
	Disagree	2	14	16
	Neither agree nor disagree	10	40	50
	Agree	15	63	78
	Strongly agree	72	171	243
Total		100	301	401

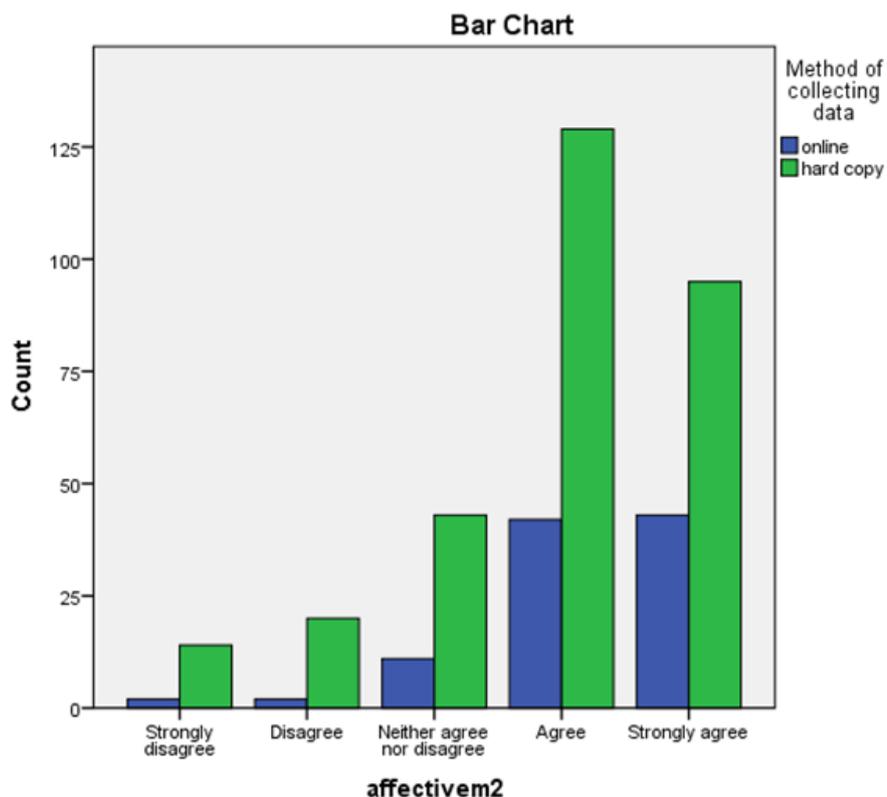


**Figure 97 Bar Chart distribution of the scores for item feeling\_sc2 online and hard copy**

2. Affective Motives

**Table 50 Frequency distribution of the scores for item affective motives2**

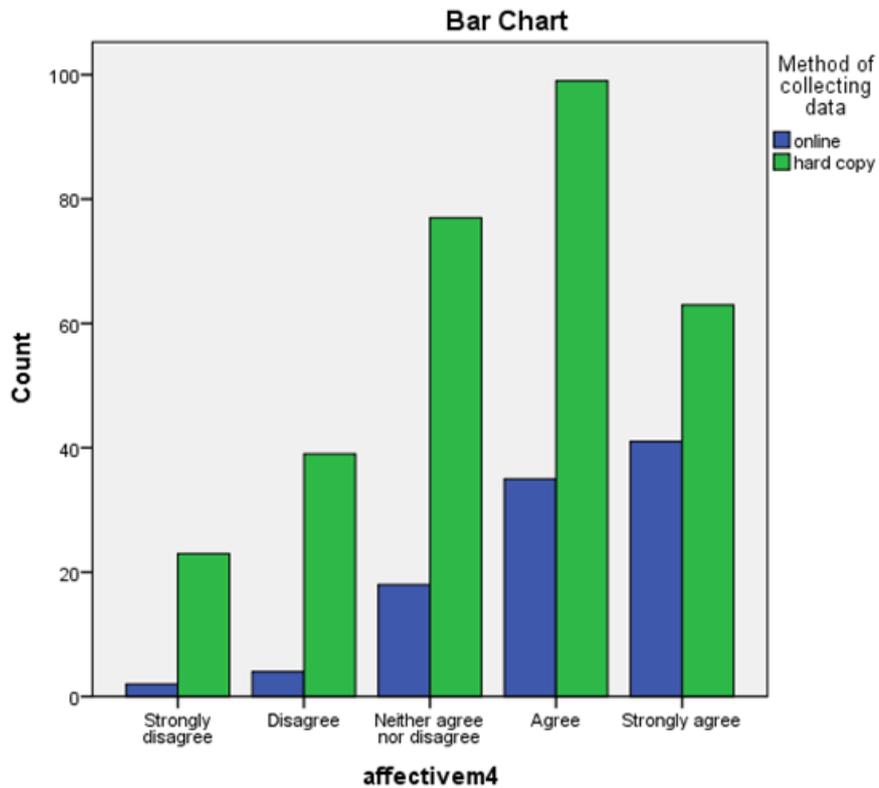
		Method of collecting data		Total
		online	hard copy	
affectivem2	Strongly disagree	2	14	16
	Disagree	2	20	22
	Neither agree nor disagree	11	43	54
	Agree	42	129	171
	Strongly agree	43	95	138
Total		100	301	401



**Figure 98 Bar Chart distribution of the scores for item affective motives2 online and hard copy**

**Table 51 Frequency distribution of the scores for item affective motives4**

		Method of collecting data		Total data
		online	hard copy	
affectivem4	Strongly disagree	2	23	25
	Disagree	4	39	43
	Neither agree nor disagree	18	77	95
	Agree	35	99	134
	Strongly agree	41	63	104
Total		100	301	401

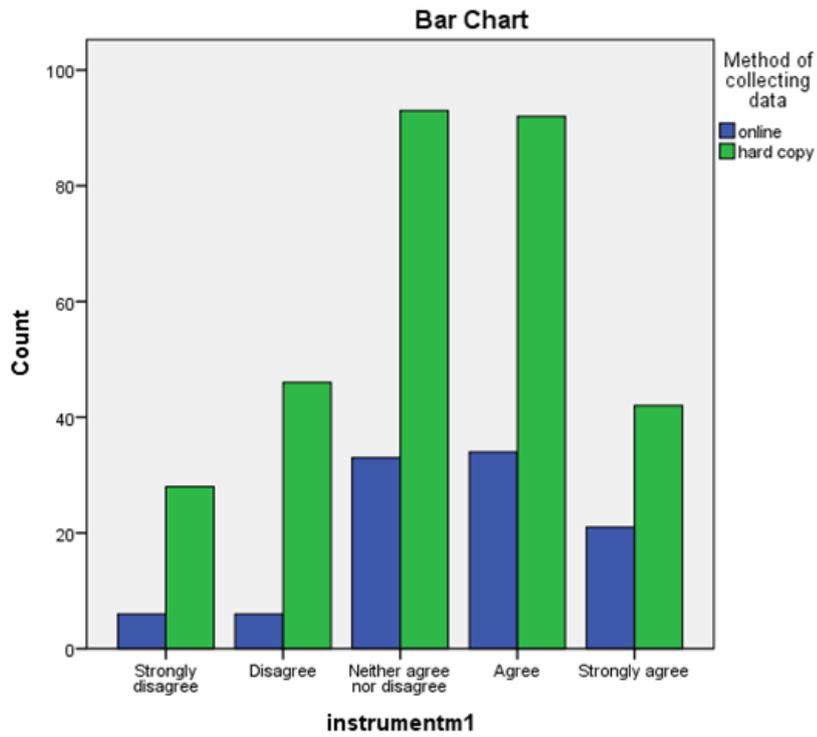


**Figure 99 Bar Chart distribution of the scores for item affective motives4 online and hard copy**

3. Instrumental motives

**Table 52 Frequency distribution of the scores for item instrumental motives1**

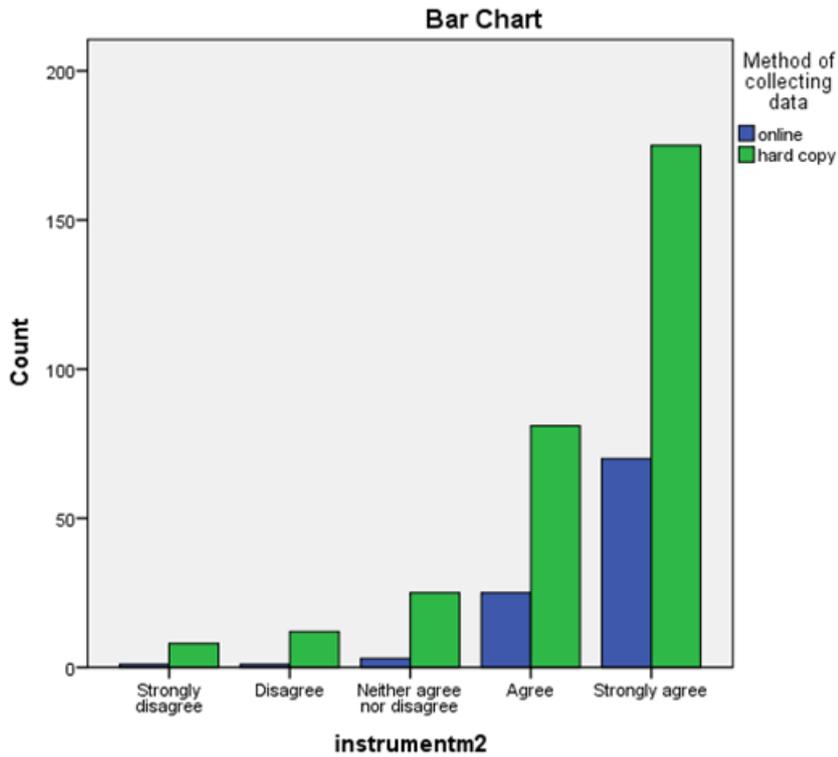
		Method of collecting data		Total
		online	hard copy	
instrumentm1	Strongly disagree	6	28	34
	Disagree	6	46	52
	Neither agree nor disagree	33	93	126
	Agree	34	92	126
	Strongly agree	21	42	63
Total		100	301	401



**Figure 100 Bar Chart distribution of the scores for item instrumental motives1 online and hard copy**

**Table 53 Frequency distribution of the scores for item instrumental motives2**

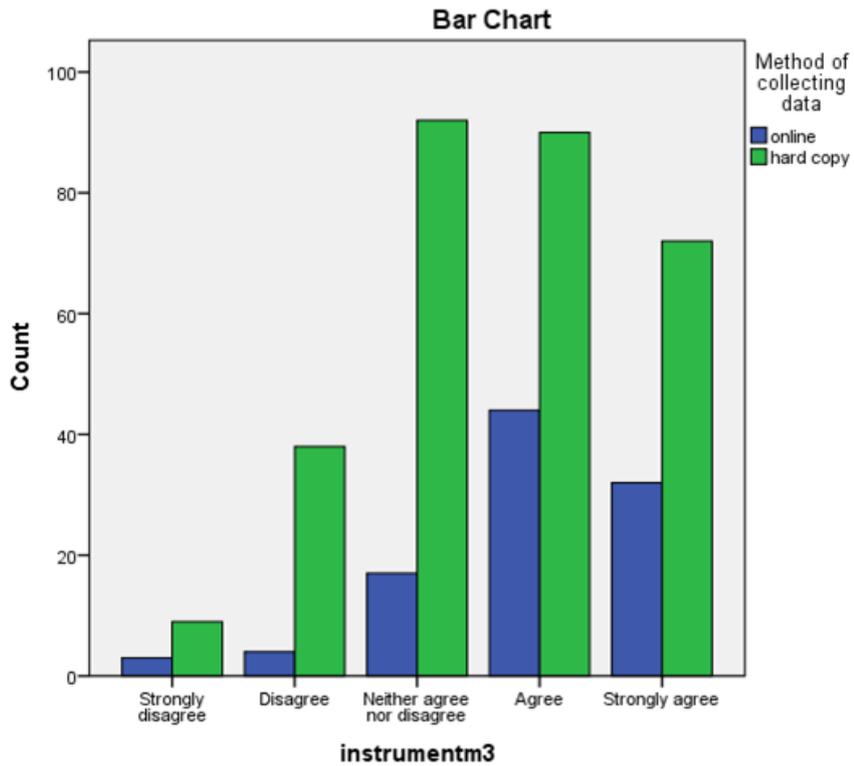
		Method of collecting data		Total
		online	hard copy	
instrumentm2	Strongly disagree	1	8	9
	Disagree	1	12	13
	Neither agree nor disagree	3	25	28
	Agree	25	81	106
	Strongly agree	70	175	245
Total		100	301	401



**Figure 101 Bar Chart distribution of the scores for item instrumental motives2 online and hard copy**

**Table 54 Frequency distribution of the scores for item instrumental motives3**

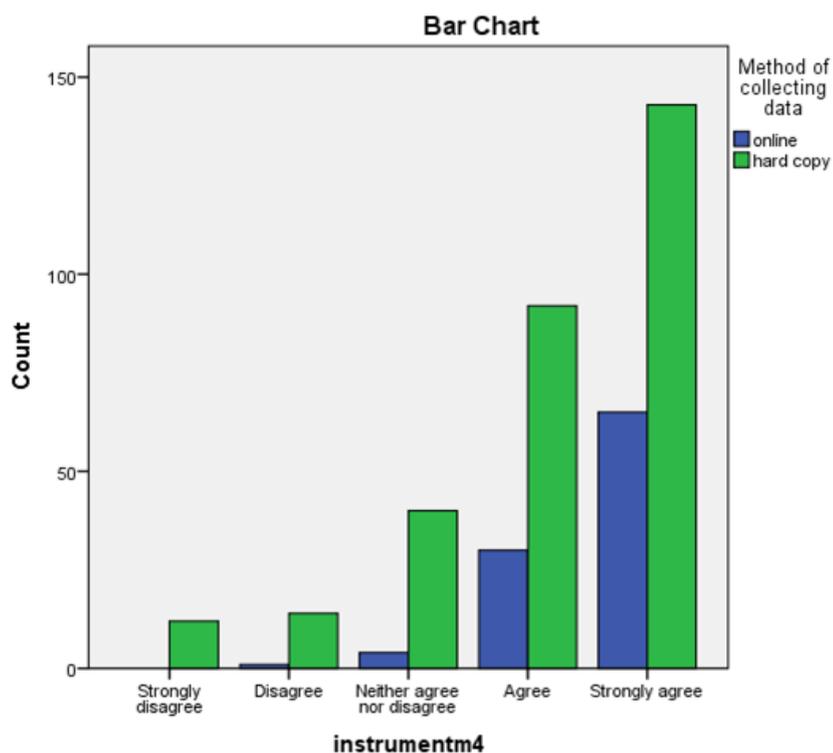
		Method of collecting data		Total
		online	hard copy	
instrumentm3	Strongly disagree	3	9	12
	Disagree	4	38	42
	Neither agree nor disagree	17	92	109
	Agree	44	90	134
	Strongly agree	32	72	104
Total		100	301	401



**Figure 102 Bar Chart distribution of the scores for item instrumental motives3 online and hard copy**

**Table 55 Frequency distribution of the scores for item instrumental motives4**

		Method of collecting data		Total data
		online	hard copy	
instrumentm4	Strongly disagree	0	12	12
	Disagree	1	14	15
	Neither agree nor disagree	4	40	44
	Agree	30	92	122
	Strongly agree	65	143	208
Total		100	301	401

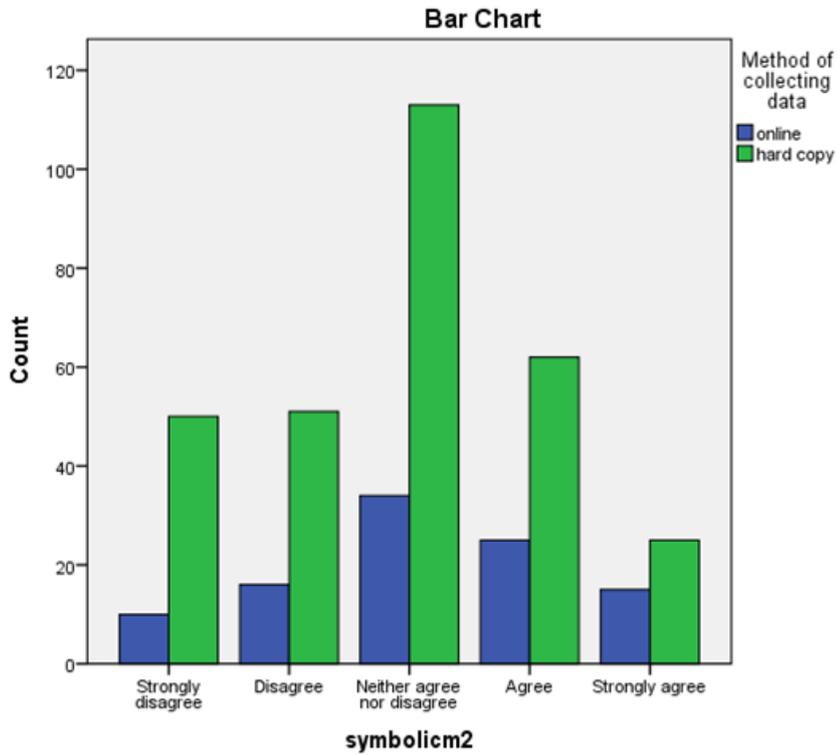


**Figure 103 Bar Chart distribution of the scores for item instrumental motives4 online and hard copy**

#### 4. Symbolic Motives

**Table 56 Frequency distribution of the scores for item Symbolic motives2**

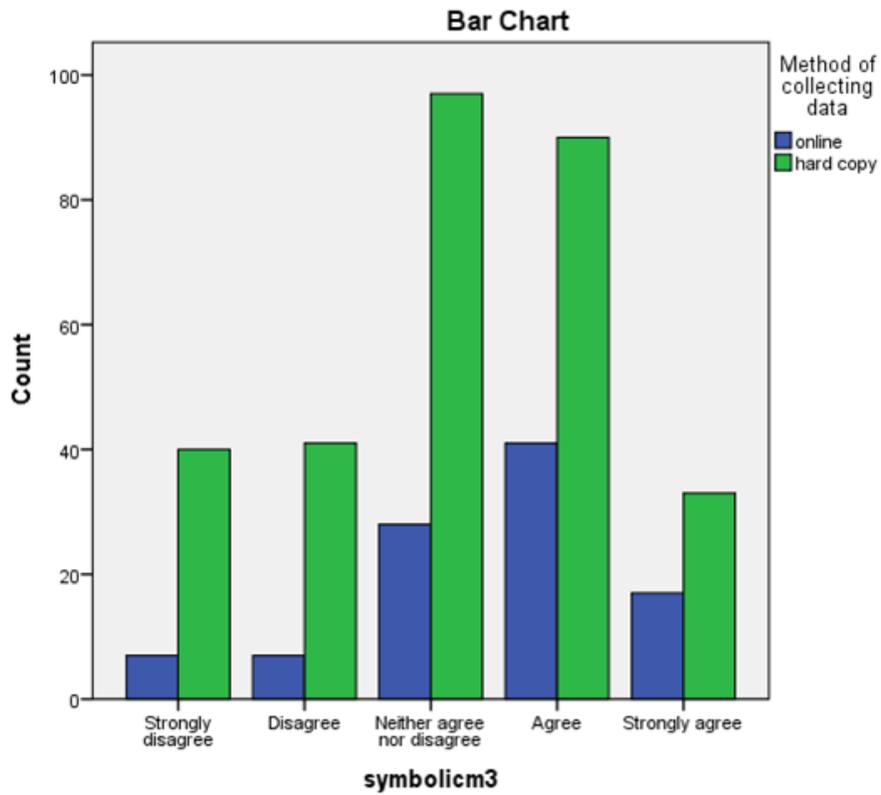
		Method of collecting data		Total
		online	hard copy	
symbolicm2	Strongly disagree	10	50	60
	Disagree	16	51	67
	Neither agree nor disagree	34	113	147
	Agree	25	62	87
	Strongly agree	15	25	40
Total		100	301	401



**Figure 104 Bar Chart distribution of the scores for item Symbolic motives2 online and hard copy**

**Table 57 Frequency distribution of the scores for item Symbolic motives3**

		Method of collecting data		Total
		online	hard copy	
symbolicm3	Strongly disagree	7	40	47
	Disagree	7	41	48
	Neither agree nor disagree	28	97	125
	Agree	41	90	131
	Strongly agree	17	33	50
Total		100	301	401

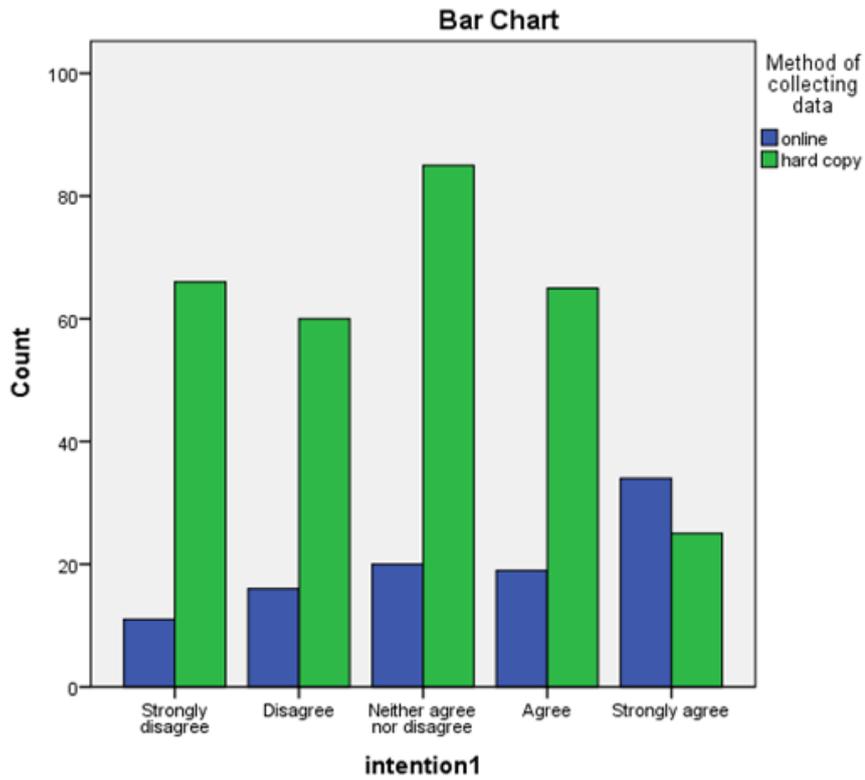


**Figure 105 Bar Chart distribution of the scores for item Symbolic motives3 online and hard copy**

5. Intention

**Table 58 Frequency distribution of the scores for item Intention 1**

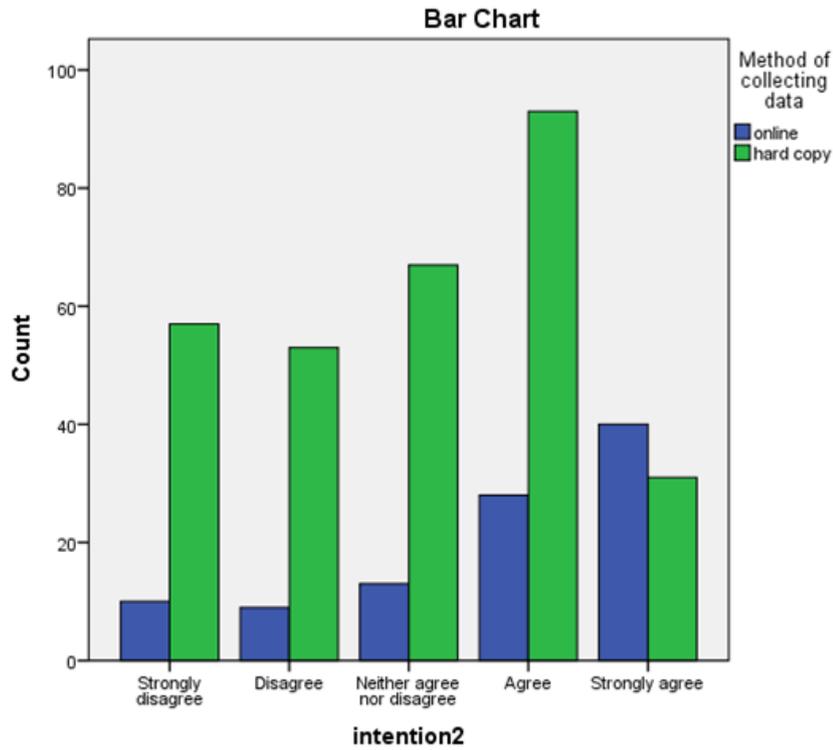
		Method of collecting data		Total
		online	hard copy	
intention1	Strongly disagree	11	66	77
	Disagree	16	60	76
	Neither agree nor disagree	20	85	105
	Agree	19	65	84
	Strongly agree	34	25	59
Total		100	301	401



**Figure 106 Bar Chart distribution of the scores for item Intention 1 online and hard copy**

**Table 59 Frequency distribution of the scores for item Intention 2**

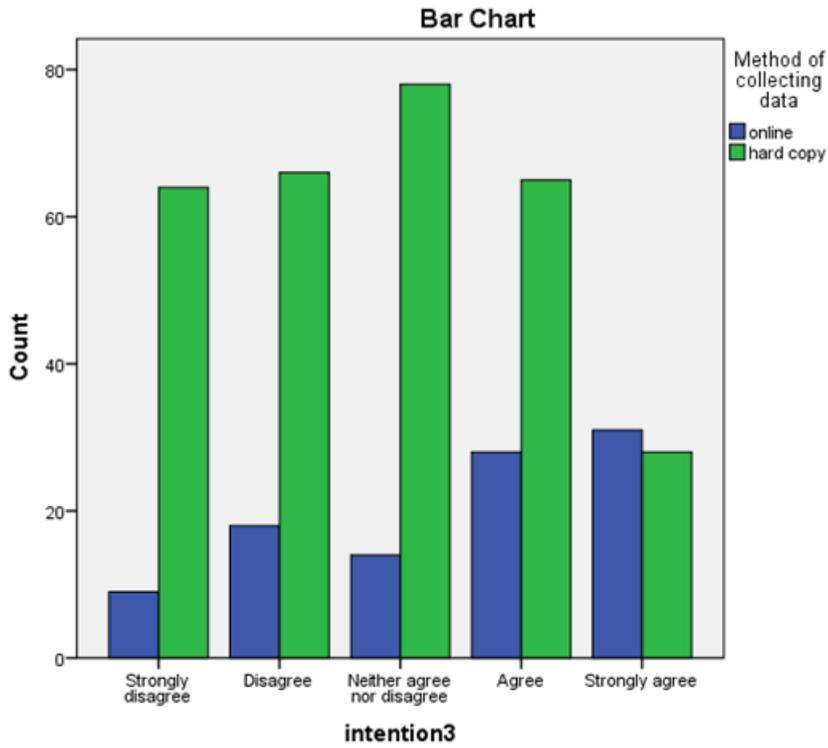
		Method of collecting data		Total
		online	hard copy	
intention2	Strongly disagree	10	57	67
	Disagree	9	53	62
	Neither agree nor disagree	13	67	80
	Agree	28	93	121
	Strongly agree	40	31	71
Total		100	301	401



**Figure 107 Bar Chart distribution of the scores for item Intention 2 online and hard copy**

**Table 60 Frequency distribution of the scores for item Intention 3**

		Method of collecting data		Total
		online	hard copy	
intention3	Strongly disagree	9	64	73
	Disagree	18	66	84
	Neither agree nor disagree	14	78	92
	Agree	28	65	93
	Strongly agree	31	28	59
Total		100	301	401

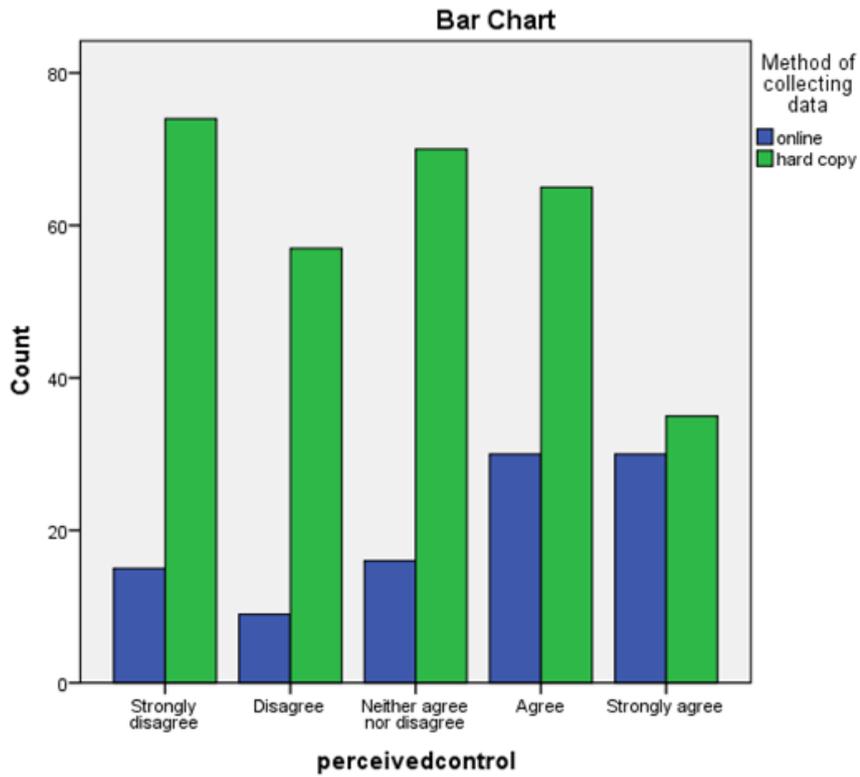


**Figure 108 Bar Chart distribution of the scores for item Intention 3 online and hard copy**

6. Perceived Behavioural Control

**Table 61 Frequency distribution of the scores for item perceived control**

		Method of collecting data		Total
		online	hard copy	
perceivedcontrol	Strongly disagree	15	74	89
	Disagree	9	57	66
	Neither agree nor disagree	16	70	86
	Agree	30	65	95
	Strongly agree	30	35	65
Total		100	301	401

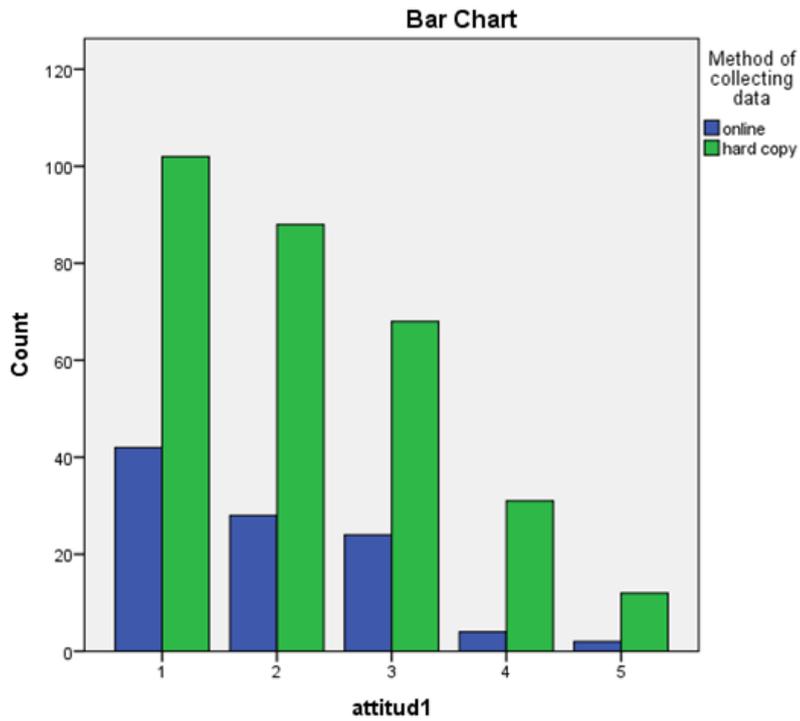


**Figure 109 Bar Chart distribution of the scores for item perceived control online and hard copy**

7. Attitudes

**Table 62 Frequency distribution of the scores for item attitud1**

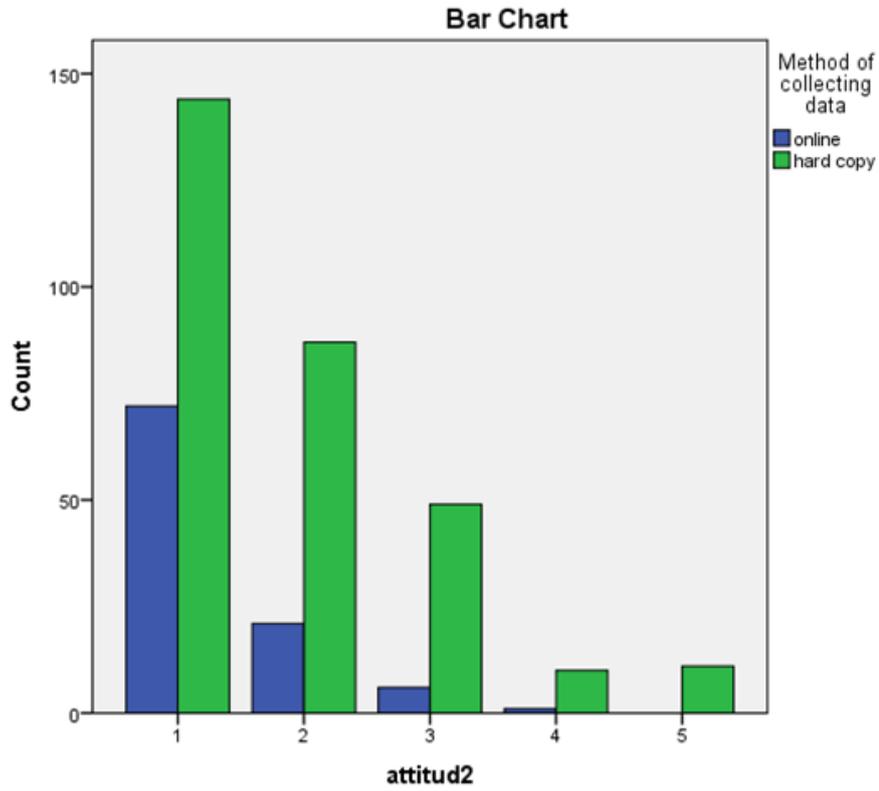
		Method of collecting data		Total
		online	hard copy	
attitud1	1	42	102	144
	2	28	88	116
	3	24	68	92
	4	4	31	35
	5	2	12	14
Total		100	301	401



**Figure 110 Bar Chart distribution of the scores for item attitud1 online and hard copy**

**Table 63 Frequency distribution of the scores for item attitud2**

		Method of collecting data		Total
		online	hard copy	
attitud2	1	72	144	216
	2	21	87	108
	3	6	49	55
	4	1	10	11
	5	0	11	11
Total		100	301	401



**Figure 111 Bar Chart distribution of the scores for item attitud2 online and hard copy**

**Table 64 Frequency distribution of the scores for item attitud3**

		Method of collecting data		Total
		online	hard copy	
attitud3	1	50	87	137
	2	30	98	128
	3	18	82	100
	4	2	18	20
	5	0	16	16
Total		100	301	401

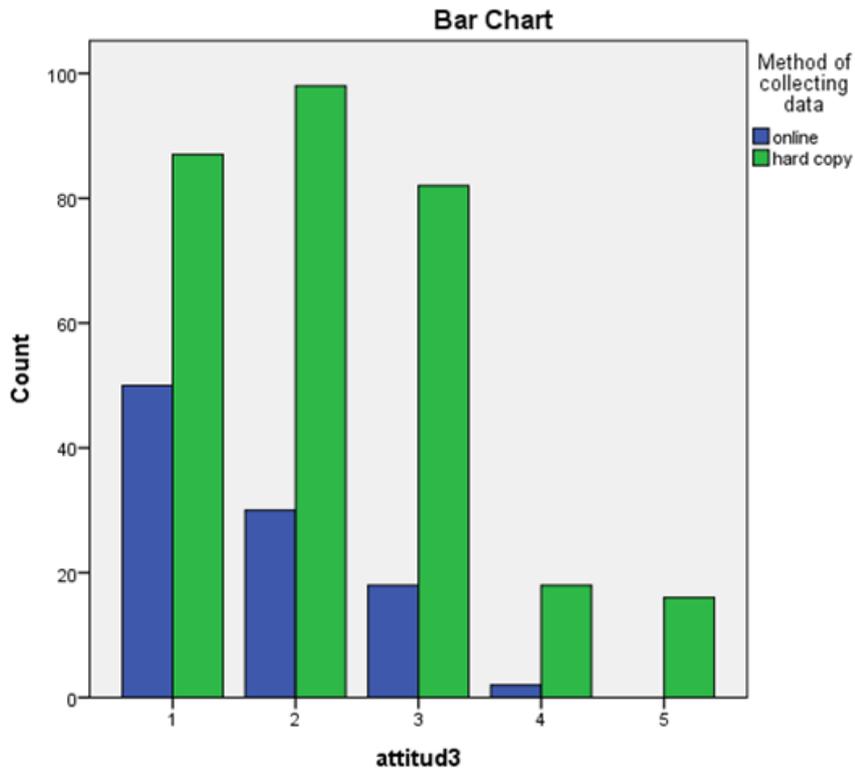
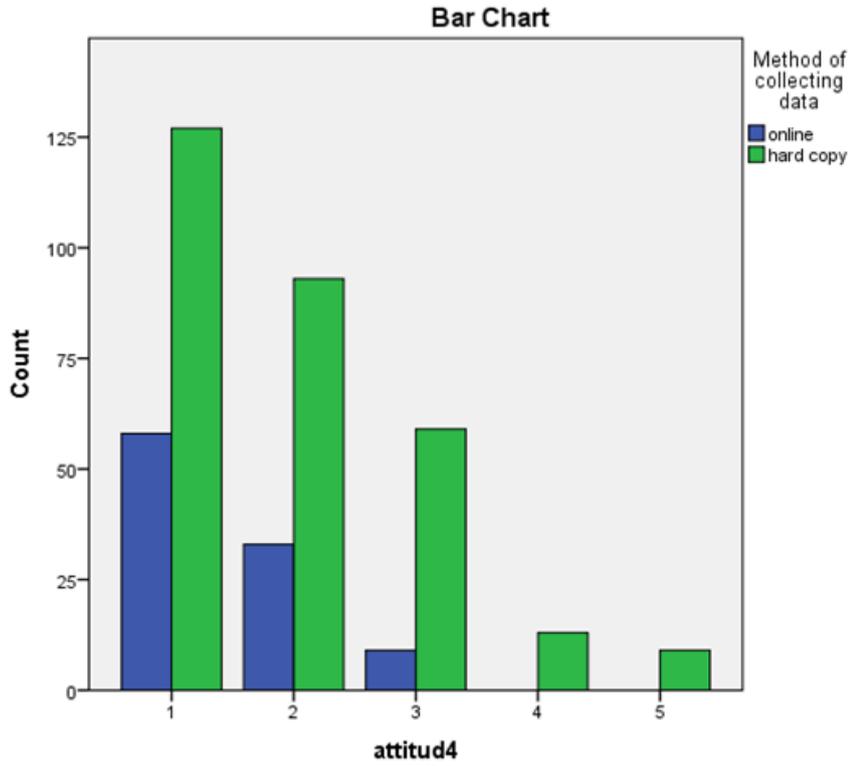


Figure 112 Bar Chart distribution of the scores for item attitud3 online and hard copy

Table 65 Frequency distribution of the scores for item attitud4

		Method of collecting data		Total
		online	hard copy	
attitud4	1	58	127	185
	2	33	93	126
	3	9	59	68
	4	0	13	13
	5	0	9	9
Total		100	301	401

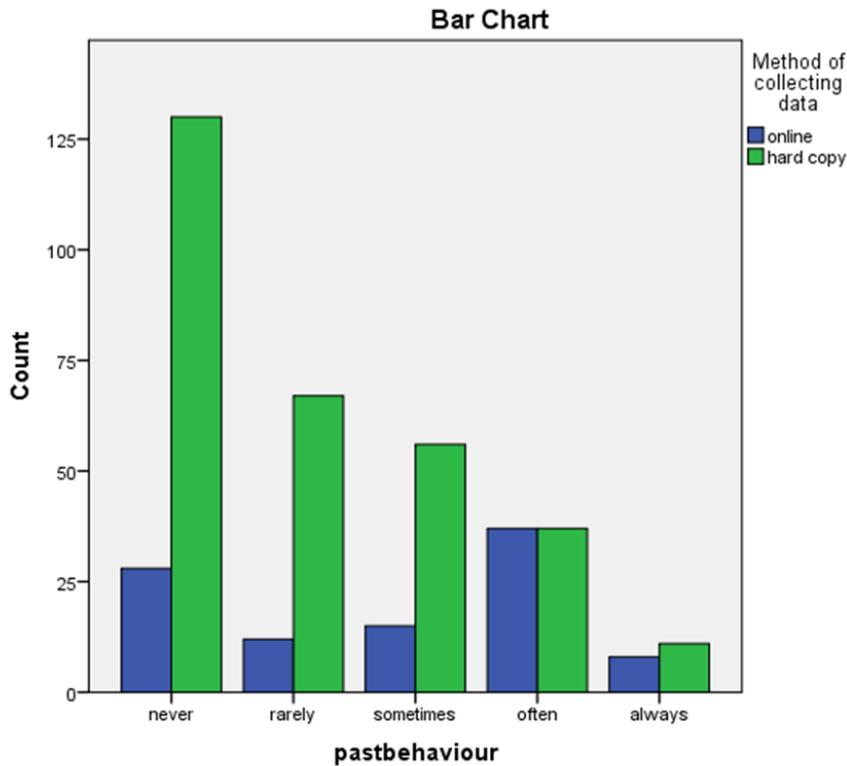


**Figure 113 Bar Chart distribution of the scores for item attitud4 online and hard copy**

8. Past Behaviour

**Table 66 Frequency distribution of the scores for item past behaviour**

		Method of collecting data		Total
		online	hard copy	
pastbehaviour	never	28	130	158
	rarely	12	67	79
	sometimes	15	56	71
	often	37	37	74
	always	8	11	19
Total		100	301	401



**Figure 114 Bar Chart distribution of the scores for item past behaviour online and hard copy**

From the visual inspection of the bar charts we can conclude that the difference in the mean of the scores from the data from the survey distributed online and the one distributed in hard copy might be due to sample size. Thus we proceed with one sample and continue with the analysis.

#### **5.4.4 Description of the Observed Variables**

To measure each of the ten latent constructs, there were designed 32 observed variables. As mentioned in Chapter Three, these ten variables intention, subjective norm, attitudes, perceived behavioural control, past behaviour, social comparison orientation, feelings from social comparison, affective motives, symbolic motives and instrumental motives are relevant to answer the research questions. See table 31 for the descriptives of each question.

The measures from TPB were based upon those suggested by Ajzen (2002). In total 11 items divided among the variables from the conceptual framework are divided as follows. Intention was

measured with three items (e.g. I expect to use my bicycle for my daily commute in the next week). Subjective norm was measured with three items (e.g. People that are important to me, want me to commute by bicycle). Perceived behavioural control was measured with one item (I am confident that I can use my bicycle to commute). All these items were measured using five-point Likert scale (1= strongly disagree to 5= strongly agree). Attitudes were measured with 4 evaluative semantic differential items in a five scale (e.g. important-not important). The variable for past behaviour was measured with one item 'How frequently have you used a bicycle to commute in the last six months' using semantic differential scale (never-always).

Social Comparison (SC) was measured with 5 items designed as five-point Likert scales (1= strongly disagree to 5=strongly agree). Three items were used to measure social comparison orientation (e.g. I often compare myself with others with respect the transport I use to commute) based on Buunk et al. (2005). Two items were used to measure feelings from social comparison. Self-enhancement was measured with the statement 'I often feel good when I see others cycle commuters' and self-evaluation was measured with 'If I commute by bicycle I often feel that other people would think I am poor' based on Buunk et al. (2005), Lee (2014) and Gibbons and Buunk (1999).

The items to measure motives for commuting by bicycle from Material Possessions Model (MPM) were based on Lois and López-Sáez (2009) and Steg et al. (2001). All measures were designed as five-point Likert scales (1=strongly disagree to 5=strongly agree) where participants would indicate their degree of agreement with the statements. Affective motives (affectivem) had five items (e.g. I enjoy riding a good bicycle). Instrumental motives (instrumentm) had five items (e.g. Cycling commuting is comfortable) and finally Symbolic motives (symbolicm) with also 5 items (e.g. If I could choose, I would prefer a classy bicycle).

**Table 67 Descriptive statistics for each observable variable**

<b>Construct</b>	<b>Item</b>	<b>Scale</b>	<b>Median</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>C. Alpha</b>
Social Comparison Orientation	scomp_ori1	5-Likert	2	2.33	1.155	.735
	scomp_ori2	5-Likert	2	2.33	1.148	
	scomp_ori3	5-Likert	2	2.14	1.165	
Feelings from Social Comparison	feeling_sc1	5-Likert	4	3.41	1.254	.185
	feeling_sc2	5-Likert	5	4.30	1.058	
Affective motives	affectivem1	5-Likert	4	3.77	1.145	.785
	affectivem2	5-Likert	4	3.98	1.029	
	affectivem3	5-Likert	3	3.25	1.105	
	affectivem4	5-Likert	4	3.62	1.160	
	affectivem5	5-Likert	4	3.58	1.155	
Instrumental motives	instrumentm1	5-Likert	3	3.33	1.143	.711
	instrumentm2	5-Likert	5	4.41	0.920	
	instrumentm3	5-Likert	4	3.69	1.061	
	instrumentm4	5-Likert	5	4.24	0.995	
	instrumentm5	5-Likert	2	2.33	1.185	
Symbolic motives	symbolicm1	5-Likert	3	3.43	1.186	.785
	symbolicm2	5-Likert	3	2.95	1.176	
	symbolicm3	5-Likert	3	3.22	1.170	
	symbolicm4	5-Likert	3	2.61	1.176	
	symbolicm5	5-Likert	1	1.93	1.126	

Intention	intention1	5-Likert	3	2.93	1.325	.928
	intention2	5-Likert	3	3.17	1.345	
	intention3	5-Likert	3	2.95	1.327	
Subjective norm	subjectnorm1	5-Likert	2	2.29	1.212	.541
	subjectnorm2	5-Likert	2	2.04	1.093	
	subjectnorm3	5-Likert	2	2.15	1.143	
PBC	percebecontrol	5-Likert	3	2.95	1.393	
Attitudes	attitud1	Sem Diff	2	2.15	1.110	.842
	attitud2	Sem Diff	1	1.74	0.982	
	attitud3	Sem Diff	2	2.13	1.066	
	attitud4	Sem Diff	2	1.84	0.969	
Past behaviour	Past-behaviour	5-Likert	2	2.29	1.286	

Five-point Likert scale (1= strongly disagree to 5= strongly agree)

\*\* Five-point Likert scale (1= Never to 5= Always)

It can be observed that one item from feeling of social comparison (feeling\_sc2) is skewed left and also the same item has a positive kurtosis. One item (instrumentm2) from instrumental motives is also negatively skewed. And also the same item has a positive kurtosis. A different instrumental item (instrumentm4) also has a positive kurtosis. The negative skew means that the left tail is longer. Whereas the positive kurtosis indicate that the distribution is clustered in the centre. This was also highlighted in the section 5.4.2 when the normality of the data was assessed, however, as the sample size is >200 these conditions will not make a difference in our data as suggested by Pallant (2013).

### 5.4.5 Reliability and Validity

The reliability of a construct refers to the internal consistency over the respondents and over the items used to measure it (Cooper, 2003). To evaluate this internal consistency it was calculated the Cronbach's alpha. Table 68 shows that the reliability for all the constructs is good ( $>0.7$ ) except for the construct feelings from social comparison and subjective norm which had .185 and .541 respectively. This was noted when developing the structural model and is addressed in that section. The two single-item measures from Perceived behavioural control (PBC) and Past behaviour are not included in the table. Regarding PBC, as mentioned in the section of Pilot Study section, the construct was piloted using 3 items to measure. The alpha was very low and deleting one item would only slightly increase the internal consistency (from an alpha of .375 to .493), thus it was chosen one single item for considering it less ambiguous to the respondent (see Wanous et al. citing Sackett and Larson) (Wanous et al., 1997) and based on Lois et al. (2015) suggesting that PBC can be measure using just one or two items to assess self-efficacy. Regarding past behaviour, Bamberg et al. (Bamberg et al., 2003) highlighted that analysing past behaviour may improve predictions of later behaviour and can express habit strength. In order to gather this information and like in the case of PBC to make it less ambiguous for the respondent the measure was narrowed to a single-item (Wanous et al., 1997).

**Table 68 Reliability for each construct**

<b>Construct</b>	<b>No. Items</b>	<b>Cronbach's Alpha</b>
Intention	3	0.928
Attitudes	4	0.842
Subjective Norm	3	0.541
Social Comparison Orientation	3	0.735
Feelings from Social Comparison	2	0.185
Affective motives	5	0.785
Symbolic motives	5	0.785
Instrumental motives	5	0.711

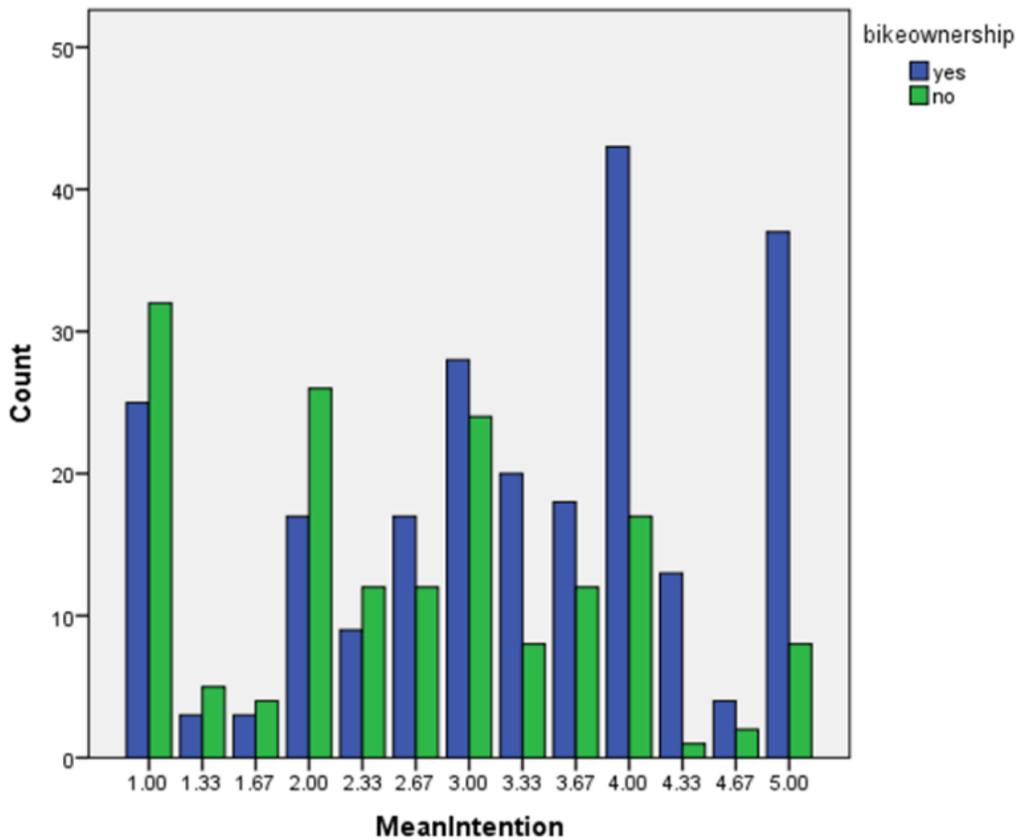
#### **5.4.6 Exploring the answers**

Following it was explored whether there was statistically significant difference in the mean score of the socio-demographic characteristics and the latent constructs by using a t-test for the dichotomous variables and ANOVA for the variables with more than two categories. Each of the constructs was treated as the dependent variables whereas the socio-demographic characteristics functioned as the independent variables. To select the independent variables to explore, first it was carried out Pearson Correlation to see which variables were correlated and the strength and direction of that relationship. "A positive correlation indicated that as one variable increases, so does the other. A negative correlation indicates that as one variable increases, the other decreases" (Pallant, 2013). The values for correlation can vary from +1 to -1 and a value of 0 indicates no relationship between the variables. (Pallant, 2013).

#### **Analysis of Intention**

Intention and bike ownership

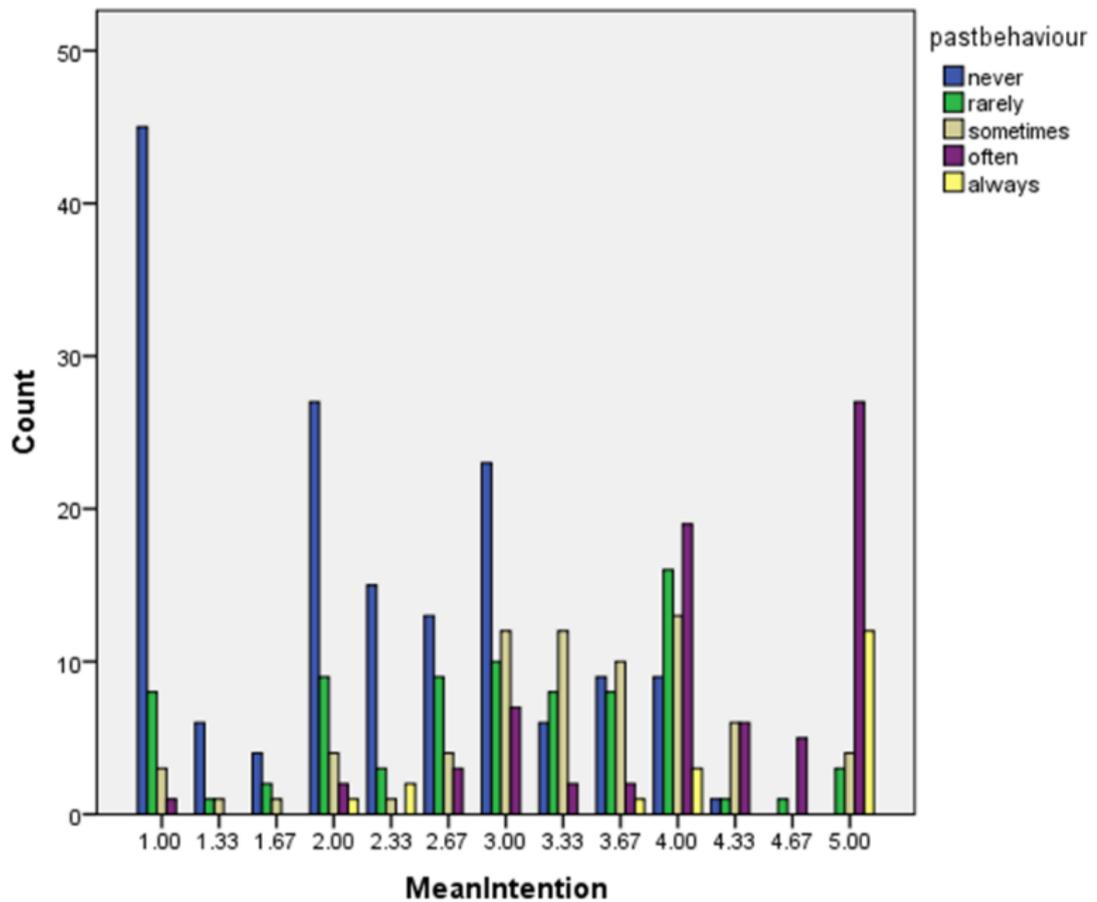
The correlation analysis between intention and bike ownership showed that there was a negative correlation between the two variables,  $r = -.28$ ,  $n = 400$ ,  $p = 0.01$ . An independent-samples t-test was conducted to compare bike ownership and intention to cycle. There was a significant difference in the scores for bike ownership ( $M = 3.30$ ,  $SD = 1.21$ ) and people not owning a bicycle ( $M = 2.58$ ,  $SD = 1.15$ );  $t(398) = 5.905$ ,  $p = 0.001$ . These results suggest that people owning a bicycle have a stronger intention to cycle, than those without no owning one (see Figure 71).



**Figure 115 Mean of intention of people owning or not a bicycle**

#### Intention and past behaviour

The correlation analysis between intention and past behaviour showed that there was a positive correlation between the two variables,  $r=0.62$ ,  $n=401$ ,  $p=0.01$ . There was a statistically significant difference between groups as determined by one-way ANOVA ( $F(4,396) = 61.3634$ ,  $p = .001$ ). A Bonferroni post hoc test revealed that the frequency of bicycle use in the past statistically significantly was different from people never use the bicycle ( $M=2.18$ ,  $SD=.977$ ) that from people that rarely ( $M=2.98$ ,  $SD=1.05$ ); sometimes ( $M=3.34$ ,  $SD=.912$ ); often ( $M=4.16$ ,  $SD=.893$ ); and always ( $M=4.33$ ,  $SD=1.04$ ) use the bicycle.



**Figure 116 Mean of intention and past behaviour**

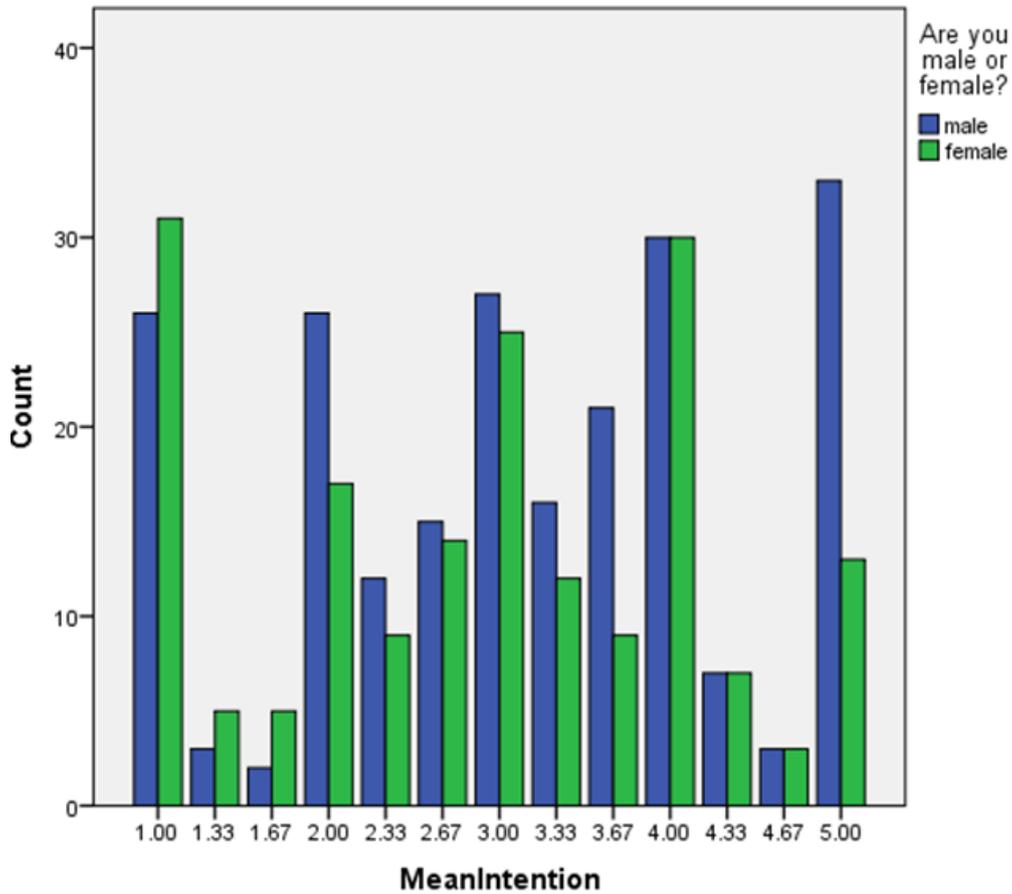
#### Intention and gender

The correlation analysis between intention and gender showed that there was a small<sup>15</sup> correlation between the two variables,  $r = -.11$ ,  $n = 401$ ,  $p = 0.027$ . An independent-samples t-test was conducted to compare gender and intention to cycle. There was a significant difference in the scores for male ( $M = 3.14$ ,  $SD = 1.24$ ) and female

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<sup>15</sup> From 0 to +/- .25 = Little or no relationship; from +/- .26 to +/- .50 = Fair degree of relationship; and from +/- .51 to +/- .75 = Moderate to good relationship. Although it is said that sometimes in social sciences a correlation between .26 to .50 could be considered high (Fink, 1995)

( $M=2.86$ ,  $SD=1.23$ );  $t(399)=2.214$ ,  $p = 0.027$ . These results suggest men have a stronger intention to cycle, than women.



**Figure 117 Mean of intention and gender**

#### Intention and occupation

The correlation analysis between intention and occupation showed that there was a small negative correlation between the two variables,  $r = -.197$ ,  $n=400$ ,  $p= 0.001$ . There was a statistically significant difference between groups as determined by one-way ANOVA ( $F(6,393) = 3.989$ ,  $p = .001$ ). A Bonferroni post hoc test revealed that people that work ( $M=3.23$ ,  $SD=1.21$ ) have stronger intention to cycle than people that combine work and studies ( $M=2.73$ ,  $SD=1.25$ ). There was no statistically significant difference with the rest of the groups.

There was no relationship between intention and age ( $r=.04$ ,  $n=383$ ,  $p=0.335$ ); studies ( $r=.03$ ,  $n=401$ ,  $p=.469$ ); income ( $r=-.015$ ,  $n=401$ ,  $p=.769$ ); travel time ( $r=-.020$ ,  $n=394$ ,  $p=.690$ ).

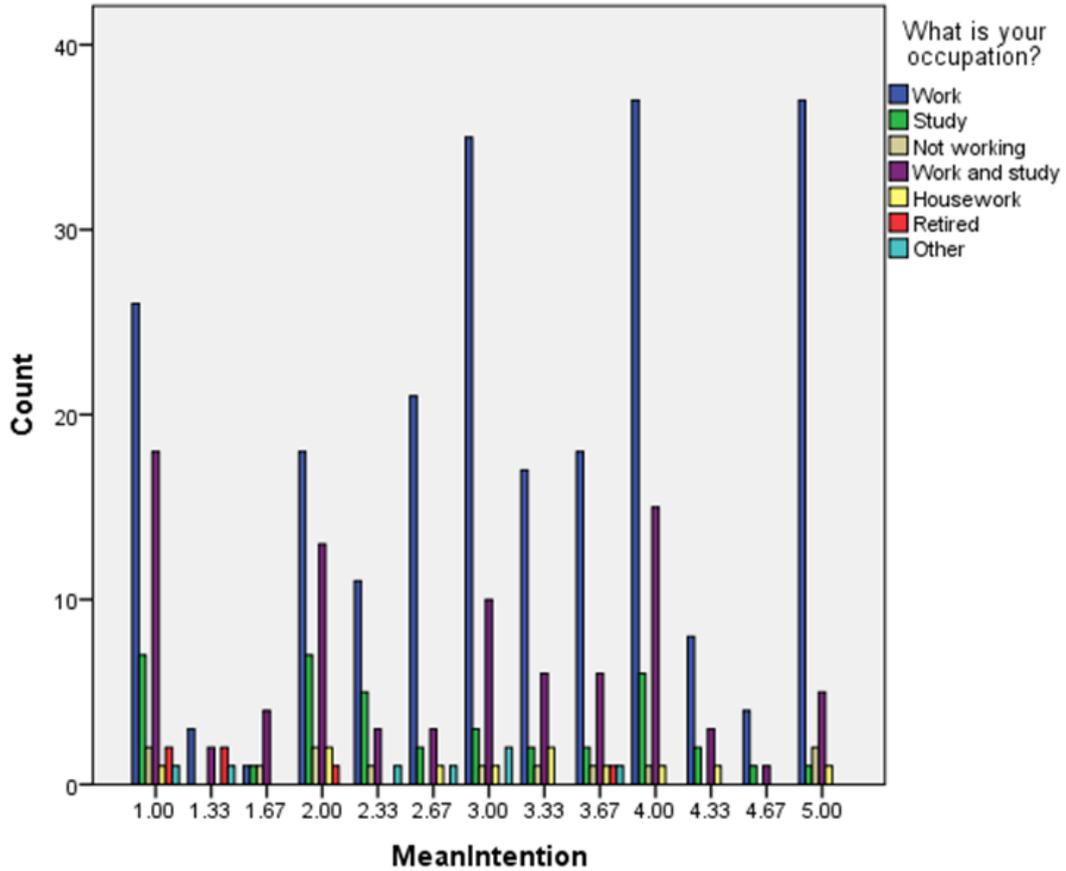


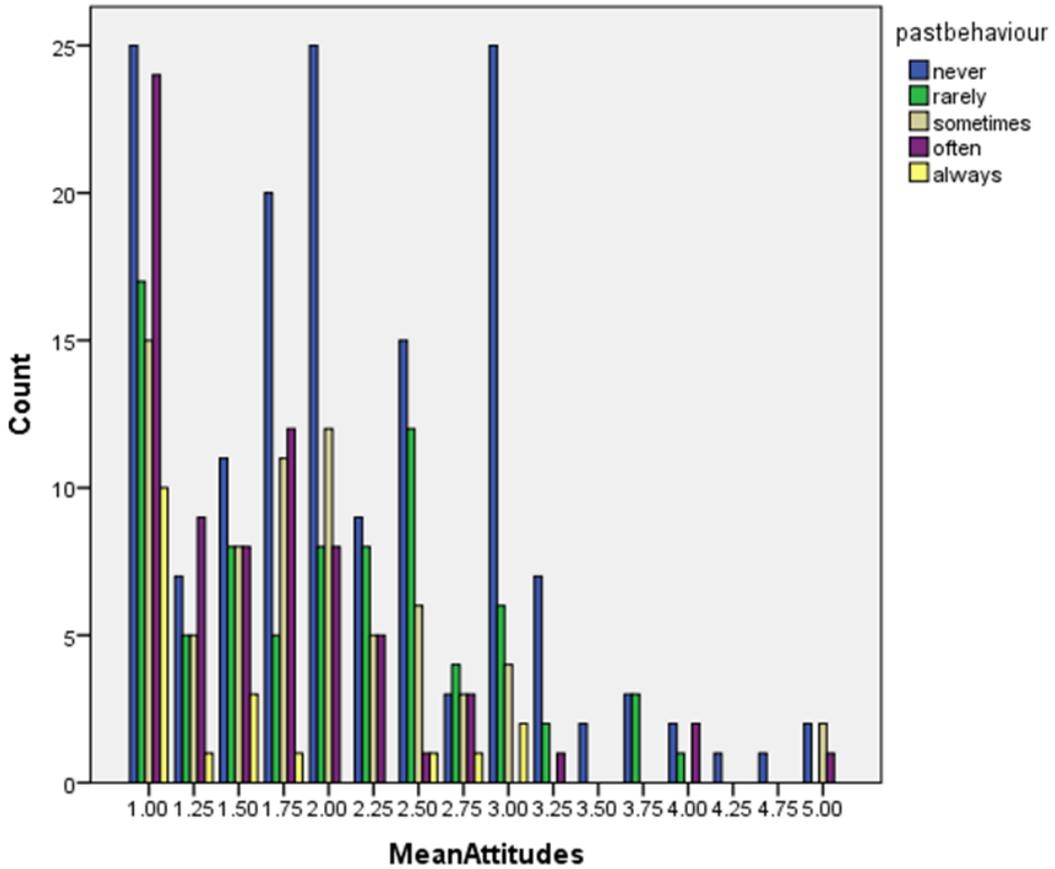
Figure 118 Mean intention and occupation

### Analysis of Attitudes

#### Attitudes and past behaviour

The correlation analysis between attitudes and past behaviour showed that there was a small negative correlation between the two variables,  $r = -0.25$ ,  $n=401$ ,  $p = 0.001$ . There was a statistically significant difference between groups as determined by one-way ANOVA ( $F(4,396) = 6.929$ ,  $p = .001$ ). A Bonferroni post hoc test revealed that the frequency of bicycle use in the past was statistically significantly different from people that never use the

bicycle (M=2.17 ,SD=.882) that from people that cycle often (M=1.65 ,SD=.774); and always (M=1.51 ,SD=.733) (see Figure 88). This suggest specifically that people that have use the bicycle in the last six months have more positive attitudes towards the bicycle.



**Figure 119 Mean of attitudes and past behaviour**

There was no relationship between attitudes and bike ownership ( $r=.06$ ,  $n=400$ ,  $p=.195$ ); age ( $r=-0.012$ ,  $n=383$ ,  $p=.812$ ); gender ( $r=-0.051$ ,  $n=401$ ,  $p=.309$ ); studies ( $r=-.073$ ,  $n=401$ ,  $p=.145$ ); occupation ( $r=.04$ ,  $n=400$ ,  $p=.343$ ); income ( $r=-.002$ ,  $n=401$ ,  $p=.961$ ); and travel time ( $r=-.021$ ,  $n=394$ ,  $p=.675$ ).

### Analysis of Subjective Norm

#### Subjective norm and past behaviour

The correlation analysis between subjective norm and past behaviour showed that there was a small positive correlation between the two variables,  $r = .15$ ,  $n = 401$ ,  $p = 0.001$ . There was a statistically significant difference between groups as determined by one-way ANOVA ( $F(4,396) = 3.438$ ,  $p = .009$ ). A Bonferroni post hoc test revealed that the frequency of bicycle use in the past was statistically significantly different from people that never use the bicycle ( $M = 1.97$ ,  $SD = .799$ ) that from people that cycle often ( $M = 2.31$ ,  $SD = .804$ ). This suggests specifically that people that have used the bicycle in the last six months have stronger influence from the subjective norm.

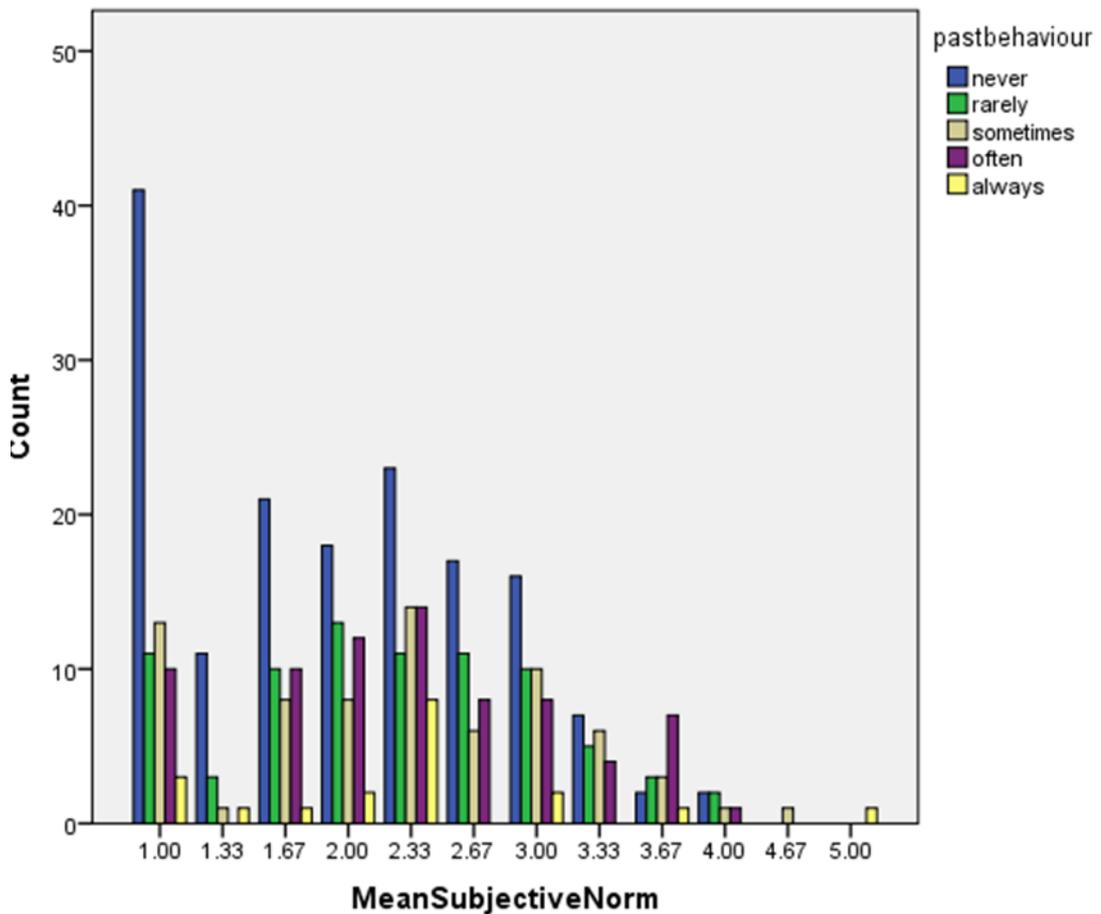


Figure 120 Mean subjective norm and past behaviour

### Subjective norm and age

The correlation analysis between subjective norm and age showed that there was a small positive correlation between the two variables,  $r = .11$ ,  $n = 383$ ,  $p = 0.025$ .

There was a statistically significant difference between groups as determined by one-way ANOVA ( $F(5,377) = 2.174$ ,  $p = .056$ ).

However, the correlation was very small and the  $p$  value  $< 0.05$ , this could explain that the Bonferroni post hoc test did not reveal any differences between the age groups.

There was not relationship between subjective norm and bike ownership ( $r = -.030$ ,  $n = 400$ ,  $p = .550$ ); gender ( $r = -.055$ ,  $n = 401$ ,  $p = .270$ ); studies ( $r = .05$ ,  $n = 401$ ,  $p = .260$ ); occupation ( $r = -.056$ ,  $n = 400$ ,  $p = .266$ ); income ( $r = -.048$ ,  $n = 401$ ,  $p = .340$ ); and travel time ( $r = -.040$ ,  $n = 394$ ,  $p = .427$ ).

### **Analysis of Social Comparison Orientation**

There was not relationship between Social Comparison Orientation and bike ownership ( $r = -.012$ ,  $n = 400$ ,  $p = .809$ ); past behaviour ( $r = .022$ ,  $n = 401$ ,  $p = .664$ ); age ( $r = .013$ ,  $n = 383$ ,  $p = .800$ ); gender ( $r = -0.018$ ,  $n = 401$ ,  $p = .724$ ); studies ( $r = .088$ ,  $n = 401$ ,  $p = .079$ ); occupation ( $r = -.036$ ,  $n = 400$ ,  $p = .469$ ); income ( $r = .084$ ,  $n = 401$ ,  $p = .093$ ); and travel time ( $r = -.091$ ,  $n = 394$ ,  $p = .071$ ).

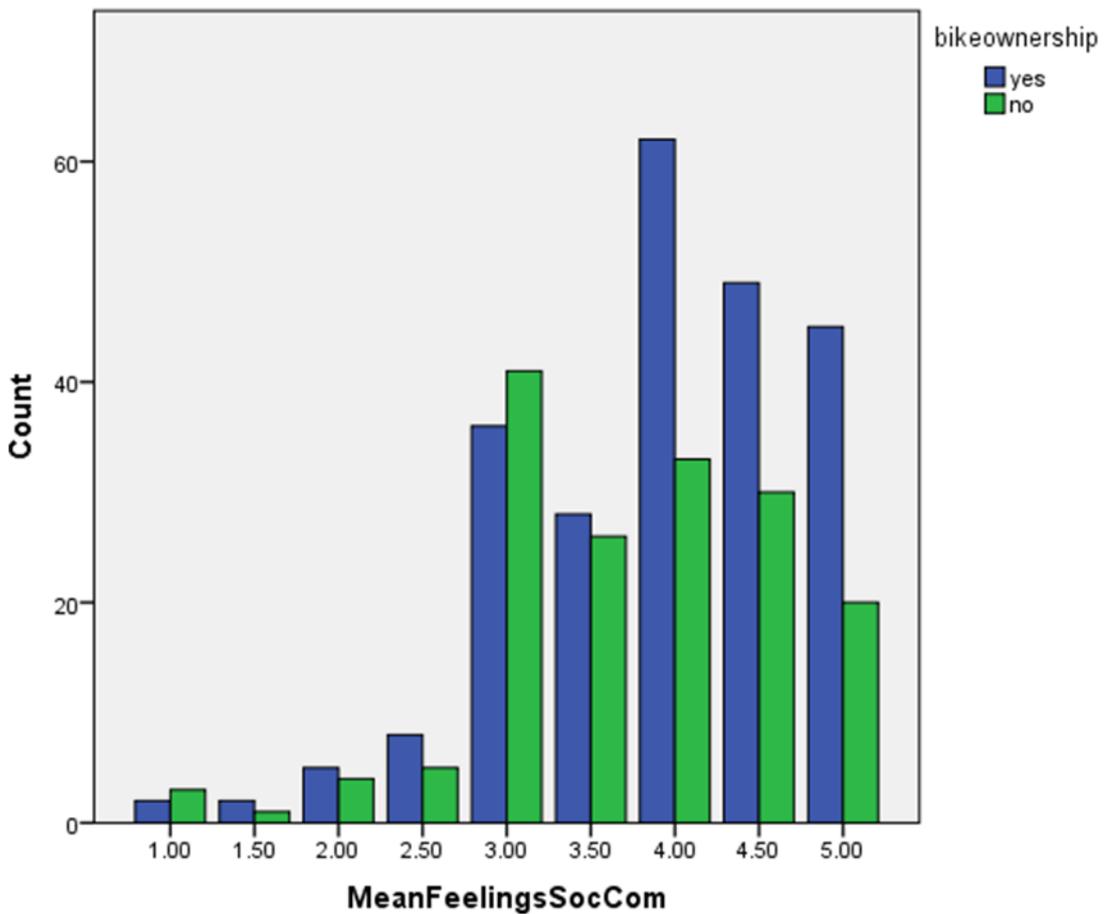
### **Analysis of Feelings from Social Comparison**

#### Feelings from social comparison and bike ownership

The correlation analysis between feelings from social comparison and bike ownership showed that there was a small negative correlation between the two variables,  $r = -.12$ ,  $n = 400$ ,  $p = 0.010$ .

An independent-samples t-test was conducted to compare feelings from social comparison and bike ownership. There was a significant

difference in the scores for people owning a bicycle ( $M=3.94$ ,  $SD=.843$ ) and people not owning a bicycle ( $M=3.71$ ,  $SD=.869$ );  $t(398)=2.591$ ,  $p = 0.010$ . These results suggest people owning a bicycle have a stronger feelings from social comparison, than people who do not own a bike. However, this construct had a very low internal consistency thus, results should be taken with caution.

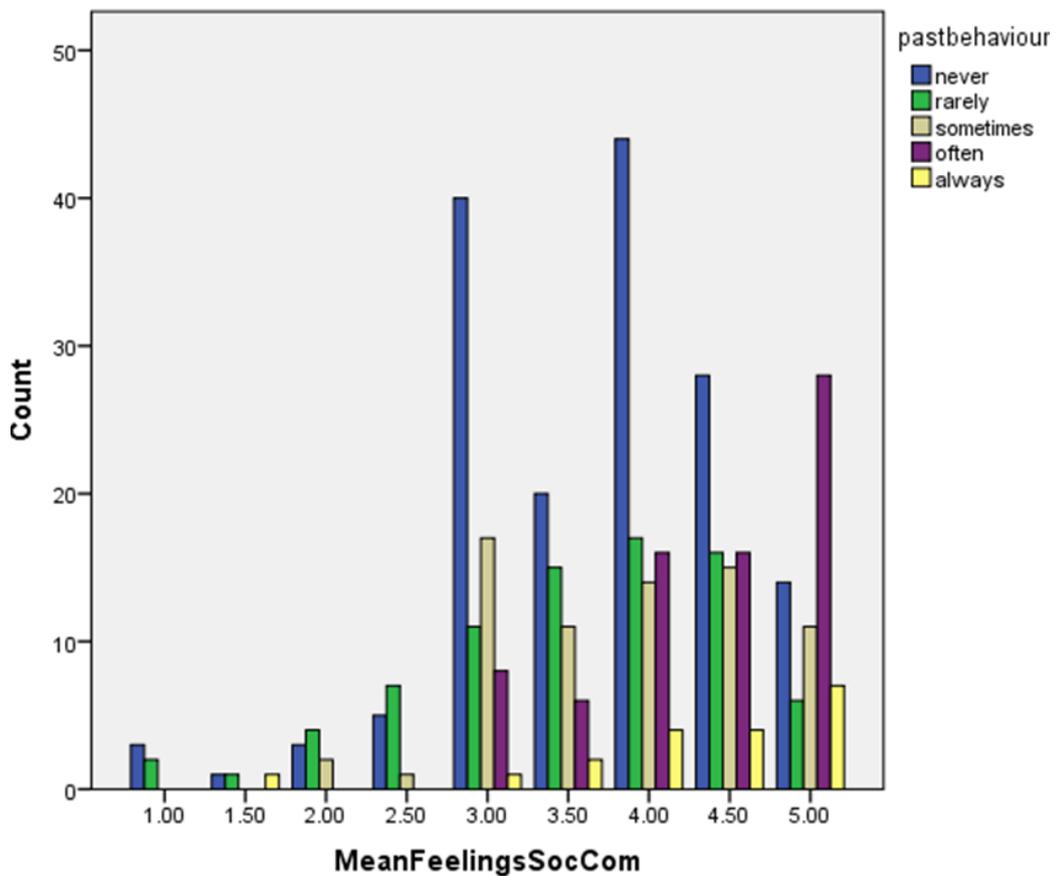


**Figure 121 Mean feelings from social comparison and bike ownership**

Feelings from social comparison and past behaviour

The correlation analysis between feelings from social comparison and past behaviour showed that there was a positive correlation between the two variables,  $r = .26$ ,  $n=401$ ,  $p=0.001$ . There was a statistically significant difference between the different studies in the sample as determined by one-way ANOVA ( $F(4, 396) = 10.638$ ,  $p =$

.001). Post hoc comparisons using the Bonferroni test indicated that the mean score of the respondents that travel by bicycle often (M=4.33, SD=0.672) were statistically significant different from the people travel sometimes (M=3.86, SD=0.788), rarely (M=3.60, SD=0.935) or never (M=3.70, SD=0.831). The same test indicated that the mean score of the respondents that travel by bicycle rarely (M=3.60, SD=0.935) were statistically significant different from the people travel always (M=4.23, SD=0.903). This suggest that the people travel more by bicycle have stronger feelings from social comparison than people that cycle less frequently. However, due to the low internal consistency of the construct. This results should be taken with caution.



**Figure 122 Mean of feeling from social comparison and past behaviour**

### Feelings from social comparison and studies

The correlation analysis between feelings from social comparison and studies showed that there was a small positive correlation between the two variables,  $r = .10$ ,  $n = 401$ ,  $p = 0.030$ . There was a statistically significant difference between the feelings from social comparison and different studies in the sample as determined by one-way ANOVA ( $F(4, 396) = 2.975$ ,  $p = .019$ ). Post hoc comparisons using the Bonferroni test indicated that the mean score of the respondents that have technical or commercial studies ( $M = 3.47$ ,  $SD = 0.912$ ) were statistically significant different from the people with university ( $M = 3.91$ ,  $SD = 0.824$ ) and post-degrees ( $M = 4.00$ ,  $SD = 0.918$ ). These results suggest that people with higher education have stronger feelings from social comparison.

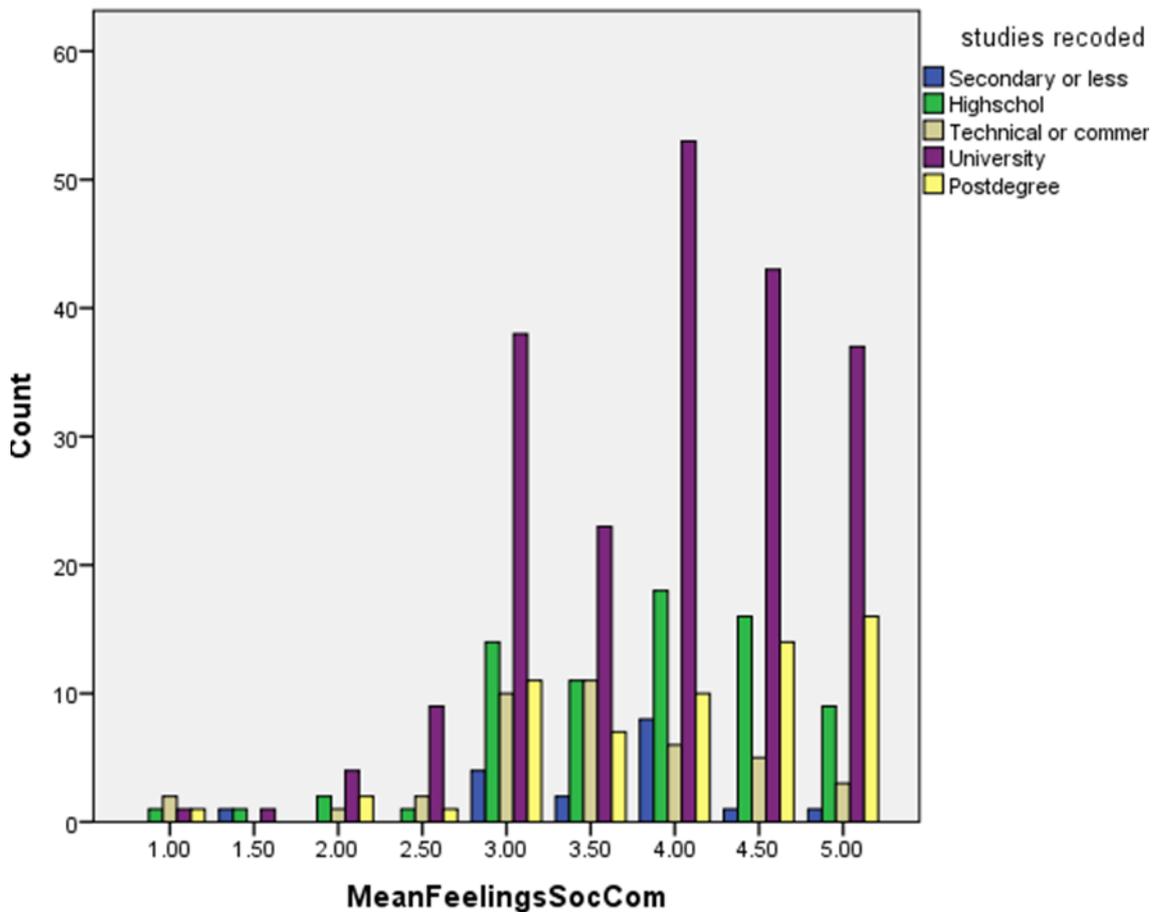


Figure 123 Mean of feelings from social comparison and studies

There was not relationship between the Feelings from Social Comparison and age ( $r=-.005$ ,  $n=383$ ,  $p=.915$ ); gender ( $r=-0.074$ ,  $n=401$ ,  $p=.137$ ); occupation ( $r=-.035$ ,  $n=400$ ,  $p=.486$ ); income ( $r=.030$ ,  $n= 401$ ,  $p= .553$ ); and travel time ( $r=-.028$ ,  $n=394$ ,  $p=.580$ ).

### Analysis of Affective motives

#### Affective Motives and bike ownership

The correlation analysis between Affective Motives and bike ownership showed that there was a negative correlation between the two variables,  $r=-.26$ ,  $n=400$ ,  $p= 0.001$ . An independent-samples t-test was conducted to compare affective motives and bike ownership. There was a significant difference in the scores for people owning a bicycle ( $M=3.81$ ,  $SD=.782$ ) and people not owning a bicycle ( $M=3.37$ ,  $SD=.806$ );  $t(398)=5.484$ ,  $p = 0.001$ . These results suggest people owning a bicycle have a stronger affective motivations associated to the use of bicycle than those without a bicycle

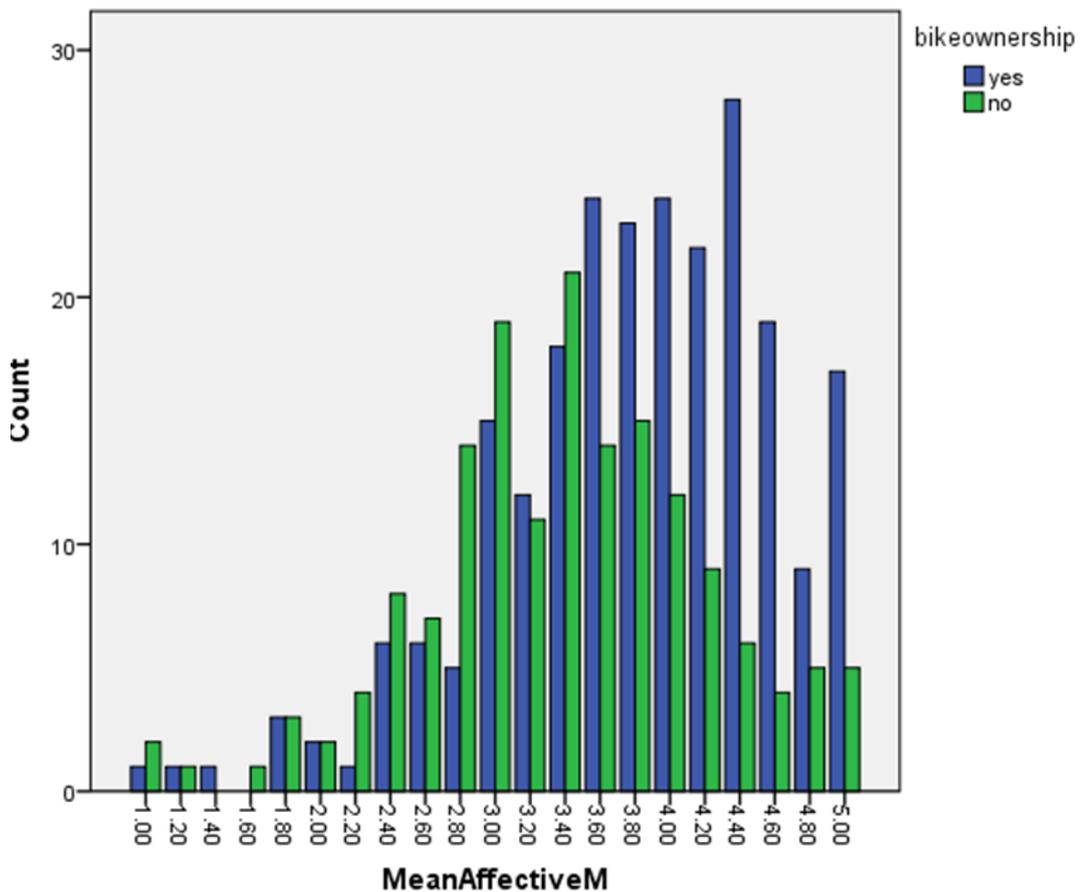


Figure 124 Mean of affective motives and bike ownership

### Affective motives and past behaviour

The correlation analysis between Affective Motives and bike ownership showed that there was a strong positive correlation between the two variables,  $r=-.44$ ,  $n=401$ ,  $p=0.001$ . There was a statistically significant difference between Affective motives and past behaviour in the sample as determined by one-way ANOVA ( $F(4, 396) = 24.997$ ,  $p = .001$ ). Post hoc comparisons using the Bonferroni test indicated that the mean score of the respondents never ( $M=3.30$ ,  $SD=0.810$ ) or rarely ( $M=3.45$ ,  $SD=0.731$ ) use the bicycle were statistically significant different from the people that cycle sometimes ( $M=3.80$ ,  $SD=0.724$ ); often ( $M=4.20$ ,  $SD=0.553$ ) and always ( $M=4.33$ ,  $SD=0.794$ ). This suggest that people that cycle more frequently have stronger affective motivations towards the use of bicycle.

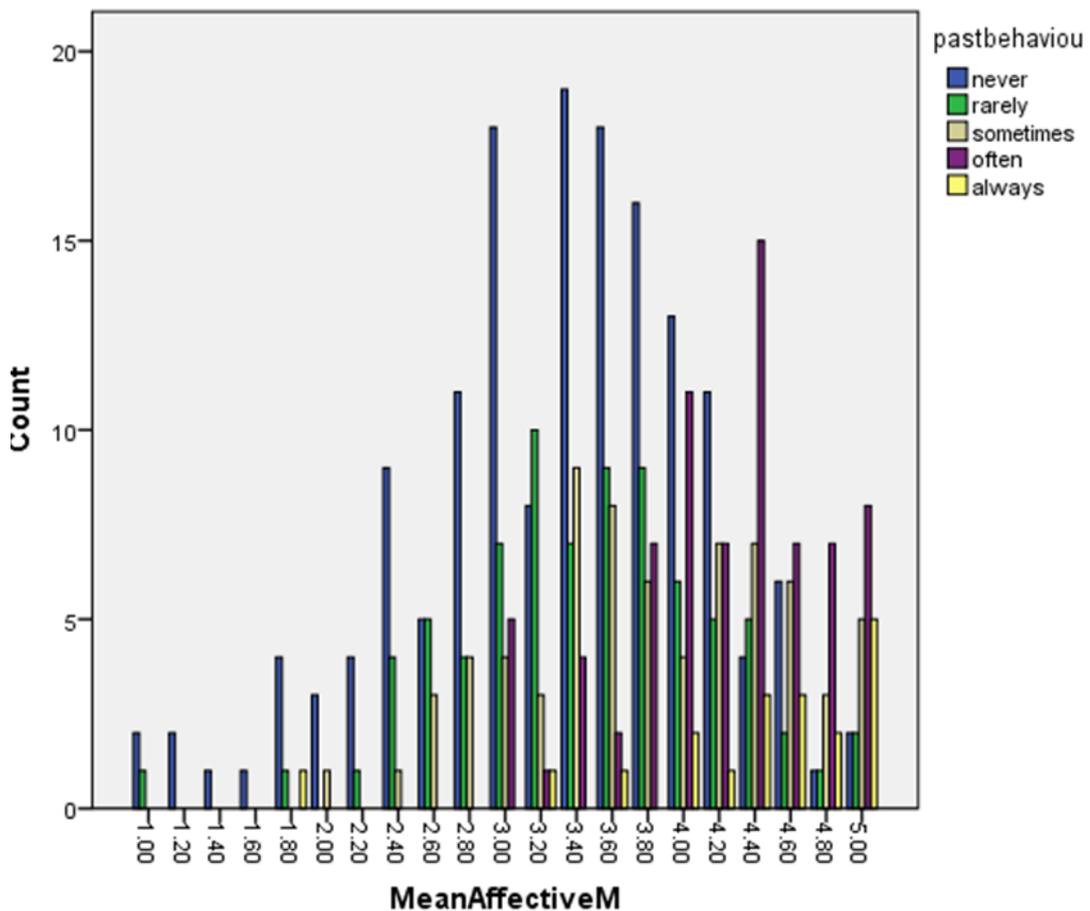


Figure 125 Mean of Affective motives and past behaviour

There was not relationship between the Affective motives and age ( $r=-.071$ ,  $n=383$ ,  $p=.163$ ); gender ( $r=-0.051$ ,  $n=401$ ,  $p=.306$ ); studies ( $r=0.093$ ,  $n=401$ ,  $p=.064$ ); occupation ( $r=.005$ ,  $n=400$ ,  $p=.913$ ); income ( $r=-.069$ ,  $n=401$ ,  $p=.165$ ); and travel time ( $r=.010$ ,  $n=394$ ,  $p=.837$ ).

### Analysis of Instrumental motives

#### Instrumental Motives and bike ownership

The correlation analysis between Instrumental Motives and bike ownership showed that there was a negative correlation between the two variables,  $r=-.20$ ,  $n=400$ ,  $p=0.001$ . An independent-samples t-test was conducted to compare instrumental motives and bike ownership. There was a significant difference in the scores for people owning a bicycle ( $M=3.72$ ,  $SD=.714$ ) and people not owning a bicycle ( $M=3.42$ ,  $SD=.707$ );  $t(398)=4.164$ ,  $p=0.001$ . These results suggest people owning a bicycle have a stronger instrumental motivations associated to the use of bicycle than those without a bicycle.

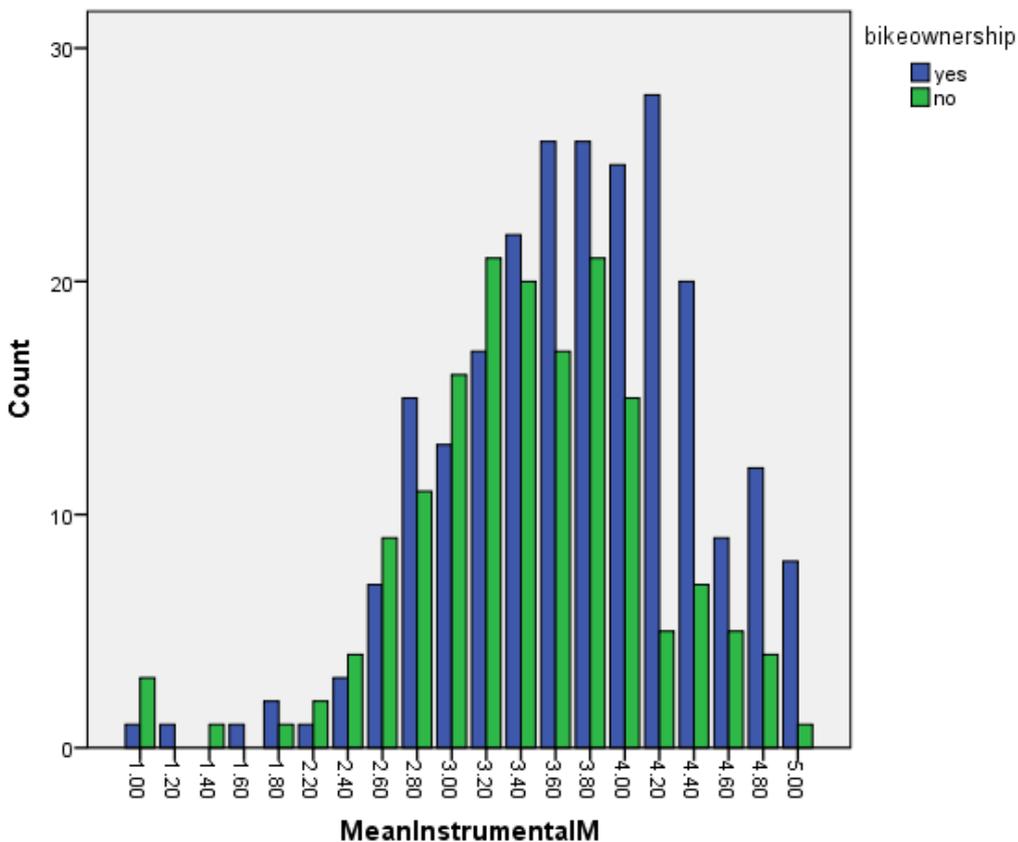


Figure 126 Mean of Instrumental Motives and bike ownership

### Instrumental Motives and past behaviour

The correlation analysis between Instrumental Motives and bike ownership showed that there was a strong positive correlation between the two variables,  $r=.41$ ,  $n=401$ ,  $p=0.001$ . There was a statistically significant difference between Affective motives and past behaviour in the sample as determined by one-way ANOVA ( $F(4, 396) = 20.992$ ,  $p = .001$ ). Post hoc comparisons using the Bonferroni test indicated that the mean score of the respondents never ( $M=3.31$ ,  $SD=0.714$ ) or rarely ( $M=3.46$ ,  $SD=0.684$ ) use the bicycle were statistically significant different from the people that cycle sometimes ( $M=3.77$ ,  $SD=0.618$ ); often ( $M=4.06$ ,  $SD=0.514$ ) and always ( $M=4.08$ ,  $SD=0.784$ ). This suggest that people that cycle more frequently have stronger instrumental motivations towards the use of bicycle.

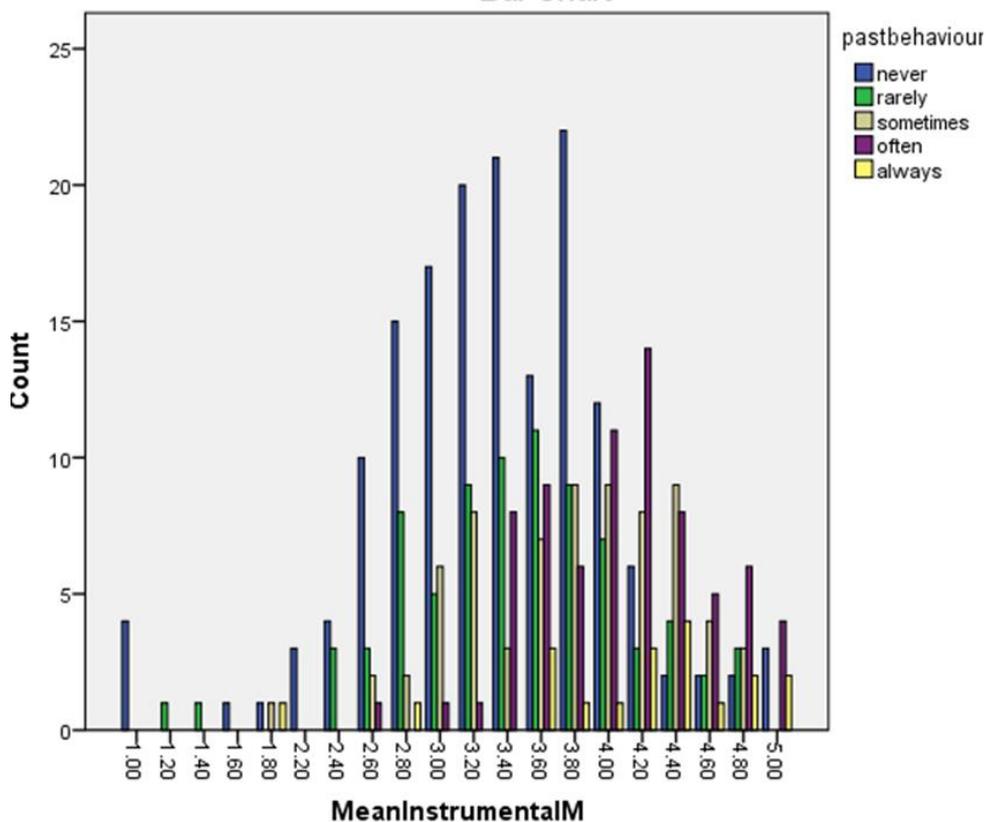


Figure 127 Mean of the Instrumental Motives and past behaviour

There was not relationship between the instrumental motives and age ( $r=-.028$ ,  $n=383$ ,  $p=.584$ ); gender ( $r=-0.081$ ,  $n=401$ ,  $p=.103$ ); studies ( $r=0.051$ ,  $n=401$ ,  $p=.305$ ); occupation ( $r=-.047$ ,  $n=400$ ,  $p=.345$ ); income ( $r=-.052$ ,  $n=401$ ,  $p=.302$ ); and travel time ( $r=-.042$ ,  $n=394$ ,  $p=.407$ ).

### **Analysis of Symbolic Motives**

#### Symbolic Motives and bike ownership

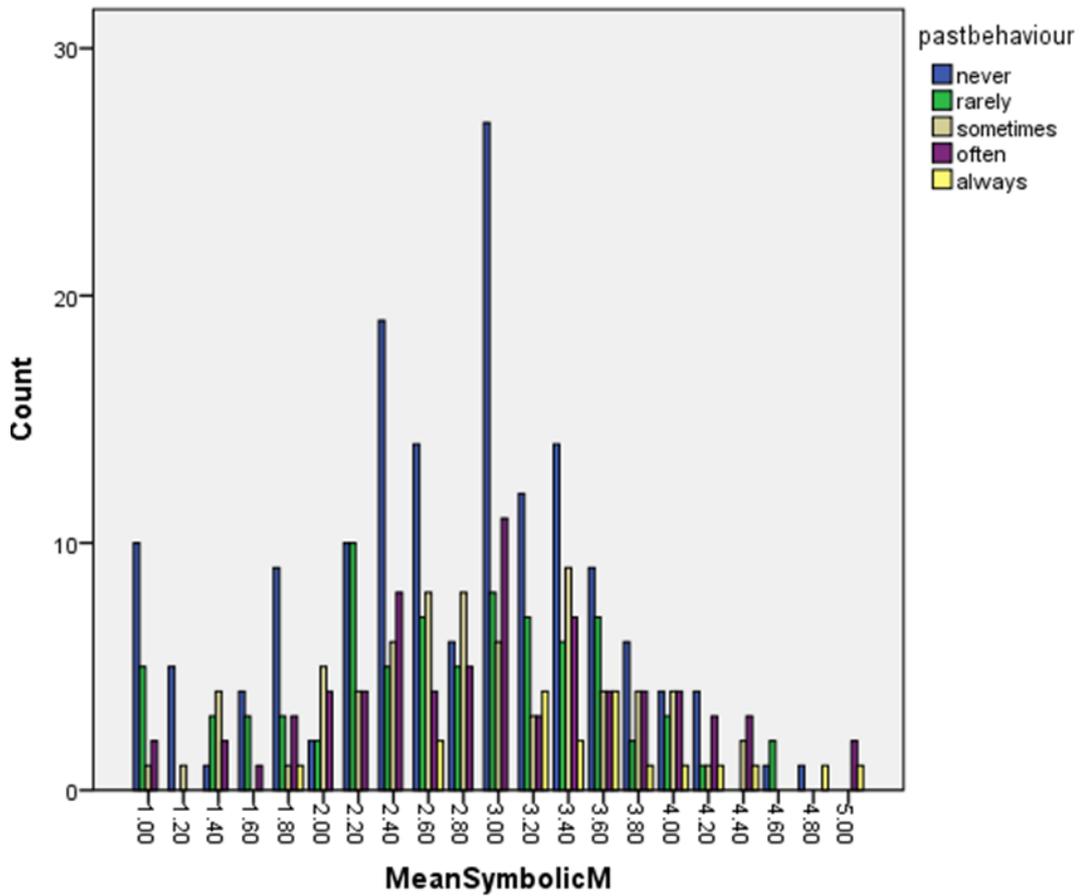
The correlation analysis between Symbolic Motives and bike ownership showed that there was very little negative correlation between the two variables,  $r=-.09$ ,  $n=400$ ,  $p=0.050$ .

An independent-samples t-test confirmed that the difference between the symbolic motives and bike ownership was very small. The scores from people owning a bicycle ( $M=2.89$ ,  $SD=.878$ ) and people not owning a bicycle ( $M=2.72$ ,  $SD=.816$ );  $t(398)=1.964$ ,  $p=0.050$ . The relationship between the two variables cannot be clearly established.

#### Symbolic Motives and past behaviour

The correlation analysis between Symbolic Motives and past behaviour showed that there was very small positive correlation between the two variables,  $r=.18$ ,  $n=400$ ,  $p=0.001$ .

There was a statistically significant difference between symbolic motives and past behaviour in the sample as determined by one-way ANOVA ( $F(4, 396) = 5.009$ ,  $p=.001$ ). Post hoc comparisons using the Bonferroni test indicated that the mean score of the respondents that always ( $M=3.31$ ,  $SD=0.714$ ) use the bicycle were statistically significant different from the people that cycle sometimes ( $M=2.85$ ,  $SD=0.790$ ); often ( $M=2.97$ ,  $SD=0.884$ ) and never ( $M=2.71$ ,  $SD=0.836$ ). This suggest that people that cycle more frequently have stronger symbolic motivations towards the use of bicycle.



**Figure 128 Mean of symbolic motives and past behaviour**

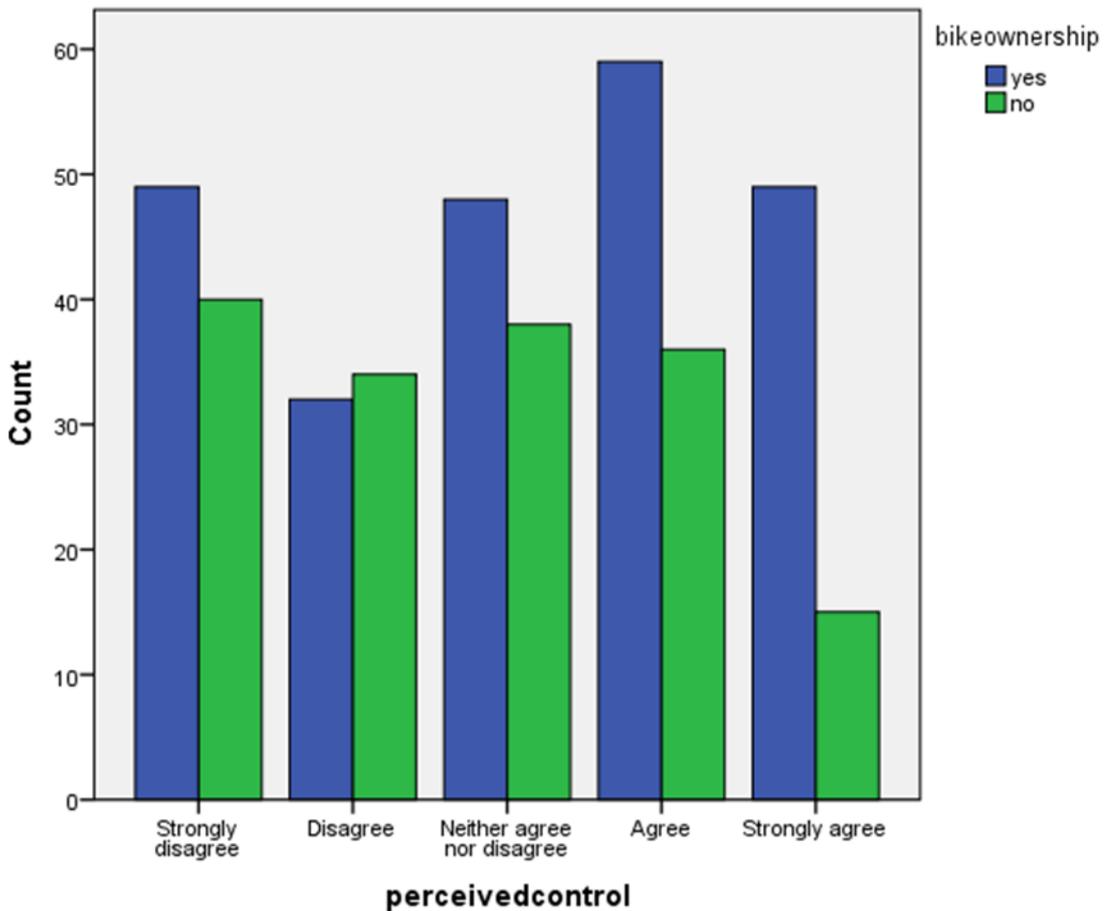
There was not relationship between the instrumental motives and age ( $r=-.089$ ,  $n=383$ ,  $p=.083$ ); gender ( $r=-0.063$ ,  $n=401$ ,  $p=.208$ ); studies ( $r=0.030$ ,  $n=401$ ,  $p=.554$ ); occupation ( $r=-.038$ ,  $n=400$ ,  $p=.451$ ); income ( $r=.067$ ,  $n=401$ ,  $p=.183$ ); and travel time ( $r=.037$ ,  $n=394$ ,  $p=.463$ ).

### **Analysis of Perceived Behavioural Control**

Perceived behavioural control and bike ownership

There was a small negative correlation between perceived control and bike ownership variables,  $r=-.14$ ,  $n=400$ ,  $p=0.004$ .

A paired-sample t-test was conducted to compare perceived behavioural control for people owning or not a bicycle. There was statistically significant difference between bicycle owners ( $M=3.11$ ,  $SD=1.426$ ) and people no owning a bicycle ( $M=2.71$ ,  $SD=1.305$ ) as determined by  $t(398) = 2.913$ ,  $p = 0.004$ . This suggest that people not owning a bicycle have a weaker perceived behavioural control over cycling.



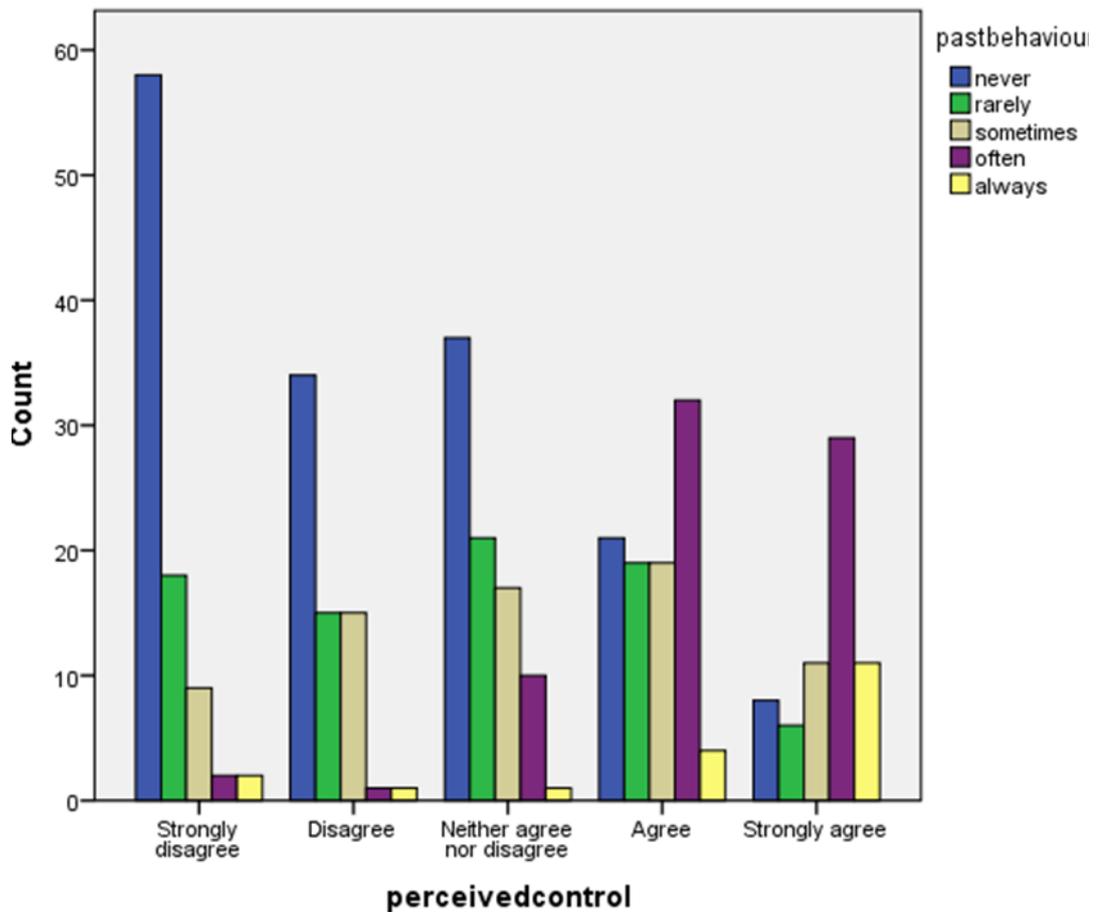
**Figure 129 Perceived behavioural control and bike ownership**

Perceived behavioural control and past behaviour

There was a strong positive correlation between perceived control and past behaviour variables,  $r=.50$ ,  $n=401$ ,  $p=0.001$ .

There was a statistically significant difference between perceived control and past behaviour variables in the sample as determined by one-way ANOVA ( $F(4, 396) = 35.94$ ,  $p = .0001$ ). Post hoc

comparisons using the Bonferroni test indicated that the mean score of the respondents that always (M=4.11, SD=1.370) use the bicycle were statistically significant different from the people that cycle often (M=4.15, SD=0.902); sometimes (M=3.11, SD=1.27); rarely (M=2.75, SD=1.266) and never (M=2.28, SD=1.232). This suggest that people that cycle more frequently have stronger perception of control towards the use of bicycle than people that cycle less frequently.

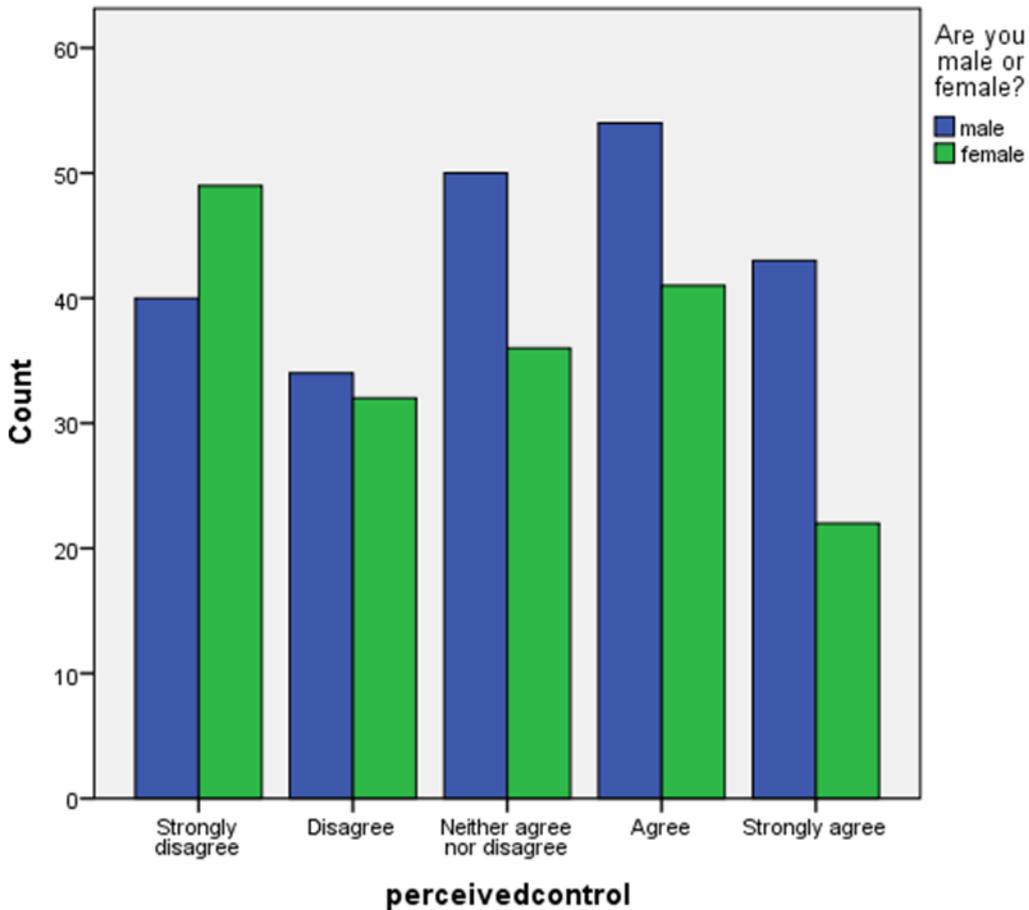


**Figure 130 Mean of Perceived behavioural control and past behaviour**

#### Perceived behavioural control and gender

There was a small negative correlation between perceived control and gender,  $r=-.131$ ,  $n=401$ ,  $p=0.008$ . There was statistically significant difference between male (M=3.12, SD=1.377) and females (M=2.75, SD=1.39) as determined by  $t(399)=2.649$ ,  $p=0.008$ . This

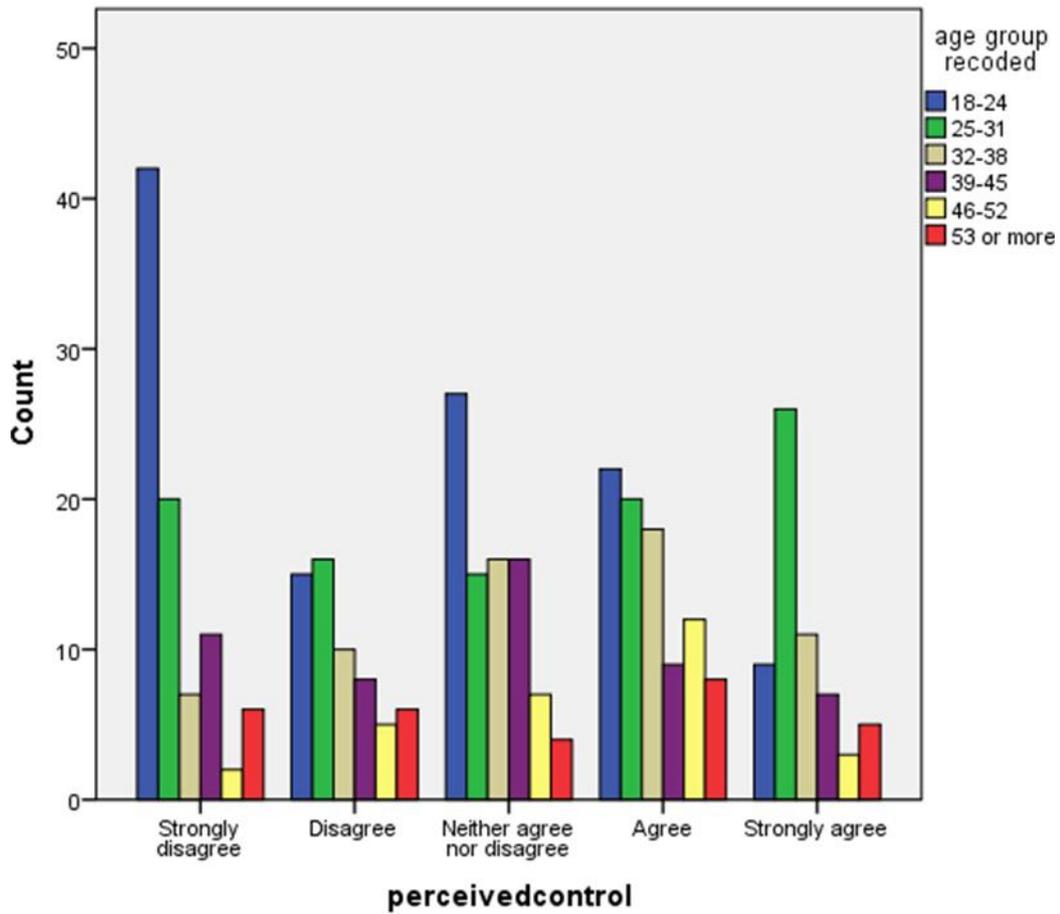
suggest that females have a weaker perceived behavioural control over cycling than males.



**Figure 131 Mean Perceived behavioural control and gender**

Perceived behavioural control and age

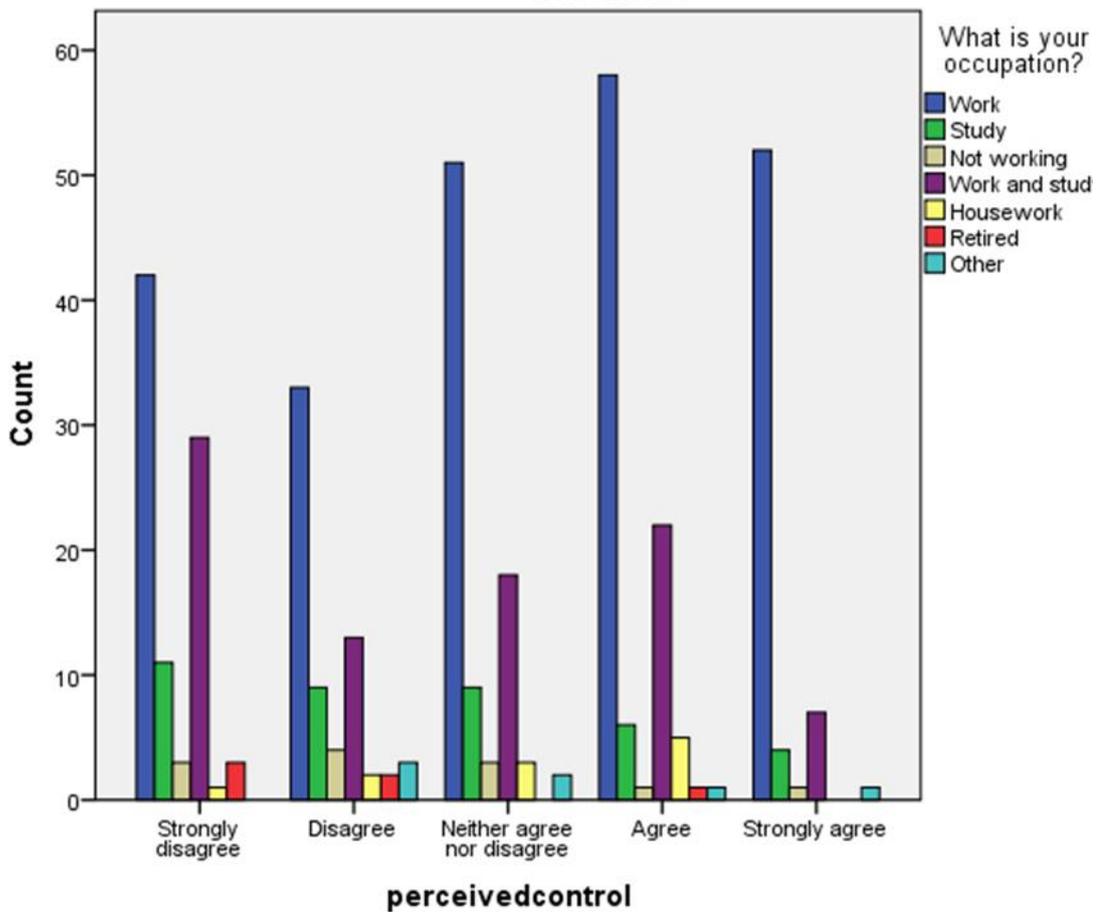
There was a small positive correlation between perceived control and age,  $r=.12$ ,  $n=383$ ,  $p=0.014$ . This was determined by the one-way ANOVA for age ( $F(5,377) = 4.193$ ,  $p = .001$ ). Post hoc comparisons using the Bonferroni test indicated that the mean score of the age group 18-24 ( $M=2.49$ ,  $SD=1.360$ ) was statistically significant different from the age groups 25-31 ( $M=3.16$ ,  $SD=1.505$ ); 32-38 ( $M=3.26$ ,  $SD=1.25$ ) and 46-52 ( $M=3.31$ ,  $SD=1.105$ ). Specifically, this suggest that the youngest age group respondents have weaker perception of control over cycling than the older groups.



**Figure 132 Mean perceived behavioural control and age**

#### Perceived behavioural control and occupation

There was a small negative correlation between perceived control and occupation,  $r = -.16$ ,  $n = 400$ ,  $p = 0.001$ . There was a statistically significant difference from different occupations determined by the one-way ANOVA for occupation ( $F(6,393) = 3.668$ ,  $p = .001$ ). Post hoc comparisons from occupation groups, using the Bonferroni test, indicated that the mean score of the group working ( $M = 3.19$ ,  $SD = 1.397$ ) was statistically significant different from the group working and studying ( $M = 2.61$ ,  $SD = 1.370$ ). This suggests that the group working have stronger perception of control over cycling.



**Figure 133 Mean of Perceived behavioural control and occupation**

### Analysis of Past Behaviour

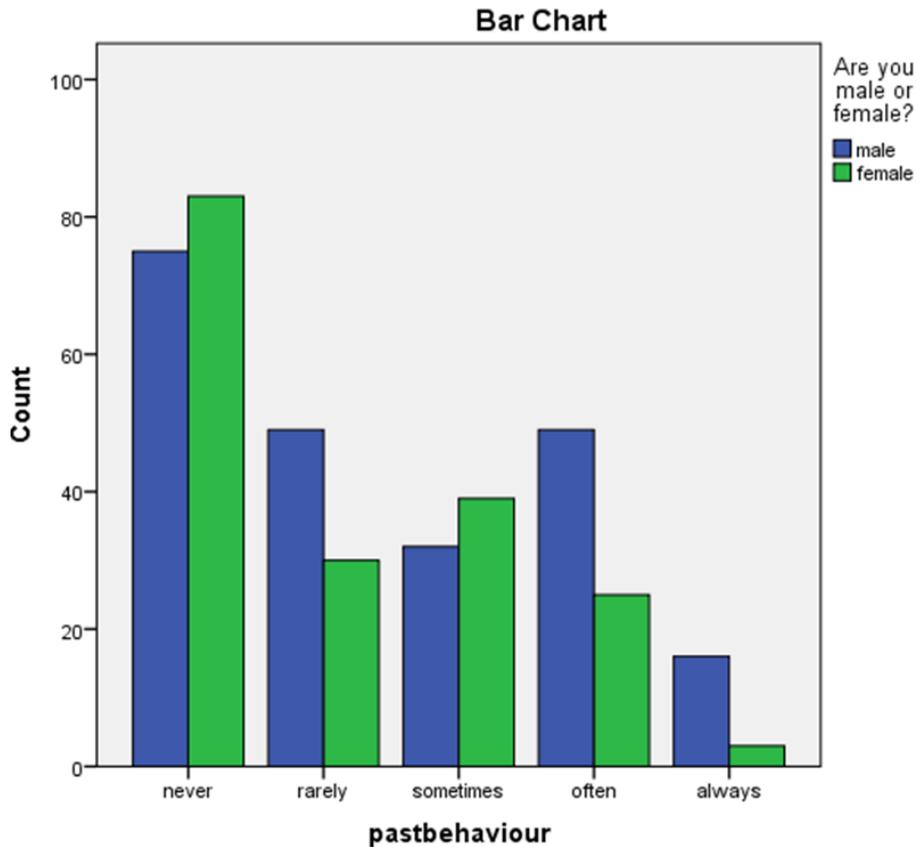
#### Past behaviour and occupation

There was a small negative correlation between past behaviour and occupation,  $r = -.13$ ,  $n = 400$ ,  $p = 0.007$ . Occupation had also statistically significant difference as determined by the ANOVA ( $F(6,393) = 2.126$ ,  $p = .050$ ). However, when carrying out the Post Hoc comparisons, there was not statistically significant differences in the mean.

#### Past behaviour and gender

There was a small negative correlation between past behaviour and gender,  $r = -.14$ ,  $n = 401$ ,  $p = 0.003$ . Regarding gender, there was statistically significant difference between male ( $M = 3.47$ ,  $SD = 1.34$ )

and females ( $M=2.08$ ,  $SD=1.17$ ) as determined by  $t(397) = 3.036$ ,  $p = 0.003$ . This suggest that females have a used a bicycle in the past six months with less frequency than males.



**Figure 134 Mean of past behaviour and gender**

Having finished the analysis of the observed variables the next step is to analyse the relationship between the variables and to develop a structural model to predict intention. In the following section this analysis is explained step by step.

## **5.5 Model Development**

### **5.5.1 Exploratory Factor Analysis (EFA)**

To analyse the relationships between our variables and to identify the minimal number of factors that account for the covariation among the

observed variables according to Byrne (2001) it was carried out the factor analysis (FA).

Before conducting the FA various data requirements must be met. The sample adequacy was checked using the Kaiser-Meyer-Olkin measure. Our sample size (>300) and the KMO=0.879 indicates that the fluctuation in the correlations coefficients provide a reliable factor solution (Beavers et al., 2013). The Bartlett's test of sphericity significant (<0.05) indicate that the correlations between items are appropriate to carry out the analysis. Having checked the data, next step was to conduct the EFA. EFA is an exploratory procedure that allows us to determine the structure of our data (Beavers et al., 2013).

EFA was calculated using maximum likelihood estimation (ML) for the extraction and oblique rotation (promax) on the 32 items. ML was used because it is appropriate for normal distributed data (Beavers et al., 2013), but additionally, because there is an a priori theory from which the hypothesis are based, and the aim is to confirm the factors and test the structural model (Field, 2013). Besides, it allows us to conduct analysis of indexes of the goodness of fit of the structural model (Beavers et al., 2013). Oblique rotation was selected for the analysis because this method allows the observed variables to be correlated (Preacher and MacCallum, 2003). And in this study the factors influencing behavioural intention to cycle are expected to be correlated.

The factor structure was examined to determine the number of factors to retain. A primary analysis was carried out looking at the Kaiser's criterion and the scree test. Eight components had eigenvalues values greater than the recommended criterion of 1 (Field, 2013); however, the scree plot showed a different number of factors to retain (six factors), thus a new analysis was carried out but now with different fixed number of factors (seven and six factors), and factor structures were compared. Exploring the communalities table to detect the common variance across the items and the pattern matrix to look at the cross-loading items it was detected that the

problematic items were those measuring feelings from social comparison and the items from subjective norm that in the last section were reported with very low internal consistency, thus it was determined to delete them as suggested by Osborne and Costello (Osborne and Costello, 2009). This process was done one by one in an iterative process until a clean pattern table was obtained.

**Table 69 Factor Structure from EFA**

**Pattern Matrix<sup>a</sup>**

	Factor				
	1	2	3	4	5
<b>Cronbach's Alpha</b>	<b>.898</b>	<b>.837</b>	<b>.842</b>	<b>.779</b>	<b>.735</b>
intention1	.978				
intention3	.925				
intention2	.821				
perceivedcontrol	.627				
pastbehaviour	.585				
affectivem5		.886			
instrumentm1		.850			
affectivem4		.680			
affectivem3		.487			
affectivem2		.482			
attitud4			.868		
attitud2			.812		
attitud3			.667		
attitud1			.642		
symbolicm2				.806	
symbolicm4				.706	
symbolicm3				.685	
scomp_ori2					.954
scomp_ori1					.572
scomp_ori3					.569

Extraction Method: Maximum Likelihood.

Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

The final factor structure (see pattern matrix Table 69) had five components that in combination explained 57.9% of the variance within the set of data in this study. To proceed with CFA, various construct validity requirements from the EFA were checked.

First, it is checked adequacy with the KMO and Bartlett Test presented above. Then, it was checked for convergent validity, that is checked when the variables loading in a single factor are highly correlated. 'High' depends on sample size, in our case (>300) acceptable anything >.30 but in the literature it is mentioned as preferable to have loadings >.50. In the pattern matrix above there are still low loadings such as affectivem2 and affectivem3 loading with lower values but this was addressed in the CFA. Discriminant validity which means whether there are not cross loadings. Looking at the factor correlation matrix there were explored correlations between the factors greater than .70. Not correlation was found between the factors which means that the factors are not highly correlated (see Table 4). Reliability was assessed looking at the Cronbach alpha to check the internal consistency. This was achieved with an alpha >0.7 for each factor. Table 78 reports the Cronbach's alpha and the name of each factor. The names were assigned after identifying common themes when looking at the content of the items loading onto the same factor.

**Table 70 Factor name and Cronbach alpha**

	Factor name	Items	Cronbach's alpha
1	Cycling habits and intention	intention1 intention2 intention3 Pastbehaviour percivecontrol	0.898
2	Cycling attributes	Affective5 Affective4 Affective3 Affective2 Instrumentm1	0.837
3	Attitudes to cycling	Attitud1 Attitud2 Attitud3 Attitud4	0.842
4	Social image and prestige	Symbolicm2 Symbolicm3 Symbolicm4	0.779
5	Social Comparison	scomp_ori1 scomp_ori2 scomp_ori3	0.735

Before modelling the interrelationships in the structural model (SEM) the latent constructs should be examined for unidimensionality (factor loadings for each latent construct to be >0.5), validity (checking that the items effectively are measuring the construct for this, three types of validity should be achieved, these are convergent, construct and discriminant) and reliability (this is how reliable the model is at measuring the constructs, which are assessed by internal reliability, composite reliability and average variance explained) (Awang, 2012). This allow us to confirm the EFA structure and it is done by carrying out the Confirmatory Factor Analysis (CFA).

### **5.5.2 Confrmatory Factor Analysis (CFA)**

The CFA was run with all the variables at the same time (Pooled-CFA) as suggested by Awang (2012). This model consisted of the five latent constructs and 20 items. Unidimensionality was achieved having all measuring items loading with values >0.5 (except one item from attributes to cycle that further is addressed and reported in

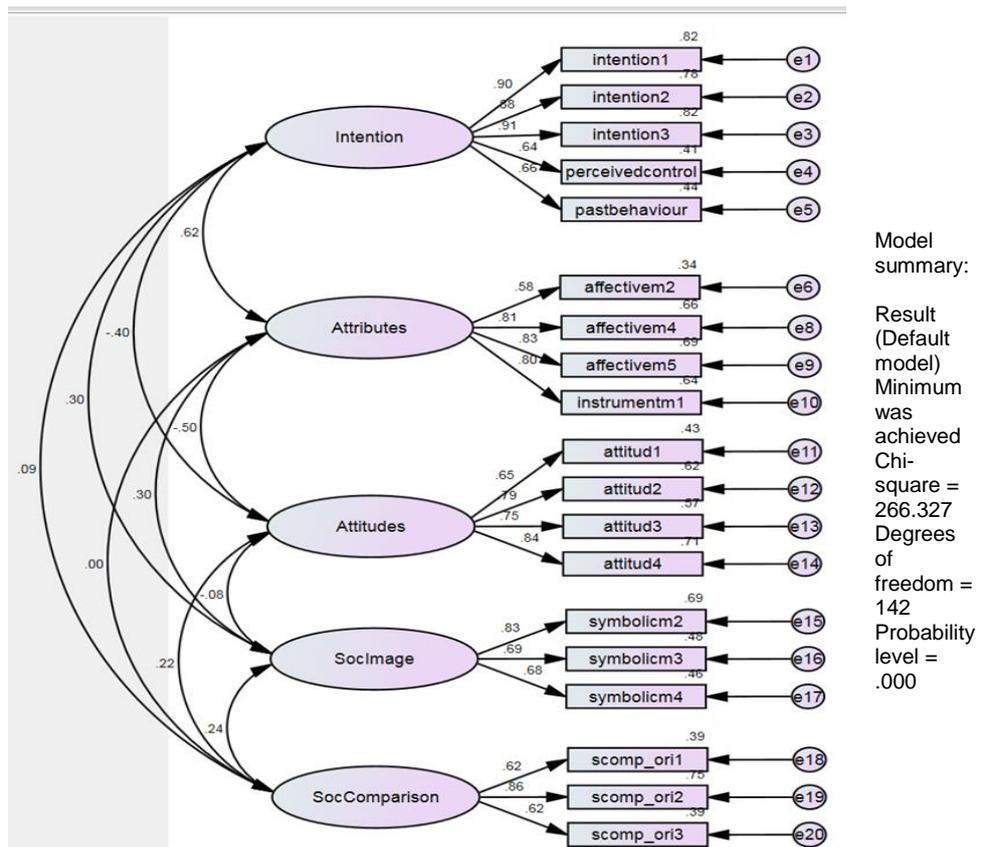
Table 70). Convergent validity was assessed with the average percentage of the variation (AVE) higher than 0.5. Discriminant validity was assessed looking at the Modification Indices. The covariances table showed that two indices from the attributes to cycle seemed to be very similar (having a covariance of 35.26 they were considered redundant). The remedy suggested was to covary the error terms in both items (Kenny, 2011); however, one of these items had factor loading  $< 5$ , and thus, this was deleted (see Table 71).

After, the **construct validity** was checked looking at the values from the Fitness Indexes. Absolute fit values were RMSEA=0.047 and GFI=0.933. The incremental fit indexes were AGFI=0.910; CFI=0.966; TLI=0.959 and NFI=0.931. The Chi-square/df from the parsimonious fit was 1.876. Finally, to assess reliability (internal consistency) of the latent constructs the Cronbach's alpha was assessed, obtaining a value  $> 0.8$  (see Table 71). The composite reliability was calculated, which achieved a value  $> 0.6$  for all the constructs. Thus in summary, the required levels of unidimensionality, validity and reliability were achieved with good model fit, based on the levels of acceptance reported in Awang (2012), and this demonstrates that the measurement model with five factors and 19 items had a good fit for the 401 sample size, and that is possible to proceed with analysis.

**Table 71 Report from the CFA**

	Construct	Items	Factor Loadings*	CR	AVE	Cr. Alpha
1	Cycling habits and intention	intention1	0.903	0.903	0.655	0.898
		intention2	0.885			
		intention3	0.907			
		Pastbehaviour	0.643			
		percivecontrol	0.662			
2	Cycling Attributes	Affective2	0.579	0.845	0.582	0.84
		Affective3	Deleted			
		Affective4	0.812			
		Affective5	0.831			
		Instrumentm1	0.801			
3	Attitudes to cycle	Attitud1	0.654	0.847	0.582	0.842
		Attitud2	0.789			
		Attitud3	0.752			
		Attitud4	0.843			
4	Social image and prestige (SocImage)	Symbolicm2	0.83	0.781	0.545	0.779
		Symbolicm3	0.695			
		Symbolicm4	0.681			
5	Social Comparison (SocComparison)	scomp_or1	0.625	0.752	0.509	0.735
		scomp_or2	0.865			
		scomp_or3	0.623			

\*Standardized Regression Weights



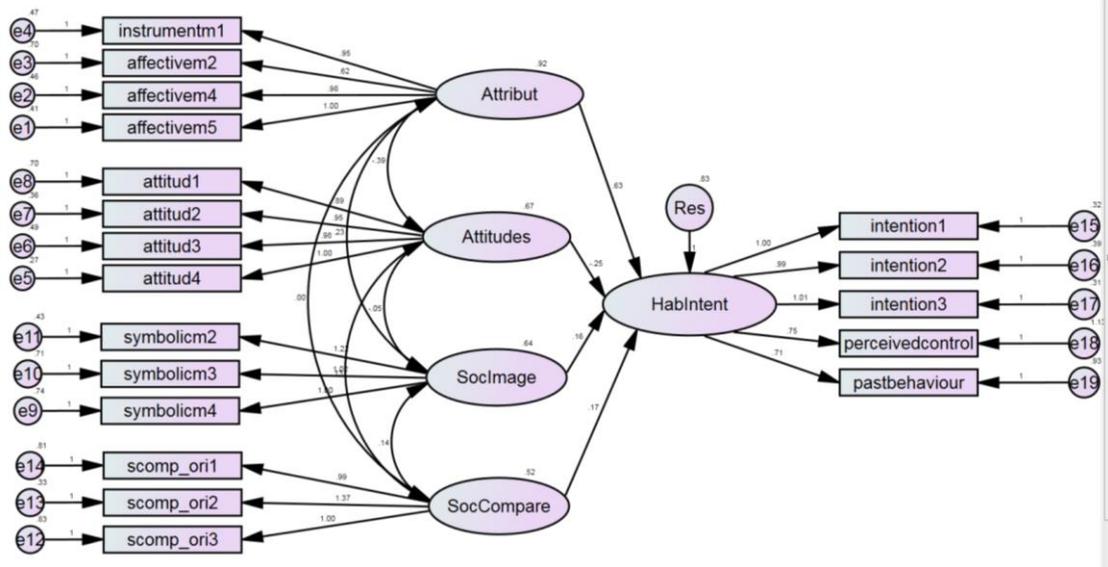
**Figure 135 Measurement Model and model summary**

### **5.5.3 Testing Invariance**

Before developing the SEM, configural and metric invariance across gender were checked. The configural invariance test with no constraints in the model provided an adequate goodness of fit across gender groups (RMSEA=0.034; GFI=0.902; AGFI=0.868; CFI=0.964 and standardized RMR=0.055). The metric invariance test showed no statistically significant difference in the measures across the groups ( $\Delta\chi^2=18.2$ ,  $\Delta df=19$ ;  $p<0.509$ ).

### **5.5.4 Structural Equation Model (SEM)**

The SEMs had been applied in travel behaviour analysis since the 1980s (Golob, 2003) and this analysis is important because it helps to determine whether the model is robust enough (Kline, 2011), this means if the model fits the data. Another advantage for using the SEM for this study is the distinction between observed (or manifested) variables; latent variables (hypothetical constructs or factors) and error terms (Kline, 2011). Based on the theoretical framework (see Figure 1 Chapter One), it was specified the schematic diagram with the exogenous variables (independent) on the left side of the model and the endogenous on the right side (intention to cycle as dependent variable on the attributes to cycle, attitudes towards cycling, social image and social comparison). Figure 136 shows the schematic diagram of the SEM.



Minimum was achieved  
 Chi-square = 266.327  
 Degrees of freedom = 142  
 Probability level = .000

**Figure 136 Schematic diagram of the SEM**

The estimated regression weights (Table 72 below) showed direct effect the exogenous constructs in the endogenous one. All p-values were statistically significant, however it should be noted that the values from social comparison and social image are low. The correlation estimate for each pair of exogenous constructs (to explore the strength of the relationship between the latent constructs) had low correlation, thus, discriminant validity is achieved indicating that the constructs are sufficiently correlated without being redundant. The squared multiple correlation (estimate R²) for the variable intention is 0.421, which means that the predictors of intention explain 42% of its variance.

**Table 72 Regression weights from the SEM**

Construct		Construct	Est.	S.E	C.R	P*
Habits & Intention	<	attributes	0.629	0.077	8.213	***
Habits & Intention	<	Attitudes	-0.248	0.084	-2.953	0.003
Habits & Intention	<	Sociimage	0.157	0.079	2.000	0.045
Habits & Intention	<	Socompari s	0.173	0.085	2.047	0.041

\*P-value of \*\*\* indicate < 0.001

After determining the model, all constructs scores were analysed with socio-demographic variables.

### 1. Cycling attributes

A paired-sample t-test was conducted to compare the mean scores of the cycling attributes for car and non-car users. There was a statistically significant difference in the scores for car users ( $M=3.54$ ,  $SD=.907$ ) and non-car users ( $M=3.74$ ,  $SD=.935$ );  $t(399)=-2.187$ ,  $p=0.029$ . These results suggest that being a car user has an effect on the cycling attributes. Specifically, this suggest that car users see less attributes on cycling than non-car users. The paired-sample t-test to compare cycling attributes for gender was no significant as determined by the  $t(399)=.776$ ,  $p=.438$ .

There was not statistically significant difference between the other groups as determined by one-way ANOVA for age ( $F(5,377) = 0.515$ ,  $p = .765$ ); income ( $F(4,396) = 1.093$ ,  $p = .360$ ); residency ( $F(6,340) = .768$ ,  $p = .595$ ) and education ( $F(4,396) = 1.412$ ,  $p = .229$ )

### 2. Attitudes to cycling

In section two, it was already reported that there was not statistically significant difference between groups as determined by t-test for gender  $t(399) = 1.018$ ,  $p = 0.309$  neither for car users  $t(399) = 0.508$ ,  $p = 0.612$ . For the rest of the groups there was not statistically significant difference between groups as determined by one-way ANOVA for age ( $F(5,377) = .410$ ,  $p = .842$ ), income ( $F(4,396) = 0.216$ ,  $p = .930$ ), residence ( $F(6,340) = .557$ ,  $p = .765$ ) and education ( $F(4,396) = .736$ ,  $p = .568$ ).

### 3. Social image and prestige

The paired-sample t-test from car usage and gender showed no statistically significant difference as determined by the  $t(399) = 1.044$ ,  $p=.297$  and  $t(399) = 1.044$ ,  $p=.297$  respectively. The ANOVA of gender showed statistically significant difference as determined by  $F(5,377) = 3.389$ ,  $p= .005$ . Post hoc comparisons using the Bonferroni test indicated that the mean score of the group aged 25-

31 ( $M=3.15$ ,  $SD=.987$ ) was statistically significant different from the age group of 53 or more ( $M=2.32$ ,  $SD=.847$ ). This specifically, this suggest that respondents aged 53 or older have weaker feeling of social image and prestige associated with the use of bicycle.

#### 4. Social comparison

The construct of social comparison as used in the model, had three items and is the same as it was analysed in the section two. So the results are the same. No statistically significant difference between groups as determined by t-test for gender  $t(399) = 0.354$ ,  $p = 0.724$  neither for car users  $t(399) = -.141$ ,  $p = 0.888$ . There was neither statistically significant difference between groups as determined by one-way ANOVA for age ( $F(5,377) = .831$ ,  $p = .453$ ), income ( $F(4,396) = 1.465$ ,  $p = .212$ ), residence ( $F(6,340) = .484$ ,  $p = .820$ ) and education ( $F(4,396) = 1.227$ ,  $p = .299$ ).

Finally, to predict the contribution of cycling attributes, attitudes to cycle, social image and social comparison to the total variance in the intention it was carried out Hierarchical Multiple Regression (HMR) that it is in the following section.

### **5.5.5 Hierarchical Multiple Regression (HMR)**

Before conducting the HMR, it was checked for the existence of linear relationship between the independent variables and the dependent variable. It was conducted first lineal regression. Although the use of SEM is helpful to model latent variables and be able to carry out the analysis with all latent constructs at the same time, however, this analysis was carried out as a way of confirmation of the results and to test the difference in particular about the strength of the independent variables in the dependent and the contribution of each of the latent construct independently.

Social comparison was found not to have a statistically significant linear relationship. Thus, it was not included in the HMR. The overall regression model was a good fit for the data. The exogenous

variables predict the dependent variable and this is a statistically significant relationship. In Table 73, the R<sup>2</sup> for each predictor shows that by adding more variables to the model helped to improve the explained variance. Adding attitudes to the model helped to predict 13.2% of the variance of the intention to cycle. Adding the variable attributes, improved the predicted percentage of variance of intention to cycle to 33.8%. But adding social image had a very low contribution to the explanatory power of the model.

The analysis of the variance shows that the full model of attitudes to cycle, cycling attributes and social image and prestige to predict intention (model 3) was statistically significant. Following are the results from ANOVA: the model with only attitudes to cycle had  $F(1,399)= 67.11, p<0.001$ ; model 2 adding cycling attributes  $F(2,398)= 85.72, p<0.001$  and model 3 adding social image  $F(3,397)= 59.25, p<0.001$ .

**Table 73 Model summary form HMR**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R <sup>2</sup> Change	F Change	df1	df2	Sig. F Change
1	.364 <sup>a</sup>	0.132	0.13	1.049	0.132	60.939	1	399	0
2	.582 <sup>b</sup>	0.338	0.335	0.918	0.206	123.913	1	398	0
3	.592 <sup>c</sup>	0.351	0.346	0.91	0.013	7.647	1	397	0.006
a. Predictors: (Constant), Attitudes									
b. Predictors: (Constant), Attitudes, Attributes									
c. Predictors: (Constant), Attitudes, Attributes, SocialImage									
d. Dependent Variable: HabitsIntention									

## 5.6 Limitations

Three limitations of this study must be mentioned. First, this study is focusing on exploring the factors influencing intention to commute by bicycle for short distances (travelled in not longer than 30 minutes by bicycle on one way). However, a source of bias can be found from the average time travelled because, from the total sample of 401, 42% of the respondents reported commuting in more than 60 minutes. Thus, this respondents face other barriers such as distance and lack of facilities (for instance showers) for choosing cycling to commute than only emotional or affective barriers. This study used

people leaving and working in Mexico City and not being frequent cyclists as a sample. On the other hand, regarding individuals that commute by car, some of them reported an average travel time of 30 minutes (one way) and driving 30 minutes presumes travelling a considerable distance. Therefore, even when this group travel for less than 30 minutes they are taking as baseline traveling by car, thus these individuals not necessarily can cycle to commute for different barriers.

The second limitation is derived from the items measuring attitudes. Following the suggestions in the literature review e.g. (Heise, 1970, Ajzen, 2002) , this construct was measured with semantic differentials. In the questionnaire online two thirds of the respondents answered the first option while the rest did not answer the full question. It was assumed this missing data was not left empty intentionally, because it was associated it to the misunderstanding of the instructions about how to answer. This because from the questionnaires handed face to face, it was noticed that people made the same mistake, thus in this case having noticed the problem with the online questionnaires, the people administering the questionnaire were instructed to review this question and make sure the question was fully answered before collecting back the questionnaire. It was dealt with the missing data in two ways. For the completely unfinished responses, these were deleted. The responses with one, two or three items out of the four not answered were replaced with the mean. This was explained in Chapter Four in the section Data processing and Analytical strategy in missing data.

## **5.7 Summary and Conclusions**

Although in the analysis of the means by the groups there were found some differences, the analysis is not implying any causality. But it helped us to determine the variability of mean scores within each group for each of the latent variables. For instance, it was noticed that social comparison orientation and symbolic motives had no relationship with any other of the independent variables. Feelings

from social comparison, although the results should be taken with caution (due to a low internal consistency), showed that people owning a bicycle or that have used a bicycle in the last six months agree more that they evaluate themselves by engaging into social comparison than people now owning a bicycle or that haven't used one in the last six months. All of this groups had also variability for the feeling of social comparison, but additionally individuals with different level of education.

Regarding intention to cycle, people with their own bicycle and that have cycle in the last six months have stronger intention to cycle. Gender differences showed that men usually working full time have stronger intention than women. Past behaviour have relationship with attitudes, which showed that the more the frequency of cycling the more positive the attitudes; and with subjective norm, showing that people that have used their bicycle in the last six months agree more that they feel social pressure regarding the use of bicycle.

Regarding the role of material possessions shaping individual's identity, the analysis of the correlation showed that affective and instrumental motivations have relationship with past behaviour and bike ownership. For instance, affective and instrumental motivations were stronger in people that have a bicycle and that have cycle in the last six months. From symbolic motivations, there was not established any relationship. Bike ownership and past behaviour also have relationship with perceived behavioural control. Results showed that having a bicycle or having using one in the last six months was related with stronger behavioural control. Regarding gender, men have stronger perceived control, whereas individuals younger than 24 have weaker perception of control.

It was used EFA to analyse the relationships between all the observed variables and to identify the minimal number of factors that account for the covariation among them. The results showed that some observed variables had to be deleted in order to achieve model fit. And a 5 factor model (with 20 observed variables) was designed with the latent variables habits and intention; attitudes to cycling;

cycling attributes, social comparison and social image and prestige. These variables in combination explained the 57.9% of the variance within the set of data. Once the EFA structure was confirmed, the CFA helped us to determine the measurement model, which maintained the five factors but included only 20 observable variables.

To test our hypothesis about the relationships between the variables, from the theoretical framework, it was carried out SEM. The model's squared multiple correlation, of the variable intention, was 0.421, which means that the predictors in the model explain 42% of its variance. Looking closer at the estimated regression weights it was identified that the exogenous constructs, named cycling attributes, attitudes to cycling, social image and prestige and social comparison, had a direct effect on the endogenous construct habits and intention. However, it is important to notice that two constructs (social image and prestige and social comparison) had a very low effect. From the structural model, it was found that the predictors of intention explained 42% of its variance.

Finally, it was carried out analysis to predict the contribution of each one of the exogenous construct to the total variance in the intention. The results indicate that social comparison had no linear relationship with intention. Thus this was excluded from the analysis. The overall regression model resulted in a good fit for the data. The exogenous variables predict the dependent variable and this was a statistically significant relationship. Each predictor added in the model helped to improve the explained variance. Adding attitudes to the model helped to predict 13.2% of the variance of the intention to cycle. Adding the variable attributes, improved the predicted percentage of variance of intention to cycle to 33.8%. However, social image had a very low contribution to the explanatory power of the model. This agrees with earlier analysis, where the estimation of the regression weights showed a very low effect of the same constructs (social image and prestige and social comparison) on habits and intention.

## **Chapter 6**

### **Latent Factors Influencing Intention to Cycle in Mexico City**

#### **6.1 Introduction**

This chapter focuses on the first three of the four research questions that were posed in Chapter One. These three questions have been grouped together here because, while they are different, they are related one to another. The findings related to the fourth research question about attitudinal transport segments are discussed in the next chapter, Chapter Seven. The four research questions guiding this study were laid out in Chapter One, in response to the explanation that, in order to reduce car use for short journeys and promote modal shift towards the use of the bicycle in Mexico City, it is important to explore the perceived image of cycling and cyclists and to investigate whether there is a socio-economic status attached to cycling and whether these factors influence intention to cycle. In Chapter Two, after carrying out the literature review, it was argued that attitudes, the perceived image of cycling, and other socio-psychological factors might play an influential role as key determinants of the choice to cycle or not to cycle in Mexico City. The conclusion of the literature review was that while there is a growing literature studying these phenomena in Europe, in Latin America, and particularly in Mexico City, to the best knowledge of the researcher, there is no empirical evidence addressing this issue. This gap in knowledge was the motivation for this study. With this in mind, after explaining the methodology used to answer the research questions in Chapter Four, in Chapter Five it was carried out the analysis to investigate which factors influence intention to cycle in Mexico City, and this chapter contains the discussion of the findings in the analysis. The three research questions addressed in this chapter are:

Research Question 1: What are the attitudes towards cycling in Mexico City and do they influence intention to cycle?

- Can road users' attitudes towards cycling be measured?
- Are attitudes influencing individuals' intention to cycle or not to cycle?

Research Question 2: What is the perceived image or identity attached to cycling and cyclists in Mexico City and does it influence intention?

- Can the perceived image of cycling be measured?
- To what extent does the perceived image of cycling influence individuals' choice to cycle or not to cycle in Mexico City?

Research Question 3: What other socio-psychological factors influence intention to cycle in Mexico City?

- Is there a socio-economic status attached to the image of cycling and cyclists?
- What other affective and symbolic factors might influence commuting by bicycle in Mexico City?

This chapter is organized as follows. The second part discusses the findings of research question one, about attitudes influencing intention to cycle. The third section discusses the findings of research question two, about perception influencing intention. The fourth section contains the discussion about other socio-psychological factors influencing intention. The fifth section contains a general discussion of the findings from the three research questions. Section six explains the limitations of this study. The final section contains the conclusion of the chapter.

## **6.2 Attitudes Influencing Behavioural Intention to Cycle**

This section aims to answer research question one: What are the attitudes towards cycling in Mexico City and do they influence intention to cycle? To answer this, the following sub-questions were posed.

- Can road users' attitudes towards cycling be measured?
- Are attitudes influencing individuals' intention to cycle or not to cycle?

### Attitudes Influencing Behavioural Intention to Cycle

An attitude is an individual's evaluation of whether they should engage in a behaviour. According to Ajzen (2002), attitudes are composed of two elements: the beliefs and the evaluation of the outcome. Because in this study the researcher was interested in predicting intention to commute by bicycle, following the recommendation of Ajzen (2002), only direct measures of the constructs that influence intention were used, in this case direct measurement of attitudes. Since attitudes are not observed variables, it was identified a behaviour that would be evaluated by the respondents and therefore representative of their attitudes. The behaviour to evaluate was: 'For someone who travels less than 8 km, to choose to commute by bicycle is...'. To measure the evaluation of the behaviour there were used four evaluative semantic differentials (SD). The extreme positive was at the left side and the extreme negative was at the right side. The adjective used were: Important-Not important; Beneficial-Harmful; Enjoyable- Unenjoyable and Good-Bad.

The correlation analysis used to determine the relationship between attitudes and the independent variables showed that there was relationship between attitudes and past behaviour. In particular the results of the test to explore the differences showed that people who have ride a bicycle in the last six months had more positive attitudes towards cycling.

Continuing with further analysis, the Exploratory Factor Analysis (EFA) showed that attitudes to cycle (the four items) formed one factor and it had a good internal consistency (Cronbach alpha of 0.842). This factor was confirmed in the measurement model of the Confirmatory Factor Analysis (CFA). When the Structural Equation Model to predict intention to cycle was developed, it showed that the latent construct of attitudes to cycle have a direct effect on the

intention to cycle. Attitudes to cycle as a predictor in the model helped to improve the explained variance of intention to cycle. These results match those observed in earlier studies about bicycle use being influenced by people's attitudes (Gatersleben and Appleton, 2007, Heinen et al., 2010, Piatkowski and Marshall, 2015).

These findings suggest that when the evaluation of cycling was negative, the intention to commute by cycling was weaker. Respondents with negative attitudes towards cycling – characterized by considering choosing cycling 30 minutes (or 8 km) to be not important, harmful, unenjoyable or bad – were less likely to commute by bicycle. Notably, founding that cycling is not considered important as a mode for commuting could be a possible explanation to current behaviour from drivers and bikers towards the cycling infrastructure , such is the case of the invasion of cycle lanes, that Meneses-Reyes (2013) highlighted in a previous study. But also could be a possible explanation for the recent rise of direct verbal and physical aggressions towards cyclists reported in the media (Arrieta, 2016, Fernández, 2016, Proal, 2012). For instance, Fruhen and Flin (2015) argued that negative attitudes towards cyclists and negative perceptions of cyclists in social norms were associated with aggressive behaviour from the drivers, however, further research is needed into this connection in Mexico City.

A possible explanation of the evaluation of cycling as “harmful” or “unenjoyable” could be that almost 60% of the respondents use car to commute. These findings are consistent with previous research stating that drivers have more negative attitudes towards other transport options. For instance, studies in the Netherlands (Molin et al., 2016) and the UK (Fruhen and Flin, 2015) argued that people who drive as their main mode of transportation held most negative attitudes towards public transport and cycling. However, further research is required to understand this link. Attitude is an individual characteristic that changes from person to person and from place to place. It is a construct that is difficult to investigate, since individuals

can be wary in expressing their underlying attitudes if these are not favourable, as Basford and Britain (2002) have noted previously.

In a heavily motorized city like Mexico City there is a lack of normality in the use of bicycle (as reported in Chapter Three), and a view of cycling as a marginal practice can be linked to low cycling levels as stated by Horton et al; (2007b). The findings from the question about attitudes towards cycling in this case study reinforce existing evidence that attitudes play an important role in cycling behaviour (Dill et al., 2014). Capron and Lopez (2016) stated that to achieve shifting from the car to public transport requires changing from negative attitudes to positive ones, and this study found that for a modal shift towards cycling in Mexico City this principle holds true.

Souza et al. (De Souza et al., 2014) explored individuals' attitudes towards cycling. The authors found that negative attitudes were reported in relation to prestige. This study did not evaluate attitudes towards cycling in relation with the symbolic meaning of cycling. Instead, in this study the analysis of attitudes is based on the evaluation of the experience of choosing to cycle for short trips. Prestige was found to be a different construct that was based on symbolic attributes given to the bicycle as a possession. This is discussed in section 6.4 of this chapter concerning other socio-psychological factors influencing intention to cycle.

The aim of this section was to explore the attitudes towards cycling in Mexico City and the extent to which these attitudes influence intention to cycle as stated at the beginning of the chapter. And to answer this, the following sub-questions were posed:

- Can road users' attitudes towards cycling be measured?
- Are attitudes influencing individuals' intention to cycle or not to cycle?

This study has shown that people's attitude is a predictor of intention to cycle in Mexico City. The results showed that respondents with negative attitudes were less likely to cycle. These results contribute to existing knowledge about the link between attitudes and behaviour

in transport studies and notably for cycling. This is the first time that attitudes towards cycling from non-cyclists or infrequent cyclists have been explored in Mexico City but further research is required to understand what factors can lead to this attitude formation in order to be able to produce policies focused on improving attitudes.

### **6.3 Perceived Image of Cycling and Cyclists**

This section aims to answer the second research question: What is the perceived image or identity attached to cycling and cyclists in Mexico City. To answer this, the following sub-questions were posed:

- Can the perceived image of cycling be measured?
- To what extent does the perceived image of cycling influence individuals' choice to cycle or not to cycle in Mexico City?

#### **The Role of Perceived Image and Identity in Influencing Intention to Cycle**

According to the Oxford dictionary perception is “the way in which something is regarded, understood, or interpreted.”<sup>16</sup> Thus, in this study perceived image of cycling is understood the way individuals see or interpret cycling as an activity and cyclists as individuals and it was evaluated by measuring two variables. The first variable is the subjective norms (construct from the TPB (Ajzen, 1991)) and the second the symbolic motivations (construct from the MPM (Dittmar, 2008)) because from the model described in Chapter Four, it is argued that these perceived image of cycling might influence intention to cycle, and that this perceived image might be shaped by these constructs. A subjective norm is made up of the individuals' normative beliefs. In this case, the subjective norm is the individual's perception of others' opinions (injunctive or descriptive referent group) about their choice to cycle. Symbolic motivations are

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<sup>16</sup> Definition of perception, see:  
<https://en.oxforddictionaries.com/definition/perception>

concerned with the individual's valuation of possessing a bicycle to commute as a symbol of their personality and achievements.

Regarding the subjective norm this was measured with three items with 5-point Likert scale (1=strongly disagree, 5=strongly agree), in the analysis it was reported a small value of the internal consistency and although it was kept for further analysis (aware of reliability problems).

The correlation analysis used to determine the relationship between subjective norm and the independent variables showed that there was a relationship between subjective norm and past behaviour. Particularly, the results suggested people that have use the bicycle in the last six months have stronger influence from the subjective norm. No correlation with the rest of the independent variables was found.

Continuing with further analysis, in the EFA this study found that subjective norm formed one factor, and the measurement model in the CFA confirmed it, however it had a critical internal consistency (Cronbach Alpha = 0.541). Nevertheless further analysis was carried out but it was taken with caution. In the development of the SEM, the items from subjective norm were not used because they didn't fit the data. This shows that the influence of others' in the individuals' perception of cycle did not help to predict intention to cycle of people who do not cycle or who cycle very infrequently. In contrast, Heinen (2011) evidenced that the perceived opinion of others only affects cyclists' choice over short distances. Therefore it could be suggested that the perceived opinion of others only influences cyclists, and has no effect on non-cyclists.

Regarding symbolic motivations, this construct was composed for items asking respondents to provide their opinion about social status linked to the use a bicycle. The correlation analysis showed that the symbolic motivations did not have any relationship with the rest of the variables.

This symbolic motivations measured with three items formed a factor that had effect in the variance within the data and this was confirmed

in the in the measurement model of the CFA showing a good internal consistency (Cronbach alpha = 0.779). The factor was renamed by identifying common themes when looking at the content of the items loading into the factor. The items from symbolic motivation were named “social image and prestige”. Then the Structural Equation Model to predict intention to cycle was developed and the effect of this construct was evaluated.

In this study empirical evidence was found to support the premise that symbolic motivations to cycle, expressed in the perceived social image and prestige associated with cycling, influences intention to cycle. Social image and prestige is a construct that explains the value associated with the bicycle as a material possession, which thus functions as a symbol of the individual’s identity (Dittmar, 2008).

In particular, this study found that by measuring the strength and direction of the effect of the individual’s symbolic motivations in their intention to cycle, it is possible to measure the extent to which the perceived social image and prestige linked to cycling influences people’s intention to cycle. The findings from the Structural Model showed that when the social image linked to commuting by bicycle was positive, the intention to cycle was strengthened. This means that people who agree with statements in the survey asking about the bicycle being an object that can distinguish them from other people and give them prestige have a stronger intention to cycle. This finding agrees with that of Gatersleben and Appleton (2007), whose research indicated that the perceived image of cycling might influence cycling as a modal choice.

Sociodemographic characteristics could influence the perceived social image and prestige of cycling. To determine, whether there was any statistically significant difference in the mean of the different characteristics and the social image and prestige, after the model was developed, it was carried out a one-way Anova. Only age was an influential characteristic. Results showed that when the construct of social image and prestige is divided by age group, it becomes clear that the group aged between 25 and 31 have more positive

social image associated with cycling, contrasting with the group aged 53 and older, who showed more negative social image. A possible explanation for this might be that these individuals are non-cyclists or infrequent cyclists, thus they do not have the habit of cycling, and neither are used to see the bicycle as a mode of transportation since it was until relatively recently, with the Ecobici system, that more cyclists for commuting purposes started to appear on the streets. However, further research is required to fully explain this correlation.

This section aimed to answer the second research question: What is the perceived image or identity attached to cycling and cyclists in Mexico City. To answer this, the following sub-questions were posed:

- Can the perceived image of cycling be measured?
- To what extent does the perceived image of cycling influence individuals' choice to cycle or not to cycle in Mexico City?

Drawing upon the construct of symbolic motivations from the Material Possessions Model, this study has shown that the social image and prestige associated to cycling can be measured. The results also showed that social image and prestige is a predictor of intention to cycle in Mexico City. The results showed that respondents with a positive social image linked to commuting by bicycle have stronger intention to cycle. These results contribute to existing knowledge about symbolic motivators influencing transport mode choice, and particularly the perceived image of cycling influencing intention to cycle. This is the first time that symbolic aspects related with bicycle use had been explored with a sample from non-cyclists or infrequent cyclists in Mexico City, and although further research is necessary, these findings have important implications for policy makers and transport practitioners. Designing transport policy measures promoting a better image associated with cycling.

## **6.4 Other Socio-Psychological Factors Influencing Intention to Cycle**

This section aims to answer research question three: What other socio-psychological factors influence intention to cycle in Mexico City? To do this, the following sub-questions were elaborated:

- Is there a socio-economic status attached to the image of cycling and cyclists?
- What other affective and symbolic factors might influence commuting by bicycle in Mexico City?

In Chapter Two it was argued that transport mode choice depends upon not only rational analysis of the advantages and disadvantages of the various transport options, but also on people's opinions. In order to understand how people evaluate and inform their opinion about cycling and whether there is a socio-economic status attached to cyclists this study draws upon the SCT (Festinger, 1954), because this theory states that evaluation of the self-worth is exclusively expressed in the process of comparison with others. The theory was improved by adding the concept of self-enhancement and self-evaluation (Thornton and Arrowood, 1966) as functions of the social comparison. Self-enhancement could be achieved by the comparison with someone better-off (upward comparison) or worse-off (downward comparison) and self-evaluation express how people engage into social comparison. Later in the theory a new concept was added, social comparison orientation (Buunk and Gibbons, 2006). Social comparison orientation is the individuals' frequency to engage into social comparison. Following this, in this study it is argued that non-cyclists comparing themselves with cyclists could be seen as a downward comparison, and this might lead to acquire certain identity or to attach a socio-economic status to the image of cycling. Socio-economic status in this study refers to the position of a person within a social structure associated with economic and social factors such as income, wealth, education, occupation, and residency.

To investigate the individuals' self-image and identity with relation to cycling and assess whether this image might be linked to a socio-economic status, this study draw upon two theories, the SCT and the MPM. Two constructs from the SCT (the social comparison orientation and the feelings evoked from social comparison) were used to assess the frequency of social comparison and the feelings from the comparison as a way for self-evaluation or to create a self-image about cyclists. The feelings from social comparison were measured with two constructs and the social comparison orientation were measured with three items both constructs used a 5-point Likert scale from 1= strongly disagree, 5=strongly agree. These constructs were used to assess the frequency of social comparison with other transport users and the feelings from seeing cyclists. The two constructs from the MPM were used (affective and instrumental motivations) were used to determine the meaning of possessing a bicycle to the individuals' identity. Each construct measure with 5 items and both with 5-point Likert scale from 1= strongly disagree, 5=strongly agree. The affective motivators were used to assess the role of the bicycle fulfilling needs and desires with affective or emotional dimension, whereas the instrumental motivators assessed the role of the functional aspects of the bicycle.

### **Socio-Economic Status and Self-image**

The correlation analysis carried out to determine whether there was a relationship between social comparison orientation and feelings from social comparison and other independent variables, showed that only feelings from social comparison had relationship with bicycle ownership and with past behaviour. Social comparison orientation was not correlated with any variable. The effect of feelings arising from social comparison could not be established. The analysis of the internal consistency of this construct showed very low reliability. Although the construct was kept, it was treated with caution in further analysis. For instance, results from the Pearson correlation carried out to explore the relationship between the construct and sociodemographic characteristics, showed that feelings from social comparison was correlated with level of studies. Thus, a one-way

ANOVA was carried out to explore the nature of the difference. The findings suggest that individuals with technical or commercial education have weaker feelings from social comparison in comparison with people with higher education (university and postdegree). However, due to the low internal consistency reported in Chapter Five, which could be due to the small number of items used to measure the construct (two items) which could have not been enough to measure a complex construct, these results therefore need to be interpreted with caution. When the EFA was carried out, feelings from social comparison did not cluster in any of the factors, thus the construct was not considered in further analysis. These results highlight the need to develop more reliable items to explore this construct.

Social comparison orientation measured with three items had a relative good internal consistency (Cronbach alpha = 0.735). Then correlation between Social comparison orientation and the independent variables showed that this construct was not correlated with any of the variables.

Regarding further analysis, no evidence was found to support the premise that the frequency of engaging in social comparison as a way to evaluate whether the individual's self-image had an effect on the intention to cycle. Although Social Comparison Orientation had a relatively good internal consistency, and the three items formed one factor in the EFA and the construct was confirmed in the measurement model in the CFA, in the development of the structural model this construct had a very low effect on intention.

From the literature review in Chapter Two it was found that understanding the process of social comparison could be helpful to measure the transport related self-image, whether this image was linked to a specific socio-economic status and the extent to which this influence intention to cycle. This study argued that self-image construction can be carried out through self-evaluation by comparison with others, for instance, by a driver comparing their situation with that of a cyclist sharing the road, because according to

Bailey (2003), self-image is related to measurable and concrete aspects of appearance (in this case e.g. the type of clothes used or the type of bicycle used) or activities (in this case e.g. riding a bicycle to commute) or material possessions ( in this study e.g. owning a bicycle). Anable et al. (2006a) pointed out that self-image construction in relation to transport mode choice as well as lifestyle have an influential role in individuals' behaviour. And for instance, Nkurunziza et al. (2012a) found that social status was a personal barrier for cycling. However, further research is required to establish the link between self-evaluation and self-image in the context of cycling in Mexico City.

### **Other Socio-Psychological Factors**

In the previous section it was explained that affective motives and instrumental motives were measured with five items each. Both constructs had an acceptable internal consistency (Cronbach alpha >0.7). Instrumental and affective motives were analysed to determine whether there was a relationship with the independent variables. The results of the analysis showed that both constructs were correlated with bike ownership and past behaviour. In particular the findings showed that people owning a bicycle or that have cycle in the last six months have stronger affective and instrumental motivations.

Results from the EFA confirmed an underlying factor made by four items measuring the affective motives and one item measuring instrumental motives. After, analysing each of the items this factor was named Cycling Attributes and then in the CFA showed an appropriate reliability (>0.8). Thus it was proceed with the structural model. Results from the model showed that one of the items from affective motives was dropped to improve the model fit. Ending with three items measuring affective motivations towards cycling and one item measuring the instrumental motivations of cycling. The four items had acceptable internal consistency (Cronbach alpha >0.8). The rest of the instrumental items did not fit in any factor. This suggests that instrumental attributes for cycling did not influence intention to use the bicycle. Similar results, but about car use, were

found by Steg (2005). The author argued that symbolic and affective motives had an effect on car use, whereas instrumental motives did not significantly contribute to the explanation of car use. We found the same, but for bicycle use. This might suggest that the role of affective motivations is higher for possessions such as cars and bicycles.

The model showed that cycling attributes was a construct that has a direct effect on the intention to cycle. When the attributes of cycling were positive the intention to cycle was strengthened. Attributes of cycling were measured with questions about affective and instrumental motives which are associated particularly with car use. The attributes used were whether cycling was relaxing and comfortable or whether riding the bicycle provides feelings of excitement, independence and freedom. There is research about the role of attributes as an influential factor for cycling from a qualitative perspective (Lois et al., 2015), but this study showed that a quantitative approach can also help to predict intention.

Road users agreeing that commuting by bicycle is relaxing, comfortable and that it provides feeling of excitement, freedom and independence showed a stronger intention to cycle. These cycling attributes entail needs and desires with an emotional dimension wherein the bicycle serves as an object for self-expression, as explained by Dittmar (2008).

The Material Possessions Model proposed by Dittmar (1994) helps to explain the role of material objects and how these material possessions shape individuals' identity. The author stated that "material goods are used as stereotypical descriptors of different socio-economic groups" (Dittmar, 1994, p. 579). For Dittmar (1994), material objects have three different functions: the instrumental function, which enables us to use an object or perform an activity; the symbolic function, which means that the object provides a way to express self-identity or a certain social position; and the affective

function, which is in charge of deeper, non-instrumental needs and desires.

Steg (2005) stated that Dittmar's model can provide useful measures of instrumental, symbolic and affective motives for car use. This study provides evidence that this model is also useful for investigating motivators of cycling, but, differing with the results from Steg (2005), the model presented here shows that using the MPM constructs contributes to the identity formation with regards to cycling as a possession.

The literature (qualitative and quantitative) about the importance of instrumental and affective attributes influencing transport mode choice is growing (Anable and Gatersleben, 2005b, Sevillano et al., 2011). But specific investigations into how these factors can act as deterrents or motivators for cycling are more limited. Anable and Gatersleben (2005b) stressed that little is known about non-instrumental factors of car use and cycling. Analysing attributes other than instrumental is useful and relevant to influencing people's perception about using another transport mode, such as the bicycle. In this sense, our study contributes to filling the gap, however, further research is still required about the effect on intention to cycle both of social image and prestige and of cycling attributes.

Returning to the research question posted at the beginning, this section aimed to investigate what other socio-psychological factors influence intention to cycle in Mexico City? To do this, the following sub-questions were elaborated:

- Is there a socio-economic status attached to the image of cycling and cyclists?
- What other affective and symbolic factors might influence commuting by bicycle in Mexico City?

Previous research Lois et al. (2015) and Murtagh et al. (2012) argued that identity plays a role in influencing travel behaviour. Horton (2007a, p. 7) stated that "the bicycle and the act of riding a bicycle unavoidably convey status". This perceived status might act as a

barrier towards cycling, if it connotes belonging to a lower social class (Horton et al., 2007b, Aldred, 2013a, Aldred and Jungnickel, 2014); a similar stigma is also attached to public-transport use (Stokes and Hallett, 1992). Aldred (2013b) suggested that a negative connotation of cycling is its attachment to low income groups, which suggests the idea that people riding bicycle are those who cannot afford a car. This is especially the case in the Latin-American context, where according to the literature review cycling is associated with low-income travellers (Bauman et al., 2013, López, 2013) and social status is considered a limitation for bicycle use (Lastra et al., 2016).

This section showed that individual's self-identity and self-image play a role influencing intention to cycle. The results show that when the cycling attributes as indicators of the identity associated with cycling were positive, the stronger was the individual's intention to commute by bicycle.

## **6.5 Perceived behavioural control, past behaviour and intention**

Perceived behavioural control results from the control beliefs and power of control factors. Is a construct that is helpful to analyse the strength of the individuals' control over the behaviour (Ajzen, 1991) . In this study it was measured with one item (I am confident that I can use my bicycle to commute). This item was measured with 5-point Likert scale (1=strongly disagree, 5= strongly agree). Past behaviour was pointed in the literature review in Chapter Two that is an indicator of the strength of later behaviour. This construct was measured also with just one item (How frequently have used a bicycle to commute in the last six months) with a 5-point Likert scale (1=Never, 5=Always). As it was explained in Chapter Four and Chapter Five these items were piloted with more items but the results showed that the internal consistency improved by deleting items. Considering this and to avoid ambiguity both constructs were used as single-item constructs. Intention is the willingness to carry out a

behaviour (Ajzen, 1991). It was measured by three items with 5-point Likert scale (1=strongly disagree, 5= strongly agree).

The analysis of the correlation between perceived behavioural control and the independent variables showed that people that owns a bicycle or that have cycle in the last six months have stronger perceived behavioural control. This control was also stronger in man than woman and in people older than 24 years old. A possible explanation for this is that younger people and women feel more vulnerable due to the lack of infrastructure for cycling (as noted in the Chapter Three).

From the analysis of the correlation of past behaviour and the independent variables, showed a negative correlation with gender. The results suggested that females have a used a bicycle in the past six months with less frequency than males. This results agree with findings from the use of Ecobici in Mexico where men cycle more than women (López, 2015).

Regarding intention, this construct had relationship with past behaviour, perceived behavioural control, gender and occupation. In particular the analysis of intention showed that people that cycle in the past 6 months and that own a bicycle have stronger intention to cycle. Men also have stronger intention to cycle than women. People working have more intention than those that have to combine work and studies.

Proceeding with the analysis, when the EFA was carried out, perceived behavioural control, past behaviour and intention formed one single factor. For the description of the items it was renamed as Habits and intention. The factor showed a good internal consistency (Cronbach Alpha = 0.898). This factor was confirmed in the measurement model. And then, in the SEM this factor was predicted by the cycling attributes, attitudes towards cycling, social image and prestige and social comparison. However, when the strength of the effect of those factors in intention was checked social comparison effect was very low. These results show the past behaviour and perceived control are components of the intention to cycle in Mexico

City. This could be because infrastructure is not well connected and available in the whole city, and then it is perceived as an obstacle. But also owning a bicycle could be linked. For instance, when the perception of control was analysed for people owning a bicycle and not owning a bicycle it showed that people owning a bicycle ( $M=3.11$ ,  $SD=1.426$ ) were slightly more confident than those not owning one ( $M=2.71$ ,  $SD=1.305$ ).

## **6.6 Conclusions**

From the literature review we found that transport mode choice depends upon not only rational analysis, but also on the evaluation of emotional factors (Stokes and Hallett, 1992, Dittmar, 1994, Steg, 2005). This study provided support for this. With the structural model developed to predict intention to cycle in Mexico City, it is shown that cycling attributes, attitudes towards cycling and social image and prestige, are powerful socio-psychological predictors of intention to cycle, explaining 42% of intention variability. When attitudes were negative the intention decreased, and when the social image and prestige and the cycling attributes associated with the use of a bicycle was positive, the stronger was the individual's intention to commute by bicycle.

Transport mode choice is complex (Parkin et al., 2007c, Beirão and Sarsfield Cabral, 2007), and this study provided evidence that emotional, symbolic and attitudinal factors play an important role. However, further research about self-image and self-evaluation as a result of social comparison influencing intention to cycle in Mexico City is required.

Dittmar (1994) argued that all material possessions function as symbols of social identity, and previous research about car use (Steg, 2005, Capron and López, 2016) supported this. In this study, the model showed that the bicycle as a possession also conveys a symbolic meaning of social status, although the social status associated with cycling might change depending on context and individual characteristics.

This study provides empirical evidence that social image and prestige as a construct have a direct effect on the intention to cycle. Attitudes and cycling attributes also had an influence on the intention to cycle. These findings have strong implications for policy interventions. For instance, regarding the role of the perceived image of cycling, it was already pointed out that cyclists and non-cyclists are different (e.g. Gatersleben and Appleton, (2007), and that the policies to increase cycling levels should consider this and produce more targeted interventions to improve the image of cycling.

This research converges with that of other researchers in concluding that barriers to cycling are diverse, and that including different constructs into the TPB helps to improve the explanation of more complex phenomena. Results from previous meta analyses showed that the use of TPB usually helps to explain between 40-50% of the variance in intention (Norman et al., 2005). We found evidence to support that this theory with additional constructs also explained similar percentage of the variance in intention (in this study 42% of the total variance in intention was explained by the constructs in the model).

Although the explanatory power of the variables from the Social Comparison Theory are not completely established in this study, it is clear that when the opinions and abilities results from the social comparison are positive, the intention to cycle is strengthened, nonetheless the findings for social comparison should be treated with caution as the strength of this construct was very low. Further research, particularly the inclusion of a larger number of items to measure the social comparison orientation and the feelings from social comparison, would be important.

Hoffmann and Lugo (2014) stated that cycling as a mode of transport can be linked to a specific socio-economic status, and literature indicates that cycling in Latin-American countries such Brazil, Colombia and Mexico is associated with being poor (Jones and Novo de Azevedo, 2013, López, 2013, Moller, 2006). From the present analysis it cannot be concluded that there is a socio-economic status

linked to the image of cycling and cyclists. However, the study found that when the cycling attributes and the opinion and self-evaluation about cycling were positive the intention of cycling increased.

Pojani et al. (2017) found that status and image were beliefs that people had about cycling. Regarding car use, in one of the study areas the author found that the car was not linked to a specific social status, but in the other two case studies the authors found that the car was still considered to be a status symbol and the bicycle to be the vehicle for the poor. Pojani et.al (2017) suggested that this difference in their case study might be due to the historic prohibition of the car under socialism. In the case of Mexico, there are also historic and current socio-economic conditions linked to the idea of cycling being for low-income groups, as explained in Chapter One. Goetzke and Rave (2011) in a study in Germany concluded that travelling by bicycle is not related to household income, however he found that in the case of recreational trips, people with lower income more generally choose to use their bikes. In other contexts like Mexico a relationship has been found between the income of households and car ownership (Guerra, 2015). Thus, further research is needed to establish whether contextual situations are determinant of this.

Regarding the link between socio-economic position and cycling, López (2013) argued that in Mexico City, lower-income households need to use the bicycle to commute for economic reasons, these are the “invisible cyclists” (Lugo, 2012, López, 2013) described in Chapter Three . The use of the bicycle as a mode for commuting to work, or the bicycle as an instrument of the job, as is the case for the cycle couriers, postmen, and food sellers, among others can originate a link between social position and transport mode in the social imaginary of the upper social classes (Herrera Miranda et al., 2014).

Yet the opposite could be claimed, too. In Mexico City, for instance, it is argued, the route where the Ecobici system is built, is in the most wealthy areas because it is focused for a middle-class profile who do

not cycle for economic reasons (López, 2013) and similarly happens in the UK (Steinbach et al., 2011). Steinbach et al. (2011) argued that cycling in London is also not very common and currently the use of bicycle as it is associated with a healthy choice, provides the opportunity to cycle mainly to a middle class or “bourgeois” to use the bicycle without being linked with lower-income travellers. This shows the existence of two type of cyclists which in turns have policy implications because the promotion of bicycle should tackle different issues. First, promoting cycling as a transport mode and not only for fitness. If cycling is more linked with a sport, it might suggest that is an activity that requires to be fit and to have the adequate equipment (Basford and Britain, 2002). Secondly, the measures and interventions should be aim to improve the image of cycling and tailored policies to the segments of the population with lower socio-psychological barriers or more willingness to change, because this has been pointed as a way to optimize .

## **6.7 Limitations**

This chapter as discussion of the findings noted a number of limitations. First, from the analysis of the correlation between the constructs and the sociodemographic variables although it is reported the correlation is very small. Secondly, although some sociodemographic characteristics such as age, gender, studies and income theoretically are considered the background of the behavioural, normative and control beliefs, other sociodemographic variables such as transport mode could have been interesting to analyse to explore the relationship with the constructs, however this variable was explored by asking the combination of transport used to commute thus it is not desegregated by mode. Third, the sample is not representative from the population because the distribution of the responses by municipality (as showed in Chapter Three) do not corresponds to the statistics of the population in Mexico City. Four, using the internet as distribution tool of the survey limited the

capacity of explain how to answer the attitude items. As mentioned before in Chapter Four, from the survey distributed face to face, it was noted that the respondents were not familiar with the use of semantic differentials, and it was required to remind them to select an answer for the four items. This opportunity was missed in the online survey, thus a number of missing responses were detected specifically for the attitude items. Thus the missing answers from the online survey (about attitudes) as explained in Chapter Five were replaced by the mean.

## Chapter 7 Attitudinal transport segments in Mexico City

### 7.1 Introduction

Investigating the socio-psychological barriers for cycling is very important, but creating the appropriate transport interventions and measures to change behaviour is also essential. In order to inform policy makers and practitioners in the design of transport interventions literature pointed that it is necessary to create meaningful groups according to their attitudes to target the interventions to those clusters more willing to change their behaviour (Anable, 2010). And as a results will help optimizing transport interventions and measures more efficiently applied (Anable, 2003, Anable, 2005a, Beirão and Sarsfield Cabral, 2007, Shiftan et al., 2008).

To date, to the best knowledge of the researcher, such segmentation analysis has not been carried out in Mexico City. However, this analysis had been carried out in seven European cities using the a Segmentation Tool developed by the Segmentation Project<sup>17</sup> EU (Anable, 2010). This tool consists of a series of detailed questions designed to understand the motivations and attitudes towards different modes of transport, to be able to “cluster consumers into relatively homogeneous groups” (Anable, 2014). Thus, one of the objectives described in the Chapter One is to identify the attitudinal transport segments in Mexico City. To achieve this, following there is the research question and a series of hypothesis that will guide the study.

Research question 4: Which are the main transport segments identified from the sample of the population?

1. Can systematic and meaningful transport segments be created for Mexico City?

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<sup>17</sup> For more information about the project see:  
<http://www.segmentproject.eu/> .

2. Can the same transport segments identified in Europe be found in Mexico City?

To address this research question, in chapter two, it was introduced the concept of social marketing and the market segmentation technique applied in transport studies. It was discussed particularly, empirical evidence of the use of segmentation techniques to create targeted marketing campaigns to promote the use of bicycle. In Chapter Four it was described the methodology of the Segmentation methodology used in the EU and in Chapter Five, it was carried out the analysis of the segments in Mexico City. In this chapter, we present the discussion of the findings presented in Chapter Five about the attitudinal transport segments.

The second part addresses the creation of systematic and meaningful transport segments in Mexico City. Here it is discussed the characteristics of the segments in Mexico City we focus particularly on then distribution of the segments in the sample and the profile of each of them. The next section address the analysis of the transferability of the Segmentation methodology. Here it is discussed whether it is possible to detect the same segments in Europe in Mexico City. To do this, this section contains the comparison between the segments detected in the European cities and those found in Mexico. To test the transferability of the methodology. This section presents the discussion of the findings by transport modes. First, there is the discussion of the attitudes towards driving, then the discussion about the attitudes towards bus use, after there is the discussion about cycling and finally the discussion of findings about walking for each of the segments. After this, there is the comparison with the European segments. The following section contains the policy implications about the segments in the context of Mexico City. Here there are some policy recommendations based on the results. In the last section, there is a summary of the chapter and the conclusions.

## 7.2 Characteristics of the segments in Mexico

Following the methodology of the Segmentation Project EU, the seven European member cities found the eight attitudinal transport segments (Anable, 2013). After using the same methodology in Mexico City, results showed that the identical segments were identified in Mexico. The biggest group was the Active Aspirers being the 25% of the total, followed by the Image Improvers and Malcontented Motorists (each one with 16.5%), the Devoted Drivers (13.5%) and the Car-free Choosers (12.2%). Whereas Public Transport Dependents (3.7%), Car Contemplators (5.5%) and Practical Travellers (6.2) were not strongly represented. This is comparable to that found in the segment project where Practical Travellers also was not well represented in the seven cities (Anable, 2013). Anable (2013) explained the variances in the distribution of the segments by the differences in transport infrastructure and social norms in each place. Similarly, in Mexico City differences in the social and urban conditions might lead to the variances in the segments.

It is not surprising finding strongly represented the segment of Malcontented Motorists This could be attributed to the city's conditions of traffic and congestion, and the high proportion of Devoted Drivers could be also linked to travel time and distance. In this sense, the Malcontented Motorists are characterised for favouring the bicycle over the use the bus. This can also be attributed to the fact that the public transport, as highlighted in chapter one, apart from being affected by the traffic, is facing diverse challenges related with capacity and safety. Likewise, those tired of the stress and the pollution due to the excess of car use could be argued that might try to be more active or try to commute by different means, in this case fitting into the profile of the Active Aspirers or Car-free Choosers. Regarding transport share, almost 60% of the total sample commute by car, this may explain the small proportion of Public Transport Dependents and Practical Travellers.

It was detailed in Chapter Five that although we found the eight segments, the profile of the segments vary between those found in the European cities and those in Mexico City. Overall, in the segments in Mexico, the gender was approximately divided equally between men and women for Image Improvers, Malcontented Motorists, Devoted Drivers, and Public Transport Dependant. For Active Aspirers, Practical Travellers and Car Contemplators the highest proportion were men; and Car free Choosers that were predominantly women. About education the higher proportion of all segments have university studies and work full time. Age was different for all the segments, but the age groups older than 53 had the smallest representation.

A detail description of the attitudes of each segment towards the different transport modes are following:

#### **Attitudes towards driving.**

A high proportion of the Car free Choosers would rather use any other transport option but car. About one third of the Public Transport Dependant also agreed on this. This agrees with the description of the segments in EU. Both groups do not like driving. However, Public Transport Dependant have less intention to reduce car use than Car free Choosers. This might be explained by the fact that because they do not commute primarily by car their attitudes towards car are less negative. In fact according with the description of this segment, they do not consider the bus as a quick mode to commute. This could be related with the findings by Molin et al. (2016) who argued that in their study, people that use more public transport have a more positive attitudes towards car. The segments, Devoted Drivers, Image Improvers, strongly agree about their preference of car use over other options. This is not surprising because both segments have symbolic associations with the car and the self. Rest of segments, Malcontented Motorists, Active Aspirers, Practical Travellers, one third or more do not have preference for driving, but more than half of the respondents are likely to drive in the next 12 months. This shows that this segments could be targeted to policies

to reduce car use because they seem to have more willingness to reduce their driving frequency.

### **Attitudes towards bus use**

The Car free Choosers and the Public Transport Dependant are the two groups who consider themselves as bus users in high proportion. Opposite to this, more than half of Devoted Drivers,, do not consider themselves as bus users. The Image Improvers segment have also one quarter of respondents that do not identify themselves as bus users. This segment actually prefer cycling rather than using the bus. The segments Active Aspirers and Practical Travellers in general see themselves as bus users, however the higher proportion prefer to use the bicycle rather than the bus. It is possible to see that the higher proportion do not identify as bus users, and even when they do, they would rather cycle. This is important finding, because it suggests that the bus is not satisfying the users or there are certain conditions that make the bus not very attractive (e.g. safety and comfort as discussed in Chapter One and Chapter Three). This potentially reflects two issues. One is the efficiency of the buses in Mexico City. If this is the case, then modal shift towards public transport requires an improvement of the buses. The second issue is that if the conditions for cycling were improved some of the segments would use it more.

### **Attitudes towards cycling**

Public Transport Dependant and Devoted Drivers, do not consider themselves as cyclists. It is interesting that a high proportion of the Malcontented Motorists (almost half of the respondents), expressed a neutral answer, however they consider it a way to keep fit. Similarly the Image Improvers and the Car Contemplators, and prefer cycling than the bus. The segments Active Aspirers, Practical Travellers and Car free Choosers see themselves as cyclists. These segments are characterized for valuing the instrumental and symbolic aspects of the bicycle. Therefore, the segments Malcontented Motorists, Image Improvers, Car Contemplators, Active Aspirers, Practical Travellers

and Car free Choosers with the appropriate measures could be encouraged to use the bicycle more.

### **Attitudes towards walking**

Almost all segments like to walk a lot. Except Devoted Drivers and Car Contemplators, who do not like it, however they see it as a way to kip fit. Therefore, the interventions or measures targeted to these segments could emphasize the health benefits from walking to achieve modal shift.

In summary, all the segments were found and the profiles are very similar to those described in the Segmentation Project. Looking at the attitudes towards each different transport mode by segment was useful to detect those segments with more potential to change their behaviour. Designing the most appropriate measure is the next step, further details about this is the section 7.5 of this chapter.

## **7.3 Transferability of methodology**

In this study, we used the methodology of the SEGMENT project<sup>18</sup>, to segment the sample population into eight different segments and this method was not used before in a different context but the European. It was established in Chapter Two that segmenting the population according to their attitudes can be very useful when developing and implementing transport measures and interventions, ensuring the budget for cycling is efficiently applied.

One of the research questions in this study was to test the transferability of the methodology. It was investigated as research question, the existence of the same eight segments in Mexico City,

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<sup>18</sup> SEGMENT Project, see:

[http://www.segmentproject.eu/hounslow/segment.nsf/Files/SFF-318/\\$file/Deliverable%207-8.3%20Social%20Marketing%20Toolkit.pdf](http://www.segmentproject.eu/hounslow/segment.nsf/Files/SFF-318/$file/Deliverable%207-8.3%20Social%20Marketing%20Toolkit.pdf).

because the main concern identified about the Segment Golden Questions was the transferability of the questionnaire into a different context.

In the transferability report from the project (Anable, 2013), it was developed a transferable market segmentation model and a methodology which can be repeated and transferred to all the European Union member states. This is supported by the results of the application in each of the seven cities, because after the analysis it was found that most of the segments were distinguished in all locations. However, the project has made the methodology to be used in different contexts too. Although it has not been tested in the Latin American context, the report for transferability explains that the different attitudinal market segments can be found in other contexts, because in the development of the methodology it was used a set of multi-variate statistical techniques to extract segments and compare their statistical viability across different locations.

In the literature from the segmentation project, it is stated that finding the same segments, does not mean that measures to change behaviour might be the same as those used in European context. As we found from the analysis, the profile of each segment differs in Europe and in Mexico, thus, the transport interventions and measures must vary from the European context to the Case study, being aware of the different urban and transport environment, social norms and current and future needs.

## **7.5 Policy implications**

There is a growing literature about transport segmentation (Elmore-Yalch, 1998, Gatersleben and Appleton, 2007, Shiftan et al., 2008, Anable, 2010, Li et al., 2013). The literature had highlighted the potential benefits of using these techniques to understand the audience and tailor policy measures to achieve effectiveness of modal shift, optimize transport interventions and particularly to promote cycling (Tapp and Parkin, 2015). The use of the

Segmentation methodology could be an opportunity to create subgroups according to their attitudes towards transport in Mexico City. And as we discussed before, the methodology is transferrable. But as Anable (2005a) stated, “the real value of segmentation, however, lies in its ability to be translated into achievable strategies by using the information to guide decisions.” And this is what needs to be discussed now, what are the most appropriate measures and how the segment groups can be used by policy makers and practitioners.

The differences in the profiles of the segments between the European and those in Mexico City suggest that the segments are specific to the context where the survey was carried out. This finding is consistent with the findings in the research carried out by Anable (2005a) . Although the author use cluster analysis to segment a population, she concluded that socio-demographic factors had little influence segments profiles, suggesting that attitudes do not depend upon personal characteristics.

Although developing a new methodology could also be valuable in Mexico City, it is suggested that the Segmentation methodology has the potential to create adequate groups to target policy measures in Mexico City.

Transport interventions and policy measures aim to reduce car use and promote modal shift towards cycling could be in the form of the called ‘soft factor interventions’ or ‘mobility management tools’ (Cairns et al., 2008) also known as soft transport policy measures (Bamberg et al., 2011). This measures are characterized for being of two kinds. One is the use of marketing or publicity and travel awareness campaigns, the second kind are individualized travel plans for commuting to work or to school.

Finding attitudinal transport segments and identify the groups with more potential to change their behaviour to target these soft policy measures is only one part of the solution to promote and increase cycling for commuting purposes in Mexico City. Transport authorities cannot leave a side hard measures (Bamberg et al., 2011) and

interventions in infrastructure and facilities. Peattie and Peattie (2009) stated that “access to appropriate cycling routes and route information, access to bikes, secure bike parking and bike maintenance services are all important to motivate and maintain cycling behaviors” (Peattie and Peattie, 2009).

## **7.6 Limitations**

We could notice from the distribution of the income across the different segments, that there could be a source of bias from the income groups. Because there are two income groups that were highest in proportion (people earning between 4000-9000 mx pesos and 28000 or more mx pesos) whereas the rest had much lower representation. A different source of bias could be that the sample is non-cyclists or infrequent cyclists and the attitudinal transport segments are supposed to test the attitudes towards driving, use of bus (public transport), walking and cycling. However, there were still found the same attitudinal segments. Another limitation was that due to sample size of the segments we couldn't test the Structural Model to predict intention to cycle.

## **7.7 Summary and Conclusions**

Considering that people respond differently to transport measures, it was noted the relevance of using attitudinal market segmentation in order to create groups and subgroups according with their key attitudes and target the transport interventions. This method is helpful at creating groups according with their attitudes and perception of cars, public transport, walking and cycling. But clustering the respondents into groups is only the step one. It is important to develop the adequate policy measures to change behaviour and achieve modal shift. Soft policy measures and transport interventions to change behaviour had been pointed as the measures most

adequate together with improvements in the cycling environment (Bamberg, et al., 2011 and Friman, 2013).

This study of the segments was focused on Mexico City but it has the potential to help building capacity to implement behaviour change interventions and campaigns across other cities in Mexico. Putting this in practice can determined whether this method can be successful in other Cities in Latin America.

## **Chapter 8**

### **Conclusions and Policy Implications**

#### **8.1 Introduction**

A review of the current attitudes and perception of cycling in Mexico City highlighted that social image and perception of socio-economic position is linked to attitudes and behaviour. However, this review also revealed that that little is known about the influence of this factors and particularly from the perspective of non-cyclists or infrequent cyclists. There was also noted the gap of knowledge about the existence of attitudinal transport segments and the potential benefits from segmenting the population according to their attitudes towards transport. The gap of knowledge in this topic was the motivation to explore the extent to which the perceived image of cycling influences individuals' choice to cycle or not to cycle. And what attitudinal transport segments are currently in Mexico City.

In this attempt and to reduce the barriers linked with the attitudes towards and the perceived image of cyclists, this study argue that a key determinant of the choice to cycle or not to cycle is the perceived socio-economic status attached to the image of cycling and cyclists. An issue pointed out by Horton et al. (2007b) is the fear of losing status due to using a stigmatized mode of transport. Socio-economic status was defined here as the position of a person within a social structure associated with economic and social factors such as income, wealth, education, occupation, and residency. Additionally, this study aimed to investigate the existence of attitudinal transport segments. The following research objectives where set:

- To explore road users' perception of and attitudes towards cycling
- To identify the extent to which the perceived image of cycling and attitudes towards cycling influences individuals' intention to cycle
- To explore whether there is a socio-economic status attached to the image of cycling and the extent to which this may act as a barrier to choosing to cycle or not.

- To develop a structural model to predict behavioural intention to cycle commute in Mexico City
- To identify the existence of attitudinal transport segments in Mexico City
- To draw attention to the social and psychological factors influencing intention to cycle in Mexico City
- To propose changes in the current policy measures focused on cycling and to recommend new strategies to address issues related with the social and psychological barriers for cycling

To investigate this, there were posted four research questions that guided the study: What are the attitudes towards cycling in Mexico City and do they influence intention to cycle?; What is the perceived image or identity attached to cycling and cyclists in Mexico City does it influence intention?; What other socio-psychological factors influence intention to cycle in Mexico City?; and Which are the main transport segments identified from the sample of the population?.

Following the literature review (Chapter Two) it was stated the methodology most adequate to answer those research questions was to develop a theory based survey to explore attitudes and perceived image of cycling, and additionally include questions to segment the population according to their attitudes towards transport (Chapter Four). Then following the methodology it was determined the sample characteristics and the distribution tool to carry out the data collection. After collecting the data, it was carried out the analysis (Chapter Five), where factor analysis and the development of a structural equation model was developed in order to predict behavioural intention to cycle for commuting purposes. The results were discussed subsequently (Chapter 6 and Chapter Seven) based on the research questions posed in Chapter One. This chapter contains the conclusions of this study and the policy implications of how the findings in this study should be taken into consideration in the development of transport interventions and policy measures in Mexico City.

This chapter is organized as follows. Section two contains the key findings. Section three contains the description of the findings in the context of the current policies in Mexico City and it contains as well a list of recommendations for policy makers and practitioners. Section four describe the limitations of the study. Section five contains the description of the key contributions to knowledge made by this study. The final section covers the lines for further research suggested by the author considering the limitations faced and the findings.

## **8.2 Key findings**

Developing a primary empirical research using a structural equation model (SEM) of the population's behavioural intention to cycle commute in Mexico City we found evidence to support that socio-psychological factors have influence in the intention to cycle in Mexico City. The correlation and analysis of the constructs showed that past behaviour and perceived behavioural control are components of the intention to cycle in Mexico City. That attitudes are correlated with past behaviour. Affective and instrumental motives are stronger in people that have cycle in the past and that own a bicycle. Intention to cycle is stronger in men than women and in people that work full time. Which is consistent with previous studies as discussed in Chapter Six.

The Structural Model developed to predict intention, showed that attitudes towards cycling, cycling attributes, social image and prestige and social comparison helped to predict the 42% of variation in intention. Regarding the contribution of each of the latent variables in the intention. Cycling Attributes was the stronger predictor, and it was found that when the attributes associated to cycling where positive the intention was strengthened. Attitudes towards cycling was the second stronger predictor. It was found that when the evaluation of cycling was negative, the intention to commute by bicycle was weaker. Finally, social image and prestige was the third predictor. It was found that when the social image and prestige associated with cycling was positive, the intention was strengthened.

This study highlighted the value of using additional variables from the SCT and the MPM to improve the explanatory power of the TPB to explain behavioural intention to cycle in Mexico City. The use of this extended version of the TPB was useful to provide the foundation for this research to study attitudes and behaviour regarding cycling in Mexico City and the findings also provide a contribution to the current literature developing applications of the TPB in the transport field.

Regarding the Attitudinal Segmentation, this study found that using the methodology from the Project Segment EU it was possible to segment the population. The study found that the eight segments found in Europe were found also in Mexico City. This is important because it suggests that the method is transferable. The distribution of the segments was as follows.

The biggest group was the Active Aspirers (25%), followed by the Image Improvers (16.5%); Malcontented Motorists (16.5%); the Devoted Drivers (13.5%) and the Car-free Choosers (12.2%). Public Transport Dependents (3.7%); Car Contemplators (5.5%) and Practical Travellers (6.2) were not strongly represented. This is comparable to the findings in the Segment Project in Europe where Practical Travellers also was not well represented in the seven cities (Anable, 2013). Anable (2013) explained that the variances in the distribution of the segments might be due to the differences in transport infrastructure and social norms in each place. Similarly, in Mexico City differences in the social and urban conditions might lead to the variances in the segments. Something important to notice is that most of the profile of segments varied particularly in gender and age. Which confirms that the policy interventions cannot be copied from other cities, but the interventions and measures need to be based on the context and particularities of Mexico City. Yet, finding the same segments, supports the idea that the methodology is transferrable to other contexts as stated by a report on the Project (Anable, 2013).

Regarding attitudes towards transport, the analysis of the segments showed that most of the segments prefer driving over other transport

options, except for the AA and PTD. But only II and DD (which are two of the main segments in Mexico) drive for the fun of it, which suggest that these two segments are harder to change their behaviour. The rest of the segments prefer driving but not for fun and neither see the car as a way for self-expression. This suggest that these four segments are more easily to be targeted with policy measures focused on more active transportation.

All segments liked walking and considered it an activity to keep fit, except for devoted drivers and car contemplators, except for practical travellers. Active aspirers, image improvers,, malcontented motorists, car free choosers, practical travellers and car contemplators have a positive attitude towards cycling except for the PrTr. Public transport dependants and devoted drivers do not like cycling but they see it as a way to keep fit. PrTr do not consider neither cycling nor walking a way to keep fit, this suggest that policy measures such as promotion of active transport for health and fitness would not encourage them to use bicycle or to walk. However, the rest of the segments, could be targeted with policy measures that emphasise active transportation for fitness.

Regarding bus use, active aspirers, car free choosers, practical travellers, car contemplators like bus but prefer the bicycle (except for car contemplators), thus this segments can actually be targeted to reduce car use by improving the image of bus and the image of cycling and with improvements in the infrastructure too. In the following section there are more specific policy recommendations based on the findings of this study.

### **8.3 Policy implications**

Different factors not investigated in this study might also be influencing intention to cycle as mentioned in Chapter One, Chapter Two and Chapter Four. Mexico City has been and is still very much a car-based city with also focused on motorized public transport. This is linked to safety, the most influential factor deterring people from cycling already identified in previous research. This factor in turn, is

also linked to the lack of infrastructure for cycling and distance travelled. The perception of risk and actual risk associated to cycling was not focus of this study however, it is important to highlight the importance of this issue as it might be important to consider simultaneously with policy measures focusing on changing the attitudes towards cycling.

From the results of this study, it can be concluded that policy-makers and practitioners need to pay attention to attitudes and the social image and prestige associated with the image of cycling. Designing policies that aim to change the negative image of cycling is important but it is also very important that those policies are targeted to groups more willing to change their behaviour as previous research has shown (Gatersleben and Appleton, 2007).

Aldred et. al (2017) suggested that in order to maximizing and optimizing budget for cycling long-term funding and strong political leadership are key factors. The authors highlighted how London has also faced powerful opponents for the creation of new cycling routes, like it has happened in the case of Mexico City. However, these challenges in London were overcome by a clear political lead.

In the next section there are presented a series of policy recommendations based on the findings from this study, but it is important to highlight the importance of the political willingness and leadership as well as collaboration between the public, different stakeholders and organizations advocating for cycling in order to implement the recommendations and achieve actual behaviour change.

To date, there are a number of policy measures and interventions such awareness campaigns, the bike share system, open streets, cycling lines and cycling courses and workshops these are focused mainly in people with positive attitudes or with intention to use the bicycle. These measures are not tailored to specific segments of the population facing social psychological barriers for cycling, neither to people with more willingness to change their behaviour. Based on the findings from this study, the current approach followed by the

policy makers and transport planners might not lead to an actual change in behaviour, and in consequence it will not contribute to the optimization of the funding for cycling.

Following there are the policy recommendations that were identified based on the findings from this study. The recommendations are presented in three sections. Section one is based on the findings from the research question one about people's attitudes towards cycling. The second section is based on the second research question about perceived image of cycling. The third section is based on the research question about other social psychological factors influencing intention to cycle. The recommendations of the three sections below grasp also from the findings of the research question four about the existence of attitudinal transport segments.

### **Recommendations to change negative attitudes**

It was stated that attitudes are determined by the positive or negative behavioural belief about the outcome of a behaviour. This study found empirical evidence to support that in Mexico City, when people consider commuting by bicycle for 30 minutes as bad, unbeneficial, not important or an activity not enjoyable their intention to cycle was weaker. This reflects a negative attitudes towards cycling.

Currently, policy interventions and measures such as the Cycle Paths, "Travel in Bicycle"; "Ride in the Night", "Cycloton"; "bike share system Ecobici, and the Cycling Trainings and Workshops are focused on people that have positive attitudes towards cycling. The results from the present study suggest that policy measures and interventions should focus on promote positive attitudes towards cycling from people that do not cycle or that are infrequent cyclists.

Measures implemented by the local government such as the Sunday parkway from 8 am to 14 hrs for walking, biking and rolling amusement (Cycloton), although they have been very successful, results from this study showed that this approach segregates the use of bicycle more as a leisure activity delegitimizing the use of bicycle as part of the transportation system, thus discouraging its use for commuting purposes.

This study suggest that policy interventions could be for instance the implementation of open street events, improving infrastructure and creating safe cycling routes and providing cycling training and educational campaigns (see recommendation 1, 2 and 4 in table 74). It is suggested to target measures to the segmentation groups that do not cycle but who are more willing to change their behaviour for instance the active aspirers and malcontented motorists. Segments such as image improvers and devoted drivers, have an effective motivation for driving, they drive for the fun of driving, thus targeting the rest of the segments could maximize the policy measures.

### **Recommendations to improve perceived image of cycling**

It was stated previously that symbolic motivators can be defined as the individual's reasons to perform a behaviour based on their self-identity or social position. Drawing upon the MPM this study found that there is a social image and prestige associated with cycling and that this had a direct effect in intention to cycle in Mexico City.

This study found empirical evidence to support that in Mexico City, when there is a positive social image and prestige associated with cycling the intention to cycle was strengthened. This means that when people perceived that the bicycle can give them prestige, it can distinguish them from the rest of people and show who they are and their tastes there was stronger intention to cycle.

As mentioned before some policy measures are focused on the use of bicycle at a specific day of the week or only on an annual celebration (such as "Cycloton" and "Ride at Night"). There is also the promotion of the bike share system Ecobici, which usually portrays only members of the system. This approach followed emphasise that the use of bicycle is not normal and that cycling is more for a very specific group of people (the Ecobici profile "Men middle class"). The results from the present study suggest that such approach is not improving the image or identity attached to cycling or cyclists and thus it is unlikely to result in actual behaviour change from people that are infrequent cyclists.

This study suggest that policy interventions to improve social image and prestige associated to cycling could be for instance encouraging bicycle use for commuting by improving the current cycling infrastructure, implementing safe routes, improving the image of cycling through media and communications as well by reinforcing law to protect the cyclists from verbal and physical aggressive behaviour and discourage this behaviour (see Recommendation 1, 2, 9 and 10 in table 74).

### **Recommendations to improve perceived attributes from cycling**

Affective motivators are needs and desires linked to emotions that individuals use as reasons to perform behaviours. Cycling attributes were possible to measure and identified as others socio-psychological factors influencing intention based on the construct “affective motivators” from the MPM. In this study these attributes showed a direct effect in intention to cycle.

People perceiving commuting by bicycle as an exciting activity; that provided them with freedom and independency; and that is relaxing and comfortable had stronger intention to cycle.

To date, there is not policy intervention to promote the cycling attributes. This study showed that the affective motivations commonly used to promote motor vehicles in advertising were identified for bicycle use. Thus to achieve behaviour change it is important to produce policy interventions aimed to highlight the cycling attributes. The results from this study suggest that policy makers should work closely with people in the media and advertising industry to promote the cycling attributes. (See recommendation 4, 5, 6, 8 and 9)

In general, it could be said that all the interventions suggested in table 74 have positive impact in general in cycling. Following there are further details of the recommendations. Open streets help to promote the use of bicycle as a normal way of travelling to commute. Cyclists need to be seen as part of the environment in a daily basis.

Improving cycling infrastructure, planning and implementing safe routes (recommendation 2) such as segregated cycling lanes and paths is important because is associated with bicycle use (Dill and

Carr 2003; Parkin et al. 2008) since it increase perception of safety and normalize the use of bicycle. The current physical infrastructure communicates mainly the Municipalities that have bike share system, but although it has been successful, there are other Municipalities with large number of trips, high percentage of car ownership (as highlighted in Chapter Three) that would benefit from a more connected cycling route (López, 2013).

As mentioned before, the safe routs and infrastructure have a positive impact on perception of risk and actual risk exposure of cyclists. Improving infrastructure and providing safe routes could help to increase the number of people choosing to cycle as a natural choice.

Cycle to work schemes and bike share system Ecobici help promoting a change in the perceived image of cycling. Currently in Mexico City there is in incentive of tax reduction for buying a conventional or electric bicycles, however, information about other cycling to work schemes is not available. Promoting change in the social image of cycling should focus on highlighting that cyclists come from very different backgrounds and not a specific socio-economic status. In the literature review it was the existence of two type of cyclists which in turns have policy implications because the promotion of bicycle should tackle different issues. First, promoting cycling as a transport mode and not only for fitness. If cycling is more linked with a sport, it might suggest that is an activity that requires to be fit and to have the adequate equipment (Basford and Britain, 2002).

Cycling Training and awareness campaigns (recommendation 4) could be carry out by implementing a compulsory program targeted to drivers and public transport users (maybe through the website for tax and fine payments online) where in order to be able to process their payment, they need to answer the segmentation questionnaire and once they are allocated to their segment, they are referred to a 10-15 minutes awareness campaign that also include elements to improve the image of cycling.

Second way is by implementing a driving test that includes apart from the awareness of the vulnerable road users, campaigns to improve the image of cycling by showing its positive attributes and how a positive social image and prestige can be also found in cycling commuting.

The measures and interventions should be aim to improve the image of cycling and tailored policies to the segments of the population with lower socio-psychological barriers or more willingness to change, because this has been pointed as a way to optimize the measures.

**Table 74 Initiatives and Policy Recommendations**

Initiative	Definition or rationale
1) Open streets	<ul style="list-style-type: none"> <li>• These programs refer to the act of temporarily closing city streets to vehicular traffic and encourage the use of alternative modes of transport.</li> <li>• Umbrella term for car free days; Sunday parkways, cyclovias; pedestrian day, etc.</li> </ul> <p><b>Recommendation:</b></p> <p>This study suggest that open streets should be also carried out at least one day throughout the week. But focusing not in the main avenues and streets as it is on the Sundays (this will have a severe impact on the traffic and congestion in the whole city). It is recommended to focus on slow speed streets well connected and that might be paralleled to the main avenues. But doing so by using the space occupied by cars parked.</p>
2) Safe routes and infrastructure	<ul style="list-style-type: none"> <li>• These programs include education, encouragement, infrastructure and enforcement programs to increase safety for people cycling</li> <li>• This measure could be important for behavioural change. Because it offers an alternative for commuting</li> </ul>

	<p>for drivers and public transport users. This can have a positive impact not only in reducing car use but in alleviating the pressure in Public Transport for the excess of demand.</p> <p><b>Recommendation:</b></p> <p>To achieve this, it is necessary to improve the perception of safety to be able to generate more trips throughout the week. A way to do this, would be implementing cycling paths between the pavement and the cars parked on the streets that are paralleled to the high speed avenues.</p>
<p>3) Cycle to work schemes</p>	<ul style="list-style-type: none"> <li>• These refer to the incentive for employees to commute by bicycle to get to their job. Which in turns can be incentives by tax exemption or monetary incentives for the employers to be used for financing incentives.</li> <li>• Incentives include free breakfasts, contests, giveaways and others.</li> </ul> <p><b>Recommendation:</b></p> <p>This study suggest that the private sector and the local government should strengthen their collaboration in order to develop “Cycling to Work” schemes to foster the use of bicycle. This may include Park and Cycle schemes when the distances are too long or there is not adequate cycling infrastructure. This would help to show that there are different types of cyclists and they can be your peers and colleagues.</p>
<p>4) Cycling training and educational campaigns</p>	<ul style="list-style-type: none"> <li>• Umbrella for training programmes, safety campaigns.</li> <li>• Currently there is wide range of training and safety campaigns for cycling and workshops to learn to fix a bicycle. However, these all</li> </ul>

	<p>are aimed to people with the intention to cycle primarily.</p> <p><b>Recommendation:</b></p> <p>This study suggest that safety and awareness campaigns should be targeted to other road users such as drivers and public transport users. Particularly, targeted to the segments more willing to change.</p>
<p>5) Cycle promotion events</p>	<ul style="list-style-type: none"> <li>• Currently, policy interventions and measures such as the “Cycle Path; “Travel in Bicycle”; “Cycloton”; “Ecobici”, Cycling Training and Workshops are focused on people that have positive attitudes towards cycling.</li> <li>• The results from the present study suggest that policy measures and interventions should focus on promote positive attitudes towards cycling from people that do not cycle or that are infrequent cyclists.</li> </ul> <p><b>Recommendation:</b></p> <p>This study suggest that using public events with diverse purposes such as annual Book fair, food fair and other cultural activities may provide a space for the promotion of bicycle. Departmental stores also run promotional events, this space could be also used by collaboration between private sector and the local government.</p> <p>First, promotional events should target the transport segments that have more willingness to change their behaviour, that like cycling and that are unhappy about the time spend commuting by car, for instance, Malcontented Motorists stressing that cycling is <b>important</b> and <b>enjoyable</b>. That cycling commuting help to improve mobility by offering an additional mean of transportation and reducing traffic congestion, thus reducing travelling time. Additional campaigns could target segments such as Car free</p>

	<p>Choosers and Active Aspirers, which like cycling and seen it as a way to keep fit. For them, stressing that cycling <b>is good and beneficial</b> for health by keeping you fit and improving mental well-being. Contributing to the reduction of obesity (and consequently diabetes) and reducing stress, and promoting a less polluted and congested environment.</p>
<p>6) Bike share system</p>	<ul style="list-style-type: none"> <li>• Currently MxC has Ecobici and recently have included electric bikes. As mentioned in this study, the launch of the system has been a success for people with the intention to cycle. However, the system's advertising usually focus on the system's users.</li> </ul> <p><b>Recommendation:</b></p> <p>This study suggest that the bike share system should include other cyclists on their advertising and publicity. This in order to show that there are all type of cyclists and thus changing the image of the current Ecobici user "men average of 25-35 years old and employed as professional".</p>
<p>7) Route planning tool</p>	<ul style="list-style-type: none"> <li>• Currently the map of the cycling routes are accessible by internet in the Bike share system website. Thus, this is more accessible to people with the intention to cycle and not targeted to other groups.</li> </ul> <p><b>Recommendation:</b></p> <p>This study suggest the inclusion of map with cycling routes to the key places in the zone in bus stops and metro stations. Currently the maps in the metro stations include the walking routes, but the same maps could include cycling routes.</p>
<p>8) Advocacy</p>	<ul style="list-style-type: none"> <li>• Currently there are individuals, groups and communities and cycling associations and NGO's showing a committed and active involvement.</li> <li>• These groups have actually influence policy in order to</li> </ul>

	<p>consider bicycle as part of the transport system.</p> <p><b>Recommendation:</b></p> <p>This study suggest to keep strengthening the relationship between the local government and the organizations and cycling groups to promote the points 1-7</p>
<p>9) Media and Communications</p>	<ul style="list-style-type: none"> <li>• As it was shown in this study, communication and media play an important role creating an idea of the car as an object of pleasure with attributes that fulfil symbolic and affective needs.</li> </ul> <p><b>Recommendation:</b></p> <p>The symbolic motivations commonly used to promote motor vehicles in advertising were identified for bicycle use. The results show that same motivations can be found in the bicycle, thus local advertising and promotion of the bicycle can be aimed at improving the social image of cycling and the attributes of cycling. This could be done in collaboration with cinemas and theatres, this visual campaigns can be presented.</p>
<p>10) Law enforcement</p>	<ul style="list-style-type: none"> <li>• When the bike share system was launched in Mexico City, there were modifications to the Traffic Laws in order to include the bicycle as part of the transportation system and just under the pedestrians in the hierarchy.</li> </ul> <p><b>Recommendation:</b></p> <p>Strengthen the traffic sanctions for people offending cyclists and, being cyclists a minority group raise the condition to case of discrimination when they are attacked arguing their condition of cyclists.</p> <p>On the other side, implementation of driving test which should include theory</p>

	and practice with special focus on awareness campaigns towards the most vulnerable road users (walking and cycling) and image improvement for cycling and public transport.
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A final consideration is that in order to follow this recommendations, it necessary as mentioned before political will but also a better administration of the budget and in some cases re-organize the distribution of the National Budget, since as noted in the Chapter three, currently the distribution of resources is not tailored to the current size and needs in some municipalities (Meléndez, 2016) which limits the implementation of measures to foster cycling.

#### **8.4 Limitations**

This research has several limitations that are important to note. First limitation is that questions to control social desirability were not included. Social desirability is the respondent's unwillingness or inability to respond accurately to the questions of the survey due to the respondent's tendency to answer what might be socially approved (Fisher, 1993). This means that, as Podsakoff et al. (2003) stated, respondents "tend to present themselves in a favourable light". The latent constructs that this research is trying to measure explore attitudes towards other individuals (in this case cyclists) and about their own true motivations for engaging in cycling or not; the relationships between these variables might be concealed due to the respondent's attempt to provide 'acceptable' answers (Podsakoff et al., 2003). It is suggested that in further research this might be considered and add a series of questions that are very similar but are designed to test the responses consistency. The second limitation is regarding the design of the survey. During the analysis it was noted that to measure the construct of feelings from social comparison and social comparison orientation, only two items and three respectively were used, and this limited the options to select the more reliable items to use in the model and furthermore, in the development of the

model each latent variable is suggested to have at least three items to be modelled in Amos. Thus it is suggested that in future research the number of items used would be bigger.

Secondly, other limitations arose from the choice of survey distribution tool. The process of data collection using online tool and face to face distribution of questionnaires had effect on the answers. Secondly, using the internet as distribution tool of the survey limited the capacity of explain how to answer the attitude items. As mentioned before in Chapter Four, from the survey distributed face to face, it was noted that the respondents were not familiar with the use of semantic differentials, and it was required to remind them to select an answer for the four items. This opportunity was missed in the online survey, thus a number of missing responses were detected specifically for the attitude items.

Third, there are also limitations with regards the sample characteristics. The sample represents a highly educated segment of road users. In addition, regarding the travel modes choice, the sample is highly drivers (60%) whereas two thirds of the population commute by public transport according to statistics, thus it is not representative of the population. This study used non-cyclists or infrequent cyclists as a sample because it was interested in the underlying attitudes of people who do not use the bicycle, however this introduces a problem, because people who drive reported also commuting longer distances (that are not easily cyclable, e.g. more than 8 km). In this case different barriers to cycling other than the emotional can be found.

Fourth, this study only explored attitudes, perception and other socio-psychological factors by using direct measures. The use of indirect measures and additional variables that could have been tested as mediators or different constructs to test any change in the link between the attributes, attitudes and social image and prestige and the intention to cycle could be recommendable since these were not included in the analysis.

Fifth, a final limitation was that due to sample size of the segments and some sociodemographic variables could not be tested in the structural model to predict intention to cycle.

## **8.5 Key contributions to knowledge**

The first key contribution is that this study provided empirical evidence to support that intention to cycle commuting in Mexico city is influence by socio-psychological factors. Specifically factors linked to social image, attitudes and cycling attributes. From the extensive search of previous work reported in Chapter Two, there was not find a previous study in Mexico City exploring attitudes and perceived image of cycling with a sample of non-cyclists or infrequent cyclists.

A second contribution to knowledge is the use of additional variables from the SCT and MPM in the TPB to explain the complex process behind the choice of bicycle to commute in Mexico City. Previous research had focused on emotional and symbolic factors to investigate car use, but little research had been carried out to explore cycling behaviour. Particularly the use of constructs from the SCT were used in diverse behaviours such as use of social networks and job performance but in the extended search of literature, it was concluded this was the first time it was applied in transport studies and notably for investigating cycling.

A third contribution to knowledge is the use of a segmentation methodology to create subgroups or people according to their attitudes towards transport in Mexico City. In the Chapter Two, the extensive search also pointed that there is not previous attempts to segment the population according to their attitudes and the potential benefits from doing this.

## **8.6 Further research**

In addition to the key findings and contributions to knowledge outlined in this chapter, a number of opportunities for further research can be also identified for future research.

First, distributing the survey with a bigger and broader sample, more representative of the population could be an important step for further research. First, a bigger sample size could be important to be able to carry out multi-group analysis and test the structural model to predict intention to cycle. Secondly, a bigger sample would allow the researcher to obtain data from cyclists and non-cyclists in order to test the existence of the segments.

Further research also includes development of different type of measures and their potential to change behaviour in Mexico City. For instance, regarding average travel time with better specification of the mode used by each participant. Exploring the effect of social environment in people's attitudes could be important too. From informal conversations with people in the sample, some of them stated that there were thieves and that the fear of being attacked to take the bike and return to the parking to not find their bicycle was also discouraging.

Further research could be carried out such as the development of a categorization of the respondents based on some of their characteristics such as travel mode, average distance travelled, past behaviour, car and bike ownership.

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## List of Abbreviations

A number of abbreviations and acronyms are used throughout the this thesis. Although these were explained alongside on their first occurrence in the text, they are listed here for ease of reference:

<b>AA</b>	Active Aspirers
<b>AGFI</b>	Adjusted Goodness of Fit Index
<b>AMOS</b>	Analysis of a Moment Structures
<b>ANOVA</b>	Analysis of Variance
<b>AVE</b>	Average Percentage of the Variation
<b>BRT</b>	Bus Rapid Transit
<b>CC</b>	Car Contemplators
<b>CF</b>	Car-free choosers
<b>AVE</b>	Average Percentage of the Variation
<b>BRT</b>	Bus Rapid Transit
<b>CC</b>	Car Contemplators
<b>CF</b>	Car-free choosers
<b>CFA</b>	Confirmatory Factor Analysis
<b>CFI</b>	Comparative Fit Index
<b>CO</b>	Carbon monoxide
<b>CR</b>	Composite Reliability
<b>DD</b>	Devoted Drivers
<b>EFA</b>	Exploratory Factor Analysis
<b>FA</b>	Factor Analysis
<b>GFI</b>	Goodness of Fit
<b>GHG</b>	Greenhouse Gas
<b>II</b>	Image Improvers
<b>KMO</b>	Kaiser-Meyer-Olkin
<b>MCMA</b>	Mexico City Metropolitan Area
<b>MM</b>	Malcontented Motorists

<b>MPM</b>	Material Possession Model
<b>NFI</b>	Normed Fit Index
<b>NOx</b>	Nitrogen oxides
<b>PBC</b>	Perceived Behavioural Control
<b>PM</b>	Particulate matter
<b>PT</b>	Practical Travellers
<b>PTD</b>	Public Transport Dependents
<b>RMR</b>	Root Mean Square Residual
<b>RMSEA</b>	Root Mean Square Error of Approximation
<b>SCO</b>	Social Comparison Orientation
<b>SCT</b>	Social Comparison Theory
<b>SE</b>	Standard Error
<b>SEGMENT</b>	Segmented Marketing for Energy Efficient Transport
<b>SEM</b>	Structural Equation Modelling
<b>SMA</b>	Ministry of Environment of Mexico City
<b>SO2</b>	Sulfur dioxide
<b>SPSS</b>	Statistical Package for the Social Sciences
<b>TLI</b>	Tucker Lewis index
<b>TPB</b>	Theory of Planned Behaviour
<b>WHO</b>	World Health Organization

## Appendix A Matrix of Literature Review

Identification			Methodological characteristics of the study				
Author & Year	Title	Country	Objective	Sample	Theory	Analysis	Findings
1. Anable, 2006a	'Complacent' Car Addicts or Aspiring Environmentalists? Identifying travel behaviour segments using attitude theory	UK	To segment a population of day trip travellers into potential 'mode switchers.'	Visitors to leisure destinations	TPB + Moral norm, Environmental attitudes, worldview and knowledge; Efficacy; Identity (behavioural norm); and Habit	Factor analysis and Cluster analysis	Travel mode choice is complex and the use of an extended version of the TPB incorporating additional factors such as moral norm and psychological attachment to the car can improve its explanatory power of reducing car use in this context.
2. Anable, 2006b	All work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes	UK	To investigate the importance that people attach to various instrumental and affective journey attributes when travelling either for work or for a leisure day trip.	Staff, academics and postgraduate students	MSPM	Multivariate analysis of variance (MANOVA)	For work journeys respondents tend to attach more importance to instrumental aspects, and especially to convenience than to affective factors. For leisure journeys, respondents appeared to attach almost equal importance to instrumental and affective aspects.
3. Bastford and Brian, 2002	Drivers' perceptions of cyclists	UK	Exploring drivers' perceptions of cyclists in UK.	Drivers	TPB and Social Identity Theory	Qualitative analysis (Content analysis) and mean ratings	Tendency of drivers to regard cyclists as an 'out group'. When prompted to consider cyclists in detail however it is clear that motorists hold negative views about cyclists.
4. Carró et al., 2016	Private and public modes of bicycle commuting: a perspective on attitude and perception.	Spain	To determine which attitudes and perceptions of behavioural control toward cycling and a bicycle-sharing system distinguish commuters with a different adherence to bicycle commuting.	Commuters with a different adherence to bicycle		Principal component analysis and multinomial logistic regression	Respondents that are used to being non-bicycle users but willing to cycle and public-bicycle commuters had more favourable perception toward public-shared bicycles compared to private cyclists.
5. Demant-Sirois et al., 2014	What's your type: a multidimensional cyclist typology	Canada	To build a useful multidimensional cyclist typology.	Cyclists and non-cyclists		Principal component factor analysis followed by a cluster analysis	Four groups resulted and those are strongly distinct from each other and are likely to react differently to efforts to increase cycling in a city.
6. Da Souza et al., 2014	Influence of attitudes with respect to cycling on the perception of existing barriers for using this mode of transport for commuting	Brazil	To examine whether individuals' attitude towards cycling influences his perception of barriers (perceived behavioural control) for cycle commuting.				
7. Jull and McNeil, 2013	Four Types of Cyclists?	USA	To test a typology developed for the city of Portland that includes four categories.	Cyclists and non-cyclists			The typology was found useful to distinguishing potential markets for cycling and understanding why some adults do not currently use the bicycle to commute.

Identification			Methodological characteristics of the study				
Author & Year	Title	Country	Objective	Sample	Theory	Analysis	Findings
8. Fineman, 2007	Bicycle messengers: Image, identity and community	UK	To explore the social meaning of cycling.	Cycling messengers		Qualitative analysis (Interviews and Ethnography) Content analysis of media	Cyclist messengers are marginalised by the work they do, the clothes they use and their riding style. One influencing factor of the outsider image is the media.
9. Garstensen and Appelon, 2007	Contingent cycling to work: Attitudes and perceptions in different stages of change.	UK	To investigate the attitudes and perceptions of people in different stages of change and to examine in more detail how more people might be persuaded to cycle.	University staff	Prochaska's model of behaviour change (Stages of Change)	Content analysis	Neither all cyclists nor all non-cyclists are the same which may have important implications for targeting cycling policies. Respondents who had never contemplated cycling had the least positive attitude towards cycling.
10. Handy et al., 2010	Factors associated with bicycle ownership and use: a study of six small US cities	USA	To provide a better understanding of the determinants of bicycle ownership and use as a basis for identifying ways to promote bicycling.	Residents of Davis, Boulder, Eugene and three comparison communities that differ with respect to their physical and social environments.	Ecological model Individual factors, social-environmental factors, and physical-environment	Factor Analysis	The model shows that social-environment factors also influence transportation bicycling. A recreational bicycling culture distavours bicycling for transportation.
11. Heavin, 2002	Extending the Theory of Planned Behavior: Predicting the Use of Public Transportation	Canada	To predict university students' public transportation use.	university students	TPB+ descriptive and moral norms, awareness of and perceived responsibility for the problems caused by car use, and environmental values	Principal component Analysis and Hierarchical multiple regression	This research confirmed that "positive influence of performing a behaviour on psychological factors and the reciprocal nature of the influence between psychological factors and the performance of a behaviour".
12. Jaccobini, 2015	Psychological Determinants of Mobility Behaviours: A Review.	Argentina	To analyse which are the psychological factors that better explain the car use and public transport use.		Systematic review		Validation of the model implies to test them in different context such as Latin America. However, the best model to predict behavioural intention for driving or public transport use was the TPB.
13. Lois et al., 2015	Cycle commuting Intention: A model based on theory of planned behaviour and social identity	Spain	To develop a theoretical framework of an extended version of the TPB to predict cycle commuting intention.	Non-cycle commuters	TPB plus social identity theory	Factor Analysis	The authors found that incorporating social identity into the TPB added explanatory value to explain motivational factors to engage into cycle commuting. There is a strong link between identifying as a cyclist and perceived self-efficacy with respect to cycling. Interventions need to address pedestrian and cyclist safety, perceptions of risk, and parental norms regarding children's independence.
14. Lorenz, 2008	Attitudes to walking and cycling among children, young people and parents: a systematic review	UK	Systematic review to explore the effectiveness of interventions for encouraging walking and cycling as an alternative to motorised transport.	Studies describing people's ideas about, or experiences of walking and cycling initiatives, what influences walking or cycling, and their ideas about what could be done to promote walking and cycling		Framework analysis to code each included study	

Identification				Methodological characteristics of the study			
Author & Year	Title	Country	Objective	Sample	Theory	Analysis	Findings
15. Molin et al., 2016	Multimodal travel groups and attitudes: A latent class cluster analysis of Dutch travellers	Netherlands	To understand the behavioural patterns of travellers to help policy makers and stakeholders to develop policies to help changing travel behaviour to a more sustainable	Adults from a large national panel		Latent class cluster analysis	Individuals that only drive for commuting have more negative attitudes towards public transport and bicycle, whereas, multimodal travellers have less negative public transport attitudes.
16. Oksaaschén and Kuhnén, 2016	Barriers and facilitators in the use of the bicycle as a means of transportation between university students	Brazil	To investigate the barriers and facilitators university students face to commute by bicycle.	University students with diverse levels of cycling		Thematic analysis	Social situation of bicycle has contributed to see its use as not normal and even delegitimizing cycling.
17. Fojani et al., 2017	Do Northwestern and Southeastern Europe Share a Common "Cycling Mindset"? Comparative Analysis of Beliefs toward Cycling in the Netherlands and the Balkans	Cross-sectional study of three cities: Gouda (The Netherlands), Shkoder (Albania), and Peja (Kosovo)	To explore the similarities and differences in beliefs about the decisions to commute by bicycle in three small, cycling-oriented cities:	Adults, of all levels of cycling	TPB	Thematic analysis	Their findings suggest that, in developing cities changes to the physical environment are crucial but insufficient if the aim is to achieve modal shift. To this end attitudes and perceptions need to be tackled as well.
18. Steg, 2005	Car use, just and must: Instrumental, symbolic and affective motives for car use	The Netherlands	To examine to what extent various motives are related to the level of car use.	Adults with driving licence	MPM	principal components analysis CFA and Multiple Regression	Useful measures of instrumental, symbolic and affective motives for car use could be developed. Especially symbolic and affective motives appeared to contribute to the explanation of car use, while instrumental motives did not significantly contribute to the explanation of commuter car use.
19. Steinbach et al., 2011	Cycling and the city: a case study of how gendered, ethnic and class identities can shape healthy transport choices	UK	Investigate the symbolic meanings of cycling and the differences across urban, gendered, ethnic and class identities.	Cyclists		Thematic analysis of interviews	If cycling cultural association or the accomplishments bound up in cycling change in London these might have a positive impact in cycling. Engaging more people from different social identities, into cycling.
20. Willis et al., 2015	Cycling under influence: summarizing the influence of perceptions, attitudes, habits, and social environments on cycling for transportation	Canada	Literature review about the role of social and psychological factors, such as perceptions, attitudes, habits and social environments affecting travel behaviour and modal choice.		Research that considers the effect of social and psychological factors on the decision to cycle for transportation		Effective policies and measures to achieve modal shift towards cycling demands better understanding about attitudes, habits, social environment and perception interact.

## Appendix B Copy of the Questionnaire (Spanish and English)



ENCUESTA A TRANSEUNTES  
SOBRE USO DE LA BICICLETA EN  
EL DISTRITO FEDERAL, 2015.



UNIVERSITY OF LEEDS

<p><i>Buenos días/ tardes.</i></p> <p><i>La Universidad de Leeds con el apoyo de CONACYT está realizando una encuesta a los transeúntes sobre la percepción del uso de la bicicleta en el DF. Toda la información proporcionada en este cuestionario incluyendo datos personales (correo electrónico, número de celular o número local) será tratada confidencialmente y será para uso exclusivo de investigación académica. No será identificado en ningún reporte o publicación y toda la información recolectada será almacenada en discos duros de la Universidad de Leeds o en unidades de almacenamiento encriptadas.</i></p> <p><i>Al responder a las preguntas participara en la rifa de</i></p> <p>_____</p> <p><i>¿Me permite unos minutos de su tiempo? Gracias.</i></p>	<b>Folio:</b>	<b>Cuestionario</b>	<b>Captura</b>
	<b>Encuestador:</b>		
<b>Fecha de aplicación:</b>	<input type="text"/> <input type="text"/> Día Mes	<b>Ho ra:</b> <input type="text"/> <input type="text"/> Hora Min	

### A. Segmentos de Transporte

1. ¿Ha manejado un automóvil o camioneta en los últimos 12 meses?

Si

No

Para las siguientes afirmaciones encierre en un círculo la respuesta que mejor exprese su opinión, en donde 1= Totalmente en desacuerdo, 2= En desacuerdo, 3= Ni de acuerdo ni en desacuerdo, 4= De Acuerdo, 5= Totalmente de acuerdo.

	Totalment e en desacuerd o	En desacuerd o	Ni de acuerdo ni en desacuerd o	De Acuerd o	Totalment e de acuerdo
2. Para la mayoría de mis trayectos, yo prefiero utilizar el automóvil a cualquier otro medio de transporte.	1	2	3	4	5
3. Me gusta manejar (automóvil o camioneta) solo por la diversión de hacerlo	1	2	3	4	5
4. No estoy interesado en reducir el uso de mi automóvil	1	2	3	4	5
5. Manejar (automóvil o camioneta) es una forma de expresarme	1	2	3	4	5

Para la afirmación número 6 encierre en un círculo la respuesta que mejor exprese su opinión, en donde 1= Totalmente improbable, 2= Improbable, 3= Ni probable ni improbable, 4= Probable, 5= Totalmente probable.

	Totalment e improbabl e	Improbabl e	Ni probable ni improbabl e	Probabl e	Totalment e probable
6. ¿Qué tan probable es que maneje (automóvil o camioneta) en los próximos 12 meses?	1	2	3	4	5

Para las siguientes afirmaciones encierre en un círculo la respuesta que mejor exprese su opinión, en donde 1= Totalmente en desacuerdo, 2= En desacuerdo, 3= Ni de acuerdo ni en desacuerdo, 4= De Acuerdo, 5= Totalmente de acuerdo.

	Totalment e en desacuerd o	En desacuerd o	Ni de acuerdo ni en desacuerd o	De Acuerd o	Totalment e de acuerdo
7. No soy el tipo de persona que anda en bicicleta	1	2	3	4	5
8. Siento que debería andar más en bicicleta para mantenerme en forma	1	2	3	4	5
9. Me parece estresante	1	2	3	4	5

andar en

bicicleta

10. Andar

en bicicleta

puede ser

el modo

1

2

3

4

5

más rápido

de

trasladarme

11. Me

gusta

1

2

3

4

5

trasladarme

en bicicleta

12. No soy

el tipo de

persona

que le

1

2

3

4

5

gusta

caminar

mucho

13. Siento

que debería

caminar

1

2

3

4

5

más para

mantenerme

e en forma

14. Me

gusta

1

2

3

4

5

trasladarme

a pie

15. No soy

el tipo de

1

2

3

4

5

persona

que usa el

transporte público					
16. En general, prefiero andar en bicicleta que usar el transporte público	1	2	3	4	5
17. Siento una obligación moral de reducir mis emisiones de gases de efecto invernadero o					
18. Debería estar permitido que las personas usen sus coches tanto como quieran	1	2	3	4	5

## B. Percepción y Actitudes

19. Para las siguientes afirmaciones encierre en un círculo la respuesta que mejor exprese su opinión, en donde 1= Totalmente en desacuerdo, 2= En desacuerdo, 3= Ni de acuerdo ni en desacuerdo, 4= De Acuerdo, 5= Totalmente de acuerdo.

	Totalment e en desacuerd o	En desacuerd o	Ni de acuerdo ni en desacuerd o	De Acuerd o	Totalment e de acuerdo
a. Seguido me comparo a mí mismo con otros	1	2	3	4	5
b. Seguido me comparo a mí mismo con otros con relación al transporte que utilizo para trasladar me	1	2	3	4	5
c. Si quiero evaluar lo que he alcanzado en la vida, comparo la forma en que me traslado diario con la forma en que otros lo hacen	1	2	3	4	5
d. Seguido me siento bien cuando veo otros andar en bicicleta	1	2	3	4	5
e. Si ando en bicicleta para trasladar me diario, seguido siento que	1	2	3	4	5

otros  
pensaran  
que soy  
pobre

20. Para explorar las motivaciones para andar en bicicleta, por favor encierre en un círculo la respuesta que mejor exprese su opinión, en donde 1= Totalmente en desacuerdo, 2= En desacuerdo, 3= Ni de acuerdo ni en desacuerdo, 4= De Acuerdo, 5= Totalmente de acuerdo.

	Totalmen te en desacuer do	En desacuer do	Ni de acuerdo ni en desacuer do	De Acuer do	Totalmen te de acuerdo
a. Disfruto andar en una bicicleta de buena calidad	1	2	3	4	5
b. Andar en bicicleta puede ser una aventura emocionante	1	2	3	4	5
c. Para mí, mi bicicleta es sobre todo, un objeto de placer	1	2	3	4	5
d. Trasladarme en bicicleta me proporciona libertad e independencia	1	2	3	4	5
e. Trasladarme en bicicleta es relajante	1	2	3	4	5

f.	Trasladar me en bicicleta es cómodo	1	2	3	4	5
g.	Trasladar me en bicicleta es bueno para el medio ambiente	1	2	3	4	5
h.	Trasladar me en bicicleta es flexible	1	2	3	4	5
i.	Usar bicicleta significa bajo costo de traslados	1	2	3	4	5
j.	Trasladar me en bicicleta es seguro	1	2	3	4	5
k.	Si pudiera escoger, preferiría una bicicleta con estilo	1	2	3	4	5
l.	Tu bicicleta te puede distinguir del resto de las personas	1	2	3	4	5
m.	Una bicicleta es un objeto el cual a veces muestra a otras personas tu forma	1	2	3	4	5

de ser y  
tus gustos

- n. La bicicleta que manejas puede darte prestigio entre tus amigos y conocidos
- |  |   |   |   |   |   |
|--|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 |
|--|---|---|---|---|---|
- o. En tanto mejor es tu bicicleta, más exitoso eres en la vida
- |  |   |   |   |   |   |
|--|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 |
|--|---|---|---|---|---|

21. Respecto a su intención de usar la bicicleta encierre en un círculo la respuesta que mejor exprese su opinión, en donde 1= Totalmente en desacuerdo, 2= En desacuerdo, 3= Ni de acuerdo ni en desacuerdo, 4= De Acuerdo, 5= Totalmente de acuerdo.

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De Acuerdo	Totalmente de acuerdo
a. Espero usar mi bicicleta para mis trayectos la próxima semana	1	2	3	4	5
b. Quiero usar mi bicicleta para mis trayectos la próxima semana	1	2	3	4	5
c. Mi intención es usar mi bicicleta	1	2	3	4	5

	para mis trayectos la próxima semana					
d.	Otras personas en general esperan de mí que no use bicicleta para mis trayectos	1	2	3	4	5
e.	Siento presión social para usar cierto modo de transporte para mis trayectos	1	2	3	4	5
f.	Las personas que son importantes para mí quieren que haga mis traslados en bicicleta	1	2	3	4	5
g.	Estoy seguro de que puedo usar la bicicleta para mis trayectos	1	2	3	4	5

A continuación se presentan cuatro opciones de adjetivos extremos o bipolares. Por favor, califique la afirmación que tiene el número 22 seleccionando el cuadro que refleje en mayor medida su opinión. Seleccione un cuadro para cada uno de los cuatro grupos de adjetivos. El lado derecho representa el extremo desfavorable y el lado izquierdo refleja el extremo favorable, el punto medio representa una posición neutral.

22. Para una persona que se traslada diario una distancia menor a 8 km elegir usar bicicleta es

	1	2	3	4	5	
Importante						Sin importancia
Benéfico						Perjudicial
Agradable						Desagradable
Bueno						Malo

23. ¿Cuenta usted con bicicleta propia?

Si

No

24. Por favor elija la opción que mejor responda a la siguiente pregunta: ¿Con que frecuencia ha usado una bicicleta para sus trayectos entre semana en los últimos 6 meses? Ya sea en bicicleta propia, rentada o prestada

- Nunca
- Rara vez
- A veces
- Seguido
- Siempre

<b>C. Datos Sociodemográficos</b>	
25. ¿Cuál es su edad?	
26. ¿Es usted hombre o mujer?	<input type="radio"/> Hombre <input type="radio"/> Mujer
27. ¿Cuál es su máximo grado de estudios (aprobado)?	<input type="radio"/> Ninguno <input type="radio"/> Primaria <input type="radio"/> Secundaria <input type="radio"/> Preparatoria o bachillerato <input type="radio"/> Carrera técnica o commercial <input type="radio"/> Licenciatura <input type="radio"/> Posgrado
28. ¿Cuál es su ocupación?	<input type="radio"/> Trabaja <input type="radio"/> Estudia <input type="radio"/> No trabaja <input type="radio"/> Estudia y trabaja <input type="radio"/> Quehaceres del hogar <input type="radio"/> Jubilado o pensionado <input type="radio"/> Otro

<b>29. ¿Cuál es su Estado Civil?</b>		
<input type="radio"/> Soltero (a)		
<input type="radio"/> Casado (a)		
<input type="radio"/> Divorciado (a)		
<input type="radio"/> Unión Libre		
<input type="radio"/> Viudo (a)		
<b>30. ¿Cuál es su ingreso mensual promedio?</b>		
<input type="radio"/> Menos de 3 mil pesos		
<input type="radio"/> de 4 mil a 9 mil pesos		
<input type="radio"/> de 10 mil a 15 mil pesos		
<input type="radio"/> de 16 mil a 21 mil pesos		
<input type="radio"/> de 22 mil a 27 mil pesos		
<input type="radio"/> de 28 mil a 33 mil pesos		
<input type="radio"/> de 34 mil a 39 mil pesos		
<input type="radio"/> de 40 mil a 45 mil pesos		
<input type="radio"/> de 46 mil a 51 mil pesos		
<input type="radio"/> de 52 mil a 57 mil pesos		
<input type="radio"/> 58 mil pesos o mas		
<b>31. Seleccione la delegación en donde se localiza su domicilio actual</b>		
<input type="radio"/> Alvaro Obregon	<input type="radio"/> Gustavo A. Madero	<input type="radio"/> Tláhuac
<input type="radio"/> Azcapotzalco	<input type="radio"/> Iztapalapa	<input type="radio"/> Tlalpan
<input type="radio"/> Benito Juárez	<input type="radio"/> Iztacalco	<input type="radio"/> V. Carranza
<input type="radio"/> Coyoacán	<input type="radio"/> M. Contreras	<input type="radio"/> Xochimilco
<input type="radio"/> Cuajimalpa	<input type="radio"/> Miguel Hidalgo	<input type="radio"/> Otra
<input type="radio"/> Cuauhtémoc	<input type="radio"/> Milpa Alta	
<b>32. ¿Cuál es su medio de transporte principal entre semana? (marque todos las opciones de transporte que utilice)</b>		
<input type="radio"/> Colectivo o microbus	<input type="radio"/> Bici Ecobici	
<input type="radio"/> Metro	<input type="radio"/> Motocicleta	

<input type="radio"/> Automóvil	<input type="radio"/> Metrobus
<input type="radio"/> Caminando	<input type="radio"/> Trolebus
<input type="radio"/> Taxi	<input type="radio"/> Tren ligero
<input type="radio"/> Bicicleta propia	<input type="radio"/> Otro
<b>33. Cuál es el tiempo aproximado que le lleva recorrer la distancia desde su domicilio hasta su trabajo? (de ida y de regreso)</b>	
<input type="radio"/> Hasta 10 minutos <input type="radio"/> 11 minutos hasta 30 minutos <input type="radio"/> 31 minutos hasta 59 minutos <input type="radio"/> Hasta 1 hora y media <input type="radio"/> Hasta 2 horas <input type="radio"/> Hasta 2 horas y media <input type="radio"/> Hasta 3 horas <input type="radio"/> Hasta 3 horas y media <input type="radio"/> Mas de 3 horas y media	
<b>34. Le gustaría recibir por correo electrónico el resultado del segmento de transporte en cual se ubica?</b>	
<input type="radio"/> Si <input type="radio"/> No	
Si contesto que sí a la pregunta 34 por favor anote un alias y un correo electrónico o cualquier otro medio de contacto para enviarle el nombre y descripción del segmento de actitud hacia el transporte en que se encuentra ubicado. Por favor, indique además si estaría de acuerdo en participar en un grupo focal sobre percepción del uso de la bicicleta para investigación futura.	
<input type="text"/>	

**Muchas gracias por participar!**

En el proyecto sobre *'La percepción y actitudes de los transeúntes hacia el uso de la bicicleta en el DF'* Esta investigación tiene el apoyo de CONACYT y el respaldo de la Universidad de Leeds. Cualquier duda contactar Magda Cepeda al correo electrónico: [ts12mrcz@leeds.ac.uk](mailto:ts12mrcz@leeds.ac.uk)

# Survey to Explore the Road Users' Perception of the Use of the Bicycle in Mexico City

## **Welcome**

This questionnaire is designed to know your perception and attitudes towards the use of the bicycle. Please answer the questions truthfully. There are not correct or incorrect answers. The questionnaire should be completed preferably before January 10, 2016.

Thank you very much for your time.

## **Privacy Notice for the Protection of Personal Data**

In terms of the provisions of the Federal Law on Protection of Personal Data Held by Individuals, the University of Leeds, an institution of higher education in the United Kingdom of Great Britain and Northern Ireland, establishes this Privacy Notice in accordance with the next:

### **Terms and Conditions**

1. The purpose of this Privacy Notice is to protect the personal data of the respondents through their legitimate, controlled and informed treatment, in order to guarantee their privacy, as well as their right to self-determination of information.
2. If the respondent provides any contact information, it will be with the sole purpose of contacting you for future research or sending you information concerning the present research project.
3. Any information that is provided in this questionnaire including contact information will be treated confidentially. And they will be for the exclusive use of academic research. The respondents will not be identified in any report or publication and all the information collected will be stored on hard drives of the University of Leeds or in encrypted storage units if necessary.

## **A. Transportation Segments**

1. Have you driven a car or truck in the last 12 months?

Yes

No

For the following statements, please indicate the answer that best represents your opinion

2. For most of my trips, I prefer to use the car to any other means of transportation.

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

3. I like to drive (car or van) just for the fun of it

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

4. I am not interested in reducing the use of my car

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

5. Driving (car or truck) is a way of expressing myself

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

6. How likely is it that you drive (car or truck) in the next 12 months? *Optional*

Totally unlikely	Unlikely	Neither probable nor unlikely	Probable	Totally probable

7. I'm not the type of person who rides a bicycle

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

8. I feel like I should ride more on the bike to stay in shape

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

9. I find it stressful to ride a bicycle

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

10. Riding a bike may be the fastest way to get around

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

11. I like to travel by bicycle

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

12. I am not the type of person who likes to walk a lot

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

--	--	--	--	--

13. I feel like I should walk more to stay in shape

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

14. I like to move on foot

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

15. I am not the type of person who uses public transport

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

16. In general, I prefer to ride a bicycle than to use public transportation

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

17. I feel a moral obligation to reduce my emissions of greenhouse gases

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

18. It should be allowed for people to use their cars as much as they want

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

## B. Perception and Attitudes

19. Please indicate the answer that best represents your opinion for each of the statements

Often I compare myself to others

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

I often compare myself to others in relation to the transportation I use to travel

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

If I want to evaluate what I have achieved in life, I compare the way I move daily with the way others do it.

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Often I feel good when I see others riding a bicycle

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

If I ride a bicycle to move daily, I often feel that others think I am poor

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

20. Regarding the motivations for riding a bicycle, please indicate the answer that best represents your opinion for each of the statements

I enjoy riding a good quality bicycle

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Riding a bicycle can be an exciting adventure

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

For me, my bicycle is, above all, an object of pleasure

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Riding a bicycle gives me freedom and independence

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Riding a bicycle is relaxing

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Riding a bicycle is comfortable

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Riding a bicycle is good for the environment

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Riding a bicycle is flexible

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Using a bicycle means low cost of transfers

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Riding a bicycle is safe

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

If I could choose, I would prefer a bicycle with style

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Your bicycle can distinguish you from the rest of the people

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

A bicycle is an object which sometimes shows other people your way of being and your tastes

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

The bike you drive can give you prestige among your friends and acquaintances

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

The better your bicycle is, the more successful you are in life

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

21. Regarding your intention to ride a bicycle, please indicate the answer that best represents your opinion for each of the statements

I hope to use my bike for my trips next week

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

I want to use my bike for my trips next week

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

My intention is to use my bike for my trips next week

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Other people in general expect me not to use a bicycle for my journeys

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

I feel social pressure to use a certain mode of transportation for my journeys

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

The people who are important to me want me to do my bicycle transfers

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

I'm sure I can use the bicycle for my trips

Totally disagree	In disagreement	Neither Agree or Disagree	Agree	Totally agree

Below are four options for extreme or bipolar adjectives. Please rate the statement that has the number 22 by selecting the box that best reflects your opinion. Select a table for each group of adjectives. The right side represents the negative end and the left side represents the positive end, the middle point represents a neutral position.

22. For someone that travels for less than 8 km, to choose commute by bicycle is:

+	1	2	3	4	5	-
Important						Unimportant
Beneficial						Harmful
Enjoyable						Unenjoyable
Good						Bad

23. Do you have your own bicycle?

Yes

No

24. How often have you used a bicycle for your weekday trips in the last 6 months? Either on your own bicycle, rented or borrowed

Never	Rarely	Sometimes	Often	Always
-------	--------	-----------	-------	--------

### C. Socio Demographic Characteristics

25. What is your age?

26. Are you a man or a woman?

27. What is your highest level of education (approved)?

Any	Primary	Secondary	High school	Technical or commercial career	Bachelor's degree	Postgraduate
-----	---------	-----------	-------------	--------------------------------	-------------------	--------------

28. What is your occupation?

Work	Study	Not working	Studying and Working	Housework	Retired or pensioned	Other
------	-------	-------------	----------------------	-----------	----------------------	-------

29. What is your marital status?

Single	Married	Divorced	free Union	Widowed
--------	---------	----------	------------	---------

30. What is your average monthly income?

- a) 3 thousand pesos or less
- b) 4 thousand to 9 thousand pesos
- c) 10 thousand to 15 thousand pesos
- d) 16 thousand to 21 thousand pesos
- e) 22 thousand to 27 thousand pesos
- f) 28 thousand to 33 thousand pesos
- g) 34 thousand to 39 thousand pesos
- h) 40 thousand to 45 thousand pesos
- i) 46 thousand to 51 thousand pesos
- j) 52 thousand to 57 thousand pesos
- k) 58 thousand pesos or more

31. Select the delegation where your current address is located

<input type="radio"/> Alvaro Obregon	<input type="radio"/> Gustavo A. Madero	<input type="radio"/> Tláhuac
<input type="radio"/> Azcapotzalco	<input type="radio"/> Iztapalapa	<input type="radio"/> Tlalpan
<input type="radio"/> Benito Juárez	<input type="radio"/> Iztacalco	<input type="radio"/> V. Carranza
<input type="radio"/> Coyoacán	<input type="radio"/> M. Contreras	<input type="radio"/> Xochimilco
<input type="radio"/> Cuajimalpa	<input type="radio"/> Miguel Hidalgo	<input type="radio"/> Otra
<input type="radio"/> Cuauhtémoc	<input type="radio"/> Milpa Alta	

32. What is your main means of transportation during the week?

(Check all transportation options you use)

- a) Collective or microbus
- b) Meter
- c) Car
- d) Walked
- e) Cab
- f) Own bicycle
- g) Ecobici Bicycle
- h) Motorcycle
- i) Metrobus
- j) Trolleybus
- k) Light Rail
- l) Other

33. What is the approximate time it takes you to travel the distance of your daily commute, be it from your home to your work or from your home to school? (with return in the usual time you travel)

- a) 10 minutes or less
- b) 11 minutes to 30 minutes
- c) 31 minutes to 59 minutes
- d) Up to 1 hour and a half
- e) Up to 2 hours
- f) Up to 2 and a half hours
- g) Up to 3 hours
- h) Up to 3 and a half hours
- i) More than 3 and a half hours

34. Would you like to receive by email the result of the transportation segment in which it is located?

Yes

No

35. If I answer yes to question 34 please write down an alias and an email or any other means of contact to send the name and description of the attitude segment to the transport in which it is located. Please also indicate if you would be interested in participating in more research in the future.

## **Appendix C Protocol of the Questionnaire (Spanish)**

### **Protocolo de la Encuesta:**

#### **Percepción y Actitudes de los transeúntes hacia el uso de la bicicleta en México DF.**

#### **GUIA PARA DISTRIBUCION Y ESPECIFICACIONES DE LAS PREGUNTAS Y AFIRMACIONES**

Este manual está hecho para ser utilizado como herramienta de entrenamiento para la aplicación de la encuesta

### **SECTION I**

#### ***DESCRIPCIÓN DE LA ENCUESTA***

##### **1. OBJETIVO DE LA ENCUESTA**

El objetivo principal de la presente investigación es explorar la percepción y actitud de los transeúntes hacia el uso de la bicicleta en el Distrito Federal. Como un objetivo adicional se va a explorar la existencia de segmentos de la población de acuerdo a sus actitudes hacia los diferentes modos de transporte (transporte público, automóvil, bicicleta y a pie). Los objetivos particulares son investigar cuál es la identidad asociada a los ciclistas en el DF, medir la percepción y actitudes hacia el uso de la bicicleta, explorar el estatus socio económico asociado al uso de la bicicleta y analizar hasta qué punto la imagen del ciclista influye en la decisión de los individuos para usarla o no.

##### **2. ENCUESTADOS**

La encuesta debe ser entregada para ser llenada a mujeres y hombres de 18 años de edad en adelante, que sean peatones, usuarios de transporte público y conductores de automóvil privado, que vivan y trabajen en el DF y que no utilicen la bicicleta como su principal medio de transporte entre semana.

##### **3. ENCUESTA**

La encuesta debe ser llenada por los encuestados. La encuesta será entregada directamente a los encuestados junto con una tabla con clip así como un lápiz (que deberá tener punta) y la persona que lo aplique debe esperar a que el encuestado lo llene y se lo regrese.

##### **4. TIEMPO PARA LA ENCUESTA**

Llenar la encuesta requiere 10 minutos en promedio, sin embargo, puede tomar un poco más dependiendo de la comprensión y el nivel de educación del encuestado.

## 5. PREGUNTAS Y AFIRMACIONES DE LA ENCUESTA

Diferentes tipos de preguntas y categorías de respuestas se utilizaron a lo largo de la encuesta.

### a. Tipo de Preguntas

- **Preguntas cerradas:** El encuestado debe elegir entre las opciones que se le presentan.

Q1. ¿Ha manejado un automóvil o camioneta en los últimos 12 meses? R= Si/No

Q2. Para la mayoría de mis trayectos, yo prefiero utilizar el automóvil a cualquier otro medio de transporte.

Totalmente en desacuerdo	En desacuerdo	Ni en desacuerdo ni de acuerdo	De Acuerdo	Totalmente de acuerdo
1	2	3	4	5

Q24. ¿Con que frecuencia ha usado una bicicleta para sus trayectos entre semana en los últimos 6 meses? Ya sea en bicicleta propia, rentada o prestada

R= Nunca/Rara vez/A veces/Seguido/Siempre

- **Preguntas abiertas:** El encuestado debe dar la respuesta en sus propias palabras. Q25. ¿Cuál es su edad?

### b. Tipos de Respuestas

- **Opciones categóricas:** El encuestado debe elegir la categoría que mejor aplica a su caso. Q27. ¿Cuál es su máximo grado de estudios (aprobado)?

R=

Ninguno

Primaria

Secundaria

Carrera técnica o bachillerato

Carrera técnica o comercial

Licenciatura

Posgrado

- **Adjetivos bipolares**

Q22. Para una persona que se traslada diario una distancia menor a 8 km elegir usar bicicleta es

	1	2	3	4	5	
Importante						Sin importancia
Benéfico						Perjudicial
Agradable						Desagradable
Bueno						Malo

- **Respuestas abiertas:** El encuestado debe dar la respuesta en sus propias palabras.

25. ¿Cuál es su edad?

## 6. REGISTRO DEL TIEMPO

El día y mes así como la hora se debe registrar en la encuesta cuando se le dé al encuestado. En la primera página hay un apartado para esto. El tiempo estará definido como 'Día' y 'Mes' y se debe registrar usando dos dígitos para el día y dos dígitos para el mes. La hora se debe registrar usando 4 dígitos en hora militar como por ejemplo: 09:00, 13:00, 15.45, etc.

## SECTION II

### A. ORIENTACION GENERAL PARA LA APLICACIÓN

#### 1. PAPEL DEL APLICADOR

El aplicador es responsable de ubicar a los posibles informantes y asegurarse de que cumplen con los requisitos necesarios para ser incluidos dentro de la muestra (en relación a la cuota de edad y género). La persona al cargo de la aplicación de la encuesta es responsable además de hacerles la pregunta filtro (¿Podría decirme si vive y trabaja en el DF?), presentarse, explicar el objetivo del estudio y entregar la encuesta para ser llenada junto con los materiales necesarios (tabla con clip y lápiz). Antes de comenzar la aplicación de la encuesta, la persona responsable debe conocer todas las preguntas y cómo se deben administrar.

## **2. PAPEL DEL ENCUESTADO**

El papel del encuestado es cooperar con el aplicador y seguir sus instrucciones. Él o ella, debe responder a la pregunta filtro y escuchar la presentación del aplicador y los objetivos de la encuesta y si está de acuerdo tomar la encuesta y contestarla. Él o ella, pueden tomarse el tiempo que necesiten para entender las preguntas y contestarla dando la respuesta más exacta posible.

## **3. PAPEL DEL SUPERVISOR**

El papel del supervisor es controlar y monitorear el progreso y calidad de la recolección de datos, y asegurar que los aplicadores realicen el levantamiento de datos. Su labor incluye entregar la logística de la recolección de datos, coordinación con todos los aplicadores y supervisarlos antes, durante y después del proceso.

## ***B. INSTRUCCIONES DE APLICACIÓN***

Objetivos

- Aprender a cómo introducirse apropiadamente a sí mismos
- Aprender a cómo involucrar a los encuestados en forma estandarizada

### **1. PRESENTACIÓN DEL APLICADOR**

El aplicador debe comunicar claramente los objetivos de la encuesta al encuestado ya que de esto depende la exactitud en las respuestas. La persona que aplique la encuesta debe establecer un buen entendimiento con el encuestado presentándose a sí mismo (a) y al proyecto. Dos cosas debe de hacer:

- Dar una buena impresión:
  - a) Tú eres un profesional de una organización legítima y de excelente reputación quien está ayudando a recolectar información para un estudio de una prestigiosa universidad.

- b) La encuesta es para reunir información muy valiosa para realizar un proyecto de investigación
- c) La participación del encuestado, es vital para el éxito del proyecto de investigación.
- d) Las respuestas que se recojan serán confidenciales y los encuestados permanecerán anónimos, y toda información será utilizada para fines académicos.

El aplicador de la encuesta puede usar el siguiente ejemplo de presentación o bien decidir cuál es el más adecuado utilizar. **Ejemplo de Presentación:**

'Hola que tal, mi nombre es... y estoy apoyando un estudio que realiza la Universidad de Leeds en Reino Unido con el apoyo de Conacyt. La razón por la que lo contacto es porque estamos realizando una encuesta sobre la percepción del uso de la bicicleta y otros medios de transporte en la Ciudad de México y me gustaría pedirle su apoyo contestando esta encuesta. Al contestarla entra en la rifa de membresías para el sistema Ecobici. Es importante destacar que su participación será anónima y que cualquier información que nos proporcione será utilizada únicamente para propósitos académicos'.

- Involucrar a los encuestados potenciales a contestar la encuesta
1. Debes de ser agradable y asertivo, y hacer que el encuestado se sienta a gusto e interesado en participar.
  2. Debes conocer la encuesta a fondo y estar bien preparado para contestar cualquier pregunta o duda que le surja al encuestado.

## 2. ALICANDO LA ENCUESTA

Cuando se haga entrega de la encuesta, el aplicador debe señalar que no hay respuestas correctas ni incorrectas, sino que estamos interesados en todas las respuestas. La entrega de la encuesta se debe hacer junto con una tabla con clip y un lápiz.

## 3. ACLARACIONES

Aclaraciones son necesarias cuando el encuestado:

- Es incapaz de contestar alguna pregunta de la encuesta
- Parece no entender la pregunta o no sabe cómo contestarla

No obstante, en cualquier caso el aplicador de la encuesta debe ser muy cuidadoso de no dirigir la respuesta y limitarse únicamente a releer la pregunta o clarificarla sin cambiar las palabras de la pregunta.

## 4. REVISIÓN

Una vez que el encuestado ha terminado de llenar la encuesta, el aplicador debe revisar rápidamente la encuesta para asegurarse que todas las preguntas fueron contestadas.

## **5. FINALIZANDO**

En caso de que falten preguntas por contestar, el aplicador deberá pedirle al encuestado que conteste la pregunta o preguntas que faltan asegurándose de hacerlo antes de que el encuestado se retire. Cuando todas las preguntas estén contestadas, entonces el aplicador recogerá la encuesta junto con los materiales (tabla con clip y lápiz) y deberá guardar las encuestas en un folder o bolsa donde estén seguros, conservando el orden del número de folio que tienen.

## **6. ENTREGA DE LA ENCUESTA**

El primer viernes después del inicio de la distribución de la encuesta, el aplicador deberá presentarse en las oficinas donde se le dio el material para entregar al supervisor las encuestas contestadas durante la semana y recoger las encuestas para aplicar en la semana 2. En ese momento deberá informar cualquier eventualidad o situación que se haya presentado durante la jornada de aplicación de la encuesta.

## **7. LUGAR, PERIODO Y HORARIO PARA LA APLICACIÓN DE LA ENCUESTA**

Fecha de aplicación: Del martes 03 de noviembre al viernes 13 de noviembre del 2015.

## **8. PUNTOS DE LEVANTAMIENTO**

- Zonas de afluencia de peatones (Calle madero y 16 de Septiembre en Centro Histórico)
- Zonas de afluencia de usuarios de transporte público (paradas principales de Metrobus que conectan con metro como Nuevo León, Etiopía, La Raza, Buenavista, Juárez y San Lázaro)
- Zonas de afluencia de conductores (parquímetros ubicados en las colonias Anzures, Lomas, Polanco y Roma-Condesa)

## **9. HORARIO DE LEVANTAMIENTO**

En horario de comida (13-16 hrs) y a la hora de fin de jornada laboral (18-21 hrs)

Derecho de autor de la encuesta y metodología utilizada

Los responsables del proyecto y autores de la encuesta y la metodología utilizada son Magda Cepeda Zorrilla, Frances Hodgson y Ann Jopson y todos los derechos del proyecto en comento pertenecen a la Universidad de Leeds. Todos los derechos reservados. Queda prohibida la reproducción total o parcial de esta encuesta sin permiso expreso y escrito.

Nombre y firma del aplicador:

Nombre y firma del Supervisor: Magda Cepeda

Ocupación: Investigadora de Posgrado

Datos de contacto del supervisor:

## Appendix D Pilot study

### Sampling strategy and questionnaire

#### Introduction

The main objective of this study is to explore road user's perceptions and attitudes towards the use of bicycle in Mexico City and the extent to which this may deter people from cycling, additionally it will be explored the existence of attitudinal transport segments for the population. This deliverable outlines the stages undertaken to develop an efficient methodology and includes the sample design and survey instrument.

The following steps were undertaken in order to achieve this objective:

1. Sampling strategy
2. Questionnaire design

#### 1. Sampling strategy

##### Sample description

The questionnaire survey will take place over the course of 2 months (from mid-October 2015 to the mid-December 2015). All residents of the Mexico City aged 18 to 60 years are defined as the reference population. Residents under the age of 18 will be excluded because they are not entitled to hold a driver's license; as a result, they cannot choose between a car and bike as means of transportation. Residents over the age of 60 will also be excluded, primarily due to the physical constraints that prevent them from riding a bicycle.

##### Sample size

The required sample size was calculated with the total population and 95% CI and 5% error. With a population of almost 5 million, the sample size will be of 384 answered surveys.

#### 2. Questionnaire design

##### Section 1 Questions for segmenting population (5-point scale)

SEG1	Have you driven a car or van in the past 12 months?	(YES/NO)
SEG2	For most journeys, I would rather use the car than any other form of transport 1	(Strongly disagree) to 5 (Strongly agree)

SEG3	I like to drive just for the fun of it	
SEG4	I am not interested in reducing my car use	
SEG5	Driving gives me a way to express myself	
SEG6	How likely are you to drive in the next 12 months?	1 (Very unlikely) to 5 (Very Likely)
SEG7	I am not the kind of person who rides a <b>bicycle</b>	
SEG8	I feel I should <b>cycle</b> more to keep fit	
SEG9	I find <b>cycling</b> stressful	
SEG10	<b>Cycling</b> can be the quickest way to travel around	
SEG11	I like travelling by <b>bicycle</b>	
SEG12	I am not the kind of person that likes to walk a lot	
SEG13	I feel I should walk more to keep fit	
SEG14	I like travelling by walking	
SEG15	I am not the kind of person to use the bus	
SEG16	In general, I would rather cycle than use the bus	
SEG17	I feel a moral obligation to reduce my emissions of greenhouse gases	
SEG18	People should be allowed to use their cars as much as they like	

**Section 2 Questions for evaluating social comparison influencing intention to cycle (5-point scale)**

SCO19	I often compare myself with others	
SCO20	I often compare myself with others with respect the transport I use to commute	
SEV21	If I want to assess what I have achieved in life, I compare the way I commute with how other people do it	
SEV22	I often feel good when I see others cycle commuters (to assess the frequency of positive affect evoked by the comparison)	

**Section 3 Questions for assessing affective, instrumental and symbolic factors influencing intention to cycle (5-point scale)**

AMC1	I enjoy riding a good bicycle	
AMC2	Riding a bicycle can be an exciting adventure	
AMC3	For me, my bicycle is, above all, an object of pleasure	
AMC4	Riding my bicycle gives me freedom and independence	
AMC5	Riding my bicycle is relaxing	
IMC6	Cycling commuting is comfortable	
IMC7	Cycling commuting is beneficial for the local environment	
IMC8	Cycling commuting is fast	
IMC9	Cycling commuting is flexible	
IMC10	Cycling commuting means low cost of traveling	
IMC11	Cycling commuting is beneficial for personal health	
IMC12	Cycling is safe	
SMC13	If I could choose, I would prefer a classy bicycle	
SMC14	Your bike can distinguish you from the rest of the people	
SMC15	A bicycle is an object with which you can sometimes show other people in general the way you are and your tastes	
SMC16	The bicycle you ride can give you prestige among friends and acquaintances	
SMC17	I fully agree with people who think that the better your bike is, the more successful you are in life	

**Section 4 Questions for assessing attitudes, social norm, PBC and habits influencing intention to cycle (5-point scale and some with semantic differential)**

INT18	I expect to use my bike for my daily commute in the next month	
INT19	I want to use my bike for my daily commute in the next month	
INT20	I intend to use my bike for my daily commute in the next month	
ATT21	For me, to cycle for my daily commute is: Valuable-Not valuable	Semantic Differential scale
ATT22	Beneficial-Harmful	Semantic Differential scale
ATT23	Enjoyable-Unenjoyable	Semantic Differential scale
ATT24	Pleasant- Unpleasant	Semantic Differential scale
ATT25	Good- Bad	Semantic Differential scale
SON26	Other people in general expect from me that I do not commute by bicycle	
SON27	I feel under social pressure to use certain mode of transport to commute	
PBC28	For me to ride my bicycle to commute for at least 30 minutes each day in the next month would be: Possible-Impossible	Semantic Differential scale
PBC29	It is mostly up to me whether or not I cycle to commute for less than 30 minutes each day in the next month Strongly Agree-Strongly Disagree	Semantic Differential scale
HAB30	For me to use the bicycle for my daily commute is something: I do automatically	
HAB31	I do without having to consciously remember	
HAB32	I start doing before I realize I am doing it	

