The value of blue-space recreation and water quality across Europe: A contingent behaviour study (Börger et al. 2021)

Supplementary Materials

Content

A. Data

A.1. Survey data

The dataset was collected in four waves between June 2017 and April 2018, resulting in a sample of $N = 18,838$ respondents across 18 countries or territories (Bulgaria, California/USA, Canada, Czech Republic, Estonia, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Netherlands, Portugal, Queensland/Australia, Spain, Sweden, United Kingdom). The analysis only uses data from 14 EU Member States (i.e. cases from California, Canada, Hong Kong and Queensland were discarded). Further exclusion criteria are detailed in Section A.3.

Respondents were asked about their visits to blue- and greenspace sites over a period of four weeks. Types of green space listed in the questionnaire included local parks, large parks, community gardens, playgrounds, cemeteries, botanical gardens or zoos, woodlands, farmland, meadows, mountains, moorland and country parks. Types of blue space listed in the questionnaire were lakes, urban rivers, rural rivers, waterfalls, ponds, wetlands, swimming pools or spas, fountains, ice rinks, esplanades or promenades, harbours, beaches, rocky shores, cliffs, lagoons or the open sea. They were then asked to give more information about trips to the last blue-space site they had visited. So whilst respondents determined themselves which site to report on, an element of random selection of site was introduced by asking them about their most recent site. This is to prevent all respondents to state visit information regarding their most favourite or most frequently visited site.

The present study differs from previous applications of the travel cost and contingent behaviour methods in that it assesses the value of recreation at different blue space sites yet without identifying each site. Instead, sites can be characterised using a number of criteria such that the recreational values can be broken down according to these categories. The good to be valued in this study is two-fold: (1) recreational

visits to blue space sites and (2) changes to this recreational value as a reaction to changes in water quality at such sites.

Although the full dataset includes a share of respondents who did not make any trip to a blue space site in the past four weeks and therefore report a zero for the trip frequency variable, no information of a visited site (incl. its location) could be recorded for these respondents. Therefore, these observations are excluded from any models which use site characteristics or distance between site and home location. As a consequence, the above sampling procedure means that the trip frequency variable is zero-truncated since no respondent provides information on a site which they have not visited. There is thus no observation with zero trip frequency (under current water quality conditions) in any of the count data models.

A.2. Extraction of distance and trip duration variables

Instead of straight-line distance, the distance on the road network was extracted and used for analysis. This distance was calculated in R (R Core Team 2020) using the osrmRoute function within the osrm package (version 3.3.1) (Giraud 2019). This function returns the travel distance (km) and duration (mins) using road networks. There were 66 instances of no route error returned. Additionally, there were 22 instances of where a route distance of 0 was returned but there was no error. In many cases this was because the start and visit locations were very close in straight-line distance (n = 6 < 100 m; n = 14 < 1 km).

The visit coordinates were saved as a .csv file and imported into ArcGIS (version 10.6.1; ESRI Inc.). The Near function was used to identify the id number of the nearest visit location. This was imported into R and the straight-line distance between each visit location and its nearest visit location was calculated using the distVincentyEllipsoid function from the geosphere package as above (version 1.5-10) (Hijmans 2019).

A.3. Useable samples and exclusion criteria

Two different samples were used at the different stages. For the count data models, a sample of $N = 5,937$ respondents was used. To estimate total annual visitation frequencies, a sample of $N = 11,443$ was used. These samples were obtained as follows. From the original dataset ($N = 18,838$), only respondents in 14 EU were retained ($N = 14,745$). In addition, observations were discarded based on a number of criteria:

- Observations for which trips were entirely for other purposes than visiting the site (1,372);
- Trips which did not start at home (1,721);
- Trips with a one-way road distance of more than 1,000km (20)

In addition, the following criteria excluded cases with unrealistic combinations of travel mode and distance travelled, or distance travelled and visit frequency:

- Observations with a one-way road distance of more than 50km *and* travel mode of either: walking (33), running/jogging (10), ferry or public boat (13) or other travel mode (9);
- Observations with a one-way road distance of more than 100km *and* travel mode cycling (9);
- Observations with a one-way distance of more than 250km *and* more than one visit in four weeks (66);
- Observations with a one-way distance of more than 100km *and* more than four visits in four weeks (34);

Finally, one criterion was applied to discard cases claiming to make more than two visits per day over the course of the reporting period:

- Observations with a contingent trip frequency (after improvement or deterioration of water quality) of more than twice per day on average (i.e. 56 visits over four weeks) (15).

This leaves a dataset with $N = 11,443$ cases to be used for calculations of total visitation numbers ("full sample"). Of this sample 2,777 cases did not make any visit to a blue space site in the preceding four weeks and for 2,729 no reliable route distance could be computed, which leaves a final sample of $N = 5,937$ to be used in the count data models and visit count prediction ("travel cost sample").

Table A.1. Inclusion criteria and associated sample sizes

Criteria	Sample size
Original survey sample	18,838
Respondents from EU countries (Bulgaria, Czech Republic, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, United Kingdom)	14,745
Trips which were entirely or partly to visit the site	13,373
Trips starting at home	11,652
Trips with a one-way road distance ≤1,000km	11,632
Trips with a one-way road distance ≤50km and travel mode of either: walking, running/jogging, ferry or public boat or other travel mode	11,567
Trips with a one-way road distance ≤100km and travel mode: cycling	11,558
Trips with a one-way road distance ≤250km and more than one visit in four weeks	11,492
Trips with a one-way road distance ≤100km and more than four visits in four weeks	11,458
Respondents reporting on average more than two visits per days over a four-week period	**11,443**
Respondents with at least one visit to a blue space site in the preceding four weeks	8,666
Criteria above + reliable home + visit + congruent home location	**5,937**

A.4. Country-specific descriptive statistics

Tables A.2 to A.15 show descriptive statistics of respondents-specific variables per country. Descriptive statistics are reported for both the full sample and the travel cost sample for each country. For variables for which they are available, respective population figures are reported as well. Note that population-level shares are with respect to each country's adult population (aged 18 and above).

Table A.2: Sample characteristics (all respondent-specific variables used in visit count modelling) – Bulgaria

Variable	Full sample (N=771)		Travel cost sample (N=427)		Population 18+ (5,857,080)[a]	
	N	%	N	%	N	%
Male	370	0.48	205	0.48	2,808,993	0.48
Age group						
Age18-29	118	0.15	65	0.15	895,097	0.15
Age30-39	129	0.17	71	0.17	979,421	0.17
Age40-49	141	0.18	78	0.18	1,067,440	0.18
Age50-59	124	0.16	69	0.16	945,874	0.16
Age60+	259	0.34	144	0.34	1,969,248	0.34
Education						
Not complete primary ed.	2	0.00	2	0.00		
Completed primary ed.	12	0.02	4	0.01		
Completed secondary ed.	228	0.30	123	0.29		
Completed higher ed.	529	0.69	498	0.70		
Marital status						
Married	475	0.62	271	0.64		
Single	241	0.31	127	0.30		
Neither	37	0.05	19	0.04		
Prefer not to answer	19	0.02	9	0.02		
Own dog	204	0.26	109	0.26		0.25[b]
Self-rated competent swimmer	210	0.27	119	0.28	-	-
Survey wave						
Jun-17	204	0.27	123	0.29	-	-
Sep-17	171	0.22	103	0.24	-	-
Dec-17	187	0.24	107	0.25	-	-
Mar-18	209	0.27	94	0.22	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	6.45	2.24	6.55	2.18		

Notes: Country-specific sampling weights applied.
[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"
[b] Source: FEDIAF (2018)

Table A.3: Sample characteristics (all respondent-specific variables used in visit count modelling) – Czech Republic

Variable	Full sample (N=831)		Travel cost sample (N=401)		Population 18+ (8,660,507)[a]	
	N	%	N	%	N	%
Male	405	0.49	195	0.49	4,219,749	0.49
Age group						
Age18-29	133	0.16	64	0.16	1,386,749	0.16
Age30-39	148	0.18	71	0.18	1,541,809	0.18
Age40-49	161	0.19	78	0.19	1,675,966	0.19
Age50-59	127	0.15	61	0.15	1,317,890	0.15
Age60+	262	0.32	127	0.32	2,738,093	0.32
Education						
Not complete primary ed.	0	0.00	0	0.00		
Completed primary ed.	33	0.04	15	0.04		
Completed secondary ed.	560	0.67	262	0.65		
Completed higher ed.	238	0.29	124	0.31		
Marital status						
Married	491	0.59	251	0.63		
Single	331	0.40	146	0.37		
Neither	5	0.01	3	0.01		
Prefer not to answer	4	0.00	1	0.00		
Own dog	327	0.39	158	0.39		0.41[b]
Self-rated competent swimmer	405	0.49	205	0.51	-	**-**
Survey wave						
Jun-17	232	0.28	123	0.31	-	**-**
Sep-17	174	0.21	92	0.23	-	**-**
Dec-17	216	0.26	99	0.25	-	**-**
Mar-18	209	0.25	87	0.22	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	12.06	5.87	12.41	5.91		

Notes: Country-specific sampling weights applied.
[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"
[b] Source: FEDIAF (2018)

Table A.4: Sample characteristics (all respondent-specific variables used in visit count modelling) – Estonia

Variable	Full sample (N=699)		Travel cost sample (N=379)		Population 18+ (1,066,907)[a]	
	N	%	N	%	N	%
Male	322	0.46	175	0.46	491,390	0.46
Age group						
Age18-29	120	0.17	65	0.17	183,258	0.17
Age30-39	123	0.18	67	0.18	188,315	0.18
Age40-49	118	0.17	64	0.17	180,698	0.17
Age50-59	113	0.16	61	0.16	172,219	0.16
Age60+	224	0.32	122	0.32	342,417	0.32
Education						
Not complete primary ed.	2	0.00	2	0.00		
Completed primary ed.	44	0.06	20	0.05		
Completed secondary ed.	636	0.52	204	0.54		
Completed higher ed.	290	0.41	153	0.40		
Marital status						
Married	414	0.59	230	0.61		
Single	241	0.35	127	0.33		
Neither	26	0.04	11	0.03		
Prefer not to answer	18	0.03	11	0.03		
Own dog	217	0.31	123	0.32		0.22[b]
Self-rated competent swimmer	251	0.36	146	0.38	-	-
Survey wave						
Jun-17	130	0.19	89	0.23	-	-
Sep-17	180	0.26	118	0.31	-	-
Dec-17	200	0.29	89	0.23	-	-
Mar-18	189	0.27	83	0.22	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	13.13	8.98	13.60	9.14		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

Table A.5: Sample characteristics (all respondent-specific variables used in visit count modelling) – Finland

Variable	Full sample (N=847)		Travel cost sample (N=422)		Population 18+ (4,446,015)[a]	
	N	%	N	%	N	%
Male	414	0.49	206	0.49	2,173,599	0.49
Age group						
Age18-29	153	0.18	76	0.18	802,295	0.18
Age30-39	134	0.16	67	0.16	702,767	0.16
Age40-49	126	0.15	63	0.15	660,703	0.15
Age50-59	140	0.17	70	0.17	734,554	0.17
Age60+	294	0.35	147	0.35	1,545,696	0.35
Education						
Not complete primary ed.	9	0.01	3	0.01		
Completed primary ed.	106	0.13	44	0.10		
Completed secondary ed.	388	0.46	189	0.45		
Completed higher ed.	344	0.41	185	0.44		
Marital status						
Married	468	0.55	247	0.59		
Single	318	0.38	147	0.35		
Neither	54	0.06	25	0.06		
Prefer not to answer	8	0.01	3	0.01		
Own dog	196	0.23	102	0.24		0.24[b]
Self-rated competent swimmer	454	0.54	241	0.57	-	-
Survey wave						
Jun-17	205	0.24	118	0.28	-	-
Sep-17	194	0.23	106	0.25	-	-
Dec-17	215	0.25	96	0.23	-	-
Mar-18	232	0.27	101	0.24	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	32.22	18.02	33.64	17.85		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

Table A.6: Sample characteristics (all respondent-specific variables used in visit count modelling) – France

Variable	Full sample (N=775)		Travel cost sample (N=335)		Population 18+ (52,228,132)[a]	
	N	%	N	%	N	%
Male	369	0.48	159	0.48	24,850,139	0.48
Age group						
Age18-29	136	0.18	59	0.18	9,183,290	0.18
Age30-39	123	0.16	54	0.16	8,278,103	0.16
Age40-49	130	0.17	56	0.17	8,750,979	0.17
Age50-59	130	0.17	56	0.17	8,780,966	0.17
Age60+	256	0.33	111	0.33	17,234,794	0.33
Education						
Not complete primary ed.	4	0.01	2	0.01		
Completed primary ed.	37	0.05	14	0.04		
Completed secondary ed.	303	0.39	117	0.35		
Completed higher ed.	431	0.56	202	0.60		
Marital status						
Married	450	0.58	217	0.65		
Single	305	0.39	111	0.33		
Neither	13	0.02	6	0.02		
Prefer not to answer	8	0.01	1	0.00		
Own dog	207	0.27	96	0.29		0.21[b]
Self-rated competent swimmer	338	0.44	177	0.53	-	-
Survey wave						
Jun-17	182	0.23	84	0.25	-	-
Sep-17	174	0.22	87	0.26	-	-
Dec-17	204	0.26	78	0.23	-	-
Mar-18	215	0.28	86	0.26	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	30.79	14.58	32.57	15.21		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

Table A.7: Sample characteristics (all respondent-specific variables used in visit count modelling) – Germany

Variable	Full sample (N=830)		Travel cost sample (N=404)		Population 18+ (69,240,011)[a]	
	N	%	N	%	N	%
Male	406	0.49	198	0.49	33,872,866	0.49
Age group						
Age18-29	139	0.17	68	0.17	11,614,774	0.17
Age30-39	125	0.15	61	0.15	10,453,462	0.15
Age40-49	129	0.16	63	0.16	10,731,644	0.15
Age50-59	160	0.19	78	0.19	13,369,561	0.19
Age60+	277	0.33	135	0.33	23,070,570	0.33
Education						
Not complete primary ed.	1	0.00	1	0.00		
Completed primary ed.	423	0.51	185	0.46		
Completed secondary ed.	204	0.25	104	0.26		
Completed higher ed.	202	0.24	113	0.28		
Marital status						
Married	437	0.53	216	0.54		
Single	350	0.42	163	0.40		
Neither	37	0.04	20	0.05		
Prefer not to answer	5	0.01	5	0.01		
Own dog	181	0.22	96	0.24		0.19[b]
Self-rated competent swimmer	507	0.61	263	0.65	-	-
Survey wave						
Jun-17	199	0.24	118	0.29	-	-
Sep-17	194	0.23	97	0.24	-	-
Dec-17	219	0.26	94	0.23	-	-
Mar-18	218	0.26	94	0.23	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	30.65	16.52	31.17	16.68		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

Table A.8: Sample characteristics (all respondent-specific variables used in visit count modelling) – Greece

Variable	Full sample (N=781)		Travel cost sample (N=522)		Population 18+ (8,860,863)[a]	
	N	%	N	%	N	%
Male	374	0.48	250	0.48	4,244,625	0.48
Age group						
Age18-29	119	0.15	79	0.15	1,347,410	0.15
Age30-39	125	0.16	84	0.16	1,418,805	0.16
Age40-49	143	0.18	95	0.18	1,619,329	0.18
Age50-59	131	0.17	87	0.17	1,483,863	0.17
Age60+	254	0.34	176	0.34	2,991,456	0.34
Education						
Not complete primary ed.	1	0.00	0	0.00		
Completed primary ed.	12	0.02	9	0.02		
Completed secondary ed.	253	0.32	169	0.32		
Completed higher ed.	515	0.66	344	0.66		
Marital status						
Married	461	0.59	309	0.59		
Single	283	0.36	190	0.36		
Neither	27	0.03	16	0.03		
Prefer not to answer	10	0.01	7	0.01		
Own dog	239	0.31	160	0.31		0.14[b]
Self-rated competent swimmer	301	0.39	203	0.39	-	-
Survey wave						
Jun-17	193	0.25	132	0.25	-	-
Sep-17	215	0.28	160	0.31	-	-
Dec-17	188	0.24	105	0.20	-	-
Mar-18	185	0.24	126	0.24	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	15.28	8.27	15.65	8.37		

Notes: Country-specific sampling weights applied.
[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"
[b] Source: FEDIAF (2018)

Table A.9: Sample characteristics (all respondent-specific variables used in visit count modelling) – Ireland

Variable	Full sample (N=857)		Travel cost sample (N=460)		Population 18+ (3,633,704)[a]	
	N	%	N	%	N	%
Male	420	0.49	225	0.49	1,780,994	0.49
Age group						
Age18-29	165	0.19	88	0.19	698,906	0.19
Age30-39	173	0.20	93	0.20	733,791	0.20
Age40-49	167	0.19	89	0.19	705,708	0.19
Age50-59	137	0.16	74	0.16	582,705	0.16
Age60+	215	0.25	116	0.25	912,594	0.25
Education						
Not complete primary ed.	7	0.01	3	0.01		
Completed primary ed.	47	0.05	27	0.06		
Completed secondary ed.	349	0.41	194	0.42		
Completed higher ed.	455	0.53	236	0.51		
Marital status						
Married	557	0.65	305	0.66		
Single	275	0.32	141	0.31		
Neither	15	0.02	6	0.01		
Prefer not to answer	9	0.01	8	0.02		
Own dog	335	0.39	196	0.43		0.34[b]
Self-rated competent swimmer	366	0.43	201	0.44	-	-
Survey wave						
Jun-17	226	0.26	124	0.27	-	-
Sep-17	212	0.25	124	0.27	-	-
Dec-17	210	0.24	102	0.22	-	-
Mar-18	210	0.24	110	0.24	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	36.18	18.52	37.28	18.33		

Notes: Country-specific sampling weights applied.
[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"
[b] Source: FEDIAF (2018)

Table A.10: Sample characteristics (all respondent-specific variables used in visit count modelling) – Italy

Variable	Full sample (N=850)		Travel cost sample (N=481)		Population 18+ (50,661,969)[a]	
	N	%	N	%	N	%
Male	409	0.48	231	0.48	24,376,633	0.48
Age group						
Age18-29	124	0.15	70	0.15	7,407,342	0.15
Age30-39	121	0.14	68	0.14	7,208,084	0.14
Age40-49	158	0.19	90	0.19	9,427,258	0.19
Age50-59	155	0.18	87	0.18	9,212,746	0.18
Age60+	292	0.34	165	0.34	17,406,539	0.34
Education						
Not complete primary ed.	11	0.01	3	0.01		
Completed primary ed.	106	0.12	58	0.12		
Completed secondary ed.	375	0.44	213	0.44		
Completed higher ed.	358	0.42	208	0.43		
Marital status						
Married	578	0.68	336	0.70		
Single	246	0.29	130	0.27		
Neither	18	0.02	12	0.03		
Prefer not to answer	7	0.01	2	0.00		
Own dog	352	0.41	209	0.43		0.27[b]
Self-rated competent swimmer	359	0.42	215	0.45	-	-
Survey wave						
Jun-17	225	0.26	141	0.29	-	-
Sep-17	183	0.22	108	0.22	-	-
Dec-17	220	0.26	108	0.22	-	-
Mar-18	222	0.26	124	0.26	-	-
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Household income (€1,000)	30.06	14.91	30.25	14.64		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

Table A.11: Sample characteristics (all respondent-specific variables used in visit count modelling) – Netherlands

Variable	Full sample (N=861)		Travel cost sample (N=392)		Population 18+ (13,792,808)[a]	
	N	%	N	%	N	%
Male	424	0.49	193	0.49	6,792,417	0.49
Age group						
Age18-29	162	0.19	74	0.19	2,599,498	0.19
Age30-39	130	0.15	59	0.15	2,078,145	0.15
Age40-49	144	0.17	66	0.17	2,307,135	0.17
Age50-59	156	0.18	71	0.18	2,491,356	0.18
Age60+	269	0.31	123	0.31	4,316,674	0.31
Education						
Not complete primary ed.	3	0.00	1	0.00		
Completed primary ed.	42	0.05	14	0.04		
Completed secondary ed.	442	0.51	207	0.53		
Completed higher ed.	374	0.43	170	0.43		
Marital status						
Married	505	0.59	238	0.61		
Single	309	0.36	132	0.34		
Neither	41	0.05	19	0.05		
Prefer not to answer	7	0.01	3	0.01		
Own dog	228	0.26	112	0.29		0.18[b]
Self-rated competent swimmer	531	0.62	261	0.67	-	-
Survey wave						
Jun-17	228	0.26	120	0.31	-	-
Sep-17	196	0.23	100	0.26	-	-
Dec-17	211	0.24	78	0.20	-	-
Mar-18	226	0.26	94	0.24	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	34.43	15.66	35.16	16.04		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

Table A.12: Sample characteristics (all respondent-specific variables used in visit count modelling) – Portugal

Variable	Full sample (N=750)		Travel cost sample (N=511)		Population 18+ (8,531,350)[a]	
	N	%	N	%	N	%
Male	349	0.47	238	0.47	3,967,827	0.47
Age group						
Age18-29	115	0.15	79	0.15	1,311,155	0.15
Age30-39	114	0.15	78	0.15	1,296,718	0.15
Age40-49	139	0.19	95	0.19	1,579,162	0.19
Age50-59	130	0.17	88	0.17	1,476,210	0.17
Age60+	252	0.34	172	0.34	2,868,105	0.34
Education						
Not complete primary ed.	3	0.00	4	0.01		
Completed primary ed.	19	0.03	11	0.02		
Completed secondary ed.	339	0.45	225	0.43		
Completed higher ed.	389	0.52	271	0.53		
Marital status						
Married	447	0.60	308	0.60		
Single	291	0.39	193	0.38		
Neither	8	0.01	8	0.02		
Prefer not to answer	3	0.00	2	0.00		
Own dog	267	0.36	183	0.36		0.36[b]
Self-rated competent swimmer	303	0.40	208	0.41	-	-
Survey wave						
Jun-17	158	0.21	124	0.24	-	-
Sep-17	202	0.27	150	0.29	-	-
Dec-17	200	0.27	121	0.24	-	-
Mar-18	190	0.25	116	0.23	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	17.82	9.99	17.53	9.48		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

Table A.13: Sample characteristics (all respondent-specific variables used in visit count modelling) – Spain

Variable	Full sample (N=800)		Travel cost sample (N=422)		Population 18+ (38,295,248)[a]	
	N	%	N	%	N	%
Male	388	0.49	205	0.49	18,575,603	0.49
Age group						
Age18-29	118	0.15	62	0.15	5,664,263	0.15
Age30-39	134	0.17	71	0.17	6,431,119	0.17
Age40-49	162	0.20	85	0.20	7,740,481	0.20
Age50-59	142	0.18	75	0.18	6,797,280	0.18
Age60+	244	0.30	129	0.30	11,662,105	0.30
Education						
Not complete primary ed.	8	0.01	4	0.01		
Completed primary ed.	50	0.06	20	0.05		
Completed secondary ed.	283	0.35	148	0.35		
Completed higher ed.	459	0.57	249	0.59		
Marital status						
Married	546	0.68	296	0.70		
Single	245	0.31	122	0.29		
Neither	8	0.01	5	0.01		
Prefer not to answer	1	0.00	0	0.00		
Own dog	335	0.42	187	0.44		0.24[b]
Self-rated competent swimmer	330	0.41	190	0.45	-	-
Survey wave						
Jun-17	213	0.27	119	0.28	-	-
Sep-17	186	0.24	114	0.27	-	-
Dec-17	180	0.23	88	0.21	-	-
Mar-18	218	0.27	101	0.24	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	25.93	12.75	26.83	12.79		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

Table A.14: Sample characteristics (all respondent-specific variables used in visit count modelling) – Sweden

Variable	Full sample (N=813)		Travel cost sample (N=349)		Population 18+ (7,996,560)[a]	
	N	%	N	%	N	%
Male	406	0.50	174	0.50	3,988,519	0.50
Age group						
Age18-29	160	0.20	68	0.20	1,568,839	0.20
Age30-39	131	0.16	56	0.16	1,290,686	0.16
Age40-49	132	0.16	57	0.16	1,298,352	0.16
Age50-59	129	0.16	55	0.16	1,269,914	0.16
Age60+	261	0.32	112	0.32	2,568,769	0.32
Education						
Not complete primary ed.	5	0.01	2	0.01		
Completed primary ed.	77	0.09	24	0.07		
Completed secondary ed.	318	0.39	124	0.35		
Completed higher ed.	413	0.51	199	0.57		
Marital status						
Married	495	0.61	216	0.62		
Single	251	0.31	97	0.28		
Neither	58	0.07	32	0.09		
Prefer not to answer	8	0.01	4	0.01		
Own dog	154	0.19	64	0.18		0.15[b]
Self-rated competent swimmer	507	0.62	223	0.64	-	-
Survey wave						
Jun-17	200	0.25	99	0.28	-	-
Sep-17	181	0.22	91	0.26	-	-
Dec-17	216	0.27	89	0.25	-	-
Mar-18	216	0.27	70	0.20	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	40.23	17.64	40.37	17.61		

Notes: Country-specific sampling weights applied.
[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"
[b] Source: FEDIAF (2018)

Table A.15: Sample characteristics (all respondent-specific variables used in visit count modelling) – United Kingdom

Variable	Full sample (N=978)		Travel cost sample (N=432)		Population 18+ (52,242,741)[a]	
	N	%	N	%	N	%
Male	478	0.49	211	0.49	25,525,552	0.49
Age group						
Age18-29	192	0.20	85	0.20	10,273,404	0.20
Age30-39	164	0.17	73	0.17	8,776,124	0.17
Age40-49	160	0.16	71	0.16	8,566,903	0.16
Age50-59	167	0.17	74	0.17	8,911,564	0.17
Age60+	295	0.30	130	0.30	15,714,746	0.30
Education						
Not complete primary ed.	2	0.00	2	0.00		
Completed primary ed.	38	0.04	14	0.03		
Completed secondary ed.	439	0.45	186	0.43		
Completed higher ed.	499	0.51	231	0.53		
Marital status						
Married	592	0.61	282	0.65		
Single	335	0.34	129	0.30		
Neither	41	0.04	19	0.04		
Prefer not to answer	9	0.01	3	0.01		
Own dog	249	0.25	122	0.28		0.25[b]
Self-rated competent swimmer	585	0.60	275	0.64	-	-
Survey wave						
Jun-17	217	0.22	106	0.25	-	-
Sep-17	193	0.20	95	0.22	-	-
Dec-17	269	0.28	102	0.24	-	-
Mar-18	298	0.30	129	0.30	-	-
	Mean	SD	Mean	SD	Mean	SD
Household income (€1,000)	33.09	18.19	33.90	18.99		

Notes: Country-specific sampling weights applied.

[a] Source: Eurostat „Population on 1 January by age group, sex and NUTS2 region"

[b] Source: FEDIAF (2018)

B. Construction of travel cost variable

B.1. Overview of travel cost

The travel cost variable is constructed using the roundtrip distance between a respondent's home and the site and a per-km vehicle running cost. The calculation of the latter is detailed in Section B.2. Roundtrip distance, per-km road cost and resulting travel cost are reported per country in Table B.1.

Table B.1. Travel distance and cost

Country	1 Roundtrip distance km	2 Road cost € / km	3 Travel cost € / trip
Bulgaria	78.93	0.09	7.61
Czech Republic	32.22	0.05	2.40
Estonia	50.82	0.06	4.90
Finland	35.05	0.05	2.60
France	62.30	0.06	4.77
Germany	44.98	0.06	3.33
Greece	56.57	0.10	5.89
Ireland	41.01	0.06	2.87
Italy	62.58	0.08	5.44
Netherlands	41.10	0.07	4.20
Portugal	45.75	0.09	4.46
Spain	63.62	0.06	4.73
Sweden	34.77	0.04	2.25
UK (GB)	48.60	0.07	4.63
TOTAL (EU14)	50.14	0.07	4.35

B.2. Calculation of vehicle running cost

Route distances from the respondent's home to the visited site were extracted from open street map. These distances were used to generate a road cost variable specific to the indicated travel mode.

B.2.1. Car, van, motorbike, taxi, hire car

The calculation of country-specific per-km car running costs followed the approach in Czajkowski et al. (2015) and Bertram et al. (2020). Car running costs for a medium-sized car for petrol, oil and tyres was extracted from the Irish AA (https://www.theaa.ie/aa/motoring-advice/cost-of-motoring.aspx). Since the AA's figures assumed a petrol price of €1.319 per litre the above car running costs were adjusted for country-specific petrol prices in 2018 and finally adjusted according to purchasing power parity differences between countries. The resulting per-km car running costs per country are displayed in Table B.2.

This per-km cost is applied to respondents travelling by private car, hired car, motorbike and taxi. The cost is divided by the number of passengers in the vehicle as stated in the survey.

Table B.2. Country-specific per-km car running costs

Country	Per-km cost (€)	Source
Bulgaria	0.23180	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Czech Republic	0.17420	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Estonia	0.18447	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Finland	0.12383	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
France	0.13628	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Germany	0.13490	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Greece	0.19404	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Ireland	0.12837	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Italy	0.16577	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Netherlands	0.14826	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Portugal	0.17382	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Spain	0.14654	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
Sweden	0.10550	Irish AA adjusted by own calculations following Czajkowski et al. (2015)
United Kingdom	0.14267	Irish AA adjusted by own calculations following Czajkowski et al. (2015)

B.2.2. Walking, running, jogging

Road costs for these travel modes were set to zero.

B.2.3. Bicycle

Road costs for cycling were set to €0.06 per km for all countries following Bertram and Larondelle (2017) and Brübach (2009).

B.2.4. Bus

While in most cases bus may mean local urban bus, data on bus commuting costs were taken from EC (2016a) which provides inter-city bus fares in EU Member States. These costs are per km and per person (Table B.3).

Table B.3. Country-specific per-km costs for bus and train travel

Country	Bus Per-km cost (€)[a]	Train Per-km cost (€)[b]
Bulgaria	0.11	0.02
Czech Republic	0.07	0.04
Estonia	0.04	0.01
Finland	0.04	0.05
France	0.06	0.13
Germany	0.05	0.13
Greece	0.12	0.09
Ireland	0.04	0.11
Italy	0.025	0.07
Netherlands	0.05	0.12
Portugal	0.10	0.07
Spain	0.12	0.08
Sweden	0.09	0.05
United Kingdom	0.04	0.15
Notes: [a] from EC (2016a), [b] from EC (2016b)		

B.2.5. Train

Train costs were taken from EC (2016b). These costs are per km and per person (Table B.3).

B.2.6. Ferry or other public boat

A per-km road cost of €0.30 is assumed.

B.2.7. Other (e.g. horseback)

A per-km road cost of €0.30 is assumed.

C. Computation of confidence intervals

C.1. Confidence intervals of consumer surplus estimates

Confidence intervals of the consumer surplus estimates, $CS = -\beta_{travel.cost}^{-1}$, where $\beta_{travel.cost}$ is the estimated travel cost parameter, can be computed by taking 1,000 draws from the multivariate normal distribution defined by the MPLN model's parameter vector $\boldsymbol{\beta}$ and the asymptotic variance-covariance matrix. This results in 1,000 parameter vectors, so 1,000 consumer surplus estimates can be computed. The bounds of the 95% confidence interval are the 2.5- and 97.5-percentiles of this empirical distribution of consumer surpluses.

C.2. Confidence intervals of (changes in) predicted visit frequencies

Here too, 1,000 draws from the multivariate normal distribution defined by the MPLN model's parameter vector $\boldsymbol{\beta}$ and the asymptotic variance-covariance matrix are taken. For each of these draws, the resulting parameter vector is used to predict the number of visits for each water quality level according to eq. (4), and the mean is stored. The 2.5- and 97.5-percentile of the resulting distribution of means are reported as bounds of the 95% confidence interval. To obtain confidence intervals for the predicted changes in visit frequency the above procedure is repeated but the difference between predicted visits with improved (deteriorated) water quality and perceived current water quality is calculated for each draw.

C.3. Confidence intervals of population-level consumer surplus figures

100,000 draws with replacement are taken from the empirical distribution of annual visit frequencies ($N = 11{,}443$) and the mean is stored. Then 100,000 draws from the multivariate normal distribution defined by the MPLN model's parameter vector $\boldsymbol{\beta}$ and the asymptotic variance-covariance matrix are taken. Elementwise multiplication of these vectors is used to obtain a vector of 100,000 per-annum CS values, from which the 2.5- and 97.5-percentile are reported as bounds of the 95% confidence interval. If the elementwise products are also multiplied with the total population one obtains the confidence interval for the population-level consumer surplus figures. These procedures can be repeated for each country surveyed.

D. Alternative regression analysis as robustness check

D.1. Random effects Poisson regression models

Most applications of the TC-CB method use different versions of count data models to estimate the relationship between travel cost and visit frequency. The most common models are the Poisson model and the negative binomial model. Examples of the random effects Poisson model are Whitehead et al. (2010, 2013). Applications of the negative binomial models not accounting for truncation can be found for instance in Bertram et al. (2020) and Deely et al. (2019).

Table D.1 displays results from both models using this study's travel cost sample ($N = 5,937$) and the same set of covariates as in the MPLN paper reported in the paper. The estimated travel cost coefficients (B = -0.020 and B = -0.023, respectively) are significant and similar to the coefficient found in the MPLN model (Table 3). Consequently, the resulting consumer surplus estimates are similar (€49.58 [95% confidence interval: 46.41 - 53.21] and €44.43 [41.93 - 47.25], respectively), albeit slightly larger than the €41.32 found by means of the MPLN model.

Table D.1. Random effects Poisson and negative binomial regression models

	re Poisson model		re negative binomial model	
	Coef.	Std. Err.	Coef.	Std. Err.
Constant	0.872 ***	(0.311)	5.121 ***	(0.389)
Travel cost - Aggregate	-0.020 ***	(0.001)	-0.023 ***	(0.001)
Water quality (ref: Sufficient)				
Advice against swimming	-0.241 ***	(0.030)	-0.245 ***	(0.031)
Poor	-0.148 ***	(0.015)	-0.150 ***	(0.016)
Good	0.121 ***	(0.010)	0.124 ***	(0.011)
Excellent	0.215 ***	(0.011)	0.219 ***	(0.012)
Outstanding	0.314 ***	(0.017)	0.320 ***	(0.017)
Visit duration	-0.009 ***	(0.002)	-0.009 ***	(0.002)
Intentional visit	-0.044 *	(0.026)	-0.073 ***	(0.026)
Male	0.048 *	(0.025)	0.044 *	(0.024)
Age group (ref: 18 to 29)				
age_30.to.39	0.089 **	(0.044)	0.140 ***	(0.043)
age_40.to.49	0.122 ***	(0.044)	0.151 ***	(0.043)
age_50.to.59	0.117 ***	(0.044)	0.190 ***	(0.043)
age_60.and.over	0.218 ***	(0.039)	0.287 ***	(0.039)
Marital status (ref: Prefer not to answer)				
Married	-0.130	(0.125)	-0.304 **	(0.122)
Single	-0.151	(0.125)	-0.300 **	(0.122)
Neither	-0.102	(0.141)	-0.231 *	(0.138)
Education (ref: Primary not completed)				
Primary completed	0.020	(0.184)	-0.165	(0.183)
Secondary completed	0.034	(0.179)	-0.088	(0.179)
Higher completed	0.052	(0.179)	-0.066	(0.179)
Log(household income)	-0.001	(0.022)	-0.025	(0.021)
Own dog	0.309 ***	(0.027)	0.343 ***	(0.026)
Competent swimmer	0.143 ***	(0.026)	0.149 ***	(0.025)
Site type (ref: harbour or marina)				
Fen	-0.067	(0.125)	-0.076	(0.122)
Lake	0.079	(0.064)	0.064	(0.062)
Open sea	0.262 ***	(0.099)	0.247 **	(0.097)
Fountain	-0.110	(0.084)	-0.052	(0.082)
Pool	-0.126	(0.087)	-0.218 **	(0.085)
Ice rink	-0.469 ***	(0.119)	-0.586 ***	(0.117)

Pier	0.245 **	(0.102)	0.175 *	(0.100)
Shore	0.086	(0.112)	0.072	(0.108)
Rural river	0.295 ***	(0.066)	0.302 ***	(0.065)
Marsh	0.265	(0.193)	0.284	(0.187)
Beach	0.164 **	(0.067)	0.127 *	(0.066)
Cliffs	-0.156	(0.140)	-0.222	(0.138)
Promenade	0.097	(0.061)	0.095	(0.059)
Streams	0.199 ***	(0.067)	0.193 ***	(0.066)
Urban river	0.184 ***	(0.066)	0.185 ***	(0.064)
Waterfall	-0.124	(0.118)	-0.079	(0.115)
Survey wave (ref: Jun_2017)				
Sep_2017	-0.013	(0.034)	-0.018	(0.033)
Dec_2017	-0.106 ***	(0.035)	-0.130 ***	(0.035)
Mar_2018	-0.089 **	(0.035)	-0.099 ***	(0.034)
Country (ref: Bulgaria)				
Czech Republic	-0.136 *	(0.070)	-0.066	(0.068)
Estonia	-0.375 ***	(0.070)	-0.345 ***	(0.069)
Finland	0.122	(0.076)	0.201 ***	(0.075)
France	-0.205 ***	(0.078)	-0.076	(0.077)
Germany	-0.210 ***	(0.081)	-0.163 **	(0.079)
Greece	-0.009	(0.067)	0.056	(0.066)
Ireland	-0.197 ***	(0.076)	-0.121	(0.075)
Italy	-0.178 **	(0.073)	-0.172 **	(0.072)
Netherlands	-0.296 ***	(0.078)	-0.179 **	(0.076)
Portugal	-0.180 ***	(0.067)	-0.154 **	(0.066)
Spain	-0.042	(0.073)	0.023	(0.072)
Sweden	0.041	(0.081)	0.202 **	(0.079)
United Kingdom	-0.287 ***	(0.075)	-0.197 ***	(0.074)
Log-likelihood	-37,202		-37,794	
Parameters	64		65	

Notes: N = 5,937 respondents (with n = 17,811 observations)

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