1   # An exploration of customers' satisfaction with water and wastewater services in
2   the UK

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15  **Abstract:**
16  In this research, we examine the relationship between customer satisfaction with water and
17  wastewater services, demographic factors, communication with the utility, and perceived
18  trustworthiness. Through a survey of the UK public (n = 760), we found that 77% of the
19  respondents stated they were satisfied with their water and wastewater services. Statistical analysis
20  highlighted significant demographic differences in the level of satisfaction, particularly by age,
21  with higher satisfaction in older respondents. We found that the degree to which respondents think
22  their water utility can be trusted to provide accurate information predicted satisfaction, as did
23  more frequent engagement with a water utility's social media. More frequently contacting a water
24  utility or discussing water services with friends and family both negatively predicted satisfaction.
25  Meeting the public's expectations for accurate and timely information is coupled with their
26  perceptions of a water utility's trustworthiness and their satisfaction with water and wastewater
27  services. Water utilities may increase the satisfaction of their customers through strategies and
28  initiatives that are attentive to the credibility of the information they provide and the means
29  through which they provide it. In summary, our research indicates that the water sector's ambition
30  to develop more diverse (and inclusive) customer engagement experiences, including through
31  online platforms and social media, may deliver benefits (particularly with the less engaged and
32  younger age groups across varying regional water governance contexts) that complement overall
33  efforts to build trust and satisfaction, but we acknowledge that these are complex long-term
34  processes.

36  **Keywords:** public perceptions; water and wastewater services; customer satisfaction;
37  communication; trust.

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## 1. Introduction

Safe and sustainable water supply and sanitation are fundamental human rights but are also vulnerable to fluctuations in populations, economic development, and climate (Arnell, 2004; Boretti & Rosa, 2019). The challenge of water management is further heightened in many localities by dwindling water resources (Mekonnen & Hoekstra, 2016), aging infrastructure (Larsen et al., 2016), or infrastructure damage from extreme weather events (Hall & Borgomeo, 2013). Thus, the world over, governments and water utilities are tasked with providing the essential water and wastewater services under scenarios of growing complexity and uncertainty, increasingly severe crises, and heightened attention and engagement from the public (Doria, 2010; Gleick, 2018).

Performance indicators help water and wastewater services to benchmark and monitor the utilization of water resources, asset management, water quality, operational factors, and economic efficiency (Haider et al., 2014; Shinde, Hirayama, Mugita, et al., 2013). More recently, there has been an increasing focus on exploring customer perceptions of services as a mechanism to help gauge their performance and motivate improvements. A growing body of literature has examined customer perceptions of water and wastewater services and their underpinning influences. While these perceptions are recognised as broad and multi-dimensional (Bai et al., 2008; Brady & Cronin, 2001), previous studies have often focused on perceptions and preferences surrounding the technical aspects of services – e.g. taste, clarity, water quality, reliability of supply, odour from treatment works (see, for instance, Al-Ghuraiz & Enshassi, 2006; Arthur et al., 2009; Benameur et al., 2022; Doria, 2006 & 2010; Doria et al. 2009; Ellawala & Priyankara, 2016; Lebrero et al., 2011; Ochoo et al., 2017). The non-technical aspects of services are concerned with how the service provider operates and interacts with customers (Grönroos, 1984). Customer perceptions of these non-technical aspects of services are not as well explored in literature.

Customer satisfaction (CS) with services is often higlighted as one expression of customer perceptions. Customer satisfaction has been used as a specific performance measure (Haider et al., 2014; Shinde, Hirayama, Mugita, et al., 2013)), as well as a evidence for investment in service improvements (Donkor, 2013; Haider et al., 2016; Monks et al., 2021). As with customer perceptions more broadly, CS is recognised as multi-dimensional, and some studies have advanced different models and measurements of CS (Fattahi et al., 2011; Hormann, 2016; Hurlimann et al., 2008). Some studies have examined how demographic factors (e.g. age, gender, education, location) and technical aspects of services can affect CS (e.g. Denantes & Donoso, 2021; Dogaru et al., 2009) but overall this presents a very mixed picture.

The relationship between CS and non-technical aspects of services has been explored to a degree. For instance, CS has been linked to trust in water and wastewater service providers (Delpla et al., 2020; Hormann, 2016; Shinde, Hirayama, & Itoh, 2013). Similar links have been found other utility sectors like energy services (Hartmann & Apaolaza Ibáñez, 2007; Neto et al., 2022). Additionally, some studies have made initial inroads in exmaining the links between CS and comunication (Chenoweth et al., 2010; Fife-Schaw et al., 2007). How utilities communicate can influence people's trust and satisfaction (Beal & Flynn, 2015; Robak, 2021), but there is less evidence on the efficacy of communication methods. Some research has shown that the level of detail in water quality reports

influences satisfaction (Johnson, 2003), that visiting the website of a water service operator was not related to customer satisfaction (Romano & Masserini, 2020), and that there is potential to explore the role of communicating through digital interfaces (Beal & Flynn, 2015) and engagement with citizen science initiatives (Brouwer et al., 2018). However, the complex interlinkages between CS and these non-techncial aspects of services (such as trust and communication) remain relatively poorly understood.

In this paper, we aim to provide empirically-grounded insight into these interlinkages. The water management literature emphasizes the role of customer engagement and communications in helping to establish trust with water service customers (Doria et al., 2009; Johnson, 2003) and for enhancing perceived service quality and the customer experience (Beal & Flynn, 2015; Monks et al., 2021; Ojo, 2011; Prevos, 2017). As such, there is a case for focusing on customer perceptions of trustworthiness and exploring how trust and satisfaction are connected (Doria, 2010; Jabłoński & Jabłoński, 2019). We contribute to this by exploring how CS with water services is affected by demographic characteristics, as well as by two non-technical aspects of services – communication with water utilities, and trust. Using the context of water and wastewater services in the UK, we pursue this aim through a survey of the public.

## 2 Water services in the UK and customer satisfaction levels

Domestic water and wastewater services are provided by private companies in England, a not-for-profit company in Wales, and through public (government-owned) companies in Northern Ireland and Scotland. Several companies provide both water and wastewater services to large regions across the UK (known as water and sewerage companies or WASCs). Overlapping these regions, some companies provide drinking water services only (known as water-only companies or WOCs) and these are more numerous in the southern parts of England (see Figure 1). Hereafter, we refer to all of these service providers collectively as water utilities. Regulation is provided in England and Wales by Ofwat (economic regulator), the Drinking Water Inspectorate (water quality regulator), the Environment Agency (environmental regulator for England), and Natural Resources Wales (environmental regulator for Wales). Regulation in Scotland is by the Water Industry Commission for Scotland (economic), Drinking Water Quality Regulator for Scotland and the Scottish Environment Protection Agency. Northern Ireland Water is regulated by Northern Ireland Authority for Utility Regulation (economic), Northern Ireland Environment Agency, and the NI Drinking Water Inspectorate. Alongside the regulators, the regions have statutory independent customer representation carried out by the Consumer Council for Water (CCW) in England and Wales, Scottish Public Services Ombudsman (responsible for investigating complaints) and Citizens Advice Scotland, and The Consumer Council in Northern Ireland.
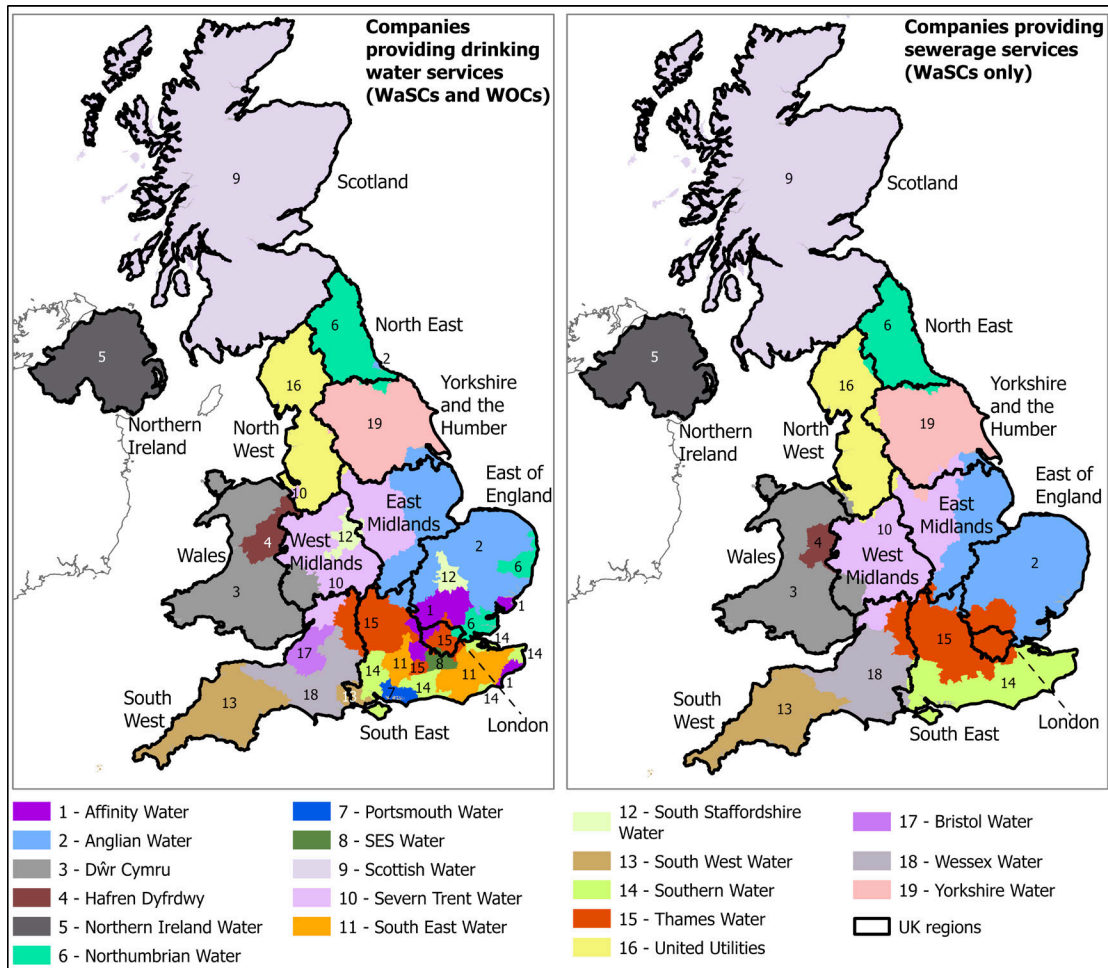
*Figure 1 Approximate service area boundaries of drinking water service providers (left) and sewerage service providers (right) overlaid with regional boundaries (black lines and text). Companies 1, 7, 8, 11, 12, and 17 are WOCs (providing drinking water services only), while the remaining companies are WaSCs (providing both drinking water and sewerage services). Some service providers do not appear in this graphic because their service area is too small to be visible. Image credit – Ian Truckell Contains public sector information licensed under the Open Government License v3.0.*

Recent customer satisfaction results include the Household Customer Experience Measure in Scotland which was 88.5 in 2021 (above the target of 82.6) (WICS, 2021). In England and Wales, Ofwat evaluates customer experience through a combination of a Customer Service Survey (CSS) & Customer Experience Survey (CES) using ten-point rating scales from 0 (extremely dissatisfied) to 10 (extremely satisfied) (Ofwat, 2020). The CES, which surveys members of the public, indicated that the average satisfaction was 83.85 in 2021, once scores were adjusted to a scale of 0-100 (Welsh Water and Northumbrian Water were the highest, Thames and Affinity Water were the lowest) (Accent, 2021). In this Accent (2021) report, women were significantly more satisfied with their water utility than men and older participants (aged 65 and over) were more satisfied than the youngest group (18-30), and both of these groups were significantly more satisfied than the in-between age groups (covering 30-64). However, the report also concluded that further research was needed to better understand the relationship between demographic characteristics and satisfaction. In Northern Ireland, efforts are still underway to establish a measure of customer satisfaction (Utility

144 Regulator, 2021). CCW (England and Wales) also evaluates customer satisfaction, and at the time
145 of writing their most recent report for 2020 put overall water service satisfaction at 92% (up 1%
146 from 2019) and overall sewerage service satisfaction at 85% (down 1% from 2019), noting that both
147 measures have been relatively static for around ten years – satisfaction with value for money was
148 76% and 78% for water and sewerage services respectively, and customer service satisfaction was
149 80% (CCW, 2020). Finally, of note, the Institute of Customer Service's UK Customer Satisfaction
150 Index (UKCSI) rates all utilities across all sectors using 26 measures categorized into five
151 dimensions, and of the water and sewerage providers, Scottish Water was rated the highest (ICS,
152 2021).
153

## 3 Methods

### 3.1 Survey instrument and respondents

156 Data was collected using a questionnaire designed and implemented using Qualtrics web-based
157 software. Following pre-testing of the survey and ethical approval, respondents over the age of 18
158 were recruited online using internet survey panels and predetermined demographic quotas aligned
159 with the UK census for age group, gender, and geographic region. The minimum age was set at 18,
160 as this is common practice in UK water industry customer research due to the age of bill payers (e.g.
161 Accent, 2021; Savanta, 2022), and due to ethical reasons. The online survey was undertaken in July
162 2018 and the final sample, after data cleaning, included 760 respondents, which gave a sample size
163 confidence interval of 95% and a 4% margin of error (Daniel & Cross, 2018) for representing the
164 UK adult population. Respondents were asked for their informed consent before starting the survey
165 and received a small remuneration from Qualtrics for completing the survey (in line with standard
166 internet survey panel practices).
167

### 3.2 Research design and variables

169 The survey collected responses to be coded into the dependent and independent variables for
170 statistical analysis. The dependent variable for this study was customer satisfaction (CS) with water
171 and wastewater services (*In general, how satisfied are you with your water and wastewater*
172 *services?*) which measured responses on a five-point scale (Extremely unsatisfied = 1 to Extremely
173 satisfied = 5). The independent variables were measures of the frequency of engagement with water
174 services, trust in the water utility to provide accurate information, and several demographic
175 categories summarized in Table 1.
176

### 3.3 Statistical analysis

178 Exploratory statistics and regression analysis was undertaken in IBM SPSS (v26). In all cases,
179 we treated the dependent variable (CS) as ordinal. Due to a small number of cases in the 'extremely
180 unsatisfied' category (n = 14), we combined the 'extremely' and 'somewhat' unsatisfied categories,
181 such that there were four ordinal categories (unsatisfied, neither satisfied nor unsatisfied, somewhat
182 satisfied and extremely satisfied) for statistical analysis.
183

184 Firstly, we explored differences in CS based on the demographics using non-parametric statistics.
185 The Mann-Whitney U-test was used for independent variables consisting of two independent
186 samples and the Kruskal-Wallis H-test was used when there were more than two categories.

Secondly, we hypothesized that characteristics of communications (trust and the frequency of communication by different channels), and demographic variables would contribute to the prediction of CS. We followed the theoretical logic of Hurlimann et al. (2008) that trust in a water utility (to provide accurate information) was a determinant of satisfaction (in their case with recycled water supply). The specification of trust as a predictor of satisfaction is further supported by research across a range of fields including health services (Chang et al., 2013), governance (Morgeson et al., 2011), and food safety (De Jonge et al., 2007).

As the dependent variable consisted of four ordered categories, we used an ordinal logistic regression model for estimating the extent to which the predictor variables estimated the outcome. We executed the ordinal regression in SPSS and obtained the log-ratios in addition to the Wald tests. Categorical variables were dummy coded if there were more than two categories (age and UK region) and one category was assigned as the reference. As SPSS ordinal regression only allows for nominal or continuous independent variables, we treated the five-point single-item measures for 'trust' and 'frequency of engagement' as continuous covariates (or ordinal approximations of continuous variables) under the assumption that the scale points approximated equivalent distances and that there was little bias from assuming interval measurements (Winship & Mare, 1984). Moreover, it is suggested that continuous methods can be used when an ordinal variable has four or more categories (Byrne, 2010) and that such assumptions are appropriate and robust, for example, to violations of assumptions of normality (Norman, 2010). The model variables were assessed for multicollinearity using the Variance Inflation Factor (VIF, where all values were less than 10 in the final models) and Condition Index (all values less than 15 in the final models) (Salmeron et al., 2018). Following this analysis, some categories were excluded (redundant, as they added no information to the prediction equation) or modified from the final model (see Table 1).

212 *Table 1 Summary of independent variables used in statistical analysis*

| Independent Variable | Description of Variable | Treatment in Ordinal regression model |
|---|---|---|
| Trust | To what extent would you trust your current water company to provide you with accurate information about water and wastewater treatment processes? A great extent (5), A lot (4), A moderate amount (3), A little (2), None at all (1) | Covariate (Continuous) |
| Frequency of Engagement (five statements) | In the past year, how often have you: (a) Read your water bill, (b) Contacted your water company, (c) Visited your water company website, (d) Engaged with your water company on social media, (e) Spoke about your water provider with friends/family. Very frequently (5), Frequently (4), Occasionally (3), Rarely (2), Never (1) | Each method of engagement entered as a covariate (Continuous) |
| Age | Categories: 18 – 24, 25-34, 35-49, 50-64, 65+ | Dummy coded (1, 0) for each category |
| Gender | Male (1), Female (0) | Binary |
| Education level | Up to Secondary school, Pre-university (A-levels, certificate, diploma), University degree (bachelor or post-graduate) | Binary (university degree = 1, or not = 0). A logistic regression analysis by Benameur et al. (2022) found satisfaction was predicted by having a university degree. The other two categories were not included due to multicollinearity (VIF > 10) and because they were accounted for in the binary variable (i.e. did not have a university degree). |
| Employment status | Employed (full-time), Employed (other - part-time or self-employed), Retired, Student (full-time or part-time), Not employed (job-seeker, unemployed), Stay-at-home (homemaker) | Binary (employed = 1, or not employed = 0). Research suggests higher income is associated with satisfaction (e.g. García-Rubio et al. 2016). The categories were simplified to a binary variable, firstly to provide some proxy for income and secondly due to high correlation with other variable categories. In particularly, 'Retired' contained similar information to the 65+ age category and 'Student' overlapped with the 18-24 age group. 'Stay-at-home' was not considered a good proxy for income as the respondent was likely to have a partner who worked. |
| UK Region | Greater London, South East, South West, East of England, East Midlands, West Midlands, Yorkshire and the Humber, North East, North West, Scotland, Wales, Northern Ireland | Dummy coded (1, 0) for each category |

213    Notes: 'Prefer not to say' and categories with <3 responses were excluded (e.g. respondents not

214 identifying as male or female); VIF = Variable Inflation Factors

215

216

# 4 Results and analysis

## 4.1 Sample descriptive statistics and analysis

The characteristics of the sample are summarized in Table 2. The proportion of respondents was within one percentage point for each of the census-based quotas (age group, gender, UK region) and thus indicated a good overall level of representativeness based on these criteria. Overall, 77% of the respondents said they were satisfied (somewhat or extremely) with their water and wastewater services, 16% were neither satisfied nor unsatisfied, whereas 7% reported being unsatisfied (somewhat or extremely). In terms of extremely satisfied, the highest values were for Scotland and Northern Ireland (both 52%). The highest value for extremely unsatisfied was for the employment status of stay-at-home (7%). Overall satisfaction was highest for retired and the over 65 years age group (both 86% satisfied and both categories were substantially correlated with 86% of the age group also being retired). Higher satisfaction was also found in the East of England and Scottish samples (85% and 84% respectively). Overall dissatisfaction was highest for stay-at-home (17%), Northern Ireland (14%), London (12%), and the 18-24 age group (12%). No dissatisfaction was reported in Scotland.

*Table 2 Summary of CS ratings for the demographic variables and results of nonparametric tests*

| Variable and statistical analysis | Category | Sample | % | Quotas - UK Census (2011) based | Extremely unsatisfied | Somewhat unsatisfied | Neither Satisfied nor unsatisfied | Somewhat satisfied | Extremely satisfied |
|---|---|---|---|---|---|---|---|---|---|
| Satisfaction | | 760 | 100% | | 2% | 5% | 16% | 48% | 29% |
| Age Group[2] $\chi2 (4) = 22.8, p = 0.001$ | 18 - 24 | 90 | 12% | 12% | 3% | 9% | 18% | 50% | 20% |
| | 25-34 | 134 | 18% | 17% | 4% | 2% | 16% | 49% | 28% |
| | 35-49 | 193 | 25% | 27% | 1% | 7% | 21% | 49% | 22% |
| | 50-64 | 179 | 24% | 23% | 1% | 4% | 16% | 46% | 32% |
| | 65+ | 164 | 22% | 21% | 1% | 4% | 9% | 47% | 39% |
| Gender[1] $z = 1.462, p = 0.227$ | Male | 368 | 48% | 49% | 1% | 5% | 15% | 49% | 30% |
| | Female | 389 | 51% | 51% | 3% | 5% | 17% | 47% | 28% |
| UK region[2] $\chi2 (11) = 30.671, p = 0.001$ | Greater London | 99 | 13% | 14% | 1% | 11% | 17% | 47% | 23% |
| | South East | 105 | 14% | 14% | 4% | 6% | 21% | 52% | 17% |
| | South West | 66 | 9% | 9% | 0% | 8% | 14% | 50% | 29% |
| | East of England | 62 | 8% | 9% | 2% | 6% | 6% | 58% | 27% |
| | East Midlands | 56 | 7% | 7% | 0% | 5% | 13% | 43% | 39% |
| | West Midlands | 68 | 9% | 9% | 4% | 4% | 12% | 56% | 24% |
| | Yorkshire and the Humber | 64 | 8% | 8% | 2% | 3% | 16% | 53% | 27% |
| | North East | 33 | 4% | 4% | 3% | 0% | 24% | 33% | 39% |
| | North West | 83 | 11% | 11% | 2% | 1% | 16% | 52% | 29% |
| | Scotland | 64 | 8% | 8% | 0% | 0% | 16% | 33% | 52% |
| | Wales | 39 | 5% | 5% | 0% | 5% | 28% | 46% | 21% |
| | Northern Ireland | 21 | 3% | 3% | 5% | 10% | 14% | 19% | 52% |
| Education level[2] $\chi2 (2) = 1.119, p = 0.572$ | Up to Secondary | 227 | 30% | | 4% | 4% | 18% | 43% | 32% |
| | Pre-University | 272 | 36% | | 1% | 5% | 17% | 47% | 31% |
| | University degree | 258 | 34% | | 2% | 7% | 14% | 53% | 25% |
| Employment status[2] $\chi2 (5) = 24.433, p = 0.001$ | Employed - Full time | 290 | 38% | | 2% | 7% | 16% | 51% | 25% |
| | Employed - Other | 139 | 18% | | 3% | 5% | 20% | 45% | 27% |
| | Retired | 171 | 23% | | 1% | 3% | 11% | 45% | 41% |
| | Student | 44 | 6% | | 2% | 7% | 18% | 52% | 20% |
| | Stay at home | 41 | 5% | | 7% | 10% | 22% | 39% | 22% |
| | Not working | 75 | 10% | | 0% | 1% | 17% | 51% | 31% |

Notes: Categories for each variable may not sum to the total sample of 760 as the 'prefer not to say' category and categories with 3 or less responses are excluded. [1] = Mann-Whitney U-test, standardised test statistic. [2] = Kruskal-Wallis H-test.

The results of the non-parametric analysis (Table 2) showed statistically significant differences between categories for Age group, UK region, and Employment status. Pairwise comparisons (with adjusted significance using Bonferroni correction) highlighted the significant differences between age groups (18-24 and 65+, 35-49 and 65+), between Scotland and two other regions (Greater London, and South-East), and between retired respondents and three other employment categories (Stay-at-home, Employed – full time, Employed – other). Satisfaction was not statistically different for Gender or Education level.

As significant differences arose for Age, Employment status and Region, we checked for associations between these categorical variables using Person Chi-squared tests to explore whether observed differences in CS might be due to confounding variables. Results of the Chi-squared tests showed statistically significant results for associations between all three pairs: Age and Employment status ($\chi^2$ (20) = 800.198, p < 0.001), Age and Region ($\chi^2$ (44) = 197.83, p = 0.022), and Employment status and Regions ($\chi^2$ (55) = 187.32, p = 0.001); indicating that in each case the variables were in some way related.

The strongest association was between Age and Employment status categories due to a range of interactions including 44% of 18-24 year olds who were students, 60% of 25-49 year olds who were working full-time, and 86% of those over 65 years were retired. Comparing Regions and Age, data for the East of England region was skewed to the oldest age category (81% in 65+ age category) compared to the other regions (not including East of England, the proportion of respondents in 65+ age category was 15% on average, min = 3%, max = 23%, UK Census 2011 = 21%). With the East of England region excluded, the result was no longer significant ($\chi^2$ (40) = 55.03, p = 0.283) thus indicating a different age distribution was potentially confounding the CS results for East of England region. Similarly, for the comparison of Employment status and Region, there was a high proportion of Retired in the East of England sample (76%). With the 11 Regions (excluding East of England) the distribution of Employment was still significantly different (($\chi^2$ (50) = 72.04, p = 0.022). Variation included higher proportions full-time employed in Yorkshire & Humber and Greater London (55% and 54% respectively), higher proportions not working in the North East (18%), higher proportions of students and working (other) in the West Midlands (26% and 13% respectively), and higher proportions of stay-at-home in Northern Ireland (19%). In summary, the statistical significance for the variables Age, Employment status, and Region that were detected through the non-parametric tests was potentially confounded by extraneous factors.

### 4.2 Predicting Customer Satisfaction
The ordinal logistic regression model was statistically significant, $\chi^2$(24) = 166.842, p < 0.001, a good fit Pearson $\chi^2$(2208) = 2306.810, p < 0.070 (non-significance indicated a good fit), and explained 21.8% (Nagelkerke $R^2$) of the variance in CS. Furthermore, the model met the assumption of proportional odds $\chi^2$(48) = 58.317, p < 0.146 (non-significance indicated the assumption was met).

The results of the regression model (Table 3) showed that the significant predictor variables were the degree to which respondents trusted their water utility to provide accurate information (positively predicted, Odds Ratios greater than 1.0), the frequency they contacted their water utility

282 or spoke about their water utility with friends or family (both negative predictors, Odds Ratios less
283 than 1.0), the frequency of engagement with the water utility's social media (positive), and three
284 age categories (spanning 18 to 49 years old, all negatively predicted). None of the UK regions
285 significantly predicted CS, however, we do note the high odds ratio for Scotland (possible positive
286 predictor) and lower odds ratios for some regions (including Greater London, South-East, and East
287 of England – all possible negative predictors). Despite noticeable odds ratios, regions also had large
288 confidence intervals on the odds, meaning low precision and high uncertainty in the effects
289 (Szumilas, 2010).
290

*Table 3 Results of ordinal regression model predicting customer satisfaction using non-technical factors*

| Variable | Variable category | Sig. (p) | Odds Ratio (with 95% CI) |
|---|---|---|---|
| Trust water utility to provide accurate information | | **0.001** | 1.71 (1.5 - 1.95) |
| Frequency of Engagement with water utility/s | Read bill | 0.142 | 1.1 (0.97 - 1.24) |
| | Direct contact | **0.018** | 0.78 (0.64 - 0.96) |
| | Visited website | 0.671 | 0.96 (0.8 - 1.16) |
| | Engaged with social media | **0.011** | 1.32 (1.06 - 1.65) |
| | Spoke about water utility/s with friends/family | **0.001** | 0.69 (0.58 - 0.83) |
| Region | Greater London | 0.280 | 0.6 (0.21 - 1.68) |
| | South East | 0.121 | 0.48 (0.17 - 1.35) |
| | South West | 0.960 | 0.98 (0.33 - 2.86) |
| | East of England | 0.203 | 0.52 (0.17 - 1.56) |
| | East Midlands | 0.561 | 1.35 (0.45 - 4.05) |
| | West Midlands | 0.587 | 0.76 (0.26 - 2.23) |
| | Yorkshire and the Humber | 0.736 | 0.85 (0.29 - 2.47) |
| | North East | 0.756 | 1.19 (0.36 - 3.87) |
| | North West | 0.564 | 0.76 (0.27 - 2.16) |
| | Scotland | 0.210 | 1.87 (0.64 - 5.49) |
| | Wales | 0.389 | 0.63 (0.2 - 1.97) |
| Age | 18 - 24 | **0.000** | 0.35 (0.2 - 0.62) |
| | 25-34 | **0.040** | 0.55 (0.32 - 0.98) |
| | 35-49 | **0.001** | 0.43 (0.26 - 0.72) |
| | 50-64 | 0.123 | 0.69 (0.43 - 1.11) |
| Gender | Female | 0.497 | 0.9 (0.67 - 1.22) |
| Education | No degree | 0.792 | 1.08 (0.77 - 1.51) |
| Employment | Not employed | 0.655 | 1.04 (0.77 - 1.4) |

Notes: CI is confidence interval. Reference categories not included in table (Northern Ireland, age 65+). Threshold values (reference category is extremely satisfied): Category 1 (unsatisfied), odds = 0.08 (0.02 - 0.25), p = 0.001. Category 2 (neither unsatisfied nor satisfied), odds = 0.36 (0.11 - 1.14) p = 0.059. Category 3 (somewhat satisfied) odds = 4.26 (1.35 - 13.46), p = 0.007.

## 5 Discussion

Customer satisfaction (CS) is an important, albeit abstract, expression of customer perceptions of water service delivery. Through understanding CS, water utilities and regulators can identify areas for improvement in both the technical aspects (e.g. measurable water service parameters) and non-technical aspects (qualities associated with how the service provider operates) of domestic water and wastewater services. In this research we explored CS with water and wastewater services in the UK and whether satisfaction varied based on the perceived trustworthiness, frequency, or method of customer communications. The insights gained from exploring the relationship between CS and

different variables (e.g. demographic categories, regional contexts, different modes of communication) can help inform the actions that regulators and water utilities take. Specifically, through developing communication strategies premised on accurate, high quality and timely communications, water utilities (and regulators) can intervene in ways that can strengthen the complementary and interrelated concepts of satisfaction and trust.

Across our UK sample, most respondents reported that they were satisfied with their water and wastewater services (77%). Moreover, only a small proportion said they were not satisfied (7%). Whilst not directly comparable due to the use of different rating scales and different survey questions, the overall satisfaction level of our respondents can be located within previous CS results obtained by the water industry in the UK (see section 2 for more details). For example, recently published results of a survey undertaken for Ofwat and CCW (Savanta, 2022) found that satisfaction with the quality of water services was 65% and 56% with wastewater and drainage services (noting that satisfied was defined as 8 and above on a 1 to 10 rating scale), with higher satisfaction in older age groups, northern geographies, higher-income groups, customers with water meters, and those not living in urban areas. We recognize some limitations to our approach, as we took an overall assessment of CS rather than attempting to measure dimensionality. However, due to the complex and somewhat abstract nature of service quality (Bai et al., 2008; Brady & Cronin, 2001) and the range of services that water utilities provide, we suggest that there are also benefits to using more simplified heuristics: a view supported by research that has shown that a single-item CS measure may provide as much information as large multi-item scales (Garbarino & Johnson, 1999). A further limitation is that we did not assess customer expectations of water and wastewater services and therefore we cannot say whether those expectations were either met (or not) through their experiences, and how that influenced satisfaction. A future line of research could investigate how antecedent expectations underpin, and potentially link, evaluations of satisfaction and trust.

Looking at the demographic factors, CS was associated to some extent with employment status and geographic region but more so with age, which was the only demographic variable predicting CS in the regression model. Gender and level of education did not predict CS in the regression analysis and their categories were not significantly different in the non-parametric tests. Our findings are in keeping with other research indicating the more case-based nature of demographics associated with satisfaction (Dogaru et al., 2009; Doria, 2010) and the limited effect of gender in particular (Benameur et al., 2022; Dogaru et al., 2009; García-Rubio et al., 2016; Hormann, 2016; Romano & Masserini, 2020), although gender has been found to delineate differences in perception of water services in the UK (Accent, 2021). The regional variations we found in non-parametric tests matched other measures of satisfaction with water utility services, indicating higher levels of satisfaction in Scotland (as found by the UK CS Index, ICS 2021) and differential performance across England particularly with lower levels of satisfaction in London and across the south (see Accent 2021). However, we also note that geographic region did not significantly predict CS in our regression model and that differences may, at least in part, be confounded by variations in regional age demographics (or other factors). Other research discusses how regional differences in CS can be driven by perceptions of water resource management and water service governance, such as the ownership model (García-Rubio et al., 2016; Romano & Masserini, 2020) and perceptions of other prominent water issues such as leakage or drought management (Cashman, 2006; Dessai & Sims,

2010; Goodwin et al., 2018; Russell-Verma et al., 2015). We also note from this study (although we cannot confirm) that regional differences in the complexity of water and wastewater service provision may be a relevant contextual factor. For example, in the South-East, satisfaction scores tend to be lower where the number of water utilities (particularly water-only companies) is highest.

Our results regarding age-based CS heterogeneity complement similar findings in water sector customer research in the UK where older age groups are the most satisfied (Accent, 2021; Savanta, 2022). Elsewhere, studies in water service satisfaction have also found lower satisfaction in younger age groups, for example, Ochoo et al. (2017) reported that Canadian respondents under the age of 50 tended to be less satisfied with their water quality than older respondents. This difference might be linked to factors such as financial stress, job insecurity and other psychological and social-gradient factors (Power et al., 2002). We conclude that, as younger age groups tend to give lower ratings to their satisfaction with water services and they tend to be less engaged (for example, read their bills infrequently - Savanta, 2022), there are opportunities to support trust-building, service legitimization, and CS through improving engagement.

Looking at the non-technical aspects of services, the literature is clear on the importance for water and wastewater service providers to establish their trustworthiness and credibility with the public (Doria, 2010; Jabłoński & Jabłoński, 2019) but less clear on the nature of the link between trust and satisfaction. Adding to a growing body of research (Delpla et al., 2020; Hormann, 2016; Shinde, Hirayama, & Itoh, 2013), we also found that the degree to which respondents thought their water utility could be trusted in providing accurate information had a strong positive statistical association with CS. This is thought to be the first time such a link has been empirically established in research relating to the UK water sector and is, therefore, a contribution of this study. We acknowledge that there is no clear precedence in the relationship between trust and satisfaction, nor clear causality, as they are interrelated concepts (Chen et al., 2015; Islam et al., 2021; Welch et al., 2005), but we have taken a stance on this for the purposes of statistical modelling. Similarly, trust is often linked to the perception of risk, yet the causal order of this relationship is not clear and may vary according to the case (Doria, 2010). Whilst establishing trust is desirable, it may not be easy. For instance, some have argued that many people's natural position towards water utilities is one of distrust (Doria et al., 2009), and that private water companies in particular are suspected of being more concerned with profits than service quality (Doria, 2010). Recent customer research in the UK found that many customers do not trust their water utility to keep them informed about service choices that could help them or to fix problems (Savanta, 2022). This could help explain some of the regional differences in satisfaction observed in our results (e.g., between Scotland, where the utility is publicly owned, and the South-East, where utilities are privatized) but this is not conclusive. Our findings suggest that initiatives designed to improve trust in the communication from water utilities could create corresponding improvements in CS (or, potentially vice versa). This premise is supported by findings from the marketing literature that show satisfaction and trust are complementary and that honest, accurate and timely communications have a strong effect on both trust and satisfaction (Selnes, 1998).

Communication and engagement can also contribute to the legitimization of water services and technologies within their social contexts (Harris-Lovett et al., 2015). Our results on the

characteristics of engagement (perceived credibility and accuracy of information, frequency and mode of communication) with the public raise several points for discussion. We found that respondents who contacted their water utility or spoke to friends or family more frequently about their water services negatively predicted satisfaction. The first point is unsurprising, as people who contact their water utility frequently do so because they have a problem. The second finding adds to literature suggesting that receiving negative interpersonal information from family members or friends relates to negative perceptions of service quality (Doria et al., 2009) but also indicates that conversations around water and wastewater services are more likely catalyzed by something going wrong rather than business-as-usual. We also found, however, that engagement with a water utility's social media positively predicted satisfaction. Again, this relationship is not definitively causal. This finding resonates with results from the most recent UK CS Index, which show the rising prominence of online engagement (including websites, web chats, and social media), increasing levels of CS with online channels of communication, and a rise in CS in younger age groups (ICS, 2022).

In summary, our findings suggest that CS (and potentially trust) could be supported by proactively engaging and communicating with the public through online channels such as social media, which may be particularly beneficial for engaging younger age groups. The water industry is already making strides in this field by mapping out methods of digital customer engagement to help improve the customer experience (Sarni et al., 2019). So, while trust might be hard to shift through occasional factual communications (such as water quality reports, Johnson 2003), social media campaigns might have some role to play in the longer-run in improving engagement and CS (particularly in younger age groups), under the caveat that social media more generally is also vulnerable to the spread misinformation that can foster distrust (Limaye et al., 2020). Emerging findings elsewhere suggest opportunities to explore the use of interactive data through digital water sensors and smart water meters as ways to promote transparency and perceived procedural fairness to help build trust and improve satisfaction (Beal & Flynn, 2015; Goulas et al., 2022)

## 6 Conclusions

In this research, we explored the interlinkages between customer satisfaction, demographic characteristics, and non-technical aspects of water and wastewater services (with a specific focus on communication with the utility and trust). In a survey undertaken with UK water customers, we found that the majority of respondents were satisfied with their water and wastewater services. The statistical analysis highlighted significant differences in the level of satisfaction by region, age group, and employment status, which corresponded with results from other UK-based customer research. We found that the degree to which respondents thought their water utility could be trusted in providing accurate information had a strong positive statistical association with CS levels. This finding was in accord with research on the role of trust-building and how this can be supported through communications. Moreover, we suggest that credible and timely communications can contribute to the legitimization of water services and technologies within their social contexts.

We found that respondents who had contacted their water utility or spoken to friends or family about their water service provider were less likely to be satisfied. These findings were aligned

438  with other research that has highlighted, firstly, that people who contact their water utility will
439  often do so because they have a problem, and secondly, that the sharing of information between
440  family or friends tends to be prompted by negative experiences. On the other hand, we found
441  engagement with a water utility's social media positively predicted satisfaction. As younger age
442  groups tend to give lower ratings to their satisfaction with water services and tend to be less
443  engaged, there are opportunities to engage with this segment of the public through online
444  platforms and social media. This type of interaction may help water utilities engage with the
445  multi-dimensionality of CS and the interconnectedness of trust with the customer experience more
446  generally.

448  Without overlooking the influence of improving the technical aspects of water and wastewater
449  services, water utilities can look to engage with CS by focusing on how people perceive customer
450  communications. Moreover, by focusing on building trust and through customer engagement and
451  communications, water utilities can develop their understandings of people's perceptions of
452  service quality and the overall customer experience. Drawing together our findings relating to age,
453  perceptions of trust in communications, and the potential link between engaging with a water
454  utility's social media and customer satisfaction, we conclude that the water industry in the UK
455  (and in other countries with comparable water management contexts) could benefit from pursuing
456  the development of diverse customer engagement methods (that are customized to demographic
457  and regional differences as well as local water governance contexts). In the longer-term, more
458  diverse and inclusive engagement methods can help to positively influence perceptions of
459  trustworthiness and customer satisfaction coincidently.

## Data access statement

462  The data underpinning this study was collected with approval from the Cranfield University
463  Research Ethics System. The data is available at: https://doi.org/10.17862/cranfield.rd.22147367.v1

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