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Tap and Bottled Water Consumption in a Higher Education Institution: Applying the Theory of Planned Behaviour

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Abstract - *This research study explores tap and bottled water consumption in a Portuguese public Higher Education Institution (HEI). Based on a sample of 413 valid responses, collected in an online survey that took place during the first quarter of 2022, and applying the Theory of Planned Behaviour (TPB) framework, the present study achieved relevant results. It is observed a positive and significant influence of individuals` attitudes, subjective norms, and perceived behavioural control in their intention to consume tap water, which has a positive and significant impact on tap water consumption behaviour. Nevertheless, it is identified the existence of an intention-behaviour gap, revealing that individuals still consume bottled water, despite their willingness to drink more tap water. Increasing the scientific information on the individuals` behaviour regarding tap and bottled water consumption, allowing policy makers and educational institutions to adopt more effective measures and policies to change behaviours and promote more tap water consumption, thus avoiding the adverse environmental effects associated with the consumption of water in single use plastic bottles.*

Keywords**:** Tap water; Bottled water; Theory of Planned Behaviour; Portugal.

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1. Introduction

In recent decades, there has been an increase in the global consumption of bottled water, particularly in developed countries where tap water is drinkable [1]. The numbers reveal the importance of this market: in the last decade, the annual growth rate was 5% [2]. For instance, in the European Union (EU), where tap water is drinkable in all Member States, presenting high quality values, except for a small minority of countries- Bulgaria, Cyprus, Latvia, Lithuania, and Romania [3], bottled water consumption reached considerably high values, being the EU average of 118 litres per person. In 2019, Italy was the leading market for the consumption of bottled water, with 200 litres of bottled water consumed per person; Germany was the second largest consumer with 168 litres consumed per person, and, in third place, Portugal appears with the consumption of 140 litres of water per person [4]. The high consumption of bottled water, especially in more developed regions that have drinking water from the tap, represents a serious problem for several reasons, namely: i) bottled water requires much more energy in terms of production and distribution; ii) the total energy required for the unit consumption of bottled water ranges from 5.6 to 10.2 megajoules (MJ) per litre, while this number is typically 0.005 MJ per litre for the treatment and distribution of piped water; iii) bottled water has a negative environmental impact, namely plastic waste; iv) plastic bottles are made from petroleum, and most bottles are not recycled, ending up in landfills, forests, lakes and oceans; v) regarding safety and health aspects, bottled

water is less regulated than municipal tap water [1], [5]–[8]. Among all these negative impacts associated with bottled water consumption, particularly PET bottles, it is unquestionable that the plastic waste generated is the most harmful environmental consequence. In the coming years, the situation is expected to get even worse. According to Lebreton and Andrady [9], plastic production is expected to double in the next two decades resulting in high amounts of plastic abandoned in the oceans and soils [10]–[12]. In response to this serious environmental problem, a growing number of public and private spaces have been adopting measures to reduce bottled water consumption, namely offering reusable glass, metal, or even reusable plastic bottles; and installing piped water sources or drinking fountains spread throughout the spaces.

HEIs have the potential to shape beliefs and practices and "can play a vital role in developing and implementing an effective intervention to decrease bottled water consumption by increasing tap water consumption" ([13], p.558). Studying the university community can help policymakers to understand perceptions, choices and behaviours towards drinking water and the best initiatives to develop for individuals to reduce bottled water consumption, not only at university but in other contexts, serving as a catalyst potential for promoting practical changes in a broader sphere towards a more sustainable future [1], [14]–[16].

This research study proposes to apply the TPB framework to deepen some of the determinants of individuals` intention and behaviour regarding tap water consumption among the academic community of Coimbra Business School, a Portuguese HEI in the management, accounting and marketing areas. Thus, this study intends to contribute to fill this gap. It is expected to be clearer the influence of some key variables on tap water consumption behaviour, such as attitudes, subjective norms, perceived behavioural control, pro-environmental measures adopted by the HEI on intentions. It is also an objective to understand how individuals` intention to increase tap water consumption influences their behaviour.

The remainder of this study is organised as follows. After an introduction to the research subject, a second section is devoted to literature review. Then, the methodology is presented. In the third section the results are presented and discussed. Finally, the last section is dedicated to the main conclusions, limitations, and future research.

2. Literature Review

2. 1. Bottled and tap water consumption

The literature on water consumption also presents several studies carried out in Higher Education Institutions (HEIs), deepening college students' behaviour regarding bottled and tap water consumption. For example, in a Dutch HEI, van der Linden [17] observed that students bought single use plastic packaging water bottles due to barriers, or perceived barriers, on university campuses. It makes it difficult to use reusable bottles, namely the lack of water fountains on campus facilities. In another study developed at Princeton University, it was observed that providing free reusable water bottles to students significantly reduced the purchase of disposable plastic bottles [18]. At Duke University, after installing several water fountains across the campus, the number of single-use water bottles disposed of in campus trash and recycling streams has reduced considerably [19]. Graydon et al. [13] developed a study to assess community risk perceptions and drinking water choices on the University of South Florida campus. The results revealed that: certain groups (college students and ethnic/racial minorities) drank significantly more bottled water; among political ideologies, liberals drank less bottled water; women reported substantially higher risk perceptions of tap water on campus. Regarding the benefits associated with tap water consumption, students indicated the fact that it is less expensive and better for the environment; and as disadvantages, students reported that tap water has a less pleasant taste than bottled water. At Purdue University, Saylor et al. [20] developed a study to understand students' and staff's beliefs and practices regarding tap water and bottled water. They noted that undergraduate students drank significantly more bottled water than graduate students, faculty and staff, and women drank more bottled water than men. The authors also found the main barriers to tap water consumption: preference for the taste of bottled water, the belief that bottled water is safer and of superior quality, the perception of convenience and ease of use of bottled water. Díez et al. [21] deepen university students' beliefs and environmental attitudes towards bottled and tap water consumption and examined tap and bottled water availability and sales volumes at the University of the Basque Country. The authors observed that students predominately drink tap water and no health or taste issues associated with its consumption were perceived. In this University, most students claimed to use reused

plastic water bottles as the most common tap water container. Nevertheless, there was a widespread presence of bottled water sales at university premises, confirming the ubiquity of this commodity. Hence, the authors concluded that a more remarkable shift in sustainable behaviour is needed in the community on and off college campuses.

2. 2. TPB Framework and Hypotheses development

The TPB, first proposed by Ajzen in 1985 [22], is a socio-cognitive model widely applied to explain the individual's behaviour. A key variable in this model is the individual's intention to adopt a specific behaviour, which may be defined as a motivational factor to a certain type of behaviour, and according to the TPB, it is influenced by attitude, subjective norms, and perceived behavioural control [22], [23]. Succinctly, attitude may be defined as a positive or negative belief in a particular behaviour; the subjective norm is an individual's engagement with a specific behaviour due to social pressure; and perceived behavioural control indicates whether an individual's motivation is influenced by how he or she perceives the level of difficulty or simplicity of a specific behaviour [22]–[24].

Despite its unquestionable contribution to scientific research development, the predictive effectiveness of the TPB has been deeply criticised, mainly due to its reduced number of explanatory variables [25]–[27]. Hence, many researchers developed extended theoretical models, including additional variables to increase the efficiency of its predictive capacity [28], [29].

Following the TPB reasoning, and to deepen the individuals` behaviour regarding tap water consumption, the extended TPB model proposed is presented in Figure 1.

The six research hypotheses proposed are:

- Hypothesis 1 (H1): Individuals` attitude has a positive influence on their intention to consume tap water.
- Hypothesis 2 (H2): Individuals` subjective norms have a positive influence on their intention to consume tap water.
- Hypothesis 3 (H3): Individuals` perceived behavioural control has a positive influence on their intention to consume tap water.
- Hypothesis 4 (H4): Individuals` perceived behavioural control has a positive influence on their tap water consumption behaviour.
- Hypothesis 5 (H5): HEI`s adopted measures to promote tap water consumption have a positive influence on individuals` intention to consume tap water.
- Hypothesis 6 (H6): Individuals` intentions have a positive influence on their tap water consumption behaviour.

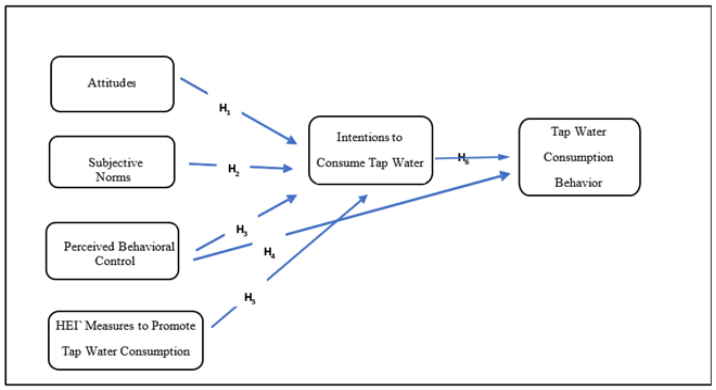

Figure 1. Proposed Extended TPB Model. Source: Authors` elaboration

3. Materials and Methods

3. 1. Survey Design and Application

From 13 January to 30 March 2022, a representative online survey was conducted among the target population (see [30]) of this study: students and teachers, aged 18 or over, of Coimbra Business School, an HEI which, in the last academic year of 2021/22, had a total of 2857 students and 170 teachers. The final and definitive version of the questionnaire resulted from an extensive literature review on the research subject and from the application of a pilot test on 6 January 2022, using the "think aloud" technique. An initial and provisory version of the questionnaire was distributed to a sample of 10 students and five teachers of the HEI, asking the respondents to think aloud as they completed the questionnaire, verbalising all thoughts that would usually be silent. This procedure took place in the classrooms of the HEI with the presence of one of the researchers in this study. The researcher only watched and took notes, not intervening or influencing the behaviour of the respondents. With this qualitative research technique, it was possible to obtain direct data on the continuous thought process of the interviewees during their activity of answering the questionnaire, enabling them to refine and clarify the questions and, in this way, increase the questionnaire's efficiency [31], [32].

The questionnaire was created and housed online using the Google Forms platform and shared with the

school community through HEI's social networks and institutional email. Links to the questionnaire were also posted to a college-wide daily email to all students and college teachers. The same link was posted to multiple student group social media pages, residence hall email lists, and sports teams email lists. Teachers of various courses at the college distributed the link to students in their classes.

The questionnaire consists of two main sections. The first section includes several questions to gather information about the demographic characteristics of the respondents, namely age, gender, academic education, and situation at the HEI. The second section includes different questions on key issues for this research study regarding the respondents' water consumption, namely tap water attitudes, subjective norms, perceived behavioural control, HEI` measures to promote tap water consumption, tap water intention, tap water consumption behaviour.

Using the non-probabilistic convenience sampling method, a sample of 413 valid responses was achieved. After collecting and verifying the obtained database, the data were analysed using the R software, version 4.0.5. To achieve the objectives set out in this study, techniques of descriptive statistics and nonparametric tests were performed. Nonparametric tests were appropriate since these do not require certain assumptions (for example, the normality of the variables) verified in the study. The data were also analysed with the structural equation modelling technique. More precisely, the covariance-based SEM (CB-SEM) approach is considered for the estimation and model validation procedures.

In this research, the following latent variables were used: tap water attitudes (TWA), subjective norms (SN), perceived behavioural control (PBC), tap water intentions (TWI), tap water behaviour (TWB), and measures of the higher education institution (MHEI) [33]–[35]. Each item presented in the questionnaire was measured with a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Table 1 shows the survey items considered in the questionnaire and the factor loading for each item. The Cronbach alpha values for all measures are also presented (see Table 2) to perceive if multiple-question Likert scale surveys are reliable.

Table 1. Variables and their measuring items included in the questionnaire.

Variable	Items	Factor Loading
TWA	I believe that by reducing the consumption of bottled water (plastic and single-use), drinking more tap water, I am helping to reduce pollution.	0.765
	I believe that by reducing the consumption of bottled water (plastic and single-use), drinking more tap water, I am helping to reduce waste.	0.749
	I believe that by reducing the consumption of bottled water (plastic and single-use) and drinking more tap water, I am helping to protect natural resources.	0.784
SN	Most people important to me would like me to reduce my consumption of bottled water (plastic and single-use) by drinking more tap water.	0.892
	Most people I admire think I should reduce my consumption of bottled water (plastic and single-use) by drinking more tap water.	0.917
	The people whose opinions I value support me in reducing my consumption of bottled water (plastic and single-use) by drinking more tap water.	0.702
PBC	I know that, if I want to, I can reduce my consumption of bottled water (plastic and single-use) by drinking more tap water.	0.772
	I have conditions/opportunities to reduce the consumption of bottled water (plastic and single-use) by drinking more tap water.	0.768
TWI	I plan to reduce my consumption of bottled water (plastic and single-use) by drinking more tap water.	0.909
	I am willing to reduce my consumption of bottled water (plastic and single-use) by drinking more tap water.	0.936
	I will try to reduce my consumption of bottled water (plastic and single-use) by drinking more tap water.	0.921
	I usually consume little bottled water.	0.747

TWB	I usually consume a lot of tap water.	0.857
	I usually use reusable bottles that I fill with tap water/drinking fountains.	0.478
MHEI	The installation of drinking fountains allowed me to change my behaviour, as I can now fill my reusable bottle with water.	0.481
	Information campaigns on tap water consumption and the reduction of plastic and single-use bottles	0.768
	Distribution of glass bottles for refill.	1.000

4. Results and Discussion

4. 1. Respondents' demographic profile

The sample is composed of 413 respondents: 374 students and 39 teachers of the HEI. Around 63% of respondents are female, 63% are aged between 18 and 21, about 73% are undergraduate students, 17% are master's students, and 10% are teachers. Regarding academic education, 62% of respondents have completed secondary education, 29% have a degree, and about 9% hold a master's or doctorate (this is the case of teachers or even students attending a second degree or a second master's degree).

4. 2. Measurement Model Analysis

The measurement model includes six latent factors indicating tap water attitudes (TWA), subjective norms (SN), perceived behavioural control (PBC), tap water intentions (TWI), and tap water behaviour (TWB), and measures of the higher institution (MHEI). To assess the measurement model's validity, CFA was performed using the covariance-based SEM approach (CB-SEM). The measurement model demonstrated acceptable goodness of fit for the empirical data. The fit indices commonly reported for CFA were calculated and met recommended guidelines [36], [37]. The following values were obtained for the model: CFI = 0.972, TLI = 0.964, both above 0.9 and RMSEA = 0.053 (less than 0.08). Moreover, accordingly to Bentler (2006), the chi-square normalised by degrees of freedom should be less than five, and in this case, it was equal to 1.85.

As described by Gefen et al. [39], the assessment of the constructs involves determining internal consistency reliability, convergent validity, and discriminant validity. To analyse convergent validity, the values of factor loadings and the average variance extracted (AVE) were determined. From Table 1, it can be seen that the factor loadings values of most of the items were above 0.6 (with an exception of two items). Regarding the AVE, it is recommended that it exceeds 0.5 [40]. All the values of AVE verified this condition, as shown in Table 2. These results indicated convergent validity. To assess internal consistency, the composite reliability and Cronbach alpha values were calculated. Table 2 shows that all of the measures were above the recommended value of 0.7, suggesting the high reliability of the scales [37].

Table 2. Convergent validity and internal consistency reliability.

Latent Variables	Composite Reliability	Cronbach's Alpha	AVE
TWA	0.809	0.806	0.587
SN	0.880	0.869	0.711
PBC	0.744	0.744	0.593
TWI	0.944	0.943	0.848
TWB	0.765	0.730	0.542
MHEI	0.761	0.749	0.524

According to Hair et al. [37], a rigorous test to assess discriminant validity is to compare the AVE values for any of the constructs with the square of the correlation estimate between these two constructs. The discriminant validity examines the constructs' variances and uniqueness. This criterion requires that the diagonal value in bold be higher than the values in its row and column, the correlation must be relatively low to exhibit discriminant validity. As depicted in Table 3, this criterion was accomplished for all constructs; therefore, it could be confirmed as the discriminant validity.

From Table 3, it also can be seen that the mean values of tap water attitude, perceived behaviour control and measures adopted by HEI were relatively high (out of 5), and the mean values of the other variables were also relatively favourable.

Table 3. Descriptive findings and correlations between latent variables.

	TWA	SN	PBC	TWI	TWB	MHEI	Mean	SD
TWA	**0.766**						4.129	0.152
SN	0.492*	**0.843**					2.973	0.355
PBC	0.539*	0.400 *	**0.770**				4.289	0.001
TWI	0.608 *	0.464*	0.755	**0.921**			3.948	0.110
TWB	0.500 *	0.344*	0.661 *	0.821 *	**0.736**		3.681	0.277
MHEI	0.233 *	0.101**	0.208 *	0.206 *	0.108***	**0.724**	4.345	0.418

Note: Bold numbers on diagonal are the square roots of AVE. Below the diagonal elements are the correlations between the constructs (* p-value < 0.001, ** p-value < 0.05, *** p-value < 0.10).

4. 3. Structural Model

The results of the structural model assessment are shown in Table 4.

Table 4 outlines the hypothesis testing and reports the structural model's main results in terms of path coefficients. This study identifies a positive and significant effect of tap water attitude, subjective norms, and perceived behaviour control on tap water intention, at the 5% level of significance, supporting H1, H2, and H3, respectively. We highlight that the strongest impact was obtained by perceived behaviour control (coefficient = 0.854; t-statistics = 5.777), followed by tap water attitudes (coefficient = 0.414; t-statistics = 2.546), and subjective norms (coefficient = 0104; t-statistics = 2.542). Hypothesis H5 was not supported, so the measures implemented on HEI had no significant impact on tap water intentions, at the 5% level of significance.

Table 4. Structural path estimates.

Hypothesis	Path	Coefficient	t-Statistics	p-value	Results
H1	TWA -> TWI	0.414	2.546	0.011	Supported
H2	SN -> TWI	0.107	2.542	0.011	Supported
H3	PBC -> TWI	0.854	5.777	0.000	Supported
H5	MHEI -> TWI	0.036	0.371	0.710	Not supported
H4	PBC -> TWB	0.122	1.009	0.313	Not supported
H6	TWI -> TWB	0.713	8.471	0.000	Supported

Hypothesis H4 is not supported, so the perceived behaviour control does not influence tap water behaviour. Finally, the hypothesis H6 is supported, and we can conclude that tap water intention has a positive and significant impact on the tap water behaviour (coefficient = 0.713; t-statistics = 8.471).

Results also suggest that there is an intention-behaviour gap regarding the consumption of water. To verify if this gap is statistically significant, a paired samples test was applied. The composite variables intention and behaviour were created by computing each respondent's sum response scores to the items corresponding to each dimension. Since the data are not normally distributed, the non-parametric Wilcoxon Signed-Ranks test was run. The results are presented in Table 5.

Table 5. Results of Wilcoxon Signed-Ranks test.

		n	Mean rank	Sum of ranks	Z	p-value
Intention-Behaviour	Negative Ranks	90a	135.29	12176.50	-6.209	0.000
	Positive Ranks	199b	149.39	29728.50		
	Ties	124c				

Note: a: Intention < Behaviour; b: Intention > Behaviour; c: Intention = Behaviour

From Table 5, it can be concluded that there are significant differences between the respondents` intentions and behaviour regarding tap and bottled water consumption. Note that there are 199 cases where the intention score is higher than the behaviour score and only 90 cases where the opposite occurs. This means that intention is not always converted into behaviour. Therefore, the gap between intention and environmental behaviour still cannot be ignored [41].

4. 4. Results Discussion

As the findings of our study reveal, an integrated view of attitudes, social norms, and perceived behavioural control (as the TPB requires) provides an explanation of intention to behave in a pro-environmental way. The favourable assessment of the reduction in bottled water consumption (attitude) positively influences the intention to increase tap water consumption. This positive relationship between eco-friendly attitude and eco-friendly intention was also verified in previous studies using TPB. For example, Borusiak et al. [33] found that attitude was the most important predictor of intention to bottled water consumption; Fedi et al. [42] also concluded that attitude positively influences the intention of university students to drink tap water from reusable bottles. The authors also found that the impact of attitude on the intention of humanities and social sciences students is more significant than that of exact sciences students. They suggest the first group of students placed more importance on the evaluation/interpretation of behaviour. Considering that the respondents in our study are mostly students belonging to the social sciences, this may help to explain the positive relationship found.

Findings also reveal a positive impact of subjective norms on intention to reduce the bottled water consumption. This is in line with previous studies such as [42], [43], and [33]. Although we can conclude that the more an individual feels pressure from important and valued people in their social network to reduce bottled water consumption, the more likely they will be to intend to reduce this consumption. This may be related to the fact that the majority of respondents are young and they may be more susceptible to social influences [44]. However, this (subjective norms) seems to be the weakest factor influencing intention to reduce bottled water consumption. Other studies found similar results (e.g., [33]) and confirm the conclusions of [45] who identify the subjective norm as a weak predictor of intentions when applying the TPB.

On the other hand, perceived behavioural control proved to be the strongest predictor of intention to reduce bottled water consumption, also following results from previous studies related to the water consumption (e.g., [33], [42]). Nevertheless, the same influence is not observed regarding the behaviour.

Considering that we employed an extended TPB model, we assumed that the adoption of measures from the higher institution to promote the consumption of tap water would influence intention to reduce bottled water consumption. However, our results suggest that the assumption is not valid. Several studies have found that many people who choose to drink bottled water do so because they can buy it almost anywhere [20], [46], [47]. Thus, the results obtained may indicate that these types of measures are not sufficient to positively influence the intention to change behaviour. Access to bottled water appears to trump the availability, access, and other advantages of bottled water. Even its affordable price can be a barrier to the intention of consuming more bottled water.

It should also be noted that the results show that the intention predicts behaviour, which is in accordance with the TPB.

5. Conclusions, Limitations, and Future Research

In recent decades, there has been more significant investment and commitment in education for environmentally friendly behaviours and sustainability. In fact, education may be considered the driving force of establishing sustainability since it is one of the primary communication vehicles and the basis for the "sustainability mindset". Education institutions, particularly HEIs, play a crucial role in society, providing students - the world's future leaders - broad information, awareness and understanding of sustainability issues [48]. HEIs have the potential to shape beliefs and practices and “can play a vital role in developing and implementing an effective intervention to decrease bottled water consumption by increasing tap water consumption” ([13], pp. 558). Studying the university community can help policymakers to understand perceptions, choices and behaviours towards drinking water and the best initiatives to develop for individuals to reduce bottled water consumption, not only at university but in other contexts, serving as a catalyst

potential for promoting practical changes in a broader sphere towards a more sustainable future [1], [14]–[16].

This study intends to contribute to the deepening of knowledge about the consumption of tap water vs. bottled water in a Portuguese HEI. Nevertheless, it presents some limitations, namely: it collects information solely and exclusively from a questionnaire; the majority of respondents are students at an HEI in central Portugal, thus presenting a certain homogeneity in terms of age, academic education and residence.

In the future, it is intended to investigate even more in detail the issue of water consumption, both tap and bottled, expanding the collection of information to more countries on all continents, students and non-students, with a greater range of age, academic education and professional occupations, considering other factors that may influence intentions and behaviours, and based on the observation of actual behaviour.

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