

OPPORTUNITY COST OF THIRST: BEHAVIORAL INSIGHTS INTO WATER BOTTLE USE AT AIRPORTS

Mirela Karabatić, University of Applied Sciences Velika Gorica

Sandra Lovrić, University of Applied Sciences Velika Gorica

Irina Kacian, University of Applied Sciences Velika Gorica

Address for correspondence: **Mirela Karabatić**, mirela.karabatic@vvg.hr

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Abstract: *There is no official data on the availability of free drinking water from the tap at airports. The aim of the study is to examine whether passengers are informed about the availability of free drinking water at the airport and whether they are willing to take water in a reusable bottle. The question arises: what is the opportunity cost of not having an empty bottle ready when someone is thirsty? The study examined whether there is a difference in the share of passengers who buy disposable water bottles at an airport that has access to drinking water from a fountain compared to an airport that does not have a drinking water fountain. How to influence consumer behavior and reduce water consumption from single-use plastic bottles?*

Keywords: *opportunity cost, sustainable travel, consumer decision-making*

1. INTRODUCTION

The human right to water extends beyond private homes, encompassing access to clean and safe drinking water in public spaces such as airports, parks, schools, and transport hubs. Ensuring water availability in these locations is essential for public health, social equity, and the dignity of all individuals, particularly travelers, children, the elderly, and people with limited resources. Public access to water does not necessarily mean it must be free, but it should be easily obtainable, affordable, and hygienic, without barriers that could prevent individuals from meeting their basic hydration needs. Policies that promote water fountains, refill stations, and sanitary facilities in high-traffic areas support the practical realization of the human right to water, complementing broader efforts to secure this right in households. Scholars emphasize that accessible public water points play a critical role in reducing inequalities and supporting public well-being, especially in urban environments where bottled water may be costly or unavailable.

The aim of the study is to examine whether passengers are informed about the availability of free drinking water at the airport and whether they are willing to take water in a reusable bottle. The question arises as to what is the opportunity cost of not having an empty bottle ready when they are thirsty. The study examined difference in the share of passengers who buy disposable

water bottles and how to influence consumer behavior and reduce water consumption from single-use plastic bottles. All international airports in the Republic of Croatia were contacted, and responses were received from only two, both of which reported that dedicated drinking water fountains are not available. Despite this, bottles are often refilled by passengers at coffee bars or in restrooms, a practice that is likely more common among domestic travelers who are familiar with the safety of tap water. A notable exception is provided by Zagreb Airport, where a public drinking water fountain is available for passengers, representing a small but important step toward improving access to free drinking water. However, because most respondents in this study reported traveling primarily from Zagreb Airport, it was not meaningful to examine potential differences in the proportion of passengers purchasing disposable water bottles between airports with and without access to drinking water fountains. Additionally, as information on the availability of such fountains at other airports was not clearly defined, this comparison could not be reliably conducted.

Opportunity cost, defined as the value of the best alternative forgone, here represents the potential loss (monetary, temporal, or environmental) incurred when travelers buy bottled water instead of refilling a reusable bottle. The concept of opportunity cost explains what we give up when we make a choice. Instructors who teach introductory economics courses often observe that many foundational principles of rational choice theory, such as the concept of opportunity cost, are not immediately intuitive to students. Nevertheless, traditional economic models frequently assume that individuals are capable of understanding and applying far more complex concepts, including backward induction. This contrast highlights the gap between theoretical assumptions of rationality and the actual cognitive limitations of human learners (Thaler, 2016). In everyday consumer behavior, one of the most common trade-offs is related to packaging, especially the decision to buy products in plastic packaging. While plastic is cheap and convenient, the hidden opportunity costs are often much higher than we realize. Consumers face daily choices: a plastic water bottle or a reusable one, packaged vegetables or bulk produce. Each decision involves an implicit opportunity cost, supporting unsustainable systems instead of contributing to ecological balance. Thaler's (2016) provides a framework for considering opportunity costs, biases, and heuristics in everyday economic choices, such as sustainability-related consumer decisions.

By examining passengers' awareness and purchasing behavior at airports, this research applies behavioral economic principles to a real-world sustainability problem. Specifically, it explores how information asymmetry, habit, and perceived convenience influence the opportunity cost of water consumption choices. Understanding these behavioral mechanisms can help design more effective interventions that promote sustainable decision-making in travel environments. In summary, prior behavior should be understood not merely as a manifestation of habit, but as an outcome shaped by a combination of underlying motives, contextual influences, and situational factors. Analyzing past actions in this way allows researchers and practitioners to gain deeper insight into the drivers of behavior, rather than attributing choices solely to routine or automatic responses. The correlation between past and future behavior indicates the stability and consistency of that behavior, setting an upper limit on the predictive validity of any theoretical model. When a significant effect of past behavior remains unexplained, it suggests that the tested theory omits an important variable, such as habit or other unaccounted

influences. While previous behavior is frequently regarded as a measure of habit, these findings provide a more precise evaluation of the completeness of the theoretical model. Given that the model positions intention as the primary direct determinant of behavior, a rigorous test of its adequacy involves examining the extent to which past behavior predicts outcomes after accounting for the influence of intention (Ajzen, 1991).

Every economic decision involves a trade-off. It is essential for practitioners to distinguish between primary and secondary motives behind decision-making. For instance, in the context of purchasing bottled water, the primary motive satisfying thirst is fulfilled by all available options. In such cases, secondary motives, such as convenience, brand preference, or perceived social status, become particularly relevant. A secondary motive represents an additional factor that influences the choice by providing extra justification for selecting one option over others (Hansen, 2019). The use of plastic bottles has significant environmental consequences. Most plastic bottles are made from non-biodegradable materials such as PET, which can take hundreds of years to decompose. Improper disposal leads to pollution of oceans, rivers, and soil, harming marine life and ecosystems. Plastics have a significant impact on public health and the economy in the United States, representing approximately 1.22% of the national gross domestic product through their contribution to disease and related social costs (Zoeller, 2024). These economic and health burdens are expected to rise if current levels of exposure persist. Policy actions, such as the Global Plastics Treaty and similar regulatory initiatives, have the potential to mitigate these impacts, depending on the extent to which they effectively reduce human exposure to hazardous chemicals like perfluoroalkyl substances (PFAS), phthalates, and bisphenols (Trasande et al., 2024). If economic arguments alone are insufficient to motivate the United States to support international agreements aimed at reducing plastic production, the potential improvements in public health, environmental sustainability, and overall quality of life for all Americans should provide a compelling rationale for such action (Zoeller, 2024). By identifying how awareness and attitudes relate to purchasing behavior, this study seeks to inform airport sustainability strategies. Understanding these dynamics can help design interventions, such as better signage, app notifications, or behavioral nudges, that reduce both consumer costs and environmental impacts.

2. LITERATURE REVIEW

Humans learn from others or are easily nudged by others. When individuals engage in certain behaviors or hold specific beliefs, their actions and thoughts can provide valuable cues regarding what may be considered appropriate or beneficial for others to do or believe. People think others are closely paying attention to what they are doing (Thaler & Sunstein, 2008). In their influential study “A Fine is a Price” Gneezy and Rustichini (2000) examined how monetary fines affect human behavior. Conducted in Israeli daycare centers, the experiment introduced a small fine for parents who arrived late to pick up their children. Contrary to expectations, the number of late arrivals increased after the fine was imposed. Parents began to perceive the fine as a price for extra time rather than a moral sanction. When the fine was later removed, lateness did not return to its previous lower level, suggesting that the social norm had been permanently weakened. The authors conclude that financial penalties can shift

perception from a moral to a market frame, transforming a socially inappropriate act into a purchasable service. The study is a cornerstone of behavioral economics, demonstrating that monetary incentives can sometimes produce the opposite of the intended effect. Thaler (2016) highlights how traditional economic models often assume fully rational agents, while behavioral economics incorporates psychological factors, such as biases, heuristics, and limited self-control, to better explain real-world decision-making. Past experience with a behavior is the most important source of information about behavioral control (Bandura, 1986). It thus stands to reason that perceived behavioral control can play an important role in mediating the effect of past on later behavior (Ajzen, 1991). Yoo (2024) investigated the factors that influence individuals' decisions to use reusable water bottles. The research identified key motivators, including environmental awareness, cost savings, and health benefits associated with drinking water. Conversely, the study highlighted several hindrances, such as perceived inconvenience, concerns about hygiene, and limited access to refill stations. The findings emphasize the role of both psychological and structural factors in shaping sustainable water consumption behaviors. By understanding the barriers and incentives that influence reusable bottle use, policymakers and institutions can design targeted interventions, such as increasing the availability of refill stations, providing educational campaigns on environmental impact, and promoting social norms—to encourage the adoption of reusable bottles in public spaces, including universities and airports. The randomized controlled trial evaluating the impact of the Hydrate Philly initiative yielded several significant findings. Notably, the average daily water usage nearly doubled, and water consumption at the intervention sites was more than twice as high compared to the control sites. Interventions to improve water access in summer programs in parks and recreation centers complement such programs in schools for promoting water consumption and its numerous physical, psychological, and cognitive outcomes (Lawman et al, 2020).

According to an industry news article published by Enliven (2020) pilot study at select U.S. airports tested a new hydration platform aimed at reducing plastic bottle consumption. The initiative involved distributing free reusable water bottles and providing incentives to passengers to encourage participation. The study found that providing accessible refill stations and promoting the use of reusable bottles effectively reduced the purchase of single-use plastic bottles among travelers. The Philadelphia International Airport unit is the only one placed at an airport and one of only a handful of others placed throughout the US. The primary aim of this pilot project is to assess consumer interest in such a product, evaluate the amount consumers are willing to pay for the service, and identify and resolve any operational issues within the new, innovative platform prior to a potential nationwide implementation.

3. METHOD

This section describes the data collection procedures, the characteristics of the participants, and the analytical approach used to examine passenger behavior regarding bottled water consumption at Croatian airports. Data were collected in Croatia through a structured questionnaire administered to air passengers (N = 411). The questionnaire was distributed online via Google Forms and was available to respondents from May 28 to June 7, 2025.

Statistical analysis was conducted using SPSS 22.0 (IBM Corp., Armonk, NY, USA). Participants provided demographic information (gender, age, education, flight frequency, and home airport) and answered questions related to their awareness, habits, and spending on bottled water. Although the participants primarily traveled from Croatian airports, their responses also reflected experiences on international flights, ensuring that experiences at airports outside Croatia were not excluded. Analyses used pairwise-complete data (most inferential tests $n \approx 411$); for each statistical test, only cases with complete data for the variables involved in that specific test were included. Key measures included awareness of free drinking water, purchase behavior, reusable-bottle habits, willingness to bring an empty bottle, and self-reported spending. Opportunity cost was estimated as the product of purchase probability and mean expenditure among buyers.

Descriptive statistics summarized key variables. Pearson’s chi-square tests assessed associations among categorical variables (awareness, carrying/willingness, purchase, and demographics). Spearman’s rho correlations examined relationships among numeric and ordinal variables (e.g., spending, frequency, habits). All analyses were performed in using $p < .05$ as the significance criterion.

Structural equation modeling (SEM) was used to examine the relationships between awareness of free drinking water availability, sustainable bottle-use habits, and disposable water bottle purchase behavior. SEM was chosen because it allows the simultaneous estimation of both measurement and structural components of the model, as well as the assessment of direct and indirect effects among latent constructs. The model consisted of three latent variables: awareness, sustainable habit, and purchase behavior. Awareness was specified as an exogenous construct, sustainable habit as a mediating construct, and purchase behavior as the endogenous outcome. Latent constructs were measured using multiple observed indicators derived from the survey

4. RESULTS

A total of 411 passengers participated in the survey. The sample included both male (35,77%) and female (64,23%) respondents (Table 2). Age data showed a wide range of passengers, with the majority between 25 and 54 years old, while younger (<25) and older (55+) groups were less represented (Table 1). Educational attainment was diverse, and most respondents reported flying between one and five times per year.

Table 1. Age structure

Age group	Count	Percentage
<25	92	22.38
25–35	107	26.03
35–45	63	15.33
45–55	82	19.95
55–65	51	12.41
65 and over	16	3.89

Source: Authors

Table 2. Gender distribution

Gender	Count	Percentage
Female	264	64.23
Male	147	35.77

Source: Authors

Awareness and Behavioral Indicators

Table 3 reports respondents' awareness of the availability of free drinking water at airports. Slightly more than half of the sample (53.53%) indicated that they were not aware of this option, while 46.47% reported being aware. This suggests that information about free water provision at airports is not reaching a substantial proportion of passengers.

Table 4 presents respondents' self-reported behavior regarding carrying a reusable water bottle when flying. The results show an almost even split, with 49.88% indicating that they carry a reusable bottle and 50.12% reporting that they do not. Despite the relatively high share of passengers engaging in this sustainable practice, the lack of widespread awareness observed in Table 3 may limit further adoption.

Taken together, these tables indicate a disconnect between awareness and behavior, highlighting the potential for information-based interventions to promote more sustainable consumption patterns among air travelers.

Table 3. Awareness of free water

Awareness (1=yes,0=no)	Count	Percentage
0	220	53.53
1	191	46.47

Source: Authors

Table 4. Carry reusable when flying

Carry reusable (1=yes,0=no)	Count	Percentage
0	206	50.12
1	205	49.88

Source: Authors

Table 5. Bought disposable at airport

Bought disposable at airport (1=yes,0=no)	Count	Percentage
1	239	58.15
0	172	41.85

Source: Authors

Table 6. Would bring empty bottle (signage)

Bring empty bottle if signage (1=yes,0=no)	Count	Percentage
1	347	84.43
0	64	15.57

Source: Authors

A series of Pearson's chi-square tests revealed several significant relationships:

- Awareness ↔ Purchase of disposable bottles: χ^2 test indicated a statistically significant association ($p < .001$). Passengers aware of free water were less likely to buy bottled water.
- Carrying reusable bottle ↔ Purchase behavior: significant association ($p < .01$), showing that travelers who carry reusable bottles are less likely to purchase disposable ones.
- Awareness ↔ Carrying reusable bottle: positive association ($p < .05$), suggesting that information and personal habit are mutually reinforcing.
- Gender ↔ Awareness: small but significant difference ($p < .05$), with women slightly more aware of free-water availability.

Statistically significant differences were observed between age groups in several behavioral outcomes. Younger passengers (under 35) were more aware of the availability of drinking water refill stations at Zagreb Airport. They also differed from older passengers in their motivations for carrying a reusable bottle: younger travelers tended to do so primarily for convenience, whereas older travelers were more likely to carry a bottle for financial reasons. Additionally, younger passengers purchased disposable water bottles less frequently than older passengers, with this difference approaching statistical significance ($p = 0.052$). When asked to indicate the extent to which a clear sign showing the availability of free bottle refills would influence their decision to bring and use a reusable bottle on their next trip (1 = "would completely influence," 2 = "would largely influence," 3 = "would somewhat influence," 4 = "would not influence"), younger participants reported an average response of 2, while older participants reported an average of 1.79. This difference was statistically significant ($p = 0.029$, $\alpha = 0.05$), suggesting that older travelers were slightly more influenced by signage than younger travelers. A statistically significant difference was confirmed between the responses of women and men regarding the habit of using a reusable water bottle. Women were significantly more likely to report that they always use one, while men more often responded that they use it occasionally or rarely. The difference was significant at the 5% level.

Correlational Analysis

As expected, Spearman correlations supported these patterns: the strongest correlation was observed between the amount spent and whether a passenger purchased bottled water ($\rho \approx 0.71$, $p < 0.001$). Carrying a reusable bottle correlated negatively with the general habit code ($\rho \approx -.36$, $p < .001$) and positively with willingness to bring an empty bottle if signage were visible ($\rho \approx .23$, $p < .001$).

Opportunity Cost Estimate

Among passengers who purchased bottled water, the mean expenditure was €6.63 (median €5.00). Since 28.8% of travelers bought bottled water, the expected opportunity cost of not

carrying a reusable bottle was calculated as the product of the purchase probability and the mean expenditure:

$$\text{Expected opportunity cost} = 0.288 \times \text{€}6.63 \approx \text{€}1.91 \text{ per passenger.}$$

It should be noted that this estimate only accounts for monetary expenditure and does not include time costs or environmental externalities, meaning that the true social cost is likely higher.

Structural Equation Modeling Results

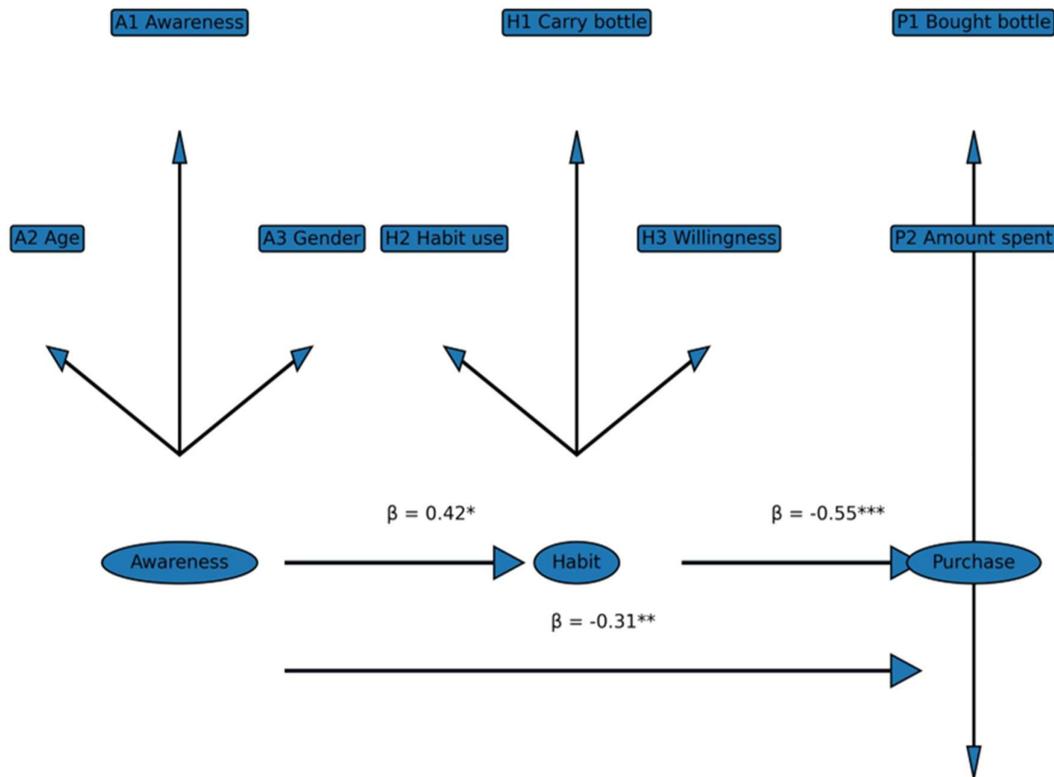


Figure 1. Full structural equation model of awareness, sustainable habit, and disposable water bottle purchase behavior.

Source: Elaborated by the authors

Note. Standardized beta coefficients are reported for structural paths. * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 1 presents the structural equation model illustrating the direct and indirect effects of awareness on disposable water bottle purchase behavior, with sustainable habit acting as a mediating construct. Standardized path coefficients indicate that awareness has a strong positive effect on sustainable habit ($\beta = 0.42$, $p < .05$), while sustainable habit exerts a substantial negative effect on disposable water bottle purchase behavior ($\beta = -0.55$, $p < .001$). Awareness also shows a significant direct negative effect on purchase behavior ($\beta = -0.31$, $p < .01$), confirming partial mediation. Sustainable habit, in turn, shows a strong negative association with disposable water bottle purchase behavior. Awareness also exhibits a direct

negative effect on purchase behavior, indicating partial mediation. Overall, the SEM results demonstrate that awareness of free drinking water availability reduces disposable water bottle purchases both directly and indirectly, with sustainable habit acting as a central mediating mechanism linking information to behavior.

5. DISCUSSION

The 2006 transatlantic aircraft plot, which involved the planned detonation of liquid explosives aboard airliners traveling from the United Kingdom to the United States and Canada, led to immediate and widespread changes in airport security protocols. Authorities worldwide banned all liquids, gels, and aerosols from carry-on luggage, a measure that significantly altered passenger experience and airport operations (Hoiijtink, 2017). These changes were initially introduced as temporary security measures but have persisted for nearly two decades, with gradual relaxations occurring only in recent years due to advancements in screening technology. This study highlights a critical gap between the availability of sustainable infrastructure and passenger awareness. Only one in four travelers knew that free drinking water was available, yet a large proportion expressed willingness to adopt more sustainable habits if informed properly. Awareness and habit strength predicted lower disposable-bottle purchases, indicating that informational interventions could substantially reduce plastic consumption. From an economic perspective, the average traveler forgoes approximately €1.91 per trip by not carrying an empty bottle. This inefficiency reflects a status quo bias and information asymmetry. Increasing awareness through clear signage and communication can therefore reduce both financial and environmental costs. Low-cost interventions such as standardized “Free Water Refill” signage, mobile app icons or pre-travel prompts can meaningfully increase sustainable behavior. Airports and airlines can collaborate to make refill points visible and convenient, reducing single-use plastic waste.

6. CONCLUSION

The study concludes that lack of awareness, not unwillingness, is the primary barrier to sustainable passenger behavior. Increasing visibility of refill options and communicating their availability can significantly reduce single-use plastic consumption and passenger opportunity costs. The observed patterns align with behavioral economic theories emphasizing bounded rationality and status quo bias (Thaler & Sunstein, 2008). Passengers appear to default to purchasing bottled water when refill options are not salient or clearly communicated. This highlights how subtle contextual cues, such as visibility of refill stations or social norms, can nudge travelers toward more sustainable behaviors. Awareness influences purchase behavior both directly and indirectly through sustainable habit. Future research could expand this analysis by incorporating cross-cultural comparisons between WEIRD¹ and non-WEIRD travelers, as well as experimental interventions using synthetic participants to predict behavioral responses to different pricing or signage conditions. Such approaches would

¹ WEIRD-s an acronym that stands for Western, Educated, Industrialized, Rich, and Democratic. It was introduced by psychologists Henrich et al (2010) to describe the populations that dominate psychological and social science research. These populations represent only a small and culturally specific segment of humanity, yet their behaviors, attitudes, and cognitive patterns are often treated as universal in academic studies

strengthen understanding of how economic and psychological factors jointly shape sustainable travel behavior.

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