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The Effect of Potentially Groundwater-Contaminating Ecological Disaster on Adolescents' Bottled Water Consumption and Perceived Risk to Use Tap Water

Mykolas Simas Poškus *, Audra Balundė, Lina Jovarauskaitė, Goda Kaniušonytė and Rita Žukauskienė

Institute of Psychology, Mykolas Romeris University, LT-08303 Vilnius, Lithuania; audra.balunde@mruni.eu (A.B.); lina.jovarauskaite@mruni.eu (L.J.); godakan@mruni.eu (G.K.); rzukausk@mruni.eu (R.Ž.)

* Correspondence: mykolas_poskus@mruni.eu

Abstract: We compared the extent to which a potentially groundwater-contaminating ecological disaster affected adolescents' bottled water consumption and perceived risk to use tap water. The affected group consists of 221 adolescents (56.6% were girls, M_{age} = 15.44, SD_{age} = 0.60), while the control group consisted of 156 adolescents (56.4% were girls, M_{age} = 15.50, SD_{age} = 0.55). The Comprehensive Action Determination Model that explains pro-environmental actions was used as a basis for the comparison of adolescents' bottled water use, both on mean and model-path levels. Perceived risk of tap water use was compared among affected and control groups (i.e., quasi-experimental manipulation check). The affected group perceived tap water use as riskier than the control group, although the difference was marginal. The affected group also demonstrated significantly lower intention not to consume bottled water than the control. Interestingly, however, path-level comparisons indicated that affected adolescents were more effective in translating their perceived control over sources of clean drinking water into intention to consume tap water.

Keywords: groundwater contamination; risk perception; drinking water; bottled water consumption; comprehensive action determination model; adolescents

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1. Introduction

Access to clean drinking water is a crucial resource for societal health [1,2], yet there are many determinants of how people access and consume drinking water, some of which are infrastructural and some of which are based on social aspects, subjective beliefs, and habits. People might be motivated to use drinking water from the tap when available, since this is the more environmentally friendly and cheaper option. Others might opt to use bottled water because of their concern for the quality of tap water [3] or as a way of signaling wealth [4]. Essentially, there are a multitude of factors that affect how a society consumes drinking water and whether people use bottled or tap water. Yet it is unknown how one's choice of the source of drinking water (i.e., tap vs bottled water) is affected by a potentially groundwater-contaminating ecological disaster. This is especially important to uncover in a sample of adolescents, since their risk perception differs from that of adults [5].

In the present study, we assessed how perceived normative, habitual, intentional, and situational determinants of bottled water consumption behavior, operationalized through the Comprehensive Action Determination Model (CADM) [6], were affected by an ecological disaster that had the potential to contaminate the municipal drinking water supply of Alytus, Lithuania. On 16 October 2019, a warehouse full of used tires caught fire and burned for the following ten days, resulting in toxic smoke and other contaminants being released by the fire and by the efforts to contain it. Particular concern was seen in the media over the possibility of contaminated groundwater, since the water that was used to extinguish the fire would get into the groundwater together with many potential

contaminants from the fire. Media reports stated that the nature of the toxic waste mostly comprised the materials used in manufacturing tires (rubber, resins), ash from textiles, and other unknown materials that were in the warehouse. Similar situations have been analyzed before [7], but not in an adolescent sample.

A factual evaluation of the quality of the groundwater indicated no signs of health risks; official authorities took measures to inform the public about the quality of groundwater and addressed their concerns about the quality of their drinking water. Despite the official response, many residents still had concerns about the quality of their drinking water, perhaps stemming from the proximity to the event [8], indicating a level of mistrust of the official report, which might have compelled some people to turn to bottled drinking water as a behavior aimed at avoiding risk. Thus, even though there was no actual risk in consuming drinking water and the authorities made that clear, public distrust and caution still persisted, resulting in perceived risk about contaminated drinking water.

The data of the present study is a cross-section of a currently ongoing longitudinal investigation of adolescents' drinking water consumption that is not related to the tire fire. The data were gathered in two schools in different towns, one in Alytus, the town affected by the disaster, and the other in an area not affected by the disaster. The data were gathered shortly after the natural disaster, resulting in a natural quasi-experimental design with a control group.

2. Literature Review and Hypothesis Development

2.1. The CADM as an Interacting System

The CADM is intended to be a comprehensive model of well-researched factors affecting individuals' pro-environmental behavior [6]. The model encompasses normative, habitual, intentional, and situational aspects of behavior by aggregating predictors from the Theory of Planned Behavior [9] and the Norm Activation Model [10] and by including other relevant predictors in the model itself, which was meta-analytically derived [11]. The data-driven construction of the model lends it credibility, and the variety in its components allows the assessment of complex dynamics of various behaviors in a holistic manner.

2.1.1. Situational Factors

The CADM assesses perceived behavior control and access to behavior, both of which are indicative of how an individual perceives their environment. Perceived behavior control reflects one's perceived capacity to perform a behavior [12], while access to behavior indicates the respondent's perception of whether the available infrastructure affords that behavior [6]. Essentially, situational factors are indicative of the perceptions of the available infrastructure and its affordances and personal belief as to whether one can act upon that infrastructure.

The ecological disaster that the residents of Alytus were exposed to had the potential to contaminate their groundwater, thus possibly affecting their perceptions of their municipal water supply. This sudden change in situation could have had an abrupt effect on the perceived affordances of the infrastructure, making it hard to judge if tap water was fit for drinking or not. Thus, we propose the following hypotheses for situational factors when comparing adolescents from the affected area with adolescents from the control group:

Hypothesis 1 (H1). *The affected group will have lower perceived access to safe drinking water from a tap or from a well when compared to the control group.*

Hypothesis 2 (H2). *The affected group will have lower perceived behavioral control to consume drinking water from a tap or from a well when compared to the control group.*

Hypothesis 3 (H3). *Perceived behavioral control to find drinking water from a tap or from a well will have a smaller contribution toward explaining intention not to buy bottled water in the affected group when compared to the control group.*

2.1.2. Normative Factors

Social norms identify one's perceived pressure to perform a given behavior [12] and function as a heuristic to ease cognitive load in making behavioral decisions [13,14]. Social norms are constructed through observing the behavior of important others who signal which behavior is expected. In the present study, the abrupt change in environmental factors possibly led to different reactions to the novel threat of contaminated water; thus, one's reference group for identifying common norms might not be as consistent as it was previously, leading to a diffusion of perceived social norms. Therefore, we propose the following hypotheses:

Hypothesis 4 (H4). *The affected group will have lower scores of social norms not to buy bottled water when compared to the control group.*

Hypothesis 5 (H5). *Social norms not to buy bottled water will have a smaller contribution toward explaining the intention not to buy bottled water in the affected group when compared to the control group.*

Personal norms reflect one's moral obligation to perform a behavior. They encompass a value judgement that is based on personal beliefs and the available knowledge. In the CADM, personal norms are thought to be influenced by social norms and by one's awareness of need and awareness of behavioral consequences—i.e., the belief that certain behaviors are necessary for environmental conservation and have either positive or negative consequences to the environment. Thus, the moral framework represented by personal norms is an internalized reflection of the perceived behavior of others that is strengthened by available knowledge of the positive or negative outcomes of a behavior. In the current situation, a multitude of incongruent beliefs might have been at work, and the various beliefs leading toward developing a moral understanding of a behavior might have been competing. Individuals were likely engaged in cost and benefit analyses of their behaviors and re-evaluating their previously held beliefs. Thus, we propose these hypotheses:

Hypothesis 6 (H6). *The affected group will have lower scores of personal norms not to buy bottled water when compared to the control group.*

Hypothesis 7 (H7). *Personal norms not to buy bottled water will have a smaller contribution toward explaining the intention not to buy bottled water in the affected group when compared to the control group.*

Hypothesis 8 (H8). *Awareness (of the need not to buy and of the consequences of buying bottled water) will have a smaller contribution toward explaining the personal norm not to buy bottled water in the affected group when compared to the control group.*

Hypothesis 9 (H9). *Awareness (of the need not to buy and of the consequences of buying bottled water) will have a smaller contribution toward explaining self-reported past bottled water purchasing behavior in the affected group when compared to the control group.*

2.1.3. Habitual Behavior

In the CADM, habitual behavior is understood as the most frequent actions performed automatically when faced with familiar situations. Habit tends to develop when one finds the most appropriate action in a given situation and repeats it [12], reducing cognitive load for that behavior. In the present study, we assessed the habit of buying bottled water, which, in normal circumstances, might be counteracted by one's personal norms and general moral beliefs that one should strive to conserve the environment. However, an unusual situation that disrupts the aforementioned beliefs might lead to habitual behavior having a more prominent role in predicting intention when other factors are diffused. Thus, we propose these hypotheses:

Hypothesis 10 (H10). *The affected group will report a stronger habit of buying bottled water when compared to the control group.*

Hypothesis 11 (H11). *The habit of buying bottled water will have a larger contribution toward explaining the intention of not buying bottled water in the affected group when compared to the control group.*

2.1.4. Intention and Behavior

The intention to perform a behavior is seen as the most immediate predictor of actual behavior [12,15], yet there is a vast literature on how intentions do not necessarily lead to actual behavior [16]. Intentions are a reflection of one's plans for future behavior, which are made to be consistent with held beliefs and attitudes, yet when one is faced with a behavioral decision in real time, environmental factors and the immediate context can greatly affect the behavioral outcome. This might be especially true when intentions are formed in the context of beliefs that are no longer applicable in one's current situation. Based on the above, we propose this hypothesis:

Hypothesis 12 (H12). *The intention not to buy bottled water will have a smaller contribution in predicting self-reported past bottled water purchasing behavior in the affected group when compared to the control group.*

2.2. Risk Perception

Risk perception is the degree to which an individual believes they are vulnerable to some sort of danger or harm [17]. It has been established that heightened risk perception regarding a behavior tends to affect both behavior and intention [17] and might be one of the factors contributing to the intention–behavior gap [16]. In the case of potential drinking water pollution, a factor that can threaten the health of a society [1,2], this can lead to behavior that is aimed at avoiding the risk of drinking water from risky sources, i.e., taps and wells. Thus, we propose the following hypotheses:

Hypothesis 13 (H13). *The intention not to buy bottled water will be lower in the affected group when compared to the control group.*

Hypothesis 14 (H14). *The affected group will report more bottled water purchasing behavior when compared to the control group.*

Additionally, as a quasi-experimental manipulation check, we tested the following hypothesis:

Hypothesis 15 (H15). *The affected group will report higher perceived risk regarding drinking water when compared to the control group.*

3. The Specifics of an Adolescent Sample

Adolescents are more likely to take risks than children or adults [18]; such behavior is often seen as "normative" in adolescent years. Adolescents are often viewed as being unable to judge risk appropriately because they are overly optimistic believing in their invulnerability to harm [19,20]. Although personal experience with sources of risk have been linked to higher risk perception [21], some adolescents tend to subjectively devalue sources of risk [5], which leads to risky behavior. Specifically, an increase in risky behavior was observed immediately after a major natural disaster in adolescent boys and girls [22], highlighting risky behavior as a possible adaptive response to uncertainty in adolescence. Thus, sources of risk seem to have the potential for both preventing and inspiring risky behavior if one's environment is substantially disturbed and uncertain. In the present study we explore whether adolescents' perceived risk of drinking water contamination

changed as a result of an ecological disaster and whether the disaster affected their outlook on drinking water consumption.

In addition, adolescents undergo intense psychological, physiological, and social development [23]. Being under the process of development makes adolescents more vulnerable to external environmental influences such as environmental disasters [24] because such disasters can severely disrupt daily routines, natural developmental trajectories, and compromise adolescents' capabilities to adapt to the environment and perform their developmental tasks [25]. The disruption can have major implications on learning to act environmentally friendly in adolescence (in this case, using tap water instead of bottled water), because behavior formation requires a certain level of stability in the external environment, social as well as physical, and iteration of the behavior, so that normative, habitual, intentional, and situational factors can shape certain behavior [11]. Being exposed to environmental disasters in adolescence can disrupt the process of and result in failure of new environmental behavior adoption. As a case in point, we targeted bottled water use behavior and analyzed the extent to which the potentially groundwater-contaminating tire warehouse fire could change adolescents' bottled water use habits. The disruptive event and public debate on water safety in the region could have potentially increased the subjective belief that tap water is unsafe and risky to consume, leading to increased bottled water use.

Finally, previous studies on bottled water use among adolescents indicate that normative, habitual, intentional, and situational factors indeed explain bottled water use behavior [26–28]. Specifically, the more adolescents feel pressure from society to use tap water and are aware of the damage to the environment done by bottled water use, the more they feel morally obliged to refrain from bottled water use. This in turn leads to stronger habits and intention to use tap water. Situational factors such as access to behavior lead to stronger habits. The question is whether these factors still explain bottled water use behavior of adolescents in the same manner when there is a potential risk of contamination of drinking water resources, since this can potentially trigger the perception that tap water is contaminated, which can in turn affect processes postulated by the CADM and thus result in engaging in bottled water use instead of tap water use.

4. Materials and Methods

4.1. Data Collection and Sample Characteristics

To test our hypotheses, we used a quantitative cross-sectional dataset from two schools in different Lithuanian cities (i.e., convenience sample). All 9th and 10th graders from those schools were invited to participate in a longitudinal research project. The second wave was used in this paper. The sample consisted of 413 adolescents (55.2% were girls, age range from 13 to 17, M_{age} = 15.44, SD_{age} = 0.59).

The sample was diverse in terms of family and socioeconomic background. Most participants lived with two parents (68.5%); the remaining participants had a range of other family situations owing to parental divorce (13.3%), loss (3.4%), and migration (0.2%). Regarding their socioeconomic status, 5.3% received state economic support (free nutrition at school), and in 12.3% of all cases at least one parent was unemployed. The majority of parents had achieved higher education (52.1% mothers and 28.6% fathers), 16.2% of mothers and 26.2% of fathers had vocational education, and 11.9% of mothers and 10.6% of fathers had achieved secondary or lower education.

Participants were informed about the research and asked whether they would be willing to participate. Parents were informed about the study through a written letter (distributed via e-diary and, additionally, via a paper copy given to the adolescent to bring home), and written parental consent was obtained. Participation in the study was voluntary, and adolescents had the opportunity to withdraw from the study at any time without any undesirable consequences. The measurement took place during regular school hours in the classrooms using tablet computers. Depending on the agreement with the schools, either researchers came to classrooms and handed out tablets for filling in the questionnaire, or

participants came to designated classrooms where researchers were waiting for them with prepared tablets.

To control the attention of the respondents while filling in the survey and to ensure the validity of their answers, we included four test questions asking the respondents to mark a specific answer in that row (e.g., "mark the middle option in this row"). We used the data of only those respondents who correctly marked at least three of four control questions; in total, 28 cases were eliminated at this step. Additionally, we tested for the multivariate outliers and eliminated additional 8 cases. Therefore, the final study sample consisted of 377 participants (56.5% were girls, age range from 13 to 17, M_{age} = 15.46, SD_{age} = 0.58). There were 221 adolescents in the 1st school (affected group; 56.6% were girls, age range from 13 to 17, M_{age} = 15.44, SD_{age} = 0.60) and 156 in the 2nd school (control group; 56.4% were girls, age range from 14 to 16, M_{age} = 15.50, SD_{age} = 0.55).

The tire fire made national news and was at the focus of the attention of all Lithuanian citizens during the disaster and for at least a month after it because most of Lithuania's drinking water comes from groundwater sources. There is no doubt that all participants (i.e., control group) had knowledge of the event and the potential environmental concerns associated with it [29].

4.2. Measures

4.2.1. CADM

The components of the CADM were measured using the methodology suggested by Klöckner and Blöbaum [6], maintaining the same model structure and operationalizing the components of the model in a similar manner to their research. To cover all parts of the model, we used either several items per variable or single items (see Appendix B for all items). All items were constructed based on previous research by other authors [30,31], and while single-item measures are not optimal for assessing many psychological constructs, they are useful in cases where the assessed construct is very clear and easily operationalized [32,33]. We opted to use single-item measures for some of the components of the CADM [31] to avoid repetition and to make the overall survey shorter as a means to ensure that the time needed to fill it in was suitable for the participants' attention span. Potential items were tested in a pilot study.

Three constructs were measured using one item per construct: perceived behavioral control ("It is completely up to me whether I will consume drinking water from the tap, a well, or a spring"), accesses to behavior ("I have access to the tap, a well, or a spring to get high-quality water"), and behavior ("I consumed bottled water in the last four weeks"). Awareness (of a need and consequences) was measured using 6 items (3 items reflecting need (e.g., "Bottled water consumption causes many environmental problems") and 3 items reflecting consequences (e.g., "If I reduce my bottled water consumption, I contribute to environmental protection"), Cronbach's alpha—0.89); social norms were measured with 3 items (e.g., "People who are important to me expect that I will not consume bottled water", Cronbach's alpha—0.76); personal norms with 2 items (e.g., "I feel morally obliged not to consume bottled water", Spearman–Brown coefficient of reliability—0.81); habit with 2 items (e.g., "Buying bottled water is a part of my daily routine", Spearman–Brown coefficient of reliability—0.75); intention with 2 items (e.g., "I intend not to consume bottled water in the next four weeks", Spearman–Brown coefficient of reliability—0.84). All items were rated on a 5-point Likert scale from (1) completely disagree to (5) completely agree, except for the item assessing past behavior, which was rated from (1) never or almost never to (5) constantly or almost constantly.

4.2.2. Risk Perception

Based on guidelines from Wilson et al. [34], we constructed a risk perception scale that evaluated general risk perception (2 items, e.g., "How risky it is to drink water from the tap?", Spearman–Brown coefficient of reliability—0.58) and three components of risk perception: affect (5 items, e.g., "How concerned are you about water pollution due to the

fire in Alytus?", Cronbach's alpha—0.90), probability (3 items, e.g., "How likely it is that in one year's time a similar disaster as the fire in Alytus will occur somewhere near you?", Cronbach's alpha—0.76), and consequences (2 items, e.g., "I would be negatively affected by an event like the fire in Alytus", Spearman–Brown coefficient of reliability—0.61). Items were rated on a 5-point Likert scale from (1) reflecting low risk to (5) reflecting high risk. The original Lithuanian items of the scale as well as their English translations are presented in Appendix A.

4.3. Managing Order Effects

The dataset used in the present study is a cross-section of a large longitudinal study, and the questionnaire battery contained additional measures (directed at pro-environmental behavior, values, and identity) that are not discussed in this paper. Participants were first asked to provide demographic data, followed by a battery of all other scales. To minimize the possibility of question order effects, the order of all scales and the order of items within the scales were randomized for all participants. As in all research with a multitude of measures, some possibility of priming effects remains, but any such effects should be fairly small and balanced out because of the randomization [35].

4.4. Analysis Strategy

We conducted model-based path analyses in Mplus 7.4. [36]. We evaluated the model fit by using the comparative fit index (CFI) and the root mean square error of approximation (RMSEA), following the goodness of fit recommendation provided by Little [37]; namely, CFI/TLI values higher than 0.90 indicated acceptable fit, and values higher than 0.95 represented very good fit; RMSEA values below 0.08 indicated acceptable fit, and values less than 0.05 suggested good fit.

5. Results

We tested the CADM model suggested by Klöckner and Blöbaum [6] and modified it based on previous research and statistical analysis. First, we introduced two additional regression paths: a direct path between Intention and Habit [11] and a direct path between Awareness of Consequences and self-reported Behavior [38]. Secondly, after empirically analyzing the covariance matrix in search of a solution that would best fit the data, we combined Awareness of Need and Awareness of Consequences (hereafter referred to as Awareness). This decision was also partially based on previous research [39,40]. Finally, we specified three additional paths: two regression paths, between Perceived Behavioral Control and Awareness and between Access to Behavior and Intention, and one correlation, between Access to Behavior and Social Norm (see Figure 1).

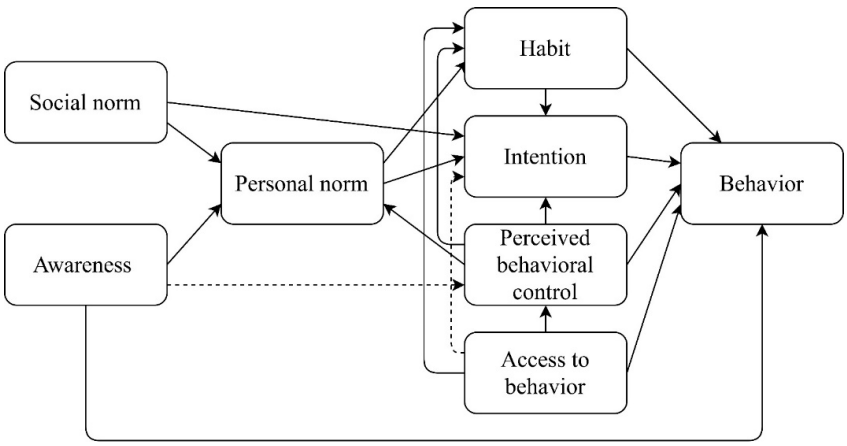

Figure 1. The theoretical model used in the present study. Note. Solid lines represent paths of the original CADM model [6] with additional paths established in other studies [11,38], while dashed lines represent additional paths added in the present study.

Descriptive statistics and rank correlations of all study variables are presented in Table 1. The skewness and kurtosis of the study variables indicated that all measures approximated the normal distribution sufficiently well except for the access to alternative water sources. Therefore, all mean comparisons were conducted using robust independent sample t-tests using bootstrapped confidence intervals. As some study variables were ordinal, we used rank correlation analysis for testing of preliminary linear relationships among them.

5.1. CADM in the General Sample of Adolescents

In preparation for group comparison, we first estimated the CADM in the full sample. Model estimation yielded an acceptable fit ($\chi^2(100) = 166.64$, CFI = 0.972, RMSEA = 0.042 (0.030, 0.053)). The results (see Figure 2) indicated that Social Norm and Awareness were significant positive predictors of Personal Norm—the moral obligation not to consume bottled water. Habit of bottled water consumption was found to be negatively predicted by the Personal Norm of not consuming bottled water, Perceived Behavioral Control, and Access to Behavior. Personal Norm positively predicted Intention not to consume bottled water. Perceived Behavioral Control was positively predicted by Access to Behavior and Awareness. Intention not to consume bottled water, additionally, was predicted negatively by Habit and positively by Social Norm. Self-reported Behavior of consuming bottled water was negatively predicted by Habit to consume bottled water. Other paths were non-significant.

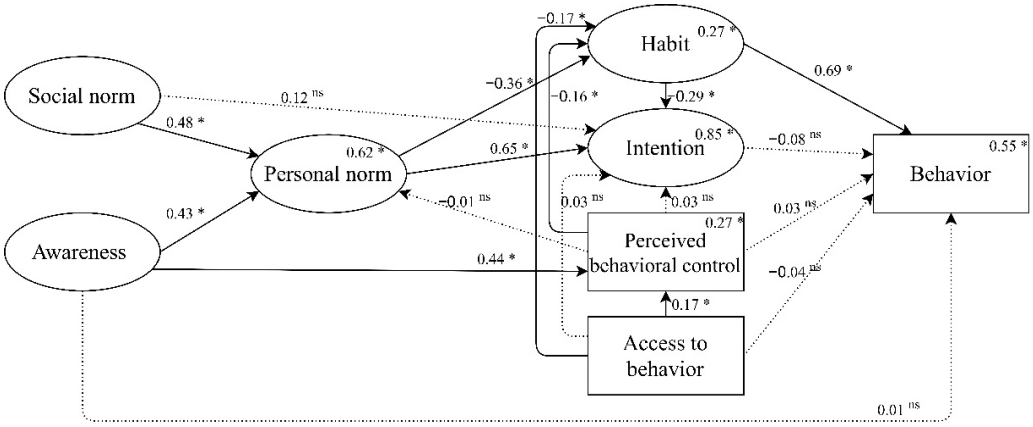

Figure 2. Standardized regression coefficients of the model paths in the general sample of adolescents (N = 377). Note. * $p < 0.01$. ns—non-significant.

5.2. Comparison of the Affected and Control Groups

First, a series of t-tests were run to compare groups on the mean level by their CADM variables and risk perception (see Table 2). We hypothesized that the affected group would have lower perceived access to safe drinking water from a tap or from a well (H1), have lower perceived behavioral control to consume drinking water from a tap or from a well (H2), have lower scores of social norms not to buy bottled water (H4), have lower scores of personal norms not to buy bottled water (H6), report a stronger habit of buying bottled water (H10), have a lower intention not to buy bottled water (H13), report more bottled water purchasing behavior (H14), and report higher perceived risk regarding drinking water (H15)—the last hypothesis being a quasi-experimental manipulation check.

Table 1. Descriptive statistics of study variables and rank correlations among them.

Variable	*M* (95% CI)	*SD* (95% CI)	S	K	1.	2.	3.	4.	5.	6.	7.	8.
1. Behavior	2.40 (2.25, 2.54)	1.15 (1.06, 1.24)	0.47	−0.61	-	−0.26 ** (−0.38, −0.13)	−0.21 * (−0.34, −0.08)	−0.35 ** (−0.47, −0.24)	−0.45 ** (−0.56, −0.32)	−0.26 ** (−0.39, −0.13)	−0.31 ** (−0.43, −0.18)	0.64 ** (0.54, 0.72)
2. Awareness	3.94 (3.83, 4.04)	0.81 (0.72, 0.89)	−0.66	0.39	−0.37 ** (−0.51, −0.22)	-	0.45 ** (0.34, 0.56)	0.53 ** (0.42, 0.63)	0.54 ** (0.43, 0.63)	0.41 ** (0.29, 0.52)	0.34 ** (0.22, 0.45)	−0.36 ** (−0.47, −0.23)
3. Social Norm	2.91 (2.78, 3.04)	1.00 (0.92, 1.08)	0.01	−0.44	−0.18 * (−0.33, −0.02)	0.44 ** (0.30, 0.56)	-	0.56 ** (0.46, 0.66)	0.53 ** (0.41, 0.63)	0.17 ** (0.04, 0.30)	0.12 (−0.01, 0.25)	−0.22 * (−0.35, −0.08)
4. Personal Norm	3.24 (3.10, 3.36)	1.02 (0.93, 1.10)	−0.22	−0.29	−0.36 ** (−0.50, −0.21)	0.59 ** (0.47, 0.68)	0.54 ** (0.41, 0.66)	-	0.68 ** (0.58, 0.76)	0.25 ** (0.12, 0.37)	0.22 ** (0.10, 0.35)	−0.34 ** (−0.47, −0.21)
5. Intention	3.42 (3.26, 3.58)	1.24 (1.15, 1.33)	−0.43	−0.82	−0.53 ** (−0.65, −0.40)	0.61 ** (0.50, 0.70)	0.50 ** (0.37, 0.62)	0.72 ** (0.62, 0.80)	-	0.42 ** (0.30, 0.52)	0.32 ** (0.20, 0.43)	−0.53 ** (−0.64, −0.41)
6. Perceived Behavioral Control	4.33 (4.22, 4.44)	0.85 (0.74, 0.96)	−1.41	2.24	−0.28 ** (−0.43, −0.13)	0.45 ** (0.30, 0.58)	0.24 ** (0.09, 0.38)	0.32 ** (0.18, 0.45)	0.36 ** (0.22, 0.49)	-	0.44 ** (0.32, 0.55)	−0.38 ** (−0.49,−0.27)
7. Access to Behavior	4.46 (4.34, 4.57)	0.88 (0.73, 1.01)	−1.85	3.51	−0.28 ** (−0.42, −0.13)	0.39 ** (0.25, 0.52)	0.01 (−0.14, 0.15)	0.19 ** (0.05, 0.34)	0.27 ** (0.12, 0.42)	0.31 ** (0.16, 0.47)	-	−0.31 ** (−0.42, −0.19)
8. Habit	2.36 (2.22, 2.49)	1.10 (1.02, 1.17)	0.33	−0.95	0.68 ** (0.57, 0.78)	−0.36 ** (−0.49, −0.21)	−0.08 (−0.23, 0.09)	−0.34 ** (−0.48, −0.18)	−0.54 ** (−0.66, −0.40)	−0.30 ** (−0.45, −0.15)	−0.29 ** (−0.44, −0.14)	-
M (95% CI)					2.29 (2.21, 2.48)	4.01 (3.88, 4.14)	2.94 (2.80, 3.08)	3.29 (3.12, 3.47)	3.69 (3.50, 3.86)	4.34 (4.19, 4.49)	4.44 (4.31, 4.57)	2.15 (1.99, 2.30)
SD (95% CI)					1.17 (1.05, 1.28)	0.83 (0.75, 0.91)	0.92 (0.81, 1.02)	1.09 (0.98, 1.18)	1.15 (1.02, 1.26)	0.92 (0.76, 1.06)	0.83 (0.71, 0.92)	1.06 (0.96, 1.15)
S					0.65	−0.64	0.04	−0.25	−0.63	−1.59	−1.26	0.61
K					−0.46	−0.37	0.01	−0.56	−0.43	2.47	0.47	−0.54

Note. CI = confidence interval; S = skewness; K = kurtosis. $N = 377$. Correlations for the affected group are presented above the diagonal, and below the diagonal for the control. On the left are means, standard deviations, skewness, and kurtosis values for the affected group, and at the bottom—for the control. * $p < 0.05$, ** $p < 0.00$.

Table 2. Mean differences of CADM variables between the affected group and the control group.

Variables	Affected Group		Not Affected Group		*d*	*t*	*p*
	M (95% CI)	*SE*	*M* (95% CI)	*SE*			
1. Behavior	2.40 (2.25, 2.56)	0.08	2.29 (2.11, 2.48)	0.09	0.10	0.88	0.376
2. Awareness	3.94 (3.85, 4.05)	0.05	4.01 (3.88, 4.13)	0.07	0.08	1.30	0.311
3. Social Norm	2.91 (2.78, 3.04)	0.07	2.94 (2.80, 3.08)	0.07	0.03	−0.34	0.736
4. Personal Norm	3.24 (3.11, 3.37)	0.07	3.29 (3.12, 3.46)	0.08	0.05	−0.49	0.626
5. Intention	3.42 (3.26, 3.58)	0.08	3.69 (3.51, 3.87)	0.09	0.22	−2.16	0.032
6. Perceived Behavioral Control	4.33 (4.22, 4.44)	0.06	4.34 (4.20, 4.47)	0.07	0.01	−0.10	0.919
7. Access to Behavior	4.46 (4.34, 4.56)	0.06	4.44 (4.31, 457)	0.07	0.02	0.17	0.868
8. Habit	2.36 (2.22, 2.50)	0.08	2.15 (1.99, 2.31)	0.09	0.19	1.86	0.063
9. General risk perception	2.78 (2.66, 2.90)	0.06	2.62 (2.49, 2.74)	0.06	0.20	1.93	0.054
10. Risk perception—affect	3.23 (3.10, 3.35)	0.06	3.18 (3.04, 3.32)	0.07	0.06	0.54	0.601
11. Risk perception—probability	2.36 (2.27, 2.46)	0.05	2.52 (2.39, 2.65)	0.07	0.20	−1.87	0.063
12. Risk perception—consequences	3.54 (3.42, 3.66)	0.06	3.44 (3.31, 3.58)	0.07	0.11	1.06	0.291

Note. *SE* = standard error. *N* = 377.

Out of all of the hypotheses regarding mean differences, only H13 was fully supported; the affected group tended to have a lower intention of refraining from buying bottled drinking water. Additionally, H10 reached marginal significance, indicating that habit takes a more prominent role in uncertain circumstances. General risk and risk probability, but not risk perception affect or perceived risk of consequences, differed between the groups, thus partially supporting H15, which implies that the potential ecological disaster affected certain aspects of risk perception to a different extent. We further proceeded with model-level comparisons.

We conducted a multiple group structural equation analysis between two schools participating in the study. To determine significant differences between groups, we assessed the difference between a fully constrained (χ^2 (237) = 363.03, CFI = 0.951, RMSEA = 0.053 (0.042, 0.064)) and a fully unconstrained (χ^2 (218) = 343.90, CFI = 0.951, RMSEA = 0.055 (0.044, 0.066)) model; at least two of these three criteria had to be met to indicate a significant difference: $\Delta\chi^2$ significant at $p < 0.05$ [41], ΔCFI $\geq$ 0.01, and ΔRMSEA $\geq$ 0.01 [42]. The results of multiple group analyses revealed that models did not differ between two schools on the model level ($\Delta\chi^2(19) = 19.13$, $p = 0.45$, ΔCFI = 0.000, ΔRMSEA = 0.002). Nevertheless, we proceeded with the post-hoc analysis based on the Wald test as an exploratory approach. The analysis revealed only two differing paths between the groups. Thus, as the final model, we retained the model with all paths fixed to be equal between groups except two: awareness predicting self-reported behavior, and perceived behavioral control predicting intention (χ^2 (235) = 355.718, CFI = 0.953, RMSEA = 0.052 (0.041, 0.063)). These results provide marginal support for the hypothesis that perceived behavioral control to find drinking water from a tap or from a well would have a smaller contribution toward explaining intention of not buying bottled water in the affected group (H3), while the other marginally significant path difference has an effect opposite to our hypothesis that awareness (of need not to buy bottled water and of the consequences of buying bottled water) would have a smaller contribution toward explaining self-reported past bottled water purchasing behavior in the affected group (H9). All other hypotheses were not supported by the data. Table 3 presents a comparison of the standardized scores of all study variables in the two groups.

Table 3. Standardized regression coefficients in the affected (N = 221) and the control (N = 156) groups and a comparison between them.

Variables	Affected Group				Control Group				Wald Test	
	β	(95% CI)	*p*	R^2	β	(95% CI)	*p*	R^2	χ^2	*p*
DV: Behavior				0.53				0.63		
Habit	0.71	(0.55, 0.87)	0		0.71	(0.54, 0.89)	0		1.67	0.197
Intention	−0.06	(−0.24, 0.12)	0.514		−0.05	(−0.21, 0.11)	0.518		0.17	0.679
Perceived behavioral control	0.03	(−0.06, 0.13)	0.489		0.04	(−0.24, 0.05)	0.499		0.64	0.425
Access to behavior	−0.03	(−0.12, 0.07)	0.556		−0.03	(−0.07, 0.14)	0.558		0.02	0.878
Awareness	0.07	(−0.07, 0.20)	0.354		−0.10	(−0.12, 0.06)	0.192		4.05	0.044
DV: Habit				0.27				0.28		
Perceived behavioral control	−0.16	(−0.27, −0.04)	0.008		−0.17	(−0.28, −0.05)	0.005		1.06	0.303
Access to behavior	−0.18	(−0.30, −0.07)	0.002		−0.17	(−0.29, −0.06)	0.003		0.18	0.675
Personal norm	−0.37	(−0.49, −0.25)	0		−0.37	(−0.51, −0.24)	0		0.08	0.780
DV: Intention				0.8				0.95		
Habit	−0.27	(−0.36, −0.18)	0		−0.31	(−0.42, −0.20)	0		0.06	0.809
Social norm	0.13	(−0.06, 0.32)	0.181		0.12	(−0.06, 0.30)	0.177		0.01	0.939
Personal norm	0.61	(0.43, 0.79)	0		0.71	(0.52, 0.90)	0		0.28	0.598
Perceived behavioral control	0.07	(−.01, 0.16)	0.098		−0.03	(−0.14, 0.07)	0.526		3.79	0.052
Access to behavior	0.03	(−0.03, 0.09)	0.323		0.03	(−0.03, 0.10)	0.32		0.19	0.660
DV: Perceived behavioral control				0.27				0.27		
Awareness	0.47	(0.31, 0.56)	0		0.43	(0.30, 0.57)	0		0.37	0.541
Access to behavior	0.18	(0.07, 0.29)	0.001		0.16	(0.07, 0.26)	0.001		0.55	0.459
DV: Personal norm				0.63				0.57		
Social norm	0.50	(0.37, 0.64)	0		0.41	(0.27, 0.55)	0		2.01	0.157
Awareness	0.42	(0.28, 0.57)	0		0.44	(0.31, 0.57)	0		0.08	0.782
Perceived behavioral control	0.01	(−0.11, 0.11)	0.977		0.01	(−0.11, 0.12)	0.977		1.30	0.254

6. Discussion

In the present study we investigated whether a potentially harmful and groundwater-contaminating environmental event had affected, and what the possible effect was on, a sample of adolescents. We compared two groups of schoolchildren, one of which was affected by a large and long-lasting fire in a tire warehouse in their city, resulting in a quasi-experimental design. Based on theoretical considerations, we proposed 15 hypotheses, only a few of which were supported by the data. Nevertheless, this served as an exploration of how and if adolescents react to potentially environmentally harmful events that have a possibility to contaminate their drinking water and what possible changes we can expect in their behavior, as well as how we could apply information tactics to nudge adolescents toward the safest and most sustainable actions. We further discuss our findings in detail.

The results of the general sample of the adolescents indicated that habit, but not intention, perceived behavioral control, access to behavior, or awareness, emerged as the sole significant predictor of self-reported bottled drinking water consumption behavior, explaining more than half of the variance. It must be noted that intention is regarded as the most robust predictor of behavior in the Theory of Planned Behavior [9,43] and one of the more reliable predictors in the CADM framework [11]. These unusual findings suggest that bottled water consumption in the present sample is more driven by automatic thinking and heuristics [6,44]. Habit can be considered as a type of heuristics-based choice where an individual [45], rather than spending cognitive effort in coming up with a behavioral choice most suitable to the available information and the current situation, just chooses those behavioral options that require little to no cognitive effort (in this case, consuming bottled water). However, normative factors, such as social norm, personal norm, or awareness, were also found to be the important components in explaining intention not to consume bottled water. It is worth noting that we found a significant link between awareness and perceived behavioral control, meaning that in the whole sample of adolescents, awareness about the harm to the environment of bottled water consumption was related to stronger self-reported control regarding the decision to consume drinking water from the tap, a well, or a spring.

As a quasi-experimental manipulation check, we measured whether the perceived risk of contaminated drinking water was different between the affected and the control groups

and found that the difference was only marginal for a general sense of risk and for the risk of such events happening in the future, with the affected group showing slightly higher scores. We expected bolder differences between the affected and control groups; however, these results could be explained by the developmental peculiarities of adolescents. It is known that adolescents are more prone toward taking risks in general [18]; thus, they might not ascribe too much importance to the possibility of contaminated drinking water, leaving their risk assessment to be subject to their own beliefs and will. Coupled with the fact that adolescents often feel invulnerable to harm [19,20], their developmental stage and their environment might lead them not to develop high perceptions of risk in situations as the tire fire in Alytus. Simply put, adolescents might not be able to fully appraise the situation and its implications, or might devalue it [5], resulting in the affected group having almost the same risk perceptions as the control. Alternatively, the widespread media coverage of the event might have affected the control group as well, which might have led to insignificant differences, but the available data does not allow us to test this.

Because the affected group did not have a large increase in risk perception, it followed that the differences at the mean and model level were also small. As hypothesized, the group affected by the tire fire intended to consume bottled water more than the control group, as well as declaring a stronger habit of such behavior. The explanation of these results lies in the idea that the role of intention becomes more significant in novel or unusual situations [40], while the beliefs leading to the intention might not be as concrete [12]. Additionally, the differences between the groups regarding the habit show that, as expected, an ecological disaster strengthens adolescents' habit to consume bottled water because the context encourages such behavior [12].

A further model-level comparison of the CADM indicated that, on the model level, the two groups did not differ significantly; however, we opted to conduct path-level analyses despite that to gain additional insight. Higher levels of perceived behavioral control to find drinking water from a tap or from a well were positively related to the intention of not buying bottled water in the affected group, while the relationship was negative in the control group, where higher perceived control over access to water sources led to lower intention not to buy bottled water. Since sources of drinking water are made important in the affected group due to possible contamination, adolescents in the affected group might have been more invested in examining their access to clean drinking water and thus more aware of their possibilities [12], while those in the control group might have felt that they generally had control over their behavior, yet when they need to have some water, they tend to choose options that are more readily available, rather than seeking out a particular water source.

A significant path difference was observed leading from awareness to behavior, but the effect was in the opposite direction than hypothesized for the affected group. Adolescents in the affected group, despite being aware of how plastic bottles damage the environment, consumed bottled water. It is possible that awareness of negative outcomes of bottled water use does not prevent adolescents from using bottled water, thus indicating that competing beliefs tend to take over in uncertain situations [12] while normative factors tend to lose importance. It might be that adolescents consider bottled water safer than water from the tap. However, given that the regression paths are insignificant in both groups, this interpretation should be considered with caution. Future studies are needed to test this further.

Limitations and Future Directions

All research has its limitations, the present study not being an exception, and each sample is affected by its own individual and contextual factors that shape how individuals behave and, in turn, how predictive models function [12,15].

First, we did not find bold differences between the affected and the control group in terms of risk perception, suggesting that future studies should test potential moderators or factors that could explain these small differences. Possible moderators might include

adolescents' individual characteristics [46–48], their trust of the media, their perceptions of the attitudes of their close others, and whether they generally think that bottled water is a safer option by default.

Second, there is potential in pursuing the topic of adolescents' pro-environmental behavior in the light of environmental crises using the CADM framework. The demographic of adolescents is largely unexplored using the CADM approach; thus, further research would create new data to add to the understanding of the functioning of the model across different age groups and would let us understand which antecedents of behaviors are truly robust and can be targeted to address the broadest possible demographic [49,50]. Third, this study was a cross-section of a larger longitudinal investigation, thus limiting the possibility of analysis procedures available and preventing us from inferring causality in linear models. Additionally, since the quasi-experimental manipulation check indicated only a marginal effect, it limits the interpretation of the results.

7. Conclusions

The present study shed light on how the CADM functions in a sample of adolescents and whether a potentially contaminating ecological disaster affects adolescents' risk perception and, subsequently, how the CADM functions on both the variable and on the model-path level. First, adolescents affected by the ecological disaster reported marginally higher risk perception of consuming contaminated water than unaffected adolescents. Second, affected adolescents reported a stronger habit of consuming bottled water and lower intention not to consume bottled water. Third, awareness of the negative consequences of bottled water consumption was linked to increased bottled water consumption in the affected group, while the effect was the opposite in the control group. Fourth, affected adolescents translated their perceived behavioral control to find sources of safe drinking water into behavioral intention more readily than unaffected adolescents. Future studies should investigate possible moderators affecting adolescents' risk perceptions considering a potentially contaminating event.

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Ethical Approval: This study was approved by the ethics committee of the Department of Psychology, Mykolas Romeris University.

Appendix A

Table A1. The scale used for assessing risk perceptions regarding possibly contaminated drinking water.

Component	Original Item	English Translation	Response Options
General	Kiek rizikinga yra gerti vandenį iš čiaupo?	How risky it is to drink water from the tap?	From *not risky at all* to *very risky*
General	Kiek rizikinga yra gerti vandenį iš šaltinio ar šulinio?	How risky it is to drink water from a spring or a well?	From *not risky at all* to *very risky*
Affect	Kiek esate susirūpinęs (-usi) dėl vandens užterštumo, atsiradusio dėl padangų gaisro Alytuje?	How concerned are you about water pollution due to the fire in Alytus?	From *completely unconcerned* to *very concerned*
Affect	Kiek jaučiate baimės, kai pagalvojate apie vandens užterštumą po padangų gaisro Alytuje?	How fearful are you about water pollution due to the fire in Alytus?	From *not fearful at all* to *very fearful*
Affect	Kiek jaučiatės nervingas (-a), kai pagalvoji apie vandens užterštumą dėl padangų gaisro Alytuje?	How anxious are you when you think about water pollution due to the fire in Alytus?	From *not anxious at all* to *very anxious*
Affect	Kiek išgyvenate, kai pagalvojate apie vandens užterštumą dėl padangų gaisro Alytuje?	How nervous are you about water pollution due to the fire in Alytus?	From *not nervous at all* to *very nervous*
Affect	Turėdami omenyje tai, kaip jus gali paveikti užterštas vanduo dėl padangų gaisro Alytuje, kiek esate tuo susirūpinęs (-usi)?	Bearing in mind how the pollution from the fire can contaminate your drinking water, how concerned are you?	From *completely unconcerned* to *very concerned*
Probability	Kiek tikėtina, kad netoli Jūsų metų laikotarpyje pasikartos tokio pobūdžio nelaimė, kaip padangų gaisras Alytuje?	How likely it is that in one year's time a similar disaster as the fire in Alytus will occur somewhere near you?	From *very unlikely* to *very likely*
Probability	Esu užtikrintas (-a), kad tokio tipo nelaimė, kaip padangų gaisras Alytuje, per artimiausius metus nenutiks ten, kur aš gyvenu.	I am certain that a disaster like the fire in Alytus will not happen anywhere near me in the coming year.	From *very uncertain* to *very certain*
Probability	Kiek dažnai Jūsų gyvenamoje aplinkoje nutinka tokios nelaimės, kaip padangų gaisras Alytuje?	How often do such disasters as the fire in Alytus occur near you?	From *very rarely* to *very often*
Consequences	Mane neigiamai paveiktų netoliese įvykusi tokia nelaimė, kaip padangų gaisras Alytuje.	I would be negatively affected by an event like the fire in Alytus.	From *completely disagree* to *completely agree*
Consequences	Labai nukentėčiau, netoliese įvykus tokiai nelaimei, kaip padangų gaisras Alytuje.	I would be greatly harmed if a disaster like the fire in Alytus happened somewhere near me.	From *completely disagree* to *completely agree*

Appendix B

Table A2. Items used to assess parts of the CADM. Lithuanian items presented on the left, their English translations—on the right.

Awareness of need	
Geriamo vandens buteliuose pirkimas didina aplinkos problemas	Bottled water consumption causes many environmental problems
Geriamo vandens buteliuose pirkimas prisideda prie klimato kaitos	Bottled water consumption contributes to climate change
Awareness of consequences	
Jei neperku geriamo vandens buteliuose - saugau aplinką	If I reduce my bottled water consumption, I contribute to environmental protection
Mano pasirinkimas pirkti geriamą vandenį buteliuose paveiks ateities kartų gyvenimo kokybę	My choice to buy/consume bottled water will affect the quality of life of future generations
Mano pasirinkimas pirkti geriamą vandenį buteliuose prisideda prie visuotinės ekologinės žalos didinimo	My choice to buy/consume bottled water contributes to the increase of global ecological damage
Social norm	
Man svarbūs žmonės norėtų, kad nepirkčiau geriamo vandens buteliuose	People who are important to me expect that I will not consume bottled water
Man svarbūs žmonės užsimena, kad prieš pirkdamas (-a) geriamą vandenį buteliuose, aš turėčiau pagalvoti apie aplinkos saugojimą	People who are important to me tell me that before buying bottled water, I should think about environmental protection
Man svarbūs žmonės palaiko mane, kai neperku geriamo vandens buteliuose	People who are important to me support me when I refuse to buy bottled water
Personal norm	
Aš jaučiuosi morališkai įsipareigojusi (-ęs) nepirkti geriamo vandens buteliuose	I feel morally obliged not to consume bottled water
Pasirinkimas nepirkti geriamo vandens buteliuose yra mano vertybių sistemos dalis	My choice not to buy/consume bottled water is a big part of my beliefs/values
Habit	
Geriamo vandens buteliuose pirkimas man yra visiškai automatinis veiksmas	Bottled water consumption is a completely automatic action for me
Man yra būdinga pirkti geriamą vandenį buteliuose	Buying bottled water is a part of my daily routine
Intention	
Aš tikrai ketinu ateinančias keturias savaites nepirkti geriamo vandens buteliuose	I intend not to consume bottled water in the next four weeks
Mano ketinimas per ateinančias keturias savaites nepirkti geriamo vandens buteliuose yra tvirtas	My intention not to consume bottled water in the next four weeks is strong
Perceived behavioral control	
Nuo manęs priklauso, ar ateinančias keturias savaites gersiu vandenį iš čiaupo, šaltinio, gręžinio ar šulinio	It is completely up to me whether I will consume drinking water from the tap, a well, or a spring
Accesses to behavior	
Man yra pasiekiamos vietos, kuriose galiu gauti kokybiško geriamo vandens (pvz., vandens čiaupas, šaltinis, gręžinys ar šulinys)	I have access to the tap, a well, or a spring to get high-quality water
Behavior	
Pirkau geriamą vandenį buteliuose	I consumed bottled water in the last four weeks

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