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Theory of Reasoned Action as a Framework for Communicating Climate Risk: A Case Study of Schoolchildren in the Mekong Delta in Vietnam

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Abstract: Communicating climate risks to vulnerable groups motivating them to take adaptive actions remains a significant challenge in many populations, especially to children. The theory of reasoned action (TRA) suggests that attitude and subjective norms are important for persuasive communication. This study assesses how to apply TRA, its constructs and other relevant factors to predict behavior intention and beliefs and to change behavior tendency. The randomized field experiment method was applied to explore the differences between pre- and post-communication treatments (2 × 2 design). Can Tho city, located in the Mekong Delta of Vietnam, was selected as the research context because of its vulnerability to climate change. The results show that, first, TRA was found to be a significant predictor model of children's climate change behavior intentions. Second, attitude has a significant effect on the children's intention to act while videos with subjective norm treatment had not. The treatment interaction of both constructs also had a significant effect. Third, TRA theory-based treatments are positively associated with changes in children' salient beliefs on attitude and normative belief on social norm toward climate change. In addition, past practices, knowledge and gender are further factors that influence children's behavior intentions. A theory-inspired design of communication strategy allows the prediction and influencing of intentions. This finding has strong implications for both research and development in Vietnam.

1. Introduction

Vietnam is among the most vulnerable countries in the world to the expected impacts of climate change [1]. The Vietnamese government expressed a strong commitment to assist and empower vulnerable

communities to adapt. Part of these efforts is communication to increase awareness of climate-related risks and to promote adaptation actions that enhance the resilience and the adaption capacity of vulnerable groups [1]. However, for most of the Vietnamese people, climate change is understood as global warming and glacier melting [2]. This illustrates some ignorance about climate change. Two barriers are important in this aspect: the invisibility of the causes and the remote perception of the effects [3].

Recent research involving over 3500 people by BBC Media Action investigates the effects of climate change communication in several provinces in Vietnam. The results showed that 82% of respondents did not change their livelihoods or lifestyles to cope with climate change impacts, even though they were informed about climate change impacts and potential measures to reduce the risk [4]. Moreover, many participants did not know about human activities contributing to climate change. These two barriers can be compromised when the effects are framed in an environmental health context which includes heat stroke, vector-borne diseases, and blue alga blooms [4]. As the climate continues to get warmer, such environmental health issues will pose a greater risk. For example, in the case of vector-borne diseases such as dengue fever, warmer temperatures and increased precipitation may contribute to an increase in dengue incidence [5].

In addition, existing knowledge, attitudes, past behavior, and social pressure could also be barriers for adopting adaptation and mitigation actions. Persuasive communication aimed at changing behavior is one way to overcome these barriers [6,7]. One of the psychological theories of behavioral change to achieve this target that has recently attracted attention and support is the theory of reasoned action (TRA) [8]. TRA allows the prediction of intentions and behavior and it has been widely used in related sustainability research [9–12]. Furthermore, it has provided a theoretical framework for health studies, including slimming and eating behavior, addiction to smoking and alcohol abuse, condom use and HIV [13]. Recently, some studies have applied TRA for energy, green IT technology adoption, environment-friendly energy use, waste management, and vehicle use [14–18]. Very few studies, however, deal with the psychological determinants of behavior change with respect to climate change risks, especially adaptation [19]. Research on TRA's predictability of behavior change deals mainly with Western societies. Until now, very few studies in South-East Asia have explicitly tested the TRA propositions in any domain. For example, Arunrat et al. [20] examined climate change adaptation intentions of non-adaptive farmers in Thailand using the theory of planned behavior (TPB)—an extended theory of TRA. In addition, a Malaysian study performed by Masud et al. [21] addressed the impact of attitude, subjective norm and perceived behavior control on climate change "pro-environment" intentions. A meta-analysis review concluded that the predictive power of both the TRA and the TPB depends on the context [13]. Therefore, it is essential to address the correlation between constructs of TRA and change in behavior and intentions in rapidly developing countries such as in Vietnam.

Although TRA and its extended theory TPB have been intensively applied in prior research, three major gaps exist in the literature [22]. First, the literature on how to use these models to change behavior is limited [23]. Second, many 'theory intervention studies' use the TPB/TRA as a tracking device to assess intervention effectiveness, rather than (also) as a tool to develop the intervention [24]. Third, TPB/TRA is used to design messages, but the impact of the messages on the theory's constructs after interventions are not addressed [25]. Both theoretical and practical accounts of using the TRA and TPB to develop and evaluate an intervention are rare [24–26]. This study contributes to filling these gaps in the context of adopting climate change behavior and also the research gap between the West and East on the topic.

Furthermore, an important constraint is the 'intention–behavior gap' in which a major change in intention only leads to a limited change in behavior. This shows that behavior is not only driven by intentions [27–29]. A growing body of research, for instance, shows that past behavior is a significant predictor of intentions [30]. Other studies suggest adapting to changing climatic conditions is associated with climate change knowledge [21,31]. There is an urgent need for climate communication research to understand cognitive, social-psychological, and behavioral challenges on adaptation in developing countries [21].

Children are particularly sensitive to climate change because of physiology which makes them more vulnerable to extreme weather conditions or climate health-related issues. Their development increases their risk of contracting diseases and succumbing to related complications [32,33]. Unaccompanied children are also often at higher risk in extreme events like storms or floods because they cannot appraise the risks. Therefore, child-sensitive strategies to respond to the environmental and social impacts caused by climate change need to be identified [34]. Children are also sensitive to climate risks through vector-borne diseases in Vietnam such as dengue fever.

This study tests whether a communication intervention designed according to key constructs of TRA significantly increases the intentions of schoolchildren in Vietnam to take climate change adaption actions. As indicated by previous studies on the communication of climate change risks, the role of past behavior and knowledge of climate change as predictors of intentions were also examined.

Therefore, the main research proposition and hypotheses are:

Proposition: the TRA model significantly predicts the intention of climate change adaptation behavior.

Hypothesis 1. *TRA-based treatments have significantly positive effects on the intention of climate change adaptation behavior of schoolchildren.*

Hypothesis 2. *TRA-based treatments have significantly positive effects on the attitude and normative belief of climate change adaptation behavior.*

2. Theory of Reasoned Action (TRA)

Within the TRA framework, behavioral intention, which largely determines actual behavior, is an additive function of two variables: attitudes (positive or negative evaluation of performing a behavior), and subjective norms (perceived influences that others may have) [26]. In general, an increase in attitude and subjective norms leads to a stronger intention to perform the behavior.

Attitude is an individual's favorable or unfavorable feeling about performing a specific behavior. These beliefs are called behavioral beliefs. An individual will intend to perform a certain behavior when he or she evaluates it positively. Attitudes are determined by an individual's belief about the consequences of performing the behavior (behavioral beliefs), weighted by his/her evaluation of these consequences (outcome evaluations). Thus, attitude is an individual's salient belief as to whether the outcome of his or her behavior will be positive or negative [24,26].

Subjective norms are assumed to be a function of beliefs that individuals approve or disapprove of the behavior. Beliefs that underlie subjective norms are normative beliefs. Normative social influence is defined by the influence of other people which leads us to conform in order to be liked and accepted by them [35]. Although an action may not be accepted or approved by an individual, normative social influence places pressure on an individual to comply with the group's social norms. Normative social influence has been shown to impose a high persuasive influence on individuals. An individual will intend a behavior when he/she perceives that important others think he/she should do so. Important others might be a spouse, close friends or the physician, among others. This is assessed by asking respondents to judge how likely it is that most people who are important to them would approve or disapprove of their behavior [36].

3. Materials and Methods

3.1. Site and Sample Selection

Can Tho is a city in the Mekong Delta of Vietnam and was selected for this study because of its vulnerability to climate change. The anticipated impacts of climate change are more saltwater intrusion affecting crops and access to fresh water, and an increase in vector-borne diseases such as dengue fever [5]. Dengue fever is chosen because it is a particularly relevant environmental health risk in Vietnam. In the first eight months of 2017, more than 80,000 dengue fever cases were reported

before the normal dengue season (from September to November) increasing 67.8% compared to the same period in 2016. Dengue infection in Vietnam is unstable but peaks from June to October annually. Dengue morbidity per 100,000 population increased steadily from 32.5 in the year 2000 (24,434 cases) to 120.0 in 2009 (105,370 cases), and 78.0 in 2011 (69,680 cases). Over 85% of all dengue cases and 90% of all deaths due to dengue occur in the southern provinces of Vietnam. Some 90% of dengue deaths affect people under the age of 15 years [37]. The main factors responsible for the emergence and re-emergence of dengue include a high density of the dengue vector, wide geographic distribution of the vector, and circulation of all four type of dengue virus. In Vietnam, a lack of a reliable water supply in rural areas and substandard housing, plus inadequate water supplies and waste management systems in rapidly expanding peri-urban areas, means that people have to store water in or near to their homes. This supports increasing dengue vector density. The epidemiological situation is worsened by the failure of health systems to maintain adequate control of the spread of *Aedes aegypti* [38].

　　Dengue fever affects many people in Can Tho every year, especially children. With increasing temperatures and more precipitation during the wet season, the conditions for dengue mosquitoes to breed become more favorable, leading to an increased health risk [39]. Increased risk of dengue is a long-term impact of the changing climate [40]. Moreover, temperature and rainfall are expected to change (2.0 °C to 2.6 °C and 4.1% to 8.0% respectively) in the next decades [41]. The number of dengue patients aged 10–15 have been increasing over the years, especially in rural areas [40]. Therefore, this study was set up in the peri-urban district of Phong Dien in December 2015. Four schools were randomly selected from the list of schools in the district; 693 schoolchildren participated in the study. They were also chosen at random. The schoolchildren were attending grades 7 or 8. The sample entails 294 boys (42.4%) and 399 girls (57.6%), ranging from 11 to 14 years (M = 13.13, SD = 0.696).

3.2. Experimental Design

　　The study applied a 2 × 2 full factorial design. The two experimental factors entailed: attitude (ATT) and subjective norm (SN). Four video treatments were prepared which are different in term of the presence or absence of two factors, which were: (SN + ATT), (ATT + no SN), (no ATT + SN) and (no ATT + no SN) (Table 1). The messages in videos were designed according to TRA constructs [42], climate change knowledge, and suggested adaptation actions for the community. Climate change information and adaptation actions were held constant in all four video treatments. A control group was also included, to ascertain baseline information. Each treatment group consisted of about 170 individuals.

Table 1. Video treatments of 2 × 2 experiment design.

| Video Treatment	Attitude (ATT)	No ATT
Subjective norm (SN)	Video 1	Video 3
No SN	Video 2	Video 4

　　The content of each video was developed through two stages. First, documents related to climate change impacts were consulted providing an overview of local climate-related risk and adaptation options. Then, formative research was set up using in-depth interviews with related stakeholders, including schoolchildren, teachers, parents, and local education officers. The interviews allowed the exploration of salient beliefs and norms about climate change impacts and adaptation measures. The results also suggested that climate change adaptation measures should address the most important emerging climate-related impact, which increases the risk of dengue fever. Video scripts and storyboards were developed by the research team in consultation with filmmakers. Two focus group discussions with schoolchildren were organized. Findings from these discussions were used to refine the scripts and storyboard further preparing for the final production. Filming took place in Can Tho to ensure familiarity with the subjects (Table 2).

Table 2. Video theory of reasoned action (TRA) treatments.

Video Treatment	Description of the Video
Attitude	*Challenging belief that adaptation actions require a lot of time are not easy and ineffective.* Two schoolchildren (girl and boy) undertook actions to eliminate the mosquito breeding sites by covering water containers, overturning anything that could collect rainwater like bottles, jars, coconut shells, clearing bushes and rubbish in house's garden. While doing so, they explained how easy the actions were, how effective the actions are in reducing mosquito populations, and how they can help people adapt to the changing climate in Can Tho in the long run.
Subjective Norm	*To highlight/emphasize social pressures on taking actions to reduce the number of mosquitos for short-term prevention and long-term adaptation.* Two teachers and two schoolchildren expressed their expectation that schoolchildren in Can Tho will undertake adaptation actions for climate-related impact on dengue fever.

3.3. Experimental Survey Procedure

Participants were asked to give consent to participate in a one-hour experimental survey. They were told that participation was completely voluntary and that they could quit at any time. Survey questions were asked and answered verbally; responses were recorded on tablets. The experimental survey was conducted face-to-face and structured in the following order: (1) a pre-intervention questionnaire survey to collect baseline data; (2) a video treatment introducing messages with different combinations of ATT and SN (independent variables) were randomly assigned and shown to a participant; and (3) a post-intervention questionnaire survey to assess the effects of the intervention (Figure 1).
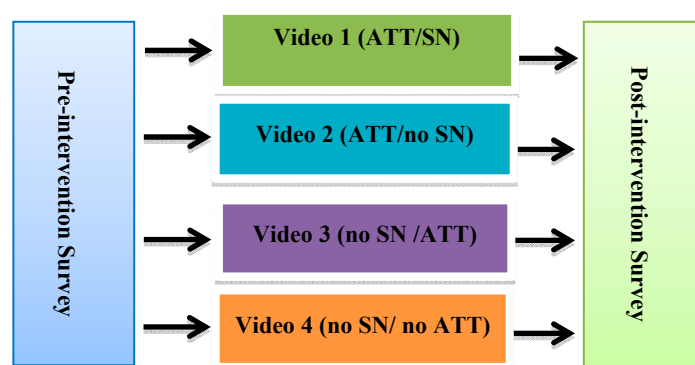
Figure 1. Experiment survey procedure.

Questionnaires were based on the standard format questionnaire by Ajzen [43]. Each question was tailored to the specific local climate, health threats and study population. The standard format allowed measurement of the intention of behavioral change, and the effects of knowledge, past practices, ATT and SN on behavioral intentions. The post-intervention survey was identical to the pre-intervention questionnaire.

Consultant workshops were organized to collect feedback from schoolchildren on the questionnaires if they understood the questions and were able to answer. A pilot survey with 20 participants allowed revision of the questionnaire once before the actual survey. During the actual face-to-face survey, questions were asked and answered verbally, and interviewers recorded responses on tablets.

Tablets were used to collect data but also to show the videos. An "Open data kit—ODK" software was installed on all tablets, which allowed the researchers to collect and enter data at the same time, submit completed forms online, and insert media files. Once the survey was completed, the collected data could be submitted to an online server. The dataset then could be downloaded for clean-up and analysis.

3.4. Key Measures

Measuring the actual behavior uptake of the adaptation measures in the messages was not possible. Behavioral intention is the most relevant predictor of actual behavior [44]. Therefore, behavioral intentions were examined in this study. Four outcome variables were derived from the questionnaire as follows:

1. Change in intention to undertake dengue fever risk reduction practices (DF intention change): an index measuring the improvement of intention to act on climate risk reduction actions before and after watching video treatments (post score of intention on dengue fever practice—pre-score of intention on dengue fever practice). The intention measure index was composed of 9 items to increase reliability.
2. Change in intention to seek information (INFO intention change): an index measuring the improvement of intention to seek information on climate change, dengue fever, and the linkage between climate change and dengue fever before and after treatment (post-score of intention on seeking information—pre-score of intention on seeking information).
3. Past practices on dengue fever risk reduction (DF practices): an index which is computed from the scores of three actions, covering water tanks, overturning things that collect rainwater, and clearing bushes in the house yard. If a specific practice was not possible—for example, a student's family did not have water tanks—then this item was dropped from the index calculation.
4. Past practices on seeking information (INFO practices): an index measuring actions on seeking information on climate change, dengue fever, and the linkage between climate change and dengue fever. These questions were answered on a 6-point scale of frequency of practice (never, very rarely, rare, occasionally, frequently, very frequently).

As part of the analysis, variables were included to evaluate treatment effects which are likely to be important to intentions or behavior in the future (Table 3):

1. Attitude (ATT) index: an index measuring respondents' level of salient belief toward their actions through a series of questions.
2. Subjective norm (SN) index: index measuring the extent to which respondent's actions were influenced by teachers, parents, and neighbors.
3. Climate change knowledge score (CC knowledge): is based on the score from the climate change knowledge test. CC knowledge improved = CC knowledge post-test—CC knowledge pretest.
4. Gender: is a dummy variable (0 = male, 1 = female).

The results of reliability analysis are shown in Table 3. Cronbach's alpha values (α) for constructs ranged from 0.65 to 0.92, meaning all measures have relatively high internal consistency reliability.

Table 3. Variables and example of items on dengue fever and on information-seeking.

Factor	Items	α	Item Example	Scoring
Behavior intention—dengue risk reduction	9	0.92	How often will you clear bushes and rubbish in the yard of your house in the next 12 months?	1 = never, 6 = very often
Behavior intention—seek information	3	0.90	How often will you seek information on climate change in the next 12 months?	1 = never, 6 = very often
Past practices—dengue risk reduction	9	0.88	How often did you clear bushes and rubbish in the yard of your house in the last 12 months?	1 = never, 6 = very often
Past practices—seek information	3	0.84	How often did you seek more information on climate change in the last 12 months?	1 = never, 6 = very often

Table 3. *Cont.*

Factor	Items	α	Item Example	Scoring
SN index	5	0.71	Teachers who are important to me expect that I will clear bushes in my house's yard.	1 = Strongly disagree 6 = Strongly agree
ATT index	6	0.90	My family and I can easily overturn things that collect rainwater like bottles, jars, coconut shells around my house.	1 = Strongly disagree 6 = Strongly agree
Climate change (CC) knowledge score	7	NA	Climate change may cause more rain during the rainy season in Can Tho in about 30 years.	True/False/Don't know

3.5. Analyses

Data were analyzed using SPSS 18 (IBM, New York, USA). Possible intervention effects were tested using intention-to-treat analyses of covariance (ANCOVA) with all randomized participants remaining in the analyses. Main and interaction effects of the four intervention combinations were tested within a 2 × 2 full factorial ANCOVA with gender as a covariate. Effect sizes are given using Eta squared (SN = 0.004; ATT = 0.021; SN*ATT = 0.004).

4. Results

First, the results of examining the proposition that the TRA model will significantly and positively predict the intention of climate change adaptation behavior are described. Following this, the results relating to H_1 on TRA-based treatments having significant effects on the climate change adaptation behavior intention are shown. Subsequently, the results relating to H_2 that TRA-based treatments have significant effects on attitude and the normative beliefs of climate change adaptation are discussed.

4.1. TRA Model Will Significantly Predict the Intention of Climate Change Adaptation Behavior

To analyze the predictive power of TRA, baseline survey data were used. Multiple regression analyses (when analyzed cross-sectionally at baseline survey) showed that the TRA was able to explain 36% of the variance in intention to dengue fever prevention and 22% of the variance in the intention of seeking climate change information (Table 4).

Table 4. Multiple regressions examining the association between SN, ATT, gender, past practice, climate change knowledge, and intention.

	Dengue Fever (DF) Intention Change	Information (INFO) Intention Change
Adjusted R^2	0.36	0.22
ATT index	0.146 ***	0.097 *
SN index	0.118 **	0.112 **
Gender (0 = male, 1 = female)	0.064 *	0.093 **
Past practice	0.461 ***	0.311 ***
CC knowledge score	0.124 ***	0.193 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 4 shows the ability of TRA using baseline measures and other variables, including gender, past practice, and climate change knowledge score. Both ATT and SN are significant predictors of dengue fever risk prevention and the intention of seeking climate change information.

The past practices of schoolchildren on dengue fever prevention and seeking climate change information were positively associated with their intention prior to the experiment. The analysis also indicates that girls were more likely to be intending to act on dengue fever prevention and seek more climate change information than boys.

4.2. Effects of TRA-Based Treatments on the Behavior Intention for Climate Change Adaptation

The analysis in the previous sections shows that constructs from TRA are good predictors of behavioral intention. This section examines if the two constructs of the theory enhance communication impacts of video treatments on the intention of dengue fever practices and seeking climate change information. In these models, ATT and SN are treatments; climate change knowledge and past practices on dengue fever risk reduction and information seeking are covariates (Table 5).

Table 5. Effects of TRA-based video treatments on the change in intention to undertake dengue fever prevention.

Dependent Variable: DF Intention		
Source	**F**	**Sig.**
Intercept	20.593	0.000
Gender (female)	2.299	0.130
ATT index	11.060	0.001
SN index	1.217	0.270
ATT*SN	4.793	0.029
Past practice on dengue fever	61.817	0.000
Climate change knowledge improved	5.808	0.016

Those who received the ATT video treatment significantly increased their intentions to undertake dengue fever risk reduction practices (Table 5) and sought more climate change information (Table 6). There was no difference between those who received SN treatment (Tables 5 and 6) and those in the control group for either practice. Repeated ANCOVA showed a significant effect of interaction between ATT and SN on the intention for dengue fever practices ($p = 0.029$) but non-significant for climate change information seeking ($p = 0.282$). Those who already had practices are likely to change their intentions positively. Those who learned more about climate change as shown in the video are more likely to increase (change) their intention to act. Gender analysis showed no effect.

Table 6. Effects of ATT, SN and ATT*SN video manipulations on the intentions to seek more information on climate change or dengue fever.

Dependent Variable: INFO Intention		
Source	**F**	**Sig.**
Intercept	43.034	0.000
Gender (female)	0.960	0.327
ATT index	21.379	0.000
SN index	3.184	0.075
ATT*SN	1.158	0.282
Past practice on dengue fever	47.939	0.000
CC knowledge improved	0.994	0.319

4.3. Effects of TRA-Based Treatments on Changes of Salient and Normative Beliefs of Climate Change Adaptation

The baseline scores for all the main TRA constructs were compared to the post-survey scores. This comparison was to figure out whether any changes could be noticed as a result of video treatments. Results were analyzed by type of impact (e.g., attitude scores were analyzed by awareness of the attitude video treatment, etc.).

Table 7 shows that schoolchildren who saw the ATT treatment significantly changed their belief and attitudes on dengue fever prevention (mean difference = 0.188, t = 8.8, $p < 0.001$). The results revealed that the change in SN was significant after watching the SN video (mean difference = 0.105, t = 4.2, $p < 0.001$). The analysis also indicates that intentions post-survey significantly changed (mean deference = 0.388, t = 14.49, $p < 0.001$).

Table 7. Effects of ATT and SN video treatments on the change in salient and normative beliefs.

Paired Samples Test	Paired Differences					t	df	Sig. (2-Tailed)
	Mean	Standard Deviation (SD)	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
IntentionPostDF—IntentionPreDF	0.38889	0.70616	0.02682	0.33622	0.44156	14.497	692	0.000
ATT PostDF—ATT PreDF	0.18821	0.55892	0.02123	0.14652	0.22989	8.865	692	0.000
SN PostDF—SN PreDF	0.10534	0.65694	0.02495	0.05634	0.15434	4.221	692	0.000
Post-Test—Pre-test on CC knowledge	1.17027	1.60648	0.06103	1.05046	1.29009	19.177	692	0.000

5. Discussion

Climate change adaptation in general and links between changing the climate and vector-borne diseases, in particular, received increasing attention from the Vietnamese government, public, and researchers during recent years. Understanding determinants affecting vulnerable groups such as children contributes to the evolving literature and provides important policy implications for adaptation practitioners in Vietnam. This study builds upon rational choice theories to understand how attitudes, social norms, past experience and knowledge influence the intention toward adaptation behavior. The study also extends knowledge about adaptation behavior in developing countries where psychological determinants have been less analyzed than those in Western countries.

This study is one of the first which analyses the utility of a persuasive communication directly derived from the TRA in Vietnam. Measurable changes in schoolchildren's climate change attitudes and intentions are analyzed. More specifically, the first full factorial experimental test results on interventions targeting changes in salient behavioral beliefs and intentions of schoolchildren in the south of Vietnam to increase their adaptive capacity were identified. A limited number of empirical studies are published on how TRA contributes to effective communication, in particular when the motivation to act is not taken for granted. TRA constructs can be useful for obtaining data on individuals' beliefs, attitudes, perceptions, and intentions of what determine possible internal and external barriers to behavior. Once internal barriers and external barriers have been identified, a community-based communication program/campaign/strategy can be developed to address and reduce barriers to the promoted behavior [45]. Well-designed studies that measure the effects on intention, as well as behavior, are needed to provide guidance to policymakers and practitioners on the design of communication materials in developing countries such as Vietnam.

5.1. The TRA Model Significantly Predicts the Intention of Climate Change Adaptation Behavior

The findings showed that TRA provides a useful model to predict potential behavior intentions on climate change. Many studies applied the TRA and TPB models to predict pro-environmental behavior [46–51]. This study supports the results of Nguyen et al. [9] in Vietnam, Masud et al. [21] in Malaysia and Arunrat et al. [20] in Thailand and indicates that attitudes and subjective norms are significant predictors of the intentions to engage in climate change behavior. Schoolchildren encounter factors which enable climate change adaptation behavior as well as benefits to exemplary others who are important to them. However, our study results are not in line with the study of Meijer et al. [52] showing non-significant prediction effects of subjective norms. In general, a meta-analysis showed that the effects of attitudes (r = 0.42) were stronger than those of subjective norms (r = 0.31) [53]. These findings support the idea that TRA-based frameworks can be used to understand pro-environmental behaviors.

The intentions are significantly more positive for students who practiced dengue fever prevention and climate change information-seeking compared to those who did not participate in any of those actions during the past 12 months. This suggests that children who engage in past behavior feel more encouraged by experiencing benefits and hindrances. This result is consistent with Read et al. [51], who investigated whether past behavior predicted intentions to oppose wind farm developments in

Australia. It is equally in line with Norman and Connor [54] who investigated past behavior as a predictor of engaging in binge-drinking behavior. The results of this study also add to the increasing literature showing that past behavior is a strong predictor of behavioral intentions. Moreover, this study demonstrates that climate change knowledge is significantly associated with behavior intentions. Knowledge, and climate change knowledge, in particular, is a barrier related to limited cognition [6,19]. As indicated by an international study from BBC Media Action in South-East Asia, many Vietnamese are unaware of the realities of climate change, and therefore are unlikely to act [2]. Others, who are more aware, are limited by their lack of knowledge of specific adaptation behavior, its relative benefits and how to undertake that behavior. This study shows that sufficient climate change knowledge is a pre-requisite in any climate risk communication campaign in Vietnam.

5.2. Effects of TRA-Based Treatments on the Behavior Intention for Climate Change Adaptation

Our main hypothesis that TRA constructs (attitude and subjective norms) in communication interventions significantly influence the behavior intentions of schoolchildren towards dengue fever prevention and seeking information was only partially supported. Of the two TRA variables, only attitude influences the behavior intentions for climate change adaptation. This suggests that intentions on climate change adaptation to dengue prevention may be strongly influenced by salient belief, not by pressures from others. This finding complements the findings of the BBC Climate Asia project, which surveyed over 3500 individuals in Vietnam on their perceptions of climate change. The conclusion was that social approval is a strong motivating factor in the Vietnamese local context [2]. This could be explained in different ways. One is that the social norm has less affect on intentions because normative social influence is something that schoolchildren are familiar with. In Vietnam, "village-community culture" is a strong normative intergenerational belief. Moreover, social approval is the daily "norm" in rural and peri-urban areas. Another explanation may be that the attitude video was designed explicitly to increase schoolchildren' behavioral salient belief. This differs from other adaptation campaigns which do not target attitudinal determinants of climate change while using social daily norms as a driver of behavior change. This finding is broadly consistent with Ajzen's proposal that "manipulations of behavioral beliefs should influence intentions via attitudes and not via subjective norms or perceptions of control" [43]. The study finding is also in line with results from Chatzisarantis and Hagger [55] who found that the salient belief intervention is positively associated with behavior tendency. The study implies that it is possible to design communication campaigns based on persuasive theoretical constructs for behavior change.

Our hypothesis on the positive influence of TRA is partly supported. The interaction between attitude and subjective norm is significantly associated with intention-behavior only on dengue fever prevention and not on seeking more information on climate change. A possible interpretation is that undertaking dengue prevention was mentioned in the video treatments while searching for more information on climate change was not. The option of seeking information was added to examine if the changes will go beyond targeted behavioral intention of dengue fever intention in the video treatments.

5.3. Effects of TRA-Based Treatments on Changes of Salient and Normative Beliefs of Climate Change Adaptation

This study indicates that TRA can be used as the theoretical underpinning to change psychological determinants of climate change adaptation. Significant changes were detected in the post-survey. The results point to a strong association between TRA-based interventions and changes in attitude and subjective norm of climate change adaptation. In other words, the TRA-based intervention was designed to challenge schoolchildren's salient and normative belief toward climate change. This influences beliefs about both instrumental benefits and the motivation to comply with the social norm of adaptive behaviors. Interestingly, the interventions substantially affect climate change knowledge scores. This is important as it shows that even brief interventions can improve people's knowledge on climate change.

This study is limited by the potential biases involved in self-reported behavior. Another limitation is that it was not possible to measure the lag time after the intervention. The measurement of behavior intention was measured immediately after the intervention, and there was no follow up to observe the long-term impacts of TRA-based communication interventions.

5.4. Policy Implications

In addition to efforts from the government, researchers and practitioners have increased attention in communication for adaptation. This study has important implications for practitioners in capacity-building programs and communication strategies for vulnerable groups. Insights into determinants of adaptation behavior provide valuable inputs for effective communication interventions and education programs. Given the prominence of attitude on behavior intention influence, communication and educational programs should manipulate attitude toward behavior in a positive way. Or in other words, the intrinsic reward should be promoted. The extrinsic motivation that those engaged in behavior to please others is the historically social norm from generation to generation in Vietnam. To facilitate change in beliefs and intention, communication interventions or education programs should stress that measures to prevent and adapt to climate risk do not take too much time and effort as people might perceive that to be a consequences of not changing behavior, which in turn would motivate them to act for their adaptive capacity. Therefore, the intention to adapt to climate change conditions and knowledge about its impacts, are essential elements to support decision-making.

6. Conclusions

The Vietnamese government is determined to increase the resilience of vulnerable groups to climate change through capacity building. Therefore, studies exploring communication and awareness of climate-related risks to vulnerable groups such as schoolchildren are important. Overall, this study provides empirical evidence supporting TRA-based communication interventions. It adds to the limited literature on the application of TRA theory in developing interventions. This experimental test of theory-based interventions to manipulate constructs crucial to producing positive intentions is the first of its kind and the first attempt to demonstrate experimentally the importance of this theory-based framework for predicting and changing beliefs and behavioral tendencies in Vietnam. The findings indicate that TRA is a good model for predicting climate change behavior intentions. Although the expection of TRA constructs in influencing the tendency of behavior was partly supported, it is a promising approach for further research on psychological determinants of climate change of vulnerable groups as well as a practical tool for developing communication campaigns. In addition, past behavior and knowledge are factors that strongly predict and affect the intention of behavior. These findings provide an important implication for scaling up these interventions in other populations in Vietnam, since the theory-based interventions provide a foundation for the generalization of findings across populations.

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