Perceived Knowledge, Coping Efficacy and Consumer Consumption Changes in Response to Food Recall

Chuanhui Liao 1, Huang Yu 2 and Weiwei Zhu 2,*

1 School of Economics and Management, Southwest University of Science and Technology, 59 Qinglong Road, Mianyang 621010, China; liaochuanhui@163.com
2 School of Marxism, Hefei University of Technology, Hefei Univ Technol, Sch Marxism, 96 Tunxi Rd, Hefei 230009, China; yhmimijiejie@163.com
* Correspondence: zwwhfut@hfut.edu.cn

Received: 19 February 2020; Accepted: 19 March 2020; Published: 30 March 2020

Abstract: With a serious food safety situation in China, lots of major food recalls have been initiated. This study examined the key determinants underlying consumers’ protection and behavioral intention in response to major food recalls. An augmented protection motivation theory model (PMT) was developed by incorporating trust in food safety management and food recall concern into the original PMT. Structural equation model analysis was conducted using survey data in China (N = 631). The results showed that perceived knowledge significantly and positively influence protection motivation via its positive influence on the threat appraisal and coping appraisal. Moreover, protection motivation, trust in food safety management (TFSM), and food recall concern (FRC) significantly affect protection behavior intention. It was indicated that the inclusion of TFSM and FRC into the PMT significantly increase the explanatory power of the PMT model. Further analysis of quadratic regression demonstrated that the relationship between perceived knowledge and protection motivation presented an inverted U shape, which indicates the importance of continuous education in developing consumers’ food safety knowledge. Implications for future research are discussed.

Keywords: food safety; response behavior; perceived knowledge; PMT; food recall

1. Introduction

Food safety is a major issue around the world since it can cause serious damage to public health. Due to a series of food safety scandals, food and drug safety issues are listed as the most concerning issues in Chinese society [1,2]. To guide sustainable production, guarantee the sustainable consumption and protect public health, the Chinese government established the food recall system in 2007, and further issued a regulation to make the recall process practical. There are three grades of food recalls, from Class I to Class III, with the decreasing of potential harm. In this study, we define major food recall as food recalls categorized as Class I and Class II. The first level recall refers to food safety events that have caused or may cause serious health damage or even death to consumers after consumption, and the second level recall refers to the general health damage that has been or may be caused after consumption. The food manufacturers shall start the recall within 24 and 48 hours after knowing the food safety risk in food recall Class I and Class II respectively. Those who violate the recall regulations will be fined or even shut down for rectification. Since its application, most of the food manufacturers adhere to the food safety procedures and food recall regulations. Besides its effect on consumers’ health, food recall is also an important issue concerning relevant stakeholders, because consumers’ response to major food recall will cause significant economic and reputation losses to recall enterprises, the supply chain, and even the whole industry, thus producing spillover effects [3]. Previous studies mainly focused on economic, technical, and reputable impacts of food recalls [4–6]; less attention
has been paid to consumer’s food safety perception and response behavior in the context of food recalls [4,5,7]. Compared to the technical and health effects of hazardous substances involved in recalls, consumers’ intricate mental and cognitive processes underlying food safety risk perception is of more importance to policymakers and recalling manufacturers [5,8]. Hence, it is critical for the policymakers and recalling manufacturers to explore and understand what factors drive consumers to change their consumption behavior during and after food recalls [5,9].

This study will explore factors that affect consumers’ consumption change intentions to abuse of additives detected in major food recalls in China. Unlike western countries, food safety accidents caused by the abuse of additives are far greater than those caused by microorganisms in China, because people like to cook food before eating it. Adding food additives beyond the legal regulation is not in accordance with cleaner production and sustainable consumption. To this end, we develop a conceptual framework built on the basis of protection motivation theory (PMT) [10,11], which is widely used in the fields of risky health situations and food choice [12]. A survey was conducted among Chinese consumers based on a fabricated food recall that imitates a series of real Chinese liquor recalls. Structural equation model was used to analyze the proposed model.

The thesis consists of five parts. The first section is the introduction. The second part presents the theoretical framework and research hypotheses. The method is described in Section 3. Sections 4 and 5 present the results and discussion respectively. Robustness check is presented in Section 6. The last part puts forward policy suggestions.

2. Theory and Hypotheses Development

2.1. The Protection Motivation Theory

PMT was developed to explain changes in people’s behavior in response to health risks, environmental risks, and food safety hazards [10,12,13]. As a comprehensive persuasion model, PMT analyzes the effects of two cognitive processes, i.e. threat appraisal and coping appraisal, on the motivations and intentions of protective actions. When confronted with a risky situation, people first evaluate the gravity (severity) of and exposure (vulnerability) to a personal risk, which leads to an estimation of threat appraisal based on perceived knowledge [10,11,14]. People further evaluate the coping appraisal with response efficacy to estimate the efficacy of the solutions suggested to remove the threat and the self-efficacy to estimate their perceived belief and confidence in their competence and control to handle the risky issue [15]. The results of the estimation of threat and coping appraisal then further activate the protection motivation and protection behavioral intention [10,11].

2.2. Research Model Development

Literatures show that PMT is less used to study consumers’ behavioral responses to health threats caused by abuse of additives in major food recalls. We employ the PMT model for the following reasons. First, a food safety hazard disclosed in a major food recall will affect consumers’ health. When food recalls caused by illegal additive additions are announced, people tend to think that this illegal action may be a typical practice in the industry, such as melamine being commonly used in the milk industry and sodium cyclamate in the white wine industry. Then, people must spend energy, time, and even money to find safe or alternative products. Hence, food safety hazards resulting from major food recalls require effort to find safe food and/or require extra money to buy expensive alternatives (such as expensive, famous brands or imported goods). Therefore, consumers’ consumption behavior decisions in response to major food recall issues can be taken as a health protection behavior, and PMT is applicable in this case. Second, the PMT model is more appropriate here than other health behavior models. The PMT model incorporates threat appraisal and coping appraisal factors simultaneously for maintaining or changing health behavior [16], while the Theory of Planned Behavior (TPB) [17] and Social Cognitive Theory (SCT) [15] do not explicitly measure threats. Threat and coping appraisal factors are extremely important in the context of food safety hazards because people estimate the real
or potential risk first and then evaluate the efficacy of protective behavior. People can either follow the suggested solutions or behave beyond the recommendations [18]. PMT explains that people’s behavior and decision-making in different dangerous situations has a similar psychological process. Thirdly, PMT analyzes the process of behavioral decision in dangerous circumstances, which resembles a similar psychological process. When informed of the food recall announcement, people would form risk cognition and further evaluation of coping appraisal. These cognitive processes, in turn, encourage consumers to adopt protective behavior to alleviate the risks [10,11]. Hence, PMT fits the study circumstances, and we can employ this model to explore consumers’ consumption change decisions in response to major food recalls as suitable.

However, the PMT does not consider other antecedents that are important factors of consumers’ behavioral decisions. In the domain of food risk management, trust and concern have gained increased attention. The public’s trust in food safety management (TFSM) system acts as an important situational precursor of behavioral intention [2,12]. Existing literature shows that trust significantly affects food safety concerns and consumer confidence in food safety [2], and risk perceptions originate either from natural or synthetic substances [2,19]. Furthermore, food recall concern and an individual’s awareness of food recalls, is always associated with consumer reaction [20]. Risk research indicates that consumers are prone to adjusting their consumption habits when confronted with a highly publicized recall [2,18]. Therefore, this study develops an extended PMT model by incorporating the two additional conditional factors of TFSM and food recall concern. As shown in Figure 1, the research model asserts that in the situation of major food recall, consumers evaluate the severity of the potential harm to their health, as well as the possibility that they would be affected based on their knowledge (threat appraisal). Then they would further assess the effectiveness of the recommended solutions as well as their competence to conduct these response measures (coping appraisal). Then these two cognitive processes may trigger protection motivation, which may subsequently lead to protective behavior intentions. At the same time, consumers’ social and demographic features are included in the model to estimate their effects on protective behavioral intentions [21]. The proposed constructs and hypotheses are discussed below (Figure 1).

![Conceptual model](Figure 1. Conceptual model.)

2.2.1. Perceived Knowledge

Perceived knowledge is defined as what consumers think they know about an issue [2,6]. In PMT, perceived knowledge is regarded as one of the intrapersonal characteristic factors that influence protection motivation and behavior via the threat appraisal and coping appraisal processes [10,22]. Perceived knowledge is also a vital factor in shaping risk perceptions and behavioral intentions [2,23].
The amount of knowledge that an individual has about a hazardous issue is related to his/her risk perception of the potential harm. PMT has proposed that knowledge will decrease an individual’s severity and vulnerability beliefs, thus leading to a reduction in additional problem-solving behaviors [24]. There are two types of knowledge, subjective and objective. Subjective knowledge refers to what people believe they know. Objective knowledge estimates the accurate knowledge that people really master about a specific thing [25,26]. It is indicated that measuring objective knowledge requires procedures which are hard to organize and conduct, while measuring subjective knowledge appears much easier, therefore, we employ subjective knowledge in this study [27]. However, the relationship between subjective knowledge and risk perception is diversified, being either positive, negative, or insignificant [28,29].

Moreover, people with more knowledge may have greater confidence in their competence in responding to the risk (perceived self-efficacy) and in their assessment of the efficacy of the recommended solutions (perceived response efficacy [10,24]. An individual’s knowledge base represents his/her perceived ability and control when conducting protective behavior. The higher the perceived knowledge, the more control an individual has. Those with more knowledge can better understand the risk and better interpret the recommended solutions, which leads to higher perceived response efficacy [24]. Therefore, we developed the following hypotheses:

Hypothesis 1a (H1a). Perceived knowledge of food safety risk is expected to be negatively related to perceived severity in the context of major food recalls.

Hypothesis 1b (H1b). Perceived knowledge of food safety risk is expected to be negatively related to perceived vulnerability in the context of major food recalls.

Hypothesis 1c (H1c). Perceived knowledge of food safety risk is expected to be negatively related to protection motivation in the context of major food recalls.

Hypothesis 1d (H1d). Perceived knowledge of food safety risk is expected to be positively related to perceived response efficacy in the context of food recall issues.

Hypothesis 1e (H1e). Perceived knowledge of food safety risk is expected to be positively related to perceived self-efficacy in the context of food recall issues.

2.2.2. Threat Appraisal, Coping Appraisal and Protection Motivation

Protection motivation is an inferred mental state that may stimulate the public to form behavioral intentions and actual behavior [30]. In PMT, two types of appraisals successively influence protection. In the first stage, the threat appraisal focuses on the evaluation of the level of risk threat, which includes estimation of the likelihood (vulnerability) and the severity of the harm. Perceived vulnerability refers to individuals’ subjective risk perception that a threat may occur; it is a person’s defenselessness ability to deal with the threat [31]. Perceived severity refers to an individual’s belief about the magnitude of the threat to his or her own life [16]. It has been theoretically hypothesized and empirically confirmed that these two types of threat appraisal increase fear and lead to additional protective behaviors in response to the threat [12,24]. In the case of this study, food safety problems that are discovered during food recalls may increase the perceived threat to the public via higher perceived vulnerability and severity, which will further lead to a higher level of motivation to conduct protective behaviors, which can be either adaptive or maladaptive [24].

Coping appraisal, the second process, evaluates the efficacy of the recommended responses to the appraised threat [9]. The coping appraisal consists of response efficacy and self-efficacy. The former refers to the evaluation of whether the recommended solutions will be effective, and the latter focuses on one’s beliefs about and confidence in his/her competence to carry out the suggested solutions [9,15]. In general, both response efficacy and self-efficacy have been found to be the most
significant factors positively influencing protection motivation in the context of protecting against chronic disease [10,16]. Hence, protection motivation can be regarded as a positive linear function of threat and coping appraisal [10,12]. Therefore, we proposed the following hypotheses:

**Hypothesis 2a (H2a).** Perceived severity is expected to be positively correlated with protection motivation in the context of food recall issues.

**Hypothesis 2b (H2b).** Perceived vulnerability is expected to be positively correlated with protection motivation in the context of food recall issues.

**Hypothesis 2c (H2c).** Perceived response efficacy is expected to be positively correlated with protection motivation in the context of food recall issues.

**Hypothesis 2d (H2d).** Perceived self-efficacy is expected to be positively correlated with protection motivation in the context of food recall issues.

### 2.2.3. Protection Motivation and Behavioral Intention

Behavioral intention refers to an individual’s intention to engage in a particular behavior. Rogers [11] indicated that protection motivation acts as an intervening variable that “arouses, sustains, and directs activities.” An individual’s protection motivation stimulates either adaptive or maladaptive behavior. In the meta-analysis of Bandura [16], protection motivation is an indicator of the effects of persuasion, thus leading to behavioral intention [10,16,32]. Chen analyzes the effect of behavioral motivation on the intention for safe food choice and found a significantly positive result [12]. Hence, the relationship between behavioral motivation and intention can be proposed as:

**Hypothesis 3.** Protection motivation of food safety risk is positively related to protection intention in the context of food recalls.

### 2.2.4. Food Recall Concern

Studies of egg consumption during the 2010 shell egg recall and meat consumption during a series of meat recalls showed that consumers switched their consumption to another type of product (e.g. from conventional eggs to organic eggs) or even stopped purchasing the line of products entirely [33]. This result indicates that consumers may react beyond the recommended responses in the recall announcements. They may alter their original consumption of the recalled food, and change to another brand, or even to another line of alternative food [18,33,34]. The greater consumers’ concern over a food recall, the higher the likelihood for them to adopt broad consumption behavior changes [18,34]. Furthermore, people tend to feel higher risk level with the risk message from publicity than that from word-of-mouth, which leads to higher propensity to take protective behavior [2]. Based on the discussion above, hypotheses are developed as follows:

**Hypothesis 4a (H4a).** Recall concern is positively correlated with perceived severity in the context of major food recalls.

**Hypothesis 4b (H4b).** Recall concern is positively correlated with perceived vulnerability in the context of major food recalls.

**Hypothesis 4c (H4c).** Recall concern is positively correlated with behavioral protection intention in the context of major food recalls.
2.2.5. Trust in Food Safety Management

In the domain of food risk research, the construct of trust has gained increased attention. When confronted with food safety hazards, consumers lacking knowledge and competence in solving the problem must rely on their trust on stakeholders’ abilities to cope with food safety risks [2,19]. Previous studies have illustrated that consumers’ trust in governments, manufactures, and third parties has significant effects on consumers’ food safety concern and awareness, their confidence in food safety, and their perception of severity and vulnerability risk perceptions of food hazards arising either from natural factors or human factors [2,12,19]. It is indicated that the impact of trust on risk perception might be greater when knowledge is lacking [35], which is the case since consumers’ knowledge of varieties of additives are limited. There are two types of trust: general and specific. The latter is the focus in most food safety studies [2]. Talton divides specific trust into two sub-categories: firm-level and industry-level [36]. Firm-level trust refers to trust in a specific individual or organization, while industry-level trust treats an industry as a whole [37]. Research into industry-level trust can assess the institutional and political performance [38]. Governmental departments, consumer associations and organizations (e.g. the China Consumer Protection Association) are regarded as typical institutions that are included in industry-level trust [36,37]. In China, according to a survey of 4177 Chinese residents in 2017, only 5.24% of respondents think highly of the current food safety situation, and approximately 42% of residents do not feel satisfied with food safety management [39]. Hence, the following hypothesis is proposed:

**Hypothesis 5a (H5a).** Trust in food safety management is negatively correlated with consumers’ perceived severity in the context of food recalls.

**Hypothesis 5b (H5b).** Trust in food safety management is negatively correlated with consumers’ perceived vulnerability in the context of food recalls.

**Hypothesis 5c (H5c).** Trust in food safety management is negatively correlated with consumers of food safety/protection behavioral intention in the context of food recalls.

3. Methodology

3.1. Measures and Scaling

Measurement items and scales were developed on the endeavors of previous studies [10,12,19, 20,33,40,41]. Each construct was measured with items slightly adapted to fit for the context of food safety and food recall. We used a 7-point Likert scale to score the items. Table 1 demonstrates the measurement items and the sources.

We first developed the questionnaire in English, then we translated into Chinese after discussion with two experts in food science and English. Then we asked another two experts to translate the Chinese version back into English. After careful comparison between these drafts, we discussed the differences and made revisions accordingly. Considering consumers’ education level diversified greatly, we distributed the Chinese version to 40 consumers randomly selected in two supermarkets in the city and small town. Based on the feedback, we revised the questionnaire by using more popular words instead of academic ones to make it readable and understandable for the average consumers.
Table 1. Variables in the hypothetical model.

| Construct                  | Item | Measurement                                                                 | References |
|----------------------------|------|-----------------------------------------------------------------------------|------------|
| Perceived Severity         | PS1  | I think that the recalled food could cause some type of health problems.    | [12]       |
|                            | PS2  | The thought of getting a foodborne illness scares me.                       |            |
|                            | PS3  | Consumption of the recalled food could cause me to be ill for a long time.  |            |
|                            | PS4  | Foods produced by the recalling firms should be shut down permanently.      |            |
| Perceived Vulnerability    | PV1  | I believe that the likelihood of being affected by recalled food is relatively high in China. | [12]       |
|                            | PV2  | Eating a recalled food is not a concern to me.                             |            |
|                            | PV3  | I view food recall arising from abuse of additives in the media to be a contained threat and not really a threat to me (reverse coding). |            |
|                            | PV4  | I am healthy and do not believe that I am susceptible to a foodborne illness associated with restaurants. |            |
| Perceived Response Efficacy| PRE1 | Eating natural foods can reduce health risks caused by food additive safety scandals. | [12,20]    |
|                            | PRE2 | Stopping eating the recalled food can reduce health risks caused by food additive safety scandals. |            |
|                            | PRE3 | Stopping buying the recalled food can reduce health risks caused by food additive safety scandals. |            |
|                            | PRE4 | I trust more in non-additive foods than in the recalled.                   |            |
| Perceived Self-efficacy    | PSE1 | I know the bad effects of the additives involved in the recalled product.   | [12,40]    |
|                            | PSE2 | I can easily choose an alternative safer product.                          |            |
|                            | PSE3 | I have time to find an alternative safer product.                          |            |
|                            | PSE4 | I can afford an expensive alternative safer product (e.g. import commodity). |            |
| Protection Motivation      | PM1  | I would boycott a firm involved in the food safety scandals.               | [10,12]    |
|                            | PM2  | I would boycott the firm involved in a food recall issue.                  |            |
|                            | PM3  | I would boycott the products with the same brand of the recalled food.     |            |
|                            | PM4  | I would boycott the products produced by the recalling manufacturer.       |            |
| Protection Behavioral Intention | PB1 | I would stop consuming the recalled food with the specific brand until I felt it was safe. | [33]       |
|                            | PB2  | I would stop consuming all the food in the same line as the recalled food until I felt it was safe. |            |
|                            | PB3  | I would stop consuming all the food with the same additive which caused food recall until I felt it was safe. |            |
|                            | PB4  | I intend to consume food with natural additives.                           |            |
| Perceived Knowledge        | PK1  | Preservatives are used for processed foods in order to minimize quality changes. | [41]       |
|                            | PK2  | Preservatives are used for processed foods in order to extend shelf life.  |            |
|                            | PK3  | Preservatives are used for processed foods in order to inhibit microbial growth. |            |
|                            | PK4  | It is safe to consume processed foods containing preservatives.            |            |
|                            | PK5  | Intake of processed foods containing preservatives is safe if they are consumed within acceptable daily intake. |            |
| Food Recall Concern        | FRC1 | I am typically concerned by reports of food recalls.                       | [18]       |
|                            | FRC2 | A food recall has never affected me (reverse coded).                       |            |
|                            | FRC3 | I feel that my health safety is threatened by food recall situations.      |            |
|                            | FRC4 | When I read and/or hear about a food recall, I tend to seek out additional information related to that recall. |            |
| Trust in Food Safety        | TFSM1| How much trust do you have in the following institutions or persons that they are conscious of their responsibilities in food safety affairs? | [12,19]    |
| Management                 | TFSM2| The State Food and Drug Administration and the sub-bureaus.                |            |
|                            | TFSM3| Food safety experts and scholars.                                          |            |
|                            | TFSM4| Food manufacturers and retailers.                                          |            |
|                            | TFSM5| Food certification bodies.                                                 |            |

3.2. Sample and Data Collection

We used a questionnaire survey via online and offline channels. In the online survey, we released the questionnaire on Wenjuanxing, an electronic data collection web, from 20 December 2016 to 28 February 2017. In the offline survey, we distributed the printed questionnaire in markets and kiosks. Participants finished the questionnaire anonymously and were guaranteed that their answers would only be used for academic research. Red Envelopes (Red Envelopes are one kind of appreciation given to participants who help answer the questionnaire. In the survey platform, the surveyor can use this mechanism to appreciate the participants and make the survey interesting. For example, we deposited
2000 RMB for the first 1000 participants with random amount style. When a participant finished the questionnaire, the system generates a Red Envelope automatically, with a random amount between 0.01–1000 RMB. For the first 1000 participants, they all received Red Envelopes. Those who are after the first 1000 participants will not get the appreciation. Here, the value of survey Red Envelopes is mainly to make the questionnaire more interesting.) with random amounts were provided for participants via the survey platform in the online survey, and small gifts of bookmarks and key chains were provided in the offline survey to activate the participants. We received 957 questionnaires including 634 online and 314 offline. We deleted 326 copies of the questionnaire due to missing data and identical responses in most of the items. Finally, 631 usable questionnaires were completed for further analysis, with 341 female participants accounting for 54% of the participants. Most of the respondents are 36–50 years old \( (n = 355, 56.3\%) \), and about 62.80% had completed senior high school education and above. We used a \( \chi^2 \) test to verify that the sample represents the population. The results demonstrate that the distribution of gender and age of the sample can represent the population. However, detailed official data of education and income available are from 2010, which cannot be used to represent the population of 2017. Generally, the sample can represent the population to a certain extent.

Since data were collected through online and offline channels, the existence of common method bias (CMB) may affect the effectiveness of the study. We used Harman’s one-factor test to examine all the data from two channels, and the results indicate that all the items were divided into 7 constructs. All the 7 constructs explained 68.63% of the variance, with the first factor being 23.02%, less than the benchmark of 30%. This indicates that the common method bias is not important here. Moreover, we used a t-test to compare the early and later respondents. The results demonstrated no severe non-response bias here in this study. Hence, the data was fit for further analysis.

For the robustness check, we conducted two works. Firstly, we conducted a new survey (survey round 2), using the same questionnaire, model, and analytical methods to replicate the study. Then we set group 1 using data of survey round 1, and group 2 using data of survey round 2. Then we estimated the path coefficients for each group, and then analyzed the differences between the coefficient paths.

4. Results

Structural Equation Model (SEM) was used to validate the postulated model. SEM has been widely used in social science because it allows for analyses of both direct and indirect relationships among the independent, dependent and mediating variables with minimal path construction [19]. Two steps are conducted successively in PLS-SEM. Firstly, measurement model is conducted to test the reliability and validity of the constructs. Confirmatory factor analysis (CFA) is used to test the reliability and validity of the constructs. Construct reliability is used to estimate the internal consistency of the items of each construct using Cronbach’s alpha and composite reliability values. Two kinds of validity are estimated. Convergent validity is used to test the degree to which two or more measures of constructs theoretically should be related to each, which is assessed by item’s loading on corresponding construct and construct’s average variance extracted (AVE) [42]. Furthermore, discriminant validity is adopted to evaluate the degree that two or more constructs theoretically should not be related to each other by examining if the square root of AVE for each latent construct is larger than its correlation with other constructs. In the second step, structural model testing is conducted to validate the proposed hypotheses. Hypotheses were examined by values of path coefficients, T-statistic, and significance, together with t-square effect size (\( \Omega^2 \)). Explanatory and predictive abilities of the model are evaluated by a coefficient of determination (\( R^2 \)) and construct cross-validated redundancy (\( Q^2 \)). Furthermore, we tested the multicollinearity of the data. The results demonstrate that the VIF values ranged from 1.507 to 1.967, which are all below the recommended threshold of 10.

4.1. Measurement Model Testing

Following the recommendation of Chiu and Wáng [43], we first tested the reliability and validity of the constructs. The results shown in Table 2 show that all the values of Cronbach’s alpha, factor
loading, and average variance extracted conform to the recommended thresholds. Furthermore, the square root of the AVE values was greater than all the correlations among the constructs in Table 3. Hence, the estimation of construct reliability and validity indicates that the measurement model fits the data well and is quite good for further analyses.

Table 2. Confirmatory factor analysis results for the measurement model.

| Construct                      | Item     | Factor Loading | Cronbach's Alpha | Composite Reliability | AVE  |
|--------------------------------|----------|----------------|------------------|-----------------------|------|
| Food Recall Concern (FRC)     | FRC1     | 0.79           | 0.85             | 0.89                  | 0.62 |
|                                | FRC2     | 0.83           |                  |                       |      |
|                                | FRC3     | 0.77           |                  |                       |      |
|                                | FRC4     | 0.77           |                  |                       |      |
| Perceived Knowledge (PK)      | PK1      | 0.81           | 0.92             | 0.94                  | 0.75 |
|                                | PK2      | 0.89           |                  |                       |      |
|                                | PK3      | 0.89           |                  |                       |      |
|                                | PK4      | 0.89           |                  |                       |      |
|                                | PK5      | 0.86           |                  |                       |      |
| Protection Behavioral Intention (PBI) | PBI1  | 0.85           | 0.84             | 0.89                  | 0.67 |
|                                | PBI2     | 0.84           |                  |                       |      |
|                                | PBI3     | 0.78           |                  |                       |      |
|                                | PBI4     | 0.80           |                  |                       |      |
| Protection Motivation (PM)    | PM1      | 0.72           | 0.78             | 0.86                  | 0.61 |
|                                | PM2      | 0.83           |                  |                       |      |
|                                | PM3      | 0.78           |                  |                       |      |
|                                | PM4      | 0.78           |                  |                       |      |
| Perceived Response Efficacy (PRE) | PRE1  | 0.88           | 0.91             | 0.93                  | 0.78 |
|                                | PRE2     | 0.91           |                  |                       |      |
|                                | PRE3     | 0.88           |                  |                       |      |
|                                | PRE4     | 0.87           |                  |                       |      |
| Perceived Self-Efficacy (PSE) | PSE1     | 0.80           | 0.82             | 0.88                  | 0.65 |
|                                | PSE2     | 0.79           |                  |                       |      |
|                                | PSE3     | 0.87           |                  |                       |      |
|                                | PSE4     | 0.77           |                  |                       |      |
| Perceived Severity            | PS1      | 0.89           | 0.90             | 0.92                  | 0.77 |
|                                | PS2      | 0.90           |                  |                       |      |
|                                | PS3      | 0.88           |                  |                       |      |
|                                | PS4      | 0.88           |                  |                       |      |
| Perceived Vulnerability (PV)  | PV1      | 0.93           | 0.90             | 0.93                  | 0.77 |
|                                | PV2      | 0.90           |                  |                       |      |
|                                | PV3      | 0.84           |                  |                       |      |
|                                | PV4      | 0.86           |                  |                       |      |
| Trust in Food Safety Management (TFSM) | TFSM1 | 0.89           | 0.88             | 0.91                  | 0.68 |
|                                | TFSM2    | 0.89           |                  |                       |      |
|                                | TFSM3    | 0.78           |                  |                       |      |
|                                | TFSM4    | 0.84           |                  |                       |      |
|                                | TFSM5    | 0.71           |                  |                       |      |

Note: (1) The items FRC1-TFRM5 are the items that measured the constructs of the proposed model; (2) AVE: average variance extracted.

Table 3. Means, standard deviation, and correlations.

| Construct                      | Mean  | SD    | FRC | KNOW | PBI | PM  | PRE | PSE | PS  | PV  | TFSM |
|--------------------------------|-------|-------|-----|------|-----|-----|-----|-----|-----|-----|------|
| Food Recall Concern (FRC)     | 5.46  | 0.79  | 0.79|      |     |     |     |     |     |     |      |
| Perceived Knowledge (PK)      | 5.02  | 0.97  | 0.37| 0.87 |     |     |     |     |     |     |      |
| Protection Behavioral Intention (PBI) | 5.16 | 0.83  | 0.55**| 0.44**| 0.82 |     |     |     |     |     |      |
| Protection Motivation (PM)    | 5.51  | 1.05  | 0.31| 0.58**| 0.43**| 0.45**|     |     |     |     | 0.88 |
| Perceived Response Efficacy (PRE) | 4.75 | 0.88  | 0.43**| 0.47**| 0.50**| 0.46**| 0.35 | 0.81 |     |     |      |
| Perceived Self-Efficacy (PSE) | 5.19  | 0.90  | 0.53**| 0.41**| 0.69**| 0.53**| 0.40**| 0.52**| 0.88 |     |      |
| Perceived Severity            | 4.78  | 1.21  | 0.43 | 0.4  | 0.35| 0.47| 0.3 | 0.47| 0.51**| 0.83 |      |
| Trust in Food Safety Management (TFSM) | 3.68 | 1.12  | -0.26 | -0.43**| -0.38**| -0.34| -0.27| -0.36**| -0.41**| -0.33 | 0.83 |

Note: (1) Means are measured on average factor scores; (2) SD means standard deviation; (3) Values in the diagonal row (bold) are the square roots of AVEs, and the off-diagonal elements are the correlations among constructs. (4) **means p < 0.01.
4.2. Structural Model Testing

We further conducted SEM analysis to testify the proposed model. Path analyses were conducted using the methods of partial least squares, blindfolding, and bootstrapping with 3000 subset samples, all using the SmartPLS 2.0 software package.

First, we used the following indicators to test the explanatory power: (a) a predictive validity (Q2) greater than zero; (b) an effect size (f2) with values of 0.02, 0.15 and 0.35 representing small, medium, and large effects, respectively [44]; and (c) a Goodness of Fit (GoF) with a value of 0.36, which indicates adequate fit. In this study, the value of f2 was 0.62, indicating a large effect size. The Q2 values of all the constructs are from 0.10 to 0.28, all above the threshold of zero, indicating high predictive validity. These two indicators demonstrate that the model is accurate and that the constructs are important for the adjustment model. Furthermore, the GoF value equals 0.47, which indicates that the model has an adequate adjustment.

We then further analyzed the structural model. The values of the path coefficients and T–statistics are presented in Table 4. Perceived knowledge influences perceived response efficacy (H1d: $b = 0.58$, $t = 16.89$) and perceived self–efficacy (H1e: $b = 0.47$, $t = 12.79$) significantly. Therefore, H1d and H1e are supported. Moreover, perceived knowledge influences perceived severity (H1a: $b = 0.39$, $t = 8.73$), perceived vulnerability (H1b: $b = 0.18$, $t = 3.17$), and protection motivation (H1c: $b = 0.25$, $t = 5.08$) significantly and positively. However, the directions of the relationships between perceived knowledge, perceived severity, perceived vulnerability, and protective motivation are opposite to the hypotheses, and H1a, H1b and H1c are not supported.

Table 4. Results of the PLS analysis.

| Hypothesis                      | Path Coefficient | Standard Deviation | T Statistics Values | Results |
|--------------------------------|------------------|--------------------|---------------------|---------|
| H1a: Perceived knowledge --> Perceived severity | 0.39***          | 0.045              | 8.73                | NS      |
| H1b: Perceived knowledge --> Perceived vulnerability | 0.18**           | 0.057              | 3.17                | NS      |
| H1c: Perceived knowledge --> Protection motivation | 0.25***          | 0.049              | 5.08                | NS      |
| H1d: Perceived knowledge --> Response efficacy | 0.58***          | 0.034              | 16.89               | Supported |
| H1e: Perceived knowledge --> Self–efficacy | 0.47***          | 0.037              | 12.79               | Supported |
| H2a: Perceived severity --> Protection motivation | -0.017           | 0.037              | 0.461               | NS      |
| H2b: Perceived vulnerability --> Protection motivation | 0.31***          | 0.05               | 6.12                | Supported |
| H2c: Response efficacy --> Protection motivation | 0.14**           | 0.043              | 3.17                | Supported |
| H2d: Self–efficacy --> Protection motivation | 0.15***          | 0.042              | 3.46                | Supported |
| H3: Protection motivation --> Protection intention | 0.30***          | 0.039              | 7.82                | Supported |
| H4a: Recall concern --> Perceived severity | -0.05            | 0.037682           | 1.32                | NS      |
| H4b: Recall concern --> Perceived vulnerability | 0.42***          | 0.04               | 9.83                | Supported |
| H4c: Recall concern --> Protection intention | 0.39***          | 0.0371             | 10.44               | Supported |
| H5a: TFSM --> Perceived severity | -0.24***         | 0.046              | 5.24                | Supported |
| H5b: TFSM --> Perceived vulnerability | -0.14***         | 0.045              | 3.21                | Supported |
| H5c: TFSM --> Protection intention | -0.31***         | 0.05               | 6.12                | Supported |
| Age --> Protection intention | 0.03**           | 0.01               | 3.02                |          |
| Gender --> Protection intention | 0.11***          | 0.012              | 9.17                |          |
| Monthly income --> Protection intention | 0.07             | 0.06               | 1.17                |          |
| Marriage --> Protection intention | 0.03**           | 0.01               | 3.02                |          |

Note: NS: Not supported; ***, $t > 3.29$; **, $t > 2.58$; *, $t > 1.96$. 
Next, the effects of antecedents on protective motivation were tested. Perceived vulnerability (H2b: $b = 0.31, t = 6.12$), perceived response efficacy (H2c: $b = 0.14, t = 3.17$), and perceived self-efficacy (H2d: $b = 0.15, t = 3.46$) all significantly affect protection motivation, thereby supporting H2b, H2c, and H2d. However, perceived severity does not influence protection motivation significantly (H2a: $b = -0.017, t = 0.461$), thus H2a is not supported. As for the effects of food recall concern and TFSM on threat appraisal, it is found that only the path of recall concern to perceived severity to be insignificant, and the other three paths are all significant at $p < 0.001$. Hence, the results support H4b, H5a, and H5b. Moreover, the results indicated that protection motivation (H3: $b = 0.30, t = 7.82$), food recall concern (H4c: $b = 0.39, t = 10.44$), and trust in food safety management, (H5c: $b = -0.17, t = 5.08$) appear to have significant effects on behavioral intention. Thus, hypotheses H3, H4c, and H5c are all supported.

Table 4 also provided influences of the control variables over the protective behavioral intention. The coefficients of age, gender, and marriage on protective behavioral intention were $-0.03$, $0.11$, and $0.03$, respectively, which were significant at $p < 0.01$, $0.001$ and $0.01$, respectively. The results indicated that these three demographic variables, i.e. age, gender, and marriage, exerted significantly positive effects on protective behavioral intention in cases of major food recalls. The findings suggested that individuals who are young, female, and married were more likely to form protective behavioral intentions. The coefficient between monthly income and protective behavioral intention was $0.07$, with the $T$-statistic value being less than $1.96$ ($p < 0.05$), indicating that monthly income had no insignificant effects on protective behavioral intention.

Although H1a, H1b, and H1c are significantly positive, the sign of the coefficient is contrary to the hypotheses. Therefore, we conducted three quadratic regressions to examine the role of perceived knowledge. We set perceived knowledge and the square of decentralized perceived knowledge as independent variables, and set perceived severity, vulnerability, and protection motivation as dependent variables in model 1, 2 and 3 respectively. The regression results are shown in Tables 4–6.

### Table 5. Regression analysis results of perceived severity as a dependent variable.

| Model | Independent Variable         | Std. Coefficients | Std. Error | T–Value |
|-------|-------------------------------|-------------------|------------|---------|
| 1     | Perceived knowledge           | 0.48              | 0.05       | 13.53   |
| 2     | Perceived knowledge           | 0.42              | 0.31       | 1.957   |
|       | Square of perceived knowledge | 0.06              | 0.031      | 0.29    |

Note: In model 1, $R^2 = 0.226$ and adjusted $R^2 = 0.224$; in model 2, $R^2 = 0.226$ and adjusted $R^2 = 0.223$.

### Table 6. Regression analysis results of perceived vulnerability as a dependent variable.

| Model | Independent Variable         | Std. Coefficients | Std. Error | T–Value |
|-------|-------------------------------|-------------------|------------|---------|
| 1     | Perceived knowledge           | 0.40              | 0.04       | 11.05   |
| 2     | Perceived knowledge           | 0.28              | 0.21       | 1.29    |
|       | Square of perceived knowledge | 0.12              | 0.02       | 0.55    |

Note: In model 1, $R^2 = 0.163$ and adjusted $R^2 = 0.161$; in model 2, $R^2 = 0.163$ and adjusted $R^2 = 0.161$.

As shown by model 1 in Table 4, perceived knowledge significantly and positively influences risk perception. However, in the quadratic regression, influence of the square of perceived knowledge is not significant, which indicates that the relationship between perceived knowledge and risk perception is linear rather than U–shaped. It is the same situation in Table 6. Table 7 demonstrates that perceived knowledge significantly and positively influences protection motivation, and the square of perceived knowledge exerts a significantly negative effect on protection motivation. Therefore, a convex curve is indicated in the relationship between protection motivation and knowledge. That is, an inverted U shape exists (Figure 2).
These findings conform to previous researches that have emphasized the dominant role of perceptual knowledge in threat appraisal and protection motivation is positive, which means that the greater the perceived knowledge on threat appraisal and protection motivation is, the higher their risk perception and protection motivation will be. These results are inconsistent with previous studies in which perceived knowledge was a negative determinant of low risk judgements in risk situations [28]. This can be interpreted as follows. In this study, the belief of food safety based on subjective knowledge increases risk perception, which suggests that when consumers are knowledgeable about substances involved in the major food recall, they will think highly of the consequences and take protective actions. This result has positive effects on coping appraisal, i.e. perceived response efficacy and self-efficacy, which suggests that when consumers are knowledgeable about substances involved in the major food recall, they will think highly of the effects of changes in consumption behavior and their competence in adopting these behaviors to protect their health. These findings conform to previous researches that have emphasized the dominant role of perceptual subjective knowledge in response assessment [10,24,34,40]. However, the impact of perceived knowledge on threat appraisal and protection motivation is positive, which means that the greater the consumers’ knowledge, the higher their risk perception and protection motivation will be. These results are inconsistent with previous studies in which perceived knowledge was a negative determinant of low risk judgements in risk situations [28]. This can be interpreted as follows. In this study, the mean value of perceived knowledge is relatively low at 5.02 (Table 3), which indicates that the

| Model | Independent Variable | Std. Coefficients | Std. Error | T−Value |
|-------|----------------------|-------------------|------------|---------|
| 1     | Perceived knowledge  | 0.45              | 0.03       | 12.49   |
| 2     | Perceived knowledge  | 1.52              | 0.21       | 6.55    |
|       | Square of perceived knowledge | −1.09       | 0.02      | −4.69   |

Note: In model 1, $R^2 = 0.263$ and adjusted $R^2 = 0.261$; in model 2, $R^2 = 0.275$ and adjusted $R^2 = 0.273$.

Figure 2. Results of the quadratic regressions. (Dependent variable: protection motivation; Independent variable: perceived knowledge).

Moreover, the original PMT model explained 27.35% of the variance in consumers’ protective behavioral intentions, while the augmented PMT model explained 47.15% of the variance in consumers’ intentions. This indicates that including indicators of food recall concern and TFSM increased the explained variance by 17.70% ($\Delta R^2 = 19.80\%, p < 0.01$).

5. Discussion

This study explores the influencing factors of consumers’ protective behavioral intentions in response to major food recalls based on an extended PMT model from a risk perception perspective. The results indicate that the beliefs of food safety based on subjective knowledge increases risk perception, perceived self-efficacy and perceived response effectiveness, and then stimulates the motivation and intention of protecting consumer behavior. In addition to the factors in the original PMT, the additional factors, i.e. food recall concern and TFSM, are found to exert significant influence over broad consumption change intention.

The results indicate that perceived knowledge has positive effects on coping appraisal, i.e. perceived response efficacy and self-efficacy, which suggests that when consumers are knowledgeable about substances involved in the major food recall, they will think highly of the effects of changes in consumption behavior and their competence in adopting these behaviors to protect their health. These findings conform to previous researches that have emphasized the dominant role of perceptual subjective knowledge in response assessment [10,24,34,40]. However, the impact of perceived knowledge on threat appraisal and protection motivation is positive, which means that the greater the consumers’ knowledge, the higher their risk perception and protection motivation will be. These results are inconsistent with previous studies in which perceived knowledge was a negative determinant of low risk judgements in risk situations [28]. This can be interpreted as follows. In this study, the mean value of perceived knowledge is relatively low at 5.02 (Table 3), which indicates that the

Table 7. Regression analysis results of protection motivation as a dependent variable.

| Model | Independent Variable | Std. Coefficients | Std. Error | T−Value |
|-------|----------------------|-------------------|------------|---------|
| 1 Perceived knowledge | 0.42 | 0.31 | 1.957 |
| 2 Perceived knowledge | 0.28 | 0.21 | 1.29 |
| 1 Perceived knowledge | 0.48 | 0.05 | 13.53 |
| 2 Perceived knowledge | 0.45 | 0.04 | 12.49 |

Note: In model 1, $R^2 = 0.226$ and adjusted $R^2 = 0.224$; in model 2, $R^2 = 0.226$ and adjusted $R^2 = 0.223$. 

The relationship between protection motivation and the square of perceived knowledge is inverted U-shaped. It is the same situation in Table 6. Table 7 demonstrates that the impact of perceived knowledge on protection motivation is positive, and the square of perceived knowledge exerts a significantly negative effect on protection motivation. This indicates that including indicators of food recall concern and TFSM increased the explained variance by 17.70% ($\Delta R^2 = 19.80\%, p < 0.01$).
respondents are not quite familiar with and not knowledgeable about food additives and their negative effects on human health. In the measurement, we use positive and negative information to measure perceived knowledge. Consumers with low perceived knowledge will feel low risk perception and protection motivation when they got limited information. However, consumers with high perceived knowledge may get more information, either positive or negative. Since negative information always leads to consumer misconceptions and incorrect ideas about food additives, consumers with high perceived knowledge do not necessarily perceive lower levels of risk [45]. Therefore, it is indicated that consumers’ perceived knowledge positively influences risk perception and protection motivation. Further analyses by quadratic regressions indicate that the relationship between perceived knowledge and protection motivation has an inverted U shape (Table 6 and Figure 2). This finding reveals that consumers’ protection motivation is the highest when they had moderate knowledge. The possible explanation may be as follows. In recent years, many food safety scandals occurred in China, such as cadmium contaminated rice, lean meat powder pork, and milk with hydrolyzed leather protein. Many products and manufacturers were involved in these scandals, and they remain fresh in the minds of consumers, which results in high protection motivation. With the increasing disclosure of objective knowledge by the authorities or through social media, people have found that food safety is very complex and difficult to understand due to the large amount of chemical and biological information. Hence, negligence and confusion related to objective knowledge lead to low subjective knowledge and high protection motivation [45]. However, with the improvement of education levels in China and the implementation of public food safety education promoted by the CFDA and its subordinates, people receive more correct information, and their subjective knowledge increases with the development of objective knowledge, which leads to a decrease in protection motivation for those less critical hazards, such as food additives. Future research can examine the influence of perceived knowledge over behavioral intention, discussing the influence of subjective and objective knowledge.

As for the effects of recall concern and TFSM on threat appraisal, the results show that only the path from recall concern to perceived severity is not significant. The possible reason may be explained as follows. In the recall announcements, only simplified information is required by the CFDA, resulting in less acknowledgement of perceived severity. In practice, most recalling firms only list the general reasons of the food recall, and do not give information of specified reasoning, potential harm, and recommended response methods. Therefore, even consumers with higher concern for food recall issues do not realize what and how these additives will harm their health. Moreover, frequent outbreaks of food scandals due to the abuse of food additives in China has made people feel that it is a common practice in food production, and consumers are vulnerable to the harm from abuse of food additives. Hence, the effect of recall concern on perceived vulnerability is significant while that of perceived severity is not.

The results also support the significant role of protection motivation, food recall concern, and TFSM in predicting protective behavioral intention, which is consistent with the previous studies of Chen [12] and Marsh [33]. The results show that if a person’s motivation to reduce food safety problems is attributed to his/her risk perception of safety problems disclosed in food recall, his/her intention to protect will be enhanced. Furthermore, an individual’s protective behavioral intention to avoid and mitigate food safety harm may rely on his/her awareness of food recalls and food safety [33]. In addition to concern for food safety, i.e. chemical residues, irradiation, and food terrorism, individuals’ concern about food recalls significantly influences consumers’ reactions to food hazards [7,33]. The more awareness that an individual has about a food recall, the higher his/her propensity to have protective behavioral intentions beyond the parameters and recommended responses of the recall. Furthermore, TFSM exerts a negative effect on behavioral protection intention, which is consistent with the previous studies by Chen [12] and Chen [19]. These results highlight the importance of the public’s trust in the food safety management system provided by the stakeholders, i.e. the government, the consumer associations, and the manufacturers and retailers. This indicates that in a society with low perceived TFRM, people always rely on their own ability to judge food safety issues and make
decisions based on their knowledge and diversified information from various channels [12]. These findings are also applicable in other countries [42].

Protection motivation is an essential factor that mediates the relationship between threat appraisal, coping appraisal, and protective behavioral intention [10]. In this study, perceived vulnerability, response efficacy, and self-efficacy all significantly and positively influence protection motivation, which conforms to previous studies by Zaalberg [23] and Chen [12]. This study indicates that if people think that they have a higher vulnerability of food safety problems disclosed in food recalls, then their higher risk perception increases protection motivation. Additionally, if people think that they have a higher sense of self-efficacy and self-control in alleviating food safety problems, their higher response evaluation will also increase their protection motivation. In the two sub-dimensions of threat appraisal, only the perceived vulnerability influences protection motivation significantly, conforming to the study of Chen [12]. This shows that if the consumer’s motivation to mitigate food safety hazards is only due to his or her vulnerability to major food recall issues, then his or her purchase choice is more easily explained. In the context of China, food safety incidents caused by the abuse of food additives continue to occur in China, and it has become the most common type of food safety incident and a major public concern. Recent major food scandals, such as melamine milk powder and dyed steamed buns, have increased public anxiety over a continuous increase in food safety incidents. Moreover, once these illegal addition issues are disclosed, consumers always find that it is a common practice in food production, which leads to a higher perceived vulnerability and results in higher protection motivation.

6. Robustness Check

We conducted a new survey and got two sets of data. Following Picón-Berjoyo et al. [46], we estimated the path coefficients for each group, and then analyzed the differences between the coefficient paths. We presented the $P-$values of the differences of coefficient paths in Table 8. The results show that findings in group 2 are highly consistent with those of group 2, with all the $p-$values of the differences of path coefficients being greater than 0.05 (Table 6), which indicates that there are no significant differences and the model has generalizability. Secondly, invariance tests were conducted. We combined the data of round 1 and round 2 together, then divided the data into four pairs of subsamples according to demographic characteristics such as gender, marital status, age, and education. Concerning division of education, we defined high level of education with those who had completed senior high school education and above as value 1, and low level of education with the others as value 2. Then we conducted multi-group analyses with these four subsets. The results acknowledged that multi-group invariance across gender, marital status, age, and education were observed for the structural model. As shown in Table 8, the model functioned similarly well for most of the participant groups, which supporting the generalizability of this model to some extent. However, one significant path difference was observed. In the age group, difference of coefficient value of the path from perceived severity to protection motivation was found to be significant ($\Delta b = 0.133, p < 0.05$). The result indicates that the predictive power of perceived severity over protection motivation is higher for females than it is for males. Generally speaking, the generalizability and replicate of this model has been achieved to some extent.
Table 8. Results of replication and invariance tests.

| Hypotheses and Path | Survey Sound (Round 1 vs. 2) | Marital Status (Married vs. Single) | Gender (Female vs. Male) | Education (High vs. Low) | Age (Young vs. Old) |
|---------------------|------------------------------|------------------------------------|--------------------------|--------------------------|---------------------|
|                     | Dif. of Coeff. | p Value | Dif. of Coeff. | p Value | Dif. of Coeff. | p Value | Dif. of Coeff. | p Value | Dif. of Coeff. | p Value |
| H1a: Perceived knowledge $\rightarrow$ Perceived severity | 0.159 | 0.968 | 0.107 | 0.902 | 0.072 | 0.828 | 0.072 | 0.167 | 0.061 | 0.217 |
| H1b: Perceived knowledge $\rightarrow$ Perceived vulnerability | 0.095 | 0.211 | 0.07 | 0.262 | 0.121 | 0.873 | 0.116 | 0.875 | 0.114 | 0.842 |
| H1c: Perceived knowledge $\rightarrow$ Protection motivation | 0.065 | 0.292 | 0.022 | 0.398 | 0.072 | 0.788 | 0.024 | 0.396 | 0.03 | 0.368 |
| H1d: Perceived knowledge $\rightarrow$ Response efficacy | 0.092 | 0.912 | 0.025 | 0.66 | 0.002 | 0.489 | 0.052 | 0.19 | 0.022 | 0.64 |
| H1e: Perceived knowledge $\rightarrow$ Self-efficacy | 0.001 | 0.503 | 0.046 | 0.244 | 0.145 | 0.986 | 0.009 | 0.55 | 0.037 | 0.707 |
| H2a: Perceived severity $\rightarrow$ Protection motivation | 0.057 | 0.778 | 0.086 | 0.1 | 0.034 | 0.697 | 0.078 | 0.126 | 0.097 | 0.928 |
| H2b: Perceived vulnerability $\rightarrow$ Protection motivation | 0.039 | 0.633 | 0.043 | 0.678 | 0.124 | 0.905 | 0.067 | 0.759 | 0.038 | 0.356 |
| H2c: Response efficacy $\rightarrow$ Protection motivation | 0.128 | 0.105 | 0.056 | 0.232 | 0.061 | 0.219 | 0.056 | 0.239 | 0.003 | 0.494 |
| H2d: Self-efficacy $\rightarrow$ Protection motivation | 0.101 | 0.804 | 0.085 | 0.859 | 0.133 | 0.047 | 0.014 | 0.435 | 0.005 | 0.475 |
| H3: Protection motivation $\rightarrow$ Protection intention | 0.099 | 0.109 | 0.089 | 0.873 | 0.028 | 0.655 | 0.049 | 0.763 | 0.063 | 0.811 |
| H4a: Recall concern $\rightarrow$ Perceived severity | 0.039 | 0.305 | 0.009 | 0.449 | 0.027 | 0.657 | 0.044 | 0.741 | 0.086 | 0.099 |
| H4b: Recall concern $\rightarrow$ Perceived vulnerability | 0.111 | 0.916 | 0.069 | 0.814 | 0.011 | 0.444 | 0.037 | 0.32 | 0.071 | 0.197 |
| H4c: Recall concern $\rightarrow$ Protection intention | 0.16 | 0.991 | 0.017 | 0.602 | 0.002 | 0.518 | 0.037 | 0.291 | 0.017 | 0.400 |
| H5a: TFSM $\rightarrow$ Perceived severity | 0.069 | 0.769 | 0.104 | 0.886 | 0.05 | 0.73 | 0.097 | 0.89 | 0.137 | 0.059 |
| H5b: TFSM $\rightarrow$ Perceived vulnerability | 0.078 | 0.204 | 0.035 | 0.652 | 0.061 | 0.773 | 0.093 | 0.885 | 0.056 | 0.749 |
| H5c: TFSM $\rightarrow$ Protection motivation | 0.043 | 0.698 | 0.093 | 0.086 | 0.077 | 0.12 | 0.063 | 0.847 | 0.019 | 0.387 |
7. Implications and Limitations

Considering the food safety situation in China, the food recall system has been adopted by the Chinese government. However, there are few studies on the decision-making of consumers’ coping behavior in the context of food recall. This study evaluates consumers’ protection motivation decisions in the context of major food recalls, which fills the blank of consumer behavior decision research on food safety events. The results also have some practical implications for the relevant agencies to deal with public food risks and reduce the losses of recall enterprises and retailers. Given that perceived knowledge positively influences risk perception and protection motivation, improving consumers’ knowledge seems a key point. Some measures can be applied to improve consumers’ awareness about food safety. For example, the CFDA and its subordinates, large supermarkets and nonprofits can provide public campaigns, science popularization and educational activities in schools, supermarkets and other public places. Furthermore, this study indicates that the relationship between perceived knowledge and protection motivation demonstrates an inverted U shape. Therefore, improving consumers’ food safety knowledge continuously and persistently is beneficial in that it decreases their protection motivation and broad consumption change intentions. The governments should provide reliable and sufficient public education about food safety knowledge in communities, supermarkets, and schools of all levels in China and some other developing countries.

Second, coping appraisal exerts a positive effect on protection motivation. Hence, the recalling manufacturers and retailers should provide more information and knowledge in addition to the stereotyped food recall announcements suggested by the CFDA. The recalling manufacturers and retailers should specify the causes, potential hazards and benefits of a certain food additive, and take positive measures for recalled food [33,47]. It is beneficial if supplementary advertisements provided by recall manufacturers clearly convey consumers’ consumption risks and suggestions [4].

Finally, TFSM negatively influences consumers’ protective behavioral intentions. The higher the TFSM is, the lower the likelihood of changing consumption behavior. Currently, the government, mainly the CFDA and its subordinates, have imposed comprehensive supervision of the food supply chain. In China, most food safety problems are found in food safety sampling inspection, spot checking, specialized inspection, and unannounced inspection by the government [39,48]. Therefore, the government and third parties should strengthen their supervision over the food supply chain, issue strict regulations and standards, conduct strict food safety inspections, and levy more severe punishments for irregularities [12,48].

There are some limitations in this study. First, this study only focuses on the intention of consumer protection behavior, not the actual behavior. Though behavioral intention is the immediate determinant of actual behavior, there is a gap between behavioral intention and actual behavior [17]. Further study should include actual behavior in the model using interviewing, sampling, and experimental methods. Second, perceived knowledge is measured by perceived subjective knowledge in this study. As we know, objective knowledge and experiential knowledge also influence protection motivation and protective behavioral intention [10]. Future studies may explore the effects of objective knowledge on protective motivation and intention. Third, in measuring consumption change behavioral intention, there were no items on efforts to find alternative products, which appears to be a lost opportunity. In further study, we will include these items and estimate their effects on intention and behavior. Fourthly, coping strategy in this study refers to both during and after the recall, which neglect the effects of timing. Li [39] indicates that consumers who rated food safety as being important are willing to pay a difference of 25 cents for organic eggs after and before an egg recall. Hence, in further study, we would take the timing into consideration and compare consumers’ response behavior before and after the recall. Moreover, we have left out the key construct, response cost, from the proposed model, which may lead to the risk of bias. In future research, we would include this construct and estimate its effects over protection motivation. Last but not least, this study indicates an inverted U shape for the relationship between perceived knowledge and protection motivation, and further research on this point should be extended to other relationships, such as perceived knowledge and behavioral intention.
Author Contributions: Conceptualization, C.L.; methodology, C.L.; investigation, H.Y.; writing—original draft preparation, C.L.; writing—review and editing, W.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Sichuan Science and Technology Program, grant number 2018ZR0205.

Conflicts of Interest: The authors declare no conflict of interest.

References
1. Zhao, X.; Li, Y.; Flynn, B.B. The financial impact of product recall announcements in China. *Int. J. Prod. Econ.* 2013, 142, 115–123. [CrossRef]
2. Hoque, M.Z.; Alam, M.J.S. What Determines the Purchase Intention of Liquid Milk during a Food Security Crisis? The Role of Perceived Trust, Knowledge, and Risk. *Sustainability* 2018, 10, 3722. [CrossRef]
3. Pozo, V.F.; Schroeder, T.C. Evaluating the costs of meat and poultry recalls to food firms using stock returns. *Food Policy* 2016, 59, 66–77. [CrossRef]
4. Patrick, M.E.; Griﬃn, P.M.; Voetsch, A.C.; Mead, P.S. Eﬀectiveness of recall notification: Community response to a nationwide recall of hot dogs and deli meats. *J. Food Saf.* 2007, 70, 2373–2376. [CrossRef] [PubMed]
5. Steelfisher, G.; Weldon, K.; Benson, J.M.; Blendon, R. Public perceptions of food recalls and production safety: Two surveys of the American public. *J. Food Saf.* 2010, 30, 848–866. [CrossRef]
6. Griffin, R.J.; Dunwoody, S.; Neuwirth, K. Proposed model of the relationship of risk information seeking and processing to the development of preventive behaviors. *Environ. Res.* 1999, 80, S230–S245. [CrossRef]
7. Jan, I.U.; Ji, S.; Yeo, C. Values and Green Product Purchase Behavior: The Moderating Eﬀects of the Role of Government and Media Exposure. *Sustainability* 2019, 11, 6642. [CrossRef]
8. Fleming, K.; Thorson, E.; Zhang, Y. Going beyond exposure to local news media: An information-processing examination of public perceptions of food safety. *J. Health Commun.* 2006, 11, 789–806. [CrossRef]
9. Wilcock, A.; Pun, M.; Khanona, J.; Aung, M. Technology, Consumer attitudes, knowledge and behaviour: A review of food safety issues. *Trends Food Sci. Technol.* 2004, 15, 56–66. [CrossRef]
10. Rogers, R.W. Cognitive and psychological processes in fear appeals and attitude change: A revised theory of protection motivation. In *Social Psychophysiology: A Sourcebook*; The Guilford Press: New York, NY, USA, 1983; pp. 153–176.
11. Rogers, R.W. A protection motivation theory of fear appeals and attitude change1. *J. Psychol.* 1975, 91, 93–114. [CrossRef]
12. Chen, M.-F. Extending the protection motivation theory model to predict public safe food choice behavioural intentions in Taiwan. *Food Control* 2016, 68, 145–152. [CrossRef]
13. Hunter, E.; Röös, E. Fear of climate change consequences and predictors of intentions to alter meat consumption. *Food Policy* 2016, 62, 151–160. [CrossRef]
14. Cameron, K.A. A practitioner’s guide to persuasion: An overview of 15 selected persuasion theories, models and frameworks. *Patient Educ. Couns.* 2009, 74, 309–317. [CrossRef] [PubMed]
15. Bandura, A.; Freeman, W.; Lightsey, R. *Self-eﬃcacy: The Exercise of Control*; Freeman: New York, NY, USA, 1999.
16. Milne, S.; Sheerran, P.; Orbell, S. Prediction and intervention in health-related behavior: A meta-analytic review of protection motivation theory. *J. Appl. Soc. Psychol.* 2000, 30, 106–143. [CrossRef]
17. Ajzen, H.; Fishbein, M. *Understanding Attitudes and Predicting Social Behavior*; Prentice-Hall: Englewood Cliffs, NJ, USA, 1980; pp. 178–182.
18. Peake, W.O.; Detre, J.D.; Carlson, C.C. One bad apple spoils the bunch? An exploration of broad consumption changes in response to food recalls. *Food Policy* 2014, 49, 13–22. [CrossRef]
19. Chen, W. The effects of different types of trust on consumer perceptions of food safety: An empirical study of consumers in Beijing Municipality, China. *China Agric. Econ. Rev.* 2013, 5, 43–65. [CrossRef]
20. Hallman, W.K.; Cuite, C.L.; Hooker, N.H. Consumer Responses to Food Recalls: 2008 National Survey Report. 2009. Available online: https://rucore.libraries.rutgers.edu/rutgers$L-$lib/48426/PDF/1/ (accessed on 19 October 2018).
21. Pomarici, E.; Vecchio, R. Millennial generation attitudes to sustainable wine: An exploratory study on Italian consumers. *J. Clean. Prod.* 2014, 66, 537–545. [CrossRef]
22. Renner, B.; Kwon, S.; Yang, B.-H.; Paik, K.-C.; Kim, S.H.; Roh, S.; Song, J.; Schwarzer, R. Social-cognitive predictors of dietary behaviors in South Korean men and women. *Int. J. Behav. Med.* 2008, 15, 4–13. [CrossRef]

23. Zaalberg, R.; Midden, C.; Meijnders, A.; McCalley, T. Prevention, adaptation, and threat denial: Flooding experiences in the Netherlands. *Risk Anal. Int. J.* 2009, 29, 1759–1778. [CrossRef]

24. Epplright, D.R.; Tanner, J.F., Jr.; Hunt, J.B. Knowledge and the ordered protection motivation model: Tools for preventing AIDS. *J. Bus. Res.* 1994, 30, 13–24. [CrossRef]

25. Park, C.W.; Mothersbaugh, D.L.; Feick, L. Consumer knowledge assessment. *J. Consum. Res.* 1994, 21, 71–82. [CrossRef]

26. Brucks, M.J. The effects of product class knowledge on information search behavior. *J. Consum. Res.* 1985, 12, 1–16. [CrossRef]

27. Kellens, W.; Zaalberg, R.; De Maeyer, P. The informed society: An analysis of the public’s information-seeking behavior regarding coastal flood risks. *Risk Anal. Int. J.* 2012, 32, 1369–1381. [CrossRef] [PubMed]

28. Hudson, G.M.; Watson, P.J.; Fairall, L.; Jamieson, A.G.; Schwabe, J.W.J. Insights into the recruitment of class IIa histone deacetylases (HDACs) to the SMRT/NCoR transcriptional repression complex. *J. Biol. Chem.* 2015, 290, 18237–18244. [CrossRef]

29. Falk, M. Organizational change, new information and communication technologies and the demand for labor in services. In *The New Economy and Economic Growth in Europe and the US*; Springer: Berlin/Heidelberg, Germany, 2002; pp. 161–192.

30. Ajzen, I. *Attitudes, Personality, and Behavior*; McGraw-Hill Education: New York, NY, USA, 2005.

31. Scarpa, R.; Thiene, M. Organic food choices and Protection Motivation Theory: Addressing the psychological sources of heterogeneity. *Food Qual. Prefer.* 2011, 22, 532–541. [CrossRef]

32. Floyd, D.L.; Prentice-Dunn, S.; Rogers, R.W.J. A meta-analysis of research on protection motivation theory. *J. Appl. Soc. Psychol.* 2000, 30, 407–429. [CrossRef]

33. Marsh, T.L.; Schroeder, T.C.; Mintert, J. Impacts of meat product recalls on consumer demand in the USA. *Appl. Econ.* 2004, 36, 897–909. [CrossRef]

34. Zasuwa, G. The Role of Individual- and Contextual-Level Social Capital in Product Boycotting: A Multilevel Analysis. *Sustainability* 2019, 11, 949. [CrossRef]

35. Earle, T.C. Trust in risk management: A model-based review of empirical research. *Risk Anal. An Int. J.* 2010, 30, 541–574. [CrossRef]

36. Talton, R.Y. *Winning Consumer Trust and Loyalty in Distrust-dominated Environments: A Consumer Perspective*; Case Western Reserve University: Cleveland, OH, USA, 2010.

37. Grayson, K.; Johnson, D.; Chen, D.-F.R. Is firm trust essential in a trusted environment? How trust in the business context influences customers. *J. Mark. Res.* 2008, 45, 241–256. [CrossRef]

38. Kjærnes, U.; Harvey, M.; Warde, A. *Trust in Food: A Comparative and Institutional Analysis*; Palgrave Macmillan: New York, NY, USA, 2007; pp. 142–163.

39. Li, R.; Wu, H.; Yin, S.; Chen, X. *Introductiong to 2017 China Developmet Report on Food Safety*; Pecking University Press: Beijing, China, 2017; pp. 85–95.

40. De Steur, H.; Mogendi, J.B.; Wesana, J.; Makokha, A.; Gellynck, X. Stakeholder reactions toward iodine biofortified foods. An application of protection motivation theory. *Appetite* 2015, 92, 295–302. [CrossRef] [PubMed]

41. Fornell, C.; Bookstein, F.L. Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *J. Mark. Res.* 1982, 19, 440–452. [CrossRef]

42. Hair, J.F., Jr.; Hult, G.T.M.; Ringle, C.; Sarstedt, M. *A primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*; Sage Publications: London, UK, 2016; pp. 163–168.

43. Zhu, W.; Yao, N.C.; Ma, B.; Wang, F. Consumers’ risk perception, information seeking, and intention to purchase genetically modified food. *Br. Food J.* 2018, 120, 2182–2194. [CrossRef]
46. Picón-Berjojo, A.; Ruiz-Moreno, C.; Castro, I. A mediating and multigroup analysis of customer loyalty. *Eur. Manag. J.* **2016**, *3*, 701–713.

47. Carlson, C.C.; Peake, W.O. Rethinking food recall communications for consumers. *Iridescent* **2012**, *2*, 11–23. [CrossRef]

48. Nie, W.; Abler, D.; Zhu, L.; Li, T.; Lin, G. Consumer Preferences and Welfare Evaluation under Current Food Inspection Measures in China: Evidence from Real Experiment Choice of Rice Labels. *Sustainability* **2018**, *10*, 4003. [CrossRef]

© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).