

## Article

# Loneliness Makes Consumers Avoid Unsafe Food

Saiquan Hu <sup>1</sup> , Rui Chen <sup>2</sup>, Nan Zhang <sup>3,\*</sup> and Junming Zhu <sup>3,\*</sup> <sup>1</sup> Department of Psychology, School of Social Science, Tsinghua University, Beijing 100084, China; husaiquan@126.com<sup>2</sup> School of Journalism and Communication, Xiamen University, Xiamen 361005, China; rc2015@xmu.edu.cn<sup>3</sup> School of Public Policy and Management, Tsinghua University, Beijing 100084, China

\* Correspondence: zhang-nan@tsinghua.edu.cn (N.Z.); zjunming@gmail.com (J.Z.)

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**Abstract:** Sustainable food consumption is an essential component of sustainable development. Previous literature mainly focused on consumers' environmentally friendly consumption, and paid less attention to their avoidance of unsafe consumption. This article investigated the effect of loneliness—an important psychological and social trend—on consumers' avoidance of unsafe food and the associated mechanisms. Based on a survey with 120 student participants and an experimental study with 315 non-student participants, we found that loneliness made consumers avoid unsafe food, but not safe food. We further verified that consumers' perceived immune status and concern for negative impression worked as two mechanisms between the relationship of loneliness and food avoidance. Moreover, we revealed a moderating mediation effect of food safety risk, where the indirect effect of loneliness on food avoidance via both perceived immune status and concern for negative impression only existed for unsafe food. This article extended the research setting of sustainable consumption from increasing positive consumptions to decreasing negative ones, and identified the influential factors from the interaction of consumer characteristics and food features.

**Keywords:** sustainable food consumption; loneliness; food safety risk; perceived immune status; concern for negative impression; food avoidance

## 1. Introduction

Sustainable food consumption and production are becoming increasingly urgent issues with the ever-increasing anthropogenic carbon, water and ecological footprint. It plays an increasingly essential role in achieving sustainable development. While production-side improvement could significantly contribute to reducing environmental impacts per unit of food supply through technological change and efficient operation, consumption-side improvement has recently been receiving increased attention [1]. Sustainable food consumption is considered to be an essential aspect of sustainable development [2]: The Goal 12 of the 17 Sustainable Development Goals (SDGs) proposed by the United Nations calls for sustainable consumption patterns by raising consumers' awareness and education on sustainable consumption and lifestyles.

Consumers could contribute to sustainable development by either reducing waste from food consumption or being thoughtful in their daily food choices. Both increased consumption of sustainable food and reduced consumption of unsustainable food contribute to sustainable consumption. Previous research mostly paid attention to the former, such as the choice of environmentally friendly food (e.g., organic food products) [3,4], reduction of food loss and food waste [5], and fair trade (e.g., fair prices of goods and services, decent working conditions and security of producers) [6]. Alternatively, this research focused on the latter, consumers' avoidance of unsafe food.

We investigated unsafe food avoidance in the context of sustainable food consumption because food is associated with unknown risk from two sources: On the one hand, the use of pesticides and

related technologies in food production may cause negative ecological impacts; on the other hand, high consumption of red meat and energy-intensive food increases the risk of cardiovascular diseases, high blood pressure, cancer and metabolic syndrome [7]. Food safety risk can affect consumers' decision-making [8], but consumers do not have enough knowledge to judge risks accurately when they make food related decisions. Thus, policy makers should provide consumers with adequate information through standards and labels to help them acquire more knowledge about choosing sustainable food or avoiding unsafe food.

Literature showed that consumers' food avoidance tendency could be shaped by cultural and religious traditions, social norms [9], consumers' food choice motives (e.g., health motives, environmental motives, naturalness and taste) [10], subjective knowledge on sustainable food [11,12], and socio-demographics (e.g., gender, age) [13]. However, the influence of consumers' psychological state on food avoidance has been ignored. We focused particularly on consumers' loneliness. Loneliness is defined as the perceived social isolation and a distressing feeling that one's social needs are not being met by the quantity and quality of one's social relationships [14]. Studies found that loneliness makes consumers more sensitive to threats and therefore conduct more defensive behavior [15], such as food avoidance.

In this article, we tried to answer two research questions. First, what's the effect of loneliness, one of consumers' psychological states, on consumers' reaction to unsafe food? Second, how does loneliness affect consumers' reaction to unsafe food? Based on a survey and an experimental study, we found that loneliness makes consumers avoid unsafe food. Moreover, this effect is mediated by consumers' perceived immune status and concern for negative impression. The findings contribute to the research of sustainable consumption from the perspective of avoidance of unsafe food by exploring the possible influential factors from consumers' psychological status and food characteristics.

The structure of this article proceeded as follows: Section 2 reviewed the effect and mechanism of loneliness on consumers' food avoidance, and proposed two hypotheses. Sections 3 and 4 presented results from a survey and an experimental study that test the two hypotheses. Section 5 discussed the theoretical and practical implications, research limitations and future research directions. Section 6 provided the conclusion.

## 2. Effect and Mechanism of Loneliness on Consumers' Food Avoidance

### 2.1. Lonely Consumers Prefer to Avoid Unsafe Food

Consumers' avoidance of unsafe food is of paramount importance. Previous research mainly focused on the health risks associated with natural ingredients of food such as sugar, salt and calories and how these risks affect consumers' food choice [16]. There are three kinds of risks that are often perceived in food production: Technological risk induced by food production technology such as genetically modified technology; microbiological risk caused by bacteria like salmonella and listeria; and chemical risk from the use of additives and irradiation in food processing [17,18]. However, consumers' perception and choice of food associated with the risks are not well investigated. Consumers' risk perception is determined not so much by the objective level of food hazard, but the subjective impressions of it [19]. Even if there are no hazard in food, consumers may perceive food as unsafe, and choose to reduce their food purchases [20].

As a social species, consumers need to feel connected with others to obtain a secure social environment to survive and thrive psychologically and physically. When consumers feel lonely, they have an implicit hypervigilance towards social threats [21], with high sensitivity to social threatening stimuli [22]. They also perceive themselves as more vulnerable to the potential risk [23]. These features allow lonely consumers to focus on scanning threatening social cues or information about their environment and allocating more attention resources to identify the most negative cues [24]. Therefore, when presented with food, lonely consumers tend to detect and focus on the negative information (i.e., heavy metal and pesticide residue) of food that is associated with negative health outcomes.

They tend to neglect positive information such as taste and nutrition that is tied to enjoyment and happiness [16]. As a result, they might perceive the food as high risk and avoid consuming them. However, for food that not containing threatening cues that trigger negative cognition and emotion, lonely consumers would react and behave similarly to non-lonely consumers. Therefore, we proposed the first hypothesis below:

**Hypothesis 1.** *Loneliness is positively associated with consumers' avoidance of unsafe food but not associated with their avoidance of safe food.*

## 2.2. The Mechanisms of Loneliness and Avoidance of Unsafe Food

An evolutionary perspective suggests that consumers have the fundamental motivation to avoid physical harm and illness to survive and reproduce [25]. This fundamental evolutionary motivation, in turn, influences consumers' preference, decision-making, and behaviors [26]. For food consumption, research has suggested that low level of immunity makes consumers avoid food [27]. For example, infectious diseases lead to a loss of appetite, making consumers avoid some kinds of food to reduce the risk of infection [28].

As for lonely consumers, they are usually associated with poorer health conditions than others, even controlling for age, race, socioeconomic status, exercise, alcohol consumption and smoking [29]. They experience poorer immune status, such as weak natural killer cell function [30], smaller proliferative response to phytohemagglutinin stimulation [31], and lower level of antibody response [32]. Therefore, lonely consumers are more likely to be subject to infectious illness [33]. Furthermore, consumers who have poorer immune statuses and have recently been ill would activate the behavior immune system that work to help them detect cues connoting infectious pathogens and then exhibit avoidance behaviors [34]. When presented with potentially unsafe food, lonely consumers might quickly detect the infectious cues in the food such as Salmonella and food-borne parasites. Accordingly, they are more likely to perform avoidance reactions to unsafe food. For safe food, however, lonely consumers are not sensitive to the infectious or threatening cues even if they were recently ill.

In addition to the physiological mechanism, lonely consumers might avoid unsafe food just because they thought that consuming unsafe food in public (i.e., in a restaurant) might make negative impression of themselves on others. For example, people who consume food that is commonly perceived as unsafe might be perceived by others as individuals who don't take care of themselves, and individuals with social anxiety prefer to keep to a thin ideal if they believe this ideal will protect them from negative social evaluation [35]. Moreover, looking bad in the eyes of others might compromise socialization opportunities, which might make them feel lonelier [36]. Consequently, lonely consumers might also avoid unsafe food because of concern for others' negative impressions. Therefore, we proposed the second hypothesis:

**Hypothesis 2.** *Loneliness affects food avoidance through consumers' immune status and concern for negative impression. Specifically, the effect of loneliness on food avoidance via immune status and concern for negative impression exists for unsafe food, but not for safe food.*

## 3. Study 1

In this study, we used a survey to test Hypothesis 1 that presented lonely consumers prefer to avoid unsafe food. Before the study, we completed a pretest that selected genetically modified (GM) food as a representative of food with perceived technology-driven safety risk. Though genetically modified technology is beneficial in increasing food production, it induces health concern and anxiety among a large portion of the public [37].

### 3.1. Materials and Procedure

#### 3.1.1. Pretest

Thirty undergraduate students were recruited through a Chinese online forum to participate in a pretest. They were asked to read the definition of food safety risk, and were presented with two kinds of food—genetically modified meat and natural meat. We used meat as a representative of food, as it is widely used as a stimuli in survey and experimental studies in research of consumers decision making processes [38]. Participants rated their perceptions of food safety risk on a 7-point scale (1 = definitely safe, 7 = definitely unsafe). Results showed that genetically modified meat was perceived to be unsafe ( $M_{GM} = 4.81$ ,  $SD = 1.86$ ) and natural meat was perceived as safe ( $M_{natural} = 2.43$ ,  $SD = 1.42$ ). In the following survey, we thus used genetically modified and natural meat to represent unsafe and safe food respectively.

#### 3.1.2. Participants

One hundred and twenty students ( $M_{age} = 21.4$ ,  $SD = 3.02$ ; 36.7% were male) studied in the library of a university in the southeast of China were invited to participate in a 14-question survey for a small gift of a notebook. All participants signed an informed consent before completing the questionnaire. This research was conducted in January of 2018, and was approved by the university committee on Human Research Protection.

#### 3.1.3. Measurements

The survey procedure proceeded as follows. First, food avoidance was measured. Participants rated their likelihood to choose genetically modified meat and natural meat on a 7-point scale (1 = not likely, 7 = very likely). We reversely coded this item to represent food avoidance.

Second, loneliness was measured with 10 items from the R-UCLA scale [39]. This measurement of loneliness has excellent reliability and validity, and short-form version with as little as three items express nomological validity [40]. The measurement was originally in English and subsequently translated into Chinese following the back-translation process [41]. Participants rated how often they felt the way described in each item on a 4-point scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often). Example items include: “I feel isolated” and “People are around me but not with me”. The 10-item scale of loneliness has good reliability ( $\alpha = 0.874$ ) and validity (GFI = 0.972, AGFI = 0.934, CFI = 0.997, NFI = 0.963, TFI = 0.994, and RMSEA = 0.027). After reverse coding the positively worded items, scores of the 10 items were averaged to the score of loneliness, with a higher score indicating a higher level of loneliness.

Finally, participants reported demographics including age, gender (0 = male, 1 = female) and monthly expenses.

### 3.2. Results

Using SPSS 20.0, we regressed consumers' avoidance of unsafe food and safe food on loneliness, respectively, in four models to test Hypothesis 1. In model 1, loneliness was included as the only predictor and the avoidance of unsafe food was the dependent variable. Based on model 1, model 2 included demographic variables. In model 3, loneliness was included as the only predictor and the avoidance of safe food was the dependent variable. Similarly, based on model 3, model 4 included demographic variables.

As expected, loneliness had a significantly positive effect on avoidance of unsafe food in terms of model 1 ( $\beta = 0.025$ ,  $t = 1.990$ ,  $p = 0.049$ ). The result was consistent ( $\beta = 0.022$ ,  $t = 1.895$ ,  $p = 0.061$ ), when controlling for other variables such as age, gender and monthly expense in model 2. In contrast, loneliness had no significant influence on avoidance of safe food in model 3 ( $\beta = -0.011$ ,  $t = -0.755$ ,  $p = 0.452$ ) and model 4 ( $\beta = -0.013$ ,  $t = -0.960$ ,  $p = 0.339$ ). Therefore, these results supported Hypothesis 1. More detailed information is shown in Table 1.

**Table 1.** The effect of loneliness on unsafe and safe food avoidance.

	Unsafe Food Avoidance		Safe Food Avoidance	
	Model 1	Model 2	Model 3	Model 4
<b>Main effect</b>				
Loneliness	0.025 **	0.022 *	−0.011	−0.013
<b>Controls</b>				
Age		−0.018		0.013
Gender		0.162 *		0.023
Monthly expense		−0.167 *		0.142
R <sup>2</sup>	0.059	0.128	0.008	0.064
ΔR <sup>2</sup>	0.024	0.056	0.003	0.026

Note:  $n = 120$ ; \*  $p < 0.1$ , \*\*  $p < 0.05$ .

Study 1 provided preliminary evidence that loneliness is associated with unsafe food, but is not associated with safe food. Although the results supported Hypothesis 1, alternative explanations cannot be ruled out. For example, one may argue that the food used in this study contained many other types of information besides safety risk, so participants probably avoided the genetically modified meat for its nutrition. In other words, we do not know whether the food avoidance tendency is exactly induced by food safety risk. This problem is addressed in study 2 introduced below.

#### 4. Study 2

To replicate and ensure the internal and external validity of the study 1, three modifications were made in designing study 2. First, to address the potential confounding factors of other food information in study 1, participants were randomly assigned to one of the two conditions with only one difference—food safety risk. Second, to confirm the validity of food safety risk's effect, it was manipulated by another food made of animal intestines, which may be associated with a higher microbiological risk than other food [42]. Third, as study 1's sample size was small and participants were students, a larger sample of adults was used in study 2. In addition, to test Hypothesis 2 and investigate other potential mechanism, perceived immune status and concern for negative impression were measured.

##### 4.1. Materials and Procedure

###### 4.1.1. Participants

This study was conducted in July 2018, and was approved by the university committee of Human Research Protection. Participants were recruited with payment from a professional Chinese online data collection platform: Sojump (<http://www.sojump.com>). It contains about 2.6 million sample resources with diverse demographics from more than 30 provinces in China [43]. A total of 340 Sojump workers consented to participate in the study; however, 20 of them quit the survey. The 320 other participants completed the survey. Five out of the 320 were dropped as their answers to all questions were the same. Of the final 315 participants ( $M_{age} = 31.34$ ,  $SD = 6.69$ ; 39.0% were male), 91.1% had a college or higher degree, 57.4% expended 3000~9000 RMB monthly. For the perceived socioeconomic status, 59.4% thought they lived at the average level and 15% felt they lived above the average.

Before the survey, all participants signed an informed consent electronically, and they were told that the information they provided was guaranteed anonymity and that they could end the study at any time during the survey.

#### 4.1.2. Design and Manipulation

This study employed a two (food safety risk: Unsafe vs. safe) by continuous variable (loneliness) between-subject design. Participants were randomly assigned to either an unsafe food or a safe food condition. In both conditions, participants were told to read a scenario that was described below:

You arrived at a Mexican restaurant and try to seek a new food which is currently popular: Tacos. The waiter gave you a menu with a description of this food, together with a picture.

Participants assigned to the unsafe food condition were shown a menu with information as follows: *the main ingredients of Tacos include beef, fish, pork, and animal intestine (mixed of ox liver, kidney and stomach)*. In comparison, participants assigned to the safe food condition were shown a menu with similar information but without animal intestine: *the main ingredients of Tacos include beef, fish and pork*.

#### 4.1.3. Measurements

Immediately after reading the scenario, participants in each condition were asked to complete a 24-question survey questionnaire, including measurements of food avoidance, loneliness, perceived immune status, concern for negative impression, and demographics.

All participants indicated their agreement with whether Taco shown in their scenario is associated with safety risk on a 7-point scale (1 = extremely disagree, 7 = extremely agree). This measurement served as a manipulation check for food safety risk.

The measurements of food avoidance and loneliness were the same as that in study 1. For the measurement of perceived immune status, we asked participants to rate their own occurrence of four symptoms—*anxiety, fatigue, sleep disturbance, and infectious illness*—in the last six months on a 7-point scale (1 = never happened; 7 = frequently happened). We then averaged each participant's scores to the four symptoms as an index of perceived immune status, with a higher score representing lower immune status. We did not measure objective immunity, which requires testing all participants' blood to get the mostly used indicators of Epstein-Barr virus and cytomegalovirus antibody titers. The literature showed that such objective immunity indicators were highly correlated with the presence of the four symptoms [44].

As for the measurement of concern for negative impression, we adapted the Brief Fear of Negative Evaluation Scale [45,46] and asked participants to rate "to what extent do you think you may leave a negative impression on other consumers when you had the food in the restaurant? (1 = not at all, 7 = very much so)" and "to what extent do you think you will be considered as a person not caring about your health by other consumers when you had the food in the restaurant? (1 = not at all, 7 = very much so)". These two items were highly positive correlated ( $r = 0.682, p < 0.01$ ), thus, we averaged the scores of these two items as an index of concern for negative impression ( $\alpha = 0.811$ ).

Finally, participants reported their social demographics, including age, gender (0 = male, 1 = female), education, monthly expense, perceived socioeconomic status (1 = absolutely below average, 5 = absolutely above average), and perceived knowledge of food safety (1 = extremely un-knowledgeable, 7 = extremely knowledgeable).

### 4.2. Results

#### 4.2.1. Manipulation Check

We used SPSS 20.0 to analyze the data. As expected, participants randomly assigned to two conditions differed significantly in their perception of food safety risk. Participants in the unsafe food condition perceived Taco as riskier than those in the safe food condition ( $M_{unsafe\ food} = 4.75, SD = 1.69$ ;  $M_{safe\ food} = 3.76, SD = 1.39$ ;  $p = 0.029$ ). This result suggested that random manipulation of food safety risk was successful. In addition, a balancing test showed that the difference of loneliness between two conditions was not significant, indicating that the manipulation did not affect participants' rate of their loneliness.



#### 4.2.2. Test of Hypothesis 1 (Replication of the Result of Study 1)

Considering loneliness being a continuous variable, we followed the recommendation of Aiken and West [47] to use three regression models to test Hypothesis 1 (see Table 2). In model 1, we only regressed food avoidance on loneliness and food safety risk (0 = safe food; 1 = unsafe food). The result indicated that loneliness was positively and significantly associated with food avoidance ( $\beta = 0.242$ ,  $t = 4.214$ ,  $p < 0.001$ ). In model 2, we added an interaction term between loneliness and food safety risk. The result demonstrated that the main effect of loneliness was not significant ( $\beta = 0.081$ ,  $t = 1.027$ ,  $p = 0.305$ ), but the effect of the interaction term was positive and significant ( $\beta = 0.791$ ;  $t = 2.932$ ;  $p = 0.004$ ). This result suggested that the effect of loneliness on food avoidance only existed on the unsafe food condition.

**Table 2.** The effect of loneliness on unsafe food avoidance.

Food Avoidance			
	Model 1	Model 2	Model 3
<b>Main effects</b>			
Loneliness	0.242 **	0.081	0.022
Food safety risk	0.176 **	−0.586 **	−0.567 **
<b>Interaction</b>			
Loneliness x Food safety risk		0.791 **	0.783 **
<b>Controls</b>			
Age			0.060
Gender			0.025
Education			0.006
Monthly expense			−0.113
Perceived socioeconomic status			−0.033
Knowledge of food safety			−0.181 **
R <sup>2</sup>	0.087	0.115	0.174
ΔR <sup>2</sup>	0.080	0.105	0.146

Note:  $n = 315$ ; \*  $p < 0.1$ , \*\*  $p < 0.05$ .

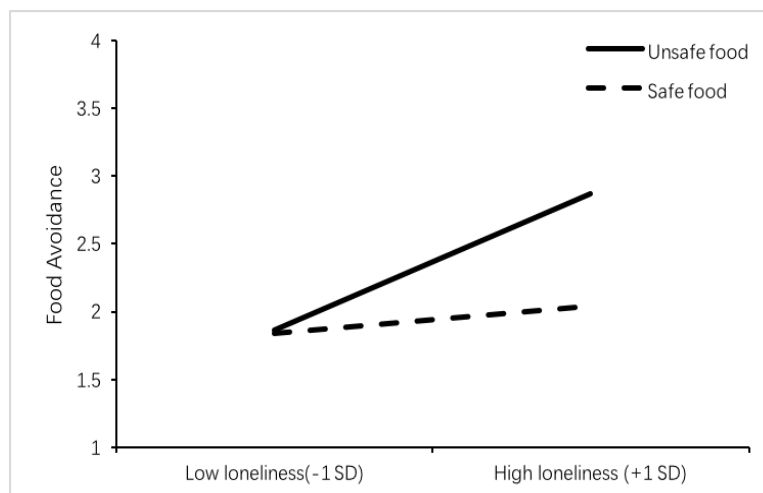
Although the explained variance increased from 8% in model 1 to 10.5% in model 2 after adding the interaction term, the variance of the estimated model was not fully explained. In model 3, more explicative variables, such as age, gender, education, monthly expense, perceived socioeconomic status, and knowledge of food safety, were included as controls. The explained variance increased to 14.6%. And the result was consistent with that in model 2. Specifically, the main effect of loneliness was not significant ( $\beta = 0.022$ ,  $t = 0.086$ ,  $p = 0.507$ ), but the effect of the interaction term remained positive and significant ( $\beta = 0.783$ ,  $t = 2.956$ ,  $p = 0.003$ ).

The result in model 3 also showed that knowledge of food safety had significantly negative effect on food avoidance ( $\beta = -0.212$ ,  $t = -2.94$ ,  $p = 0.004$ ), which means consumers who are well-informed on food safety information might less avoid food in general.

In addition, we performed a simple slope test to reveal the differential effects of loneliness on avoidance of unsafe and safe food. Results indicated that when facing unsafe food, high lonely participants showed high food avoidance than that of low lonely participants ( $\beta = 0.745$ ,  $t = 5.08$ ,  $p < 0.001$ ). In contrast, when facing safe food, high and low lonely participants did not differ significantly in their food avoidance ( $\beta = 0.146$ ,  $t = 1.03$ ,  $p = 0.305$ ).

Facilitating the interpretation of the interaction effect, Figure 1 illustrates the interactive effect of loneliness and food safety risk on food avoidance. From Figure 1, we can find that when the participants' loneliness moves from low to high, the unsafe food avoidance increases sharply, but the safe food avoidance increases only slightly. Thus, these results supported Hypothesis 1 that

loneliness is significantly associated with unsafe food avoidance, but not significantly associated with safe food avoidance.



**Figure 1.** The interaction effect of loneliness and food safety risk on food avoidance.

#### 4.2.3. Test of Hypothesis 2

Following Model 14 of the PROCESS Macro [48], we performed a 5000 resampling bootstrapping moderated mediation analysis with loneliness as the independent variable, food safety risk as the moderator, both perceived immune status and concern for negative impression as the mediators at the same time, and food avoidance as the dependent variable.

The result showed a moderated mediation effect of perceived immune status: Food safety risk moderated the mediation effect of perceived immune status between loneliness and food avoidance (indirect effect = 0.193, 95% CI = [0.063, 0.392]). In particular, the indirect effect of loneliness on food avoidance through perceived immune status was significant on the condition of unsafe food (0.207, 95% CI = [0.090, 0.376]). In contrast, on the condition of safe food, the indirect effect of loneliness on food avoidance through perceived immune status was not significant (0.014, 95% CI = [−0.061, 0.117]). Thus, this pattern of result suggested that the effect of loneliness on food avoidance through the mediating role of perceived immune status only exists for the unsafe food condition.

The result also suggested a moderated mediation effect of concern for negative impression: Food safety risk moderated the mediation effect of concern for negative impression between loneliness and food avoidance (indirect effect = 0.100, 95% CI = [0.013, 0.230]). Specifically, the indirect effect of loneliness on food avoidance through concern for negative impression was significant on the condition of unsafe food (0.069, 95% CI = [0.006, 0.170]). However, on the condition of safe food, the indirect effect of loneliness on food avoidance via concern for negative impression was not significant (−0.031, 95% CI = [−0.107, 0.030]). This result verified that the concern of creating a negative impression was a mediator that could explain the effect of loneliness on unsafe food avoidance. Taking these results together, the Hypothesis 2 that the effect of loneliness on food avoidance via perceived immune status and concern for negative impression only exists for unsafe food was supported.

## 5. General Discussions

The primary purpose of this article was to explore whether and how a psychological condition (loneliness) affect consumers' preference for sustainable food consumption. Based on a survey and an experimental design, we revealed a positive effect of loneliness on consumers' avoidance of unsafe food, and the roles of perceived immune status and concern for negative impression in mediating this effect. Our findings relate to at least two strands of literature: food avoidance and sustainable food



consumption, and loneliness and consumption behaviors. In this section, we first presented theoretical and practical implications, and then discussed the limitations of this research and possible future research directions.

### 5.1. Theoretical Implications

#### 5.1.1. Food Avoidance and Sustainable Food Consumption

Both psychological status and features of food vary across consumers and shift with social economic development. The former is continuously changing along with the trends of urbanization, industrialization, and changes of social structure. The latter, being both objectively and subjectively determined, is affected by the inputs and technologies used in food production, as well as consumers' perception of those inputs and technologies. Sustainable development may both influence consumers' psychological status by changing communities and urban forms and influence risk perception of food by directly changing the food production system. The overall trend of consumer food choice in the transition to sustainable development, therefore, could be complicated as implied by our findings.

Our findings enriched the understanding of factors that affect consumers' food choice. Previous research showed that both consumers' characteristics (e.g., eating goals and impulsivity) and food features (e.g., naturalness and taste) may influence food choice [49,50]. We showed that the two factors have an interactive effect on consumers' food choice. Particularly, loneliness as consumers' psychological state increases the tendency to avoid unsafe food. The findings complement the literature of sustainable consumption from a perspective of consumers' food avoidance. It suggests a complicated relationship of consumers' sustainable consumption being motivated by risk-reduction and health-keeping reasons rather than the environmental protection motivation. In addition, previous studies found limited significance for environmental concerns of meat-reduction, and prominent influence of health and nutrition [51]. In this article, we showed that consumers would avoid meat products with perceived safety risk. In this way, consumers may contribute to sustainable consumption by avoiding unsafe and unsustainable food.

#### 5.1.2. Loneliness and Consumption Behaviors

Our findings extend the loneliness research setting from social domain to consumption domain. Previous research about loneliness focused on social threats such as ignored by a group of peers [52] and painful facial expression [53]. Our research broadened the research scenario from social relationships to consumption behavior by using unsafe food as a typical threat in daily life. We also extended the effect of loneliness on visual and attentional avoidance that investigated in previous research to food avoidance. Furthermore, this research advanced the motivation of lonely consumers from social-reconnection to self-safety concern. Previous literature mainly concentrated on the social reaction behaviors of lonely consumers, indicating that they are more likely to choose minority products to be unique and get social attention [54], and conduct prosocial behaviors such as donating more money to charity [55] and being more willing to help others [56]. Unlike these social behaviors, our research suggested that lonely consumers would show self-protective behaviors to negative cues such as unsafe food.

As for the mechanisms between loneliness and avoidance of unsafe food, this research advanced the understanding of the effect of loneliness on food avoidance from physiological and social perspective. Previous research tried to explain the mechanisms through which loneliness could affect behaviors from psychological perspective, such as the empathy and social connection. However, in this research, we confirmed a physiological mechanism—perceived immune status. Moreover, we found a social mechanism—concern for negative impression, which suggests that gaining social acceptance and avoiding negative evaluation from others also served as motivations for lonely consumers to avoid unsafe food.

## 5.2. Practical Implications

With consumers paying increasing attention to organic, health, and wellness products in daily consumption, salient and differentiable labels (e.g., organic food, private labels) could play a greater role in facilitating sustainable consumption [57]. While we showed two mechanisms through which loneliness leads to avoidance of unsafe food, we do not suggest that sustainability should be promoted by manipulating people's emotional feeling of loneliness. There are other more practical implications based on our findings. A direct policy implication is that information provision matters. Providing more information of food safety and sustainability may not help all the public make wise choice and promote sustainability, but it is very effective to a group of people that are socially disconnected.

The differential response of the public to food risky information provision indicates another implication for public managers implementing those information policies or business managers that are conscious about sustainability. It suggests that this information and marketing programs could be better targeted at socially disconnected groups, which were often less noticed in previous practices. Because of these social groups' more active response to the information, programs tailored to them would generate more effective outcomes.

## 5.3. Limitations and Future Research Directions

Despite the contribution of our research, there are three limitations that could be addressed in future research for validity and generalizability. Firstly, this study only used meat as a representative of food and explored safety risk as one feature of food. Particularly, we focused on consumers' subjective risk perception of different food rather than measuring the objective level of food risk. Future research could investigate other kinds and features of food, such as unhealthy, but not necessarily risky food—fried food, salty food and high-calorie food. The effect of psychological status on other kinds of food may be different. Secondly, future research could use alternative measurements. For example, objective measurements of immunity, such as Epstein-Barr virus cytomegalovirus antibody titers [44], could be used to replace subjective perception of immune status. Accordingly, actual food avoidance behaviors of lonely consumers could be observed instead of collecting self-reported food avoidance. Thirdly, participants in the current research were students and well-educated adults. Future research could explore a more diverse sample, for example, senior people and non-college degree received adults, to generalize our research findings.

## 6. Conclusions

Sustainable food consumption has essential influences on consumers' health and sustainability of socioeconomic development. It has been integrated into one of the 17 SDGs, namely Goal 12 of "Ensure sustainable consumption and production patterns". While many factors affect sustainable food consumption, a fundamental factor comes from consumers' own choices. The primary purpose of this article was to test whether consumers of different loneliness status react differently in food avoidance and the associated mechanism. Based on a survey and an experimental design, we revealed that loneliness makes consumers avoid unsafe food, but not safe food. Further, we confirmed the perceived immune status and concern for negative impression, as two mechanisms of the effect of loneliness on food avoidance. Our findings indicated the importance of people's psychological factor in achieving sustainable consumption. Future research could investigate more cognitive and behavioral factors to facilitate sustainable food consumption and provide empirical implications to policy making for sustainability.

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