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Funky chicken: Temporary quality failures influence heavy users the least

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ABSTRACT

Background: Food safety is a major concern for retailers, restaurants, consumers and public health. But what happens to reputation and recovery when food becomes tainted? **Aim:** Using notions of overconfidence and self-attribution, this study shows how new and existing consumers react to temporary quality failure and perceived food safety risks. **Method:** To do this, lunchtime participants were served chicken by a local restaurant that was potentially contaminated. In reality, half of the participants' chicken had been tainted with fish sauce - a harmless but noxious-smelling ingredient that made the chicken taste somewhat spoiled. **Results:** Results showed that people decreased consumption when serving themselves the fish-sauce chicken, but would not cease to eat altogether. Interestingly, diners updated their risk perceptions and judgments based on their eating behaviors. The more chicken diners ate, the more favorably they tended to rate the food, suggesting a confirmatory bias. Consumers with previous experience with the restaurant were no better judges of the food probably because of a stronger psychological bias. **Conclusion:** This study offers an important explanation for why consumers are less responsive to public food safety information than some experts believe is appropriate.

KEY WORDS: Cognitive dissonance, confirmatory bias, food safety, justification, self-compliance

INTRODUCTION

Food safety is a major concern for retailers, restaurants, consumers and public health. In general, public regulatory agencies and private food companies should be responsible for minimizing the food safety risk and providing related information. However, a significant amount of control over these health risks lies in the hands of the consumers, who are the final decision makers of consumption. In this sense, it is important to better understand consumers' risk perception and reactions to related information. Previous studies suggest food safety information is relatively ineffective in changing consumer behavior [1], but very few offer reasons as to why this is so. This study uses experimental evidence to identify cognitive dissonance and its subsequent behavioral impacts on consumers' risk attitudes and response to information in a food safety context. The results of the experiment provide some explanations for why typical consumers are often less responsive to food safety scares.

Cognitive dissonance is a state of discomfort caused when an individual holds two contradictory beliefs [2]. Cognitive dissonance, past behavior, and experience may induce consumers to adjust their beliefs to rationalize their behaviors [3]. Further, past behavior and experience could also impact consumers' reactions to information, especially when the signals are ambiguous. Confirmatory bias is a natural tendency to reduce dissonance [4]. It can happen through different channels. One example is that it causes consumers to interpret ambiguous evidence in a more favorable light [5].

Our study complements existing research in the following ways: First, we differentiate past experience and one-time behavior to investigate the short-term behavioral effect on perception and its interaction with long-term experience. Second, we exogenously introduce an ambiguous signal of a food's safety and investigate how test subjects' risk perception changes in the presence of the signal and in lights of subjects' past experience. Third, we adopt an incentive compatible experimental design to solicit actual consumption behaviors, and the contingent effects of psychological biases on these behaviors. The results will highlight the fact that effects derived from behavioral intention and self-reflection measures may not necessarily transfer into actual consumption scenarios. Fourth, our study will be one of the very few consumer behavior studies which use cognitive dissonance theories to address food safety and public health issues.

This paper begins with a review of relevant research in Section 2, from which testing hypotheses are derived. Section 3 provides the experimental design and identification strategies. Section 4 presents the results of short- and long-term behavioral patterns, perceptions, dissonance feelings, and future behavioral changes. Section 5 checks the validity of this study and the robustness of the analytical results. Section 6 concludes.

LITERATURE REVIEW

Cognitive Dissonance and Confirmatory Bias

Cognitive dissonance theory, formulated in the mid-1950s by Festinger, refers to the uncomfortable feeling caused by holding two contradicting attitudes, beliefs, or behaviors at the same time. According to this theory, discomfort ensues when an individual beholds two or more relevant yet inconsistent pieces of knowledge. When one holds a certain belief but is forced to act against it, disagreement or dissonance exists between the action and the previously held belief. Motivated by the unpleasant state of dissonance, one engages in "psychological work" so as to reduce the inconsistency; typically this work supports the cognition which is most resistant to change. In other words, a person just did something irrevocable in opposition to a long-held belief and may end up regarding that belief as less important than before.

In general, to reduce the dissonance, an individual could add consonant cognitions, subtract dissonant cognitions, increase the importance of consonant cognitions or decrease the importance of dissonant cognitions. One of the most common ways of reducing dissonance is changing in attitudes. Attitude change is expected to occur in the direction of the cognition that is most resistant to change [6]. In tests of the theory, it is often assumed that knowledge about recent behavior is most resistant to change since it is often very difficult to undo behavior. Thus, attitudes are adjusted to be consistent with the recent behavior.

Confirmatory bias, a motivational process that aligns with cognitive dissonance, is an error in information processing that refers to selectively collecting information to reinforce an initial belief [4,7], or strategically interpret ambiguous signals as supporting evidence [8,9].

Consumer Behavior and Future Research

Several articles have described how the theories of cognitive dissonance and confirmatory bias relate to consumer behavior [6,10,11]. The empirical research generally falls into two categories: (1) Effects of dissonance on attitude change and the tendency to repurchase, and (2) effects of dissonance on selective information seeking by consumers.

In general, studies examining the effects of dissonance on attitude change and the tendency to repurchase support the theory's predictions [10,12]. By the foot-in-the-door technique, consumers who care about consistency can make bigger commitments following a smaller one [13,14]. Wessells *et al.* used survey data and showed that consumers' perceptions of seafood safety are influenced by their past experiences [15]. Furthermore, these perceptions influence the anticipated changes in consumption under different hypothetical situations concerning seafood.

Recent literature on food safety and public health provides evidence in information seeking/avoidance tendency by high dissonance subjects. Lin *et al.* found that searching for fat and cholesterol information on food labels is less likely among individuals who consume more of these nutrients, supporting the theory of selective information avoidance tendency [16]. Similarly, Case *et al.* reviewed recent studies on uptake of genetic testing and coping strategies of cancer patients and found evidence for the human tendency to avoid, ignore, or deny information, particularly in the context of health [17].

Despite the development of cognitive dissonance research on consumer behavior so far, there exist a few gaps in this field.

First, most studies used either a one-time purchase or a long-term consumption pattern as the "irrevocable" behavior to induce dissonance, but very few took into account both. The channel through which cognitive dissonance and judgment bias happen can be very different for consumers with the same short-term behavior but different long-term experiences. Potential heterogeneous impacts raise the need to differentiate short-term and long-term consumption behaviors.

Second, one general comments for the dissonance literature is the endogeneity problem (or confounding effects). Since certain purchase decision and information exposure might also be related to a consumer's long-held attitudes, using these behavioral stimuli to explain later attitude changes is subject to the endogenous problem. Some exogenous treatment is hence, needed to accurately identify the psychological terms. Forced-compliance paradigm[1] is also a complementary solution. In a food consumption situation, randomly assigning participants to certain foods will allow researchers to investigate the subsequent behaviors.

Third, when discussing the impact of dissonance feelings on future purchase, most studies limit the scope to purchase tendency, rather than the actual repurchase behavior. To the extent that consumers may not fully (consciously) admit the existence of psychological bias in their judgment, the findings derived from intention and self-reported measures may not transfer to real purchase decisions. As a result, an incentive compatible experimental design is needed to solicit reliable results for future purchase.

Last but not the least, studies on dissonance theories in consumer behavior should be differentiated between general marketing studies and public health studies. The former group, which is more fruitful so far, necessarily has a commercial focus, i.e., building consumer loyalty, promoting sustaining repurchase, etc. The latter group, in which studies are still scarce, focuses more on safety and health concerns, i.e., encouraging health behaviors, and nudging potential safety risks, etc.

Our study aims to contribute to the literature by filling into these gaps.

1 This is different from most studies in the marketing field where the free-choice paradigm is widely adopted, partially because it seems more realistic. Consumers in a forced compliance paradigm would not necessarily comply with buying sub-optimal goods if the best alternative was available.

Testing Hypotheses

Following the existing literature and the objectives of this study, we hypothesized generally that while individuals would reduce their consumption when facing strange signals indicating that the food may potentially be contaminated, they would not cease to consume altogether. This hypothesis is in line with most of the food psychology literature, which suggested that individuals have a hard time resisting food that is immediately available [4,18], or that has already been purchased and is within the household [19]. In other words, consistent taste may cause individuals to stick to their previous behaviors when they are making food choice decisions.

H1: People reduce consumption when facing ambiguous signals about food quality, but would not cease to consume altogether.

H1.1: Users with past consumption experience show higher tolerance to temporary quality changes.

Further, consumers may differ in sensitivity to the signal due to their previous eating experiences. For this reason, we hypothesized users would sense the strangeness of the food with a higher probability than non-users in the first place. However, we further hypothesized that the sensitivity would decrease as the participants ate more chicken. This hypothesis is driven from cognitive consistency and confirmatory bias that have been widely found in a variety of fields. Subjects would first update their beliefs to be consistent with their previous behaviors and then intentionally interpret signals as supporting evidence for their beliefs.

H2: Past consumption experience increases the sensitivity to food quality changes.

H3: Due to cognitive consistency and confirmatory bias, the sensitivity to food quality changes decreases as consumption increases.

EXPERIMENTAL DESIGN

Treatments and the Timeline

This food choice experiment had approval from the University's Institutional Review Board. The experiment was designed to measure participant response to ambiguous signals in food. The weight of food served to and consumed by each participant was recorded and participants' feelings, expectations, and perceptions of the food were asked afterward. We focused on the interrelationship between participants' past eating behaviors, current risk perceptions, and future information processing procedures. Even though the common observation suggests that individuals overestimate the probability of rare events [20], research on food choices also reports that consumers tend to underestimate the risk of food-borne illnesses [21]. This experimental methodology and the results provide us with an explanation for the underestimation of risk.

In this lunchtime experiment, participants were placed in a situation where they were required to eat chicken that might be tainted. This study used a 2 × 2 between-subjects design where food quality was manipulated and restaurant quality was measured. First, participants were randomly assigned to two treatment groups. In one group, we added fish sauce to a chicken dish. The fish sauce had a very strong smell and served as an ambiguous signal that the food was potentially tainted. In the other group, the participants were offered the normal chicken dish (i.e., no fish sauce). In both groups, chicken was delivered by a popular local restaurant. Further, within each group, participants were categorized as users and non-users, depending on whether they had previously eaten food from the restaurant.

Participants in the experiment were recruited for a "food marketing study," and promised $5 and a meal for their participation. Each session took place at 12:30 pm on a Tuesday, Wednesday or Thursday. Subjects were directly informed that the experiment would be conducted by a university professor. Participants were asked to enter the buffet line and select as much as they liked of each of the foods: Boneless fried chicken tenders, French fries, pudding, applesauce, celery, macaroni salad, soda and bottled water. Subjects were instructed to take at least a little of each item, and each item was to be placed on a separate small plate on their tray. At the end of the buffet line, all plates were weighed individually. After the completion of the meal, participants' plates were again weighed to determine how much of each item had been consumed. Each subject was then asked to complete a written survey and then discuss their impressions of the experiment with the experimenter.

Identification Strategies

To investigate the impact of past short-term behavior on present perceptions and feelings of cognitive dissonance, four stages in the experiment's cognitive procedure were used as measures. The first stage of measures "Short-term Eating Behavior," included the amount of food taken, the amount of food eaten, and the calculated percentage of the food eaten by each individual. The amount of food eaten was then used as a control over the intensity of the behavioral impact, with more food eaten representing stronger behavior. The second stage of measures, "Feelings and Evaluations of Food Attribute," included participants' ratings of chicken taste and quality, etc. The third stage of measures, "Perceptions and Justifications of Short-term Behavior," linked participants' perceptions with their feelings about the risk of food contamination, interpretations about the ambiguous signal of food quality and justifications for their own eating behaviors. The last stage of measures "Future Behavior and Tendency to Repurchase," elicited the participants' willingness to pay (WTP) based on past eating behaviors and perceptions of risk.

The following model is used to test the hypotheses:

$$Y = \alpha + \beta_1 FishSauce + \beta_2 ChickenEaten + \beta_3 FishSauce \times ChickenEaten + \beta_4 User + \beta_5 User \times ChickenEaten + \delta X + \in \quad (1)$$

In Equation (1), Y is the outcome variable of interest in any of the last three stages. *FishSauce* is a dummy indicator which equals to 1 if the individual participant was in the fish sauce treatment, and 0 if not. This is also the exogenous treatment which brings in the ambiguous signal about quality of the food. *User* is another dummy indicator, which equals to 1 if the individual participant has previous experience of eating the food from the local restaurant, and 0 if not. This variable controls the effect of (long-term) previous consumption experience and perceptions. *ChickenEaten* represents the amount of chicken eaten (in gram) by the individual participant in the experiment. *ChickenEaten* is used to measure of the intensity of irrevocable (short-term) behavior, with a larger eating amount meaning a higher behavioral intensity. To further capture the differentiated effects of (short-term) behavior on perception changes, *ChickenEaten* is interacted with the two dummies, *FishSauce* and *User*.

Similar analysis can be performed for the user group and non-user group separately using Equations (2) and (3) to find how people react differently due to different (long-term) previous consumption experience.

$$Y \mid User = \alpha + \beta_1 FishSauce + \beta_2 ChickenEaten + \beta_3 FishSauce \times ChickenEaten + \delta X + \in \quad (2)$$

$$Y \mid Non-User = \alpha + \beta_1 FishSauce + \beta_2 ChickenEaten + \beta_3 FishSauce \times ChickenEaten + \delta X + \in \quad (3)$$

EXPERIMENT RESULTS

Demographics and Short-term Eating Behavior

A total of 61 participants completed the experiment. Demographics can be found in Table 1. As shown in Table 1, we had a good control between age and body mass index. These demographics and day of the experiment were controlled in the data analysis. Main results are consistent between inclusion and exclusion of these control variables.

With self-reported past consumption experience, 15 out of 28 participants in the fish sauce group were categorized as users and 17 out of 33 in the non-fish sauce group were users. Since we focused on the interaction between behavior, perception, and information processing, this way of organizing participants provided the most flexibility to test our hypotheses.

Table 2 shows the food choice behavior between groups. On average, people took 150.35 g of chicken and ate 127.85 g of it. For the fish sauce effect, people ate less when the chicken contained fish sauce ($F = 8.16$, $P = 0.00$). This finding was consistent with our hypothesis H1 that consumers would decrease their consumption, but would not stop eating altogether when the food tasted strange. This trend was found in both the user group and the non-user group, although the difference in the user group is not significant.

As regards the user effect, users ate slightly more than non-users. Comparing choices between groups, in the fish sauce group, users took and ate significantly more chicken than non-users ($F = 3.48$, $P = 0.07$), but in the non-fish sauce group, users and non-users did not differ significantly ($F = 0.00$, $P = 0.98$). These results could be understood to mean that past experience did not impact behavior when the food was normal (non-fish sauce group), but when the condition of the food was compromised (fish sauce group), users had higher tolerance than non-users for the changed conditions due to their past experiences (e.g. loyalty). Note that users' higher tolerance for compromised food products does not conflict with the fact that they are at the same time more sensitive to quality changes.

Table 1: Demographics

Variable	All	Spoiled chicken (tainted with *FishSauce*)	Normal chicken (non-*FishSauce*)	*P* value
Gender (female=1)	0.525	0.667	0.357	0.015
	(0.50)	(0.48)	(0.49)	
Age	19.721	19.727	19.714	0.977
	(1.69)	(1.42)	(2.00)	
Height	67.697	66.682	68.893	0.008
	(3.31)	(3.10)	(3.19)	
Weight (lbs.)	145.377	139.879	151.857	0.080
	(26.65)	(22.42)	(30.03)	
BMI	22.166	22.020	22.338	0.648
	(2.68)	(2.37)	(3.04)	
No observations	61	28	33	

BMI: Body mass index

Table 2: Eating behaviors

Variable	All	Normal chicken (non-*FishSauce*)		Spoiled chicken (tainted with *FishSauce*)	
		Non-user	User	Non-user	User
	(1)	(2)	(3)	(4)	(5)
ChickenTaken	150.350	174.400	165.750	113.118	155.813
	(73.35)	(84.45)	(68.71)	(49.65)	(77.74)
Remaining	22.131	20.200	10.154	25.294	30.313
	(35.26)	(34.18)	(17.04)	(35.19)	(46.04)
Eaten	127.850	154.200	154.750	87.824	125.500
	(69.09)	(78.38)	(63.94)	(58.68)	(57.22)
% Eaten	0.826	0.900	0.943	0.730	0.770
	(0.27)	(0.17)	(0.10)	(0.37)	(0.29)
No observations	61	15	13	17	16

Feelings and Evaluations of Food Attributes

To investigate participants' sensitivity to food quality changes, several statements on feelings and evaluations of food attributes were presented to the participants. Individuals' agreements on these statements were collected via a nine-point scale, with 1 meaning strongly disagree and 9 meaning strongly agree. Table 3 listed all seven statements and their average levels of agreement. Principal component analysis was used to extract one common scale as a measure of evaluation for the chicken eaten. Statistical results in Table 3 showed the validity of this single common scale: An Eigen value of 4.06, with 58.02% of total variance explained. A Cronbach's alpha of 0.855 and the Kaiser–Mayer–Olkin index of 0.813 detected reliability and strong correlations. According to the loading factors, the common scale got positive weights on

the 5 positive statements and negative weights on the 2 negative statements. As a result, the common scale represented a "positive evaluation" of the food product, i.e., the chicken eaten.

Table 4 showed how (positive) evaluation of the food product was influenced by the treatment dummy *FishSauce* and the behavior variable *ChickenEaten*, in addition to the interaction terms between the two. Based on the results, participants sensed the fish sauce (treatment) in a correct way. On average they evaluated the food 3.14 points lower when they were in the fish sauce group. However, their sensitivities were mitigated as they ate more chicken. To be more detailed, the slope effects are significant and of large (positive) scale on the interaction term of *FishSauce* and *ChickenEaten*, but insignificant and of much smaller scale on *ChickenEaten* itself[2]. This combination of results suggest that in general, people do not necessarily update beliefs in response to short-term eating behaviors; but once they feel dissonance, their judgment is subject to "wishful thinking" bias [22].

2 The model with a non-zero interaction term was tested against the restricted model without interaction. Test of restriction rejected the restricted model at 95% significant level (F statistics = 4.569), suggesting that an interaction term should be included in the regression.

Table 3: Evaluation of food attributes and principal component analysis

Evaluation of food attributes					
Statement (1-9)			Mean	Standard	Loading factors
The chicken looked appealing			5.780	2.060	0.189
The chicken was very tasty			6.224	1.727	0.461
The chicken was high in quality			5.345	1.763	0.428
The chicken is better than typical			4.915	1.914	0.391
The chicken didn't taste quite right			3.776	2.095	−0.431
The chicken tasted tainted			3.259	1.943	−0.417
(Evaluation of) The last piece of chicken			4.081	1.936	0.238
Positive evaluation (principal component)					
Eigen value	% variance explained	Cronbach's alpha	KMO	Mean	Standard
4.06	58.02	0.855	0.813	0.000	2.015

KMO: Kaiser–Mayer–Olkin

When regressions were run separately for users and non-users, the pattern found in the pooled regression in Table 4, was even stronger for users. Users reported huge gaps in their evaluations when they were in the fish sauce group, showing that previous experiences made them more sensitive to the change in the food condition. However, they were also subject to stronger cognitive dissonance bias, i.e., as they ate more chicken, they tended to rate the chicken more favorably (with significant slopes for the interaction term). A possible explanation is that past experience can help consumers notice a change in the food. But an ambiguous change in the food condition triggered the tendency to interpret the change as favorably as possible. Comparing non-users to users, non-users did not show significant responses to the fish sauce treatment. However, as people ate more, they still evaluate the food in a more favorable way.

Interpretation of Ambiguous Signals and Behavioral Justification

A further investigation of the dissonance measures showed that even though people perceived some objective characteristics of the food in the right way [Tables 3 and 4], they still employed biases when making judgments that involved risk. In Table 5, two groups of statements were tested: Confirming statement, which could be used to justify the previous eating behaviors in the study; and disconfirming statement, which is conflicting with past eating behaviors.

As shown in Table 5, for the rate of agreement to the confirming statement "I ate (chicken, in the study) because I was hungry," people in the fish sauce group reported on average 1.34 points higher. Further, the more chicken they ate, the higher the rate of agreement. Results suggested that people tend to use the confirming statement to justify their previous eating behaviors. With the ambiguous signal of the food quality changes (i.e., fish sauce), it is emotionally more acceptable for a participant to claim that he ate because he was hungry than that he loved the food. User and non-user subsamples showed similar trends, except that user subsample had higher significant level and slightly larger effects than non-user subsample. Recall eating behaviors in Table 2, though users showed higher tolerance

Table 4: Positive evaluation of chicken eaten

Dependent variable: Positive evaluation of chicken (principal component)									
Variables	All			User			Non-user		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FishSauce	−3.144**	−0.862*	−1.071**	−5.289***	−1.605***	−1.613***	−2.064	−0.01	−0.614
	(1.31)	(0.48)	(0.46)	(1.95)	(0.55)	(0.54)	(1.65)	(0.98)	(0.83)
ChickenEaten	−0.003	0.006		−0.0131***	−0.00055		0.0016	0.010*	
	(0.01)	(0.00)		(0.00)	(0.01)		(0.01)	(0.01)	
FishSauce× *ChickenEaten*	0.018*			0.0264*			0.0176		
	(0.01)			(0.01)			(0.02)		
Constant	1.028	−0.285	0.583*	3.124***	1.282	1.217***	−0.183	−1.317	0.039
	(0.79)	(0.56)	(0.33)	(0.86)	(1.37)	(0.32)	(1.23)	(1.02)	(0.50)
Observations	55	55	57	26	26	27	29	29	30
R^2	0.174	0.1	0.071	0.36	0.209	0.22	0.162	0.097	0.02
Mean (dependent variable)	0			0.321			−0.289		
F-test of restriction	4.569**			5.19**			1.939		

Bootstrapping standard errors in parentheses. ***$P<0.01$, **$P<0.05$, *$P<0.1$

to the food quality changes, results here suggested that they also experienced larger dissonance feelings and hence, higher tendency to justify their eating behaviors.

With the disconfirming statement, results are just the opposite. The rate of agreement on statement "I believed the chicken was partially infected with bird flu" was significantly lower for the fish sauce group. As people ate more, the rate of agreement was even lower. When facing ambiguous signals, people are less willing to interpret it as conflicting with their previous (eating) behaviors. Breaking down the sample into users and non-users, results showed that users were subject to dissonance reduction tendency and confirmatory bias more severely than non-users. Over-justification of previous behaviors, strategically neglecting disconfirming evidence, and/or interpreting ambiguous signals are harmful when food-safety risks emerge in the real life.

Future Behavior and Tendency to Repurchase

In addition to evaluation and behavioral justification, variables regarding future behaviors were also collected. First, participants were asked about their WTP for the whole meal. The first panel in Table 6 showed the results. Fish sauce significantly decreased the users' WTP by $2.103, but did not have significant effect for non-users, suggesting that past consumption experience makes the users more sensitive to product quality changes. The amount of food eaten increased the WTP of both users and non-users. However, for users, this slope effect (of chicken eaten) could overpower the treatment effect (of fish sauce); given that on average, people ate 150 g of chicken. Though users could sense the strangeness of the food, the importance of this clue diminished as they eat more.

Since there might be disparity between consumers' self-stated WTP and their true valuation in the real market, the following incentive compatible design was implemented. Participants were given a chance to trade their $5 payment for a larger amount in gift certificates to the restaurant where the chicken came from. The procedure was that participants first chose whether to trade or not. If they chose to trade, they were then asked to pick an integer number that they would be willing to trade ranging from $5 to $20. Then a 16-sided die with sides numbered 5-20 was rolled. If the roll were greater than the amount the participant picked, the amount rolled would be given to the participant in the form of a gift certificate. If the roll were less than the chosen amount, the participant would keep the $5 in cash.

Table 5: Justification of (past) eating behaviors

Variables	Confirming statement: I ate because…								Dis-confirming statement		
	I was hungry				I usually eat what's in front of me				I believed the chicken was partially infected with bird flu		
	All	All	User	Non-user	All	All	User	Non-user	All	User	Non-user
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
FishSauce	2.214**	1.340***	1.391**	1.133*	1.099	−0.0121	0.585	−0.451	−1.492*	−3.198*	−0.503
	(1.04)	(0.46)	(0.69)	(0.65)	(1.39)	(0.66)	(0.99)	(0.84)	(0.77)	(1.59)	(0.64)
ChickenEaten	0.015***	0.012***	0.017***	0.008*	0.015***	0.011***	0.005	0.014***	−0.00651*	−0.0195**	0.00007
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
FishSauce× *ChickenEaten*	−0.00681				−0.00863				0.00816	0.0202*	−0.0000181
	(0.01)				(0.01)				(0.01)	(0.01)	(0.00)
Constant	4.482***	4.947***	4.335***	5.366***	3.974***	4.563***	5.133***	4.532***	2.629***	4.675***	1.561***
	(0.73)	(0.60)	(1.00)	(0.68)	(0.80)	(0.85)	(1.45)	(0.90)	(0.62)	(1.28)	(0.52)
Observations	55	55	26	29	54	54	25	29	57	27	30
Mean (dependent variable)	7.246		7.556	6.967	5.911		5.923	5.9	1.458	1.643	1.29

Bootstrapping standard errors in parentheses. ***$P<0.01$, **$P<0.05$, *$P<0.1$

Table 6: Future re-purchase behaviors

Variables	Tobit: WTP (0, ∞)			Probit: Willing to trade/re-purchase (0, 1)				Tobit: Trade amount ($5, $20)		
	All	User	Non-user	All	All	User	Non-user	All	User	Non-user
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FishSauce	−0.381	−2.103*	1.503	−1.053***				8.741***	10.92***	6.857***
	(1.14)	(1.13)	(1.64)	(0.34)				(2.10)	(2.71)	(1.56)
ChickenEaten	0.024**	0.025***	0.029*		0.006**	0.004	0.010*	0.0121		
	(0.01)	(0.01)	(0.02)		(0.00)	(0.01)	(0.01)	(0.02)		
User								−3.018*		
								(1.78)		
Constant	3.468***	3.924***	2.293	1.484***	0.1	0.146	−0.0845	3.459	0.122	6.234***
	(1.19)	(1.25)	(1.77)	(0.30)	(0.41)	(0.67)	(0.60)	(2.97)	(2.51)	(1.39)
Mean (dependent variable)	6.096	6.036	6.15	0.79		0.806	0.774	7.74	6.739	8.66
Obsevations	57	27	30	62	60	30	30	46	23	25
Chi-square (df)	7.57** (1)	9.21** (2)	3.86 (2)	9.55*** (1)	4.14** (1)	0.55 (1)	3.11* (1)	24.96*** (3)	16.27*** (1)	19.34*** (1)

Bootstrapping standard errors in parentheses. ***$P<0.01$, **$P<0.05$, *$P<0.1$. WTP: Willingness to pay

It was hypothesized that that people would choose to trade $5 in cash for a greater amount of gift certificate to the restaurant only if they liked the food and would commit to repurchase. Given the choice to trade, people would be willing to accept a lower amount in gift certificates if they liked the food more. Moreover, by the design of the game, people would make the trade-off between the amount they were willing to accept and the possibility they could win. If a participant valued a $1 certificate the same as $1 cash, he or she should have claimed for $9, which was the optimal choice considering the trade-off. However, in the experiment, on average, users claimed for about $10.5 and non-users claimed for $13.4, both higher than $9. This implied participants valued $1 gift certificates less than $1 cash.

Out of the 62 participants 48 chose to trade, out of whom 23 were users and 25 non-users. The second panel in Table 6 showed that fish sauce negatively impacted the probability to trade/repurchase. However as participants ate more chicken, it was more likely for them to choose to trade the $5 cash for a value gift certificate, especially among new customers, i.e., non-users (Column 7). This implies a taste of consistency among consumers. Previous consumption leads to a higher tendency to repurchase (i.e., "Foot-in-the-door") [13].

Given that participants chose to trade, participants in the fish sauce group on average claimed $8.74 more to compensate than their counterparts. Furthermore, non-users tended to claim $3.02 higher than users (Columns 8). Lack of long-term consumption experiences among non-users could be an explanation for this gap. Non-users claimed higher gift certificate values than users in order to justify their commitment to repurchase.

VALIDITY AND ROBUSTNESS

Manipulation Check

Several groups of questions were asked as manipulation checks to verify the validity of the experimental design. Table 7 provided the responses to these questions by treatment group. First, participants in the fish sauce group did notice the strangeness of the food and decreased their consumption accordingly (but not ceased to eat altogether). These results suggested a successful manipulation of food quality with expected (eating) behavioral responses.

Second, participants admitted the existence of food safety risk (i.e., bird flu) and its linkage with the food (i.e., chicken) in the study. Moreover, the risk perceptions and feelings toward the ambiguous signal (i.e., fish sauce) were comparable between groups.

Third, participants showed significant disparity in their evaluations of the food eaten at the very beginning, suggesting that participants in the fish sauce group are sensitive enough to notice the quality change. However, their evaluations converged toward the end of the meal after they ate a considerable amount of the (compromised) food.

Lastly, the study did not randomize over participants' past consumption experience, but rather used a self-reported measure to proxy the experience. Hence, independence between self-reported past experience and the exogenous treatment (i.e., fish sauce) is needed. According to the responses, this condition is satisfied.

Robustness

In addition to inclusion and exclusion of control variables, robustness check was also performed on three other directions: Effective sample size, well-behaved sample distribution and control over potential endogenous problems. Results suggested a satisfactory design. Detailed description and statistics can be found in Appendix 1.

DISCUSSION

This paper reported the results of a lab study where participants were served food with an "off-odor" and "off-taste" but which was perfectly safe to eat. The results showed risk perceptions

Table 7: Manipulation checks

Statement	Spoiled chicken (tainted with fishsauce)	Normal chicken (non-fishsauce)	F-stat
Sense of flavor			
"The chicken tasted better than usual"	3.758 (1.55)	5.034 (1.77)	9.04***
"The chicken didn't taste funny"	6.667 (2.14)	7.556 (1.76)	2.89*
Behave			
"I ate more chicken than usual"	3.273 (2.15)	5.138 (1.53)	15.79***
Link to food safety risk			
"I believed eating chicken with birdflu would be harmful to me"	6.969 (2.61)	6.444 (2.98)	0.52
"I believed there was at least a small chance of contamination"	3.094 (2.62)	2.148 (1.56)	2.70
Evaluation convergence			
"(Evaluation of) The very first piece of chicken I ate"	4.063 (2.15)	5.483 (2.35)	6.05**
"(Evaluation of) The very last piece of chicken I ate"	3.879 (1.93)	4.310 (1.95)	0.760
Independence to past experience			
"How many times did you eat carryout from ___ (the restaurant)?"	3.889 (5.71)	4.000 (5.96)	0.01
"How many times did you eat last year at ___ (the restaurant)?"	2.148 (3.45)	1.969 (3.29)	0.04
"When is the last time you ate at ___ (the restaurant)?" (weeks ago)	6.400 (13.80)	11.323 (22.25)	0.93

*$P<0.10$, **$P<0.05$, ***$P<0.01$

were influenced by the existence of (food-safety) signal, the amount of food eaten, and past experience.

Dissonance and Experience

Findings suggest that consumers were consistent in choosing what to eat and would be subject to cognitive dissonance/confirmatory bias when making judgments about what they ate. In the face of an ambiguous signal about the food quality, consumers were more likely to neglect the signal and rate the food as more favorable if they ate more of it. Since they could not change their past eating behavior, the only way for them to reduce the dissonance was to perceive the food in a more favorable way.

Yet, the question remains, does previous experience improve or worsen the experience of consumers? Based on the findings in the study, the experience helped consumers notice the signals. But the strength of previous consumption behavior (i.e., the amount of food they had eaten) also mitigated their sensitivity due to psychological biases in their judgment. Compared with non-users, experienced consumers could recognize the change in the food status with a higher possibility so long as they had not eaten too much of the food before. This finding offers an explanation for why consumers are universally unresponsive to public food safety information. Non-users might overlook the food safety issue due to inexperience. However, users could also misperceive the potential risk so as to justify their previous eating behavior and reduce the dissonance feelings in their mind.

Serious Imagination and Trust

Note that rational participants may not seriously imagine the food served in the study as tainted. However if this is the case, the (over-) trust of food source/quality would yield the amount of food eaten in the study being driven more (or only) by short-term feeling of hunger and less (or none) by initial risk perceptions. Hence, this potential effect would even strengthen our argument, i.e., short-term behavior influences subsequent perceptions. Actually, serious imagination of food being tainted is not a necessary condition to establish the results in our study. Furthermore, the over-trust of food sources (i.e., the experimenter or the restaurant) even with the presence of strange signals suggests the potential severity of food-safety risk in case of outbreak.

Learning and Adaptation

Note also that learning could be an alternative interpretation here, that is, once a new product is tasted, the consumer may begin to appreciate the flavor. However, this is of less concern for the following reasons: First, if learning exists, one should observe the "positive/favorable evaluation" pattern for both normal food and tainted food. However, Table 4 showed that the "favorable evaluation" pattern existed only for chicken tainted with fish-sauce, whereas for normal chicken, the effects of eating behavior on evaluation were insignificant and even opposite to the expected learning effect. Second, one can still argue that learning happens only with "new" taste. Following this logic, one should observe larger effects on non-users than on users. However, separate regressions of these food evaluation measures for user and non-user groups disproved this argument. Last but not the least, the potential existence of the so-called "love it once taste it" learning effect does not exclude, but rather complements the behavioral pattern due to the desire of cognitive consistency. While learning and flavor adaption benefits marketing of some new products, it could also make those "established" consumers to be much less sensitive to the potentially tainted food at hand.

Caveats

A few caveats to this study need to be pointed out to inspire further research. First, we did have significant differences in gender, height and weight across the groups. However, the main results did not change when the demographics were included as control variables in the model.

For the experimental design, since there was no other meat immediately available, participants might have eaten some chicken that in other circumstances they would have avoided. Future work could address this potential interaction with substitutes by adding more choices of meat-based main dishes in addition to the non-meat side dishes (i.e., French fries and pudding, etc.).

Moreover, the food served in the study was delivered by a local restaurant right before consumption, thus, the level of consumption might reflect an inherent trust that restaurant would not provide tainted food due to liability concerns. Even without trusting the local restaurant, participants' eating behaviors might also reflect their original perceptions regarding the food to some extent. Being unable to tease out those effects would yield potentially biased results and so this study chose three groups of instrumental variables to address this uncertainty.

Summary

Although this study used experimental settings with a single target food item, results and findings are generalizable to consumer behaviors in food marketing and public policy with the food-safety and health concerns. Results about perception changes and behavioral responses to ambiguous signals generate far-reaching implications on food safety risk management. In order to devise effective communication strategies, we suggest information providers, either policy-makers or private companies, differentiate case by case when offering messages to the public.

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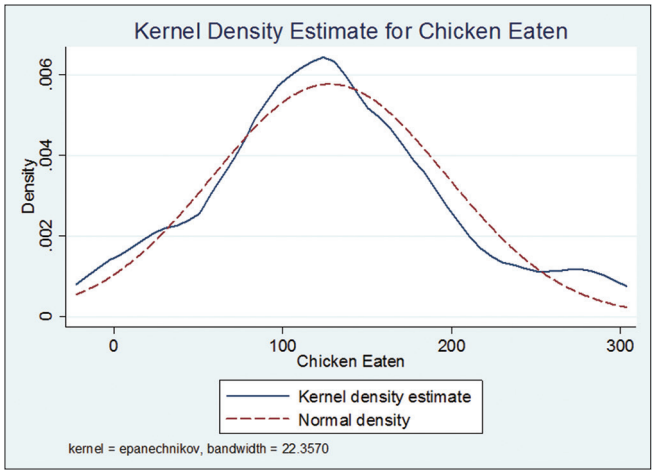
APPENDIX 1 - ROBUSTNESS CHECK

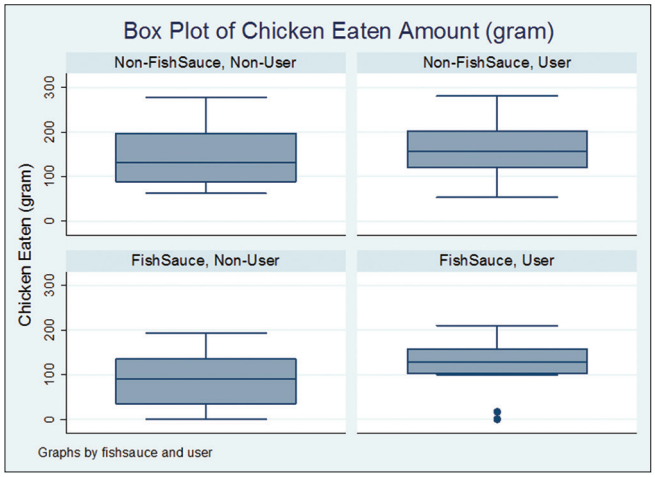
In addition to inclusion and exclusion of control variables, robustness check was also performed on three other directions: Effective sample size, well-behaved sample distribution and control over potential endogenous problems. Results suggested a satisfactory design.

First, in order to reliably detect a treatment effect that is as large as one standard deviation at 95% significant level with at least 90% statistical power, a minimum of 9 observations is needed for each group. This study recruited a total of 61 participants with roughly 30-31 in each treatment group. The sample size is large enough to test the hypotheses. Even when breaking down each group into users and non-users, each subgroup consisted of 15-18 observations, which still passed the threshold of effective sample size.

Second, generalized linear regression analysis implicitly assumes continuous variables to follow normal distribution without outliers. Appendix Figure 1 showed the kernel density of the amount of chicken eaten, which fitted pretty close to normal distribution. Appendix Figure 2 listed the box plots of amount of chicken eaten by subgroup. All other three subgroups are free from "outliers" except the "fish sauce - user" subgroup, which had two observations that were very close to zero. However, note that it is totally reasonable for some participants to eat very little amount of chicken, especially when they were experienced consumers in the fish sauce group. So, these observations are more likely to be extreme values, rather than outliers. In order to control the potential effect driven by those extreme values, bootstrapping method was used to perform all the regression analysis in the result section. Analysis was also conducted by excluding the two extreme observations and all main results did not change.



Appendix Figure 1: Density of chicken eaten



Appendix Figure 2: Box-plot of chicken eaten

Last but not the least, in order to establish reliable causal effect of eating behavior on belief updating, one needs to make sure that the eating behavior is independent of initial beliefs. However, in reality, since the amount of chicken eaten may also be influenced by feelings about the chicken's taste and its risk for contamination, endogenous problems may arise. Hence, instrumental variable (IV) method is adopted to control this endogenous problem.

In this two-step IV method, first, the amount of chicken eaten was regressed on groups of selected instrumental variables. The selected instrumental variables should be highly correlated with the amount of chicken eaten, but not correlated with past experience or initial perceptions. In the second step, the predicted value of the amount of chicken eaten from the first step was used as an explanatory variable to estimate the effect of short-term behavior on risk perceptions and belief updates.

Three groups of variables were chosen to serve as instruments. First, exogenous treatments i.e. fish sauce influenced eating behaviors and was independent of individuals' feelings. Second, the amount of food taken at the beginning of the experiment, indicative of subjects' hunger levels, are considered independent of risk feelings as well. In addition, other types of foods available on the buffet line can be used as substitutes for the main dish, i.e., chicken. Finally, demographics such as age, gender, and body mass index can impact eating behavior but not perceptions of risk.

Equation (4) is used to perform the first step of the IV method.

$$ChickenEaten = \theta_0 + \theta_1 FishSauce + \theta_2 ChickenTaken + \sum_{j=1}^{5} \theta_{3j} SideDish_j + \delta X + \in \quad (4)$$

Appendix Table 1 reported IV regression results about eating behavior on 4 different combinations of instruments (Equation 4). In general, adding fish sauce to chicken decreased the amount eaten by roughly 20 g. Whether a subject was a user or non-user did not significantly impact the amount eaten. Subjects ate about 78% of chicken they took from the buffet line. The amount eaten of side dishes, i.e., French fries, pudding, macaroni salad, celery and apple sauce, do not have any significant impact on the amount of chicken eaten. Effects

Appendix Table 1: Instrument variable (IV) regression of *ChickenEaten*

Variables	Dependent variable: Chicken eaten (g)				
	(1)	(2)	(3)	(4)	(5)
FishSauce	−23.92**	−23.75**	−20.94**	−22.39**	−19.19**
	(−2.412)	(−2.384)	(8.96)	(9.38)	(8.66)
ChickenTaken	0.798***	0.781**	0.825***	0.776***	0.794***
	(11.81)	(10.93)	(0.06)	(0.06)	(0.06)
User		7.148			
		(0.76)			
Height	−1.744	−1547	−1.941		
	(−0.931)	(−0.814)	(1.82)		
BMI	2.15	2.241	2.311		
	(1.14)	(1.18)	(1.73)		
Age	2.39	2.068	4.495*		
	(0.80)	(0.68)	(2.53)		
Male	1.333	2.471	4.751		
	(0.10)	(0.19)	(12.22)		
FrenchFries	0.129	0.133		0.139	
	(1.18)	(1.21)		(0.09)	
Pudding	0.0249	0.0339		0.0205	
	(0.30)	(0.40)		(0.08)	
MacaroniSalad	0.0662	0.0575		0.0959	
	(0.95)	(0.81)		(0.07)	
Celery	−0.0525	−0.0416		−0.0641	
	(−0.486)	(−0.380)		(0.10)	
AppleSauce	−0.021	−0.0301		−0.023	
	(−0.206)	(−0.292)		(0.09)	
Constant	32.13	21.45	4.844	9.879	19.04
	(0.24)	(0.16)	(126.30)	(13.06)	(11.86)
Observations	60	60	60	60	60
R^2	0.819	0.821	0.807	0.81	0.789

t-statistics in parentheses - ***$P<0.01$, **$P<0.05$, *$P<0.1$

of demographic variables were not significant either.[1] Using the predicted amount of chicken eaten to replace the original value of chicken eaten and re-estimate Equations (1-3), all main results preserved.

1 The amount of chicken eaten was also regressed on selected variables about "*Feelings and Evaluations*" and "*Perceptions and Justifications*". The insignificant results excluded the "intuitive" mechanism, that is, initial risk perceptions and food evaluations did not (significantly) influence the amount of chicken eaten and hence, suggested further investigations on "non-intuitive" cognitive-driven mechanism, i.e. consumption behavioral effects on risk perception and information processing. Due to space limit, regression results are available upon request.