The unintended effects of tamper-evident food closures

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The Unintended Effects of Tamper-Evident Food Closures

Abstract
Restaurant-to-consumer food delivery has experienced disruption with the growth of third-party services such as DoorDash and Uber Eats. However, this platform-to-consumer delivery method introduces increased opportunities for food tampering and contamination due to additional touchpoints in the delivery process. To mitigate these concerns, more restaurants are implementing tamper-evident closures such as seals attached to the food containers used for delivery items. Drawing on signaling theory, we examine the effect of tamper-evident closures in the third-party delivery context through two experimental studies and a focus group. Our results revealed a negative effect of tamper-evident seals on willingness to pay through lowered food quality evaluations, suggesting the seal sends contamination signals rather than the intended message of food safety. This negative effect appears robust for both food and beverages. We also demonstrate that consumers’ food safety risk perception (FSRP) acts as a boundary condition, attenuating the negative indirect effect for high-FSRP consumers.

Keywords: Packaging, food packaging, tamper-evident, signaling theory, third-party delivery, food safety risk perception

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1. Introduction

Online food delivery has experienced tremendous growth globally, with revenue projected to reach US$339.2 billion in 2022. Revenue is expected to show an annual growth rate (CAGR 2022-2026) of 8.29%, resulting in a projected market volume of US$466.4 billion by 2026 (Statista, 2021). This market can be segmented into two separate business models with two distinct delivery methods: restaurant-to-consumer delivery and platform-to-consumer delivery. In the restaurant-to-consumer delivery model, consumers order online from the restaurant’s website, and both the preparation and delivery of meals is fulfilled directly by the restaurant (e.g., Pizza Hut, Jimmy John’s). In the platform-to-consumer delivery model, the third-party platform (e.g., Uber Eats) acts as an aggregate of restaurants in the area surrounding the consumer. Consumers order online from the third-party platform’s website or app, selecting from the variety of restaurants that have partnered with the platform. The individual restaurants are responsible for food preparation while delivery is fulfilled by the third-party platform. Consumers pay a delivery fee that can range from as low as $0.99 and upwards of $7.99, and an additional service fee of ~10% of the order subtotal. When choosing to partner with a third-party delivery platform, the restaurant pays a commission for orders that were received through the platform. The third-party delivery segment of online food delivery is the largest segment, with projected market volume of US$215.9 billion in 2022 (Statista, 2021). Market share leaders include DoorDash, Uber Eats, and Grubhub, and to date more than 50% of consumers in the United States reported ordering from at least one of these food delivery providers (Perri, 2022). Notably, although the use of third-party delivery was growing in popularity prior to the COVID-19 pandemic, the pandemic rapidly accelerated demand due to social distancing, stay-at-home orders, and other restrictions (Byrd et al., 2021; Cai et al., 2022; Gursoy & Chi, 2021; Hong et al., 2021; Yang et al., 2021).

A wealth of extant literature has demonstrated the importance of both food safety and food quality in influencing consumer restaurant evaluations and behavioral intentions (Bai et al., 2019; Bujisic et al., 2014; Henson et al., 2006; Hyun, 2010; Liu & Jang, 2009; Namkung & Jang, 2007; Sharma et al., 2012; Sukhu et al., 2017; Tuncer et al., 2021). Yet, the popularity of third-party delivery presents critical food safety and quality concerns for restaurant operators (Beagelman, 2020; U.S. Foods, 2019). Specifically, the risk for contamination is heightened and beyond the
restaurant’s control while food is in the delivery driver’s possession (Durbin, 2019). The relevance of this risk is highlighted by the nearly 30% of food delivery drivers who report having taken food from an order and the 54% of drivers who admit to being tempted by the smell of deliveries. Meanwhile, just 21% of consumers suspect drivers of taking food (U.S. Foods, 2019). Further, food-delivery service Postmates, prior to its December 2020 acquisition by Uber Eats, claimed that less than 1% of its service reports involved driver tampering (Matias, 2019). This suggests that consumers are relatively unaware of potential contamination that may occur in the delivery process.

Recognizing the risk of contamination, more foodservice operators are implementing the use of tamper-evident closures, such as seals, and government agencies are beginning to put food safety procedures in place to protect consumers. For example, California approved a new section of the state’s Health and Safety Code in September 2020 which requires tamper-evident closure methods to be used by food facilities prior to the third-party deliverer taking possession of the order (Third-Party Food Delivery Platforms and Food Safety, 2020).

Despite the relevance of this packaging addition to consumer perceptions of food quality and safety in the third-party delivery context, research has yet to examine the impact of a tamper-evident closure on the consumer food delivery experience. Several researchers have sought to understand consumers’ intentions to use online food delivery, both through third-party providers and directly from restaurants. However, these studies are primarily grounded in theories of technology acceptance and, as a result, focus on factors such as performance expectancy, ease of use, perceived usefulness, system trust, and convenience (Cho et al., 2019; Gunden et al., 2020; Ray et al., 2019; Roh & Park, 2019; Yeo et al., 2017; Zhao & Bacao, 2020). As little is known about other aspects of the consumer food delivery experience, our research seeks to address the following research questions:

(1) what is the effect of a tamper-evident closure on a consumer’s evaluation of food quality and willingness to pay in the third-party food delivery experience?
(2) what is the underlying process by which tamper-evident closures influence willingness to pay?
(3) might the effect be different based on individual consumer characteristics?

To explore these questions, we conduct two live experimental studies and a focus group. More specifically, Study 1 investigates how a tamper-evident closure impacts willingness to pay through
perceived food quality. We follow Study 1 with a qualitative exploration via a focus group comprised of a sub-sample of Study 1 participants, which offered in-depth insights into the experimental results. Finally, Study 2 examines the moderating effect of food safety risk perception.

2. Conceptual background

2.1. Signaling theory

We draw on signaling theory as the foundation of our research. Signaling theory is concerned with understanding how parties involved in market exchange resolve or reduce information asymmetry about the underlying quality of an individual, product, or organization (Connelly et al., 2011; Spence, 1973). At the core of signaling theory is the notion that the signalers, or senders, are insiders who possess quality information not available to outsiders, or receivers. However, outsiders would find such information beneficial, particularly if quality attributes can only be evaluated after experience (Biswas & Biswas, 2004).

Signaling theory also focuses on the intentional communication of information by the sender in an effort to transmit positive product and/or organizational attributes to the receiver, influence perceptions, and prompt a response (Connelly et al., 2011; Pecot et al., 2018). Accordingly, a signal must be both observable and costly in order to be effective. Observability refers to the visibility of the signal and the extent to which receivers notice it; if the signal is unobservable to the receiver, the receiver remains unaware of any quality information the sender is attempting to transmit. Signal cost refers to the transaction costs incurred by the sender to implement the signal and is a means of indicating reliability and overcoming receiver skepticism. Signal honesty or reliability can also be transmitted when the “punishment costs” for dishonesty are high. If a quality signal incurs no costs for the sender, receivers may perceive the signal as false or misleading (Connelly et al., 2011; Dunham, 2011).

The third element of signaling theory is the receiver. As noted above, receivers lack relevant information about product or organizational quality. In addition to sending an observable and costly signal, for effective signaling to take place, the sender should also benefit from the receiver’s actions. In other words, the signal should have a strategic impact for the sender. At the same time, the receiver should also benefit (Connelly et al., 2011). For example, in a purchasing context, a consumer (e.g., the receiver) should benefit from purchasing goods or services associated with high-quality signals (Rao et al., 1999). Characteristics of the receiver also
contribute to signaling effectiveness, as not all receivers interpret signals in the same manner. Critically, receivers may apply their own preconceptions or distort signals such that the message deviates from the sender’s original intent (Dunham, 2011).

2.2. Food quality and food safety in restaurants

Restaurant quality generally encompasses a combination of three attributes: food quality, service quality, and ambiance (Bujisic et al., 2014; Jang & Namkung, 2009; Namkung & Jang, 2007; Ryu & Han, 2010; Sukhu et al., 2017; Tuncer et al., 2021). Of the three, food quality is the most fundamental to the restaurant dining experience (Jang & Namkung, 2009) and crucial to successful restaurant operations (Namkung & Jang, 2007; Sulek & Hensley, 2004; Tuncer et al., 2021). Prior research has also demonstrated that food quality is an important predictor of a range of consumer attitudes and behaviors, including restaurant choice (Hyun, 2010; Namkung & Jang, 2007; Ryu & Han, 2010; Sulek & Hensley, 2004), repeat visit/purchase intention (Bujisic et al., 2014; Richardson et al., 2019), and willingness to pay (WTP) (Dutta et al., 2014; Kang et al., 2012; Sukhu et al., 2017).

Food quality and food safety are intrinsically linked, as food safety is the most basic standard for consumers regarding evaluations of food quality (Liu & Jang, 2009). Unsurprisingly, then, consumer perceptions of food safety also contribute to consumer restaurant choice (Bai et al., 2019), revisit intention (Liu & Lee, 2018), and WTP (Sharma et al., 2012). Consumers pay attention to visible cues, or signals, from the restaurant to ascertain food safety and form quality evaluations, such as dining room/tableware/restroom cleanliness, staff appearance/cleanliness, staff health, health inspection notices, food temperature, and signs of contamination/foreign objects in food (Bai et al., 2019; Fatimah et al., 2011; Henson et al., 2006; Liu & Lee, 2018; Namkung & Jang, 2007; Sulek & Hensley, 2004). The effort required from a restaurant to maintain food safety standards is significant from both a financial perspective and a resource perspective (e.g., time invested in safety checks, time spent training staff) (Sharma et al., 2012). The punishment costs associated with falsely signaling food quality, such as a foodborne illness outbreak, are also significant (Liu & Lee, 2018; Whitworth, 2022). Therefore, the imperative of a signal cost is also fulfilled.

However, the majority of food safety cues are only evident to consumers dining inside the restaurant. In the third-party delivery experience, consumers are dining on restaurant food at home. Cues such as tableware cleanliness are rendered irrelevant, and as consumers have not physically
been inside the restaurant themselves, they can no longer observe attributes like dining room cleanliness or staff appearance to assess food safety and subsequent food quality. Thus, in order to effectively signal food safety to consumers utilizing third-party delivery, restaurants must consider cues which are observable outside of the restaurant and for the entirety of the delivery experience.

2.3. Tamper-evident packaging and the use of tamper-evident closures

Tamper-evident packaging refers to packaging that includes a feature indicating whether the product has been altered or opened before being purchased by consumers and may include packaging that cannot be resealed or the use of tamper-evident seals (Conference for Food Protection, 2020; Jinkarn & Suwannaporn, 2015). Packaging that cannot be resealed or leaves clear evidence it has been opened (i.e., ragged tears) indicates that tampering has occurred (Theobald, 2012), and many food and beverage products packaged and sold in ready-to-eat formats now include tamper-evident features such as breakaway closures, special printing on bottle liners or composite cans, and banding (Marsh & Bugusu, 2007).

Within the specific context of third-party delivery, as items are paid for at the time the order is placed, we modify the definition of tamper-evident packaging slightly to reflect packaging features which indicate whether items have been altered before being delivered to and received by consumers. For example, tamper-evident seals, as defined by the U.S. Food and Drug Administration, are seals “having one or more indicators or barriers to entry which, if breached or missing, can reasonably be expected to provide visible evidence to consumers that tampering has occurred” (Food and Drugs, 2022). Tamper-evident seals must also be “distinctive by design”, meaning the tamper-evident feature is designed from material not readily available to the public in order to ensure it is not easily duplicated (Food and Drugs, 2022). This form of tamper-evident closure, which can be affixed to food containers in such a way that consumers can readily determine whether the food has been tampered with by looking for tears (Theobald, 2012), is the focus of the current research. Tamper-evident seals are particularly relevant for third-party delivery, as inserting an individual not directly employed by the restaurant into the delivery process increases the risk of food contamination or alteration while in transit from the restaurant to the consumer.

Despite their potential to reduce food contamination and ensure food safety, tamper-evident closures and in particular seals introduce a new element to food packaging which has received little attention in the existing literature. Spink et al. (2011) noted that tamper-evident
packaging can influence consumer purchasing decisions, while Jinkarn and Suwannaporn (2015) found that in a convenience foods context consumers are willing to pay slightly more when packaging has tamper-evident features. Yet, while empirical research which directly addresses tamper-evident closures is lacking, particularly in the third-party delivery context, the larger bodies of packaging and food labeling literature demonstrate the ability of packaging to impart information and impact consumer judgements and behavior.

Extant research has shown that non-edible components of packaging can exert significant effects on evaluations of food quality and WTP for food and beverage (Lefebvre & Orlowski, 2019; Magnier et al., 2016). Packaging informs consumers’ perceptions of food products and influences judgements about taste, price, value, and healthiness, among other factors (Lefebvre & Orlowski, 2019; Mai et al., 2016; Yang et al., 2021). Packaging attributes that have received attention include the exterior texture (e.g., rough vs. smooth or shiny vs. matte; Carvalho et al., 2020; Marckhgott & Kamleitner, 2019), durability (Krishna & Morrin, 2008), color (Ares & Deliza, 2010), and shape (Lefebvre & Orlowski, 2019). Further, food labeling research suggests that informational labels can send signals to consumers and influence WTP (Hawley et al., 2013; Temple, 2020).

However, packaging can also affect consumer evaluations and behaviors by acting as a contamination cue, signaling to the consumer that the product has been previously touched by others (Argo et al., 2006; Argo & White, 2012; White et al., 2016). Contamination decreases product evaluation, purchase intention, and willingness to pay (Gerard & Helme-Guizon, 2018). For example, packaging imperfections such as rips or dents imply that a product has been mishandled or tampered with, thus leading to safety concerns and negatively influencing consumers’ attitudes (White et al., 2016). Notably, Argo et al. (2006) found that even when no physical contamination occurred, consumers were still negatively influenced by the implication that another person had touched the product. Contamination concerns are particularly salient for products that are ingested (Rozin et al., 1986) and contamination may negatively influence the value of a food or beverage product (Rozin & Fallon, 1987). Importantly, many consumers perceive restaurant packaging as a source of contamination (Byrd et al., 2021).

Therefore, while the importance of packaging in acting as a visual cue for consumers is well-established, signaling theory and our review of the literature suggests two arguments can be made for the impact of packaging with tamper-evident features on consumer evaluations of food
quality and subsequent WTP in the third-party delivery experience. In the framework of signaling theory, tamper-evident closures are an efficient way for restaurants (e.g., the sender) to signal food safety efforts to consumers (e.g., the receiver) in a manner which is both observable and costly. Specifically, the use of tamper-evident seals which a consumer would have to tear open are highly visible to consumers and demonstrate the additional expense and labor by the restaurant (Callahan & Nguyen, 2020; National Restaurant Association, 2022). As food safety is one of the most important factors in food quality evaluations, and food quality has been shown to positively influence willingness to pay, we hypothesize the following:

**H1:** The presence (vs. absence) of a tamper-evident seal will increase consumer willingness to pay through food quality.

At the same time, signaling theory also emphasizes the receiver and receiver interpretation in the signaling process. Although it may be the restaurant’s intent to signal food quality through the use of a tamper-evident seal, the use of a seal also draws attention to the potential for food tampering. Accordingly, consumers may interpret this tamper-evident packaging feature as a contamination cue rather than a food safety cue, resulting in a negative quality evaluation. Therefore, we posit the following competing hypothesis:

**H1\text{Alt}:** The presence (vs. absence) of a tamper-evident seal will decrease consumer willingness to pay through food quality.

### 3. Study 1

#### 3.1. Participants and design

A single-factor between-subjects experiment with two conditions (tamper-evident closure: no seal vs. seal) was conducted at a university in the southeastern United States. A total of 82 participants (75.9% female; M\text{Age} = 23 years) completed the study in exchange for extra credit. Participants were told the researchers were “partnering with a local café to help them improve their product and delivery experience” and thus were not aware of the specific purpose of the study.

#### 3.2. Procedure

The study site comprised two dedicated rooms, each with an identical number of workstations. The workstations were set up with barriers to prevents participants from seeing and interacting with each other during the experiment. Upon arrival to the study site, participants were
randomly assigned to a workstation in one of the two rooms and directed to scan a posted QR code to begin the lab activity. The QR code launched the study’s scenario:

“We are working with a locally owned restaurant that has introduced delivery through a third-party company. They are interested in testing the delivery service as part of the training for their employees. When you press ‘Next’ you will be transferred to the third-party delivery service page to place your order.”

Participants then engaged in the process of placing an online order for the focal stimulus item, a fruit smoothie. After submitting their order, participants completed a series of filler questions unrelated to food consumption and foodservice. Approximately 20 minutes after placing their order, a smoothie was delivered to each participant by the research team.

The peach smoothie was packaged in an 8 fluid ounce clear plastic to-go cup with a flat lid. Each smoothie contained 3 fluid ounces of smoothie mix, purchased from a national retailer, blended with 4 fluid ounces of ice. The smoothies for each session were prepared by two trained culinary assistants. In the “no seal” condition, participants received the smoothie and a wrapped straw. In the “tamper-evident seal” condition, the wrapped straw was placed over the opening in the center of the lid and held in place with a piece of red tamper-evident tape measuring 0.5-inches wide x 6-inches long. The tape extended over the lid 1.5-inches on either side of the cup (see Appendix A). All participants in the same session received the same focal stimulus (no seal or tamper-evident seal). A total of four sessions were held, with approximately 20 participants per session. Upon receiving the smoothie, participants were directed to sample as much or as little as they liked and then complete a paper questionnaire about the smoothie and the delivery experience.

This study, as well as all subsequent studies, was approved by the university’s Institutional Review Board.

3.3. Measures

Participants completed a two-item measure of quality adapted from Sprott and Shimp (2004) (“Overall, the smoothie is?” [1 = Poor, 7 = Excellent], “The smoothie is:” [1 = Low Quality, 7 = High Quality], S-B = 0.81). Then, they were asked, “How much would you be willing to pay for this smoothie in the future? (Do not include delivery fees, taxes, tip etc.)” as an open-ended response measure. To ensure the tamper-evident seal did not alter the physical attractiveness of the product, a three-item measure of attractiveness was also included (“The smoothie that was delivered is: appealing, attractive, desirable”; 1 = strongly disagree to 7 = strongly agree; α = 0.91)
(Lefebvre & Orlowski, 2021). Means and standard deviations of all measurement items are provided in Appendix B. The questionnaire concluded with demographic questions.

3.4. Results

3.4.1. Attractiveness

The results of an independent samples t-test revealed no difference in perceived attractiveness of the smoothie with no seal (M_{No seal} = 5.62) and the smoothie with a tamper-evident seal (M_{Seal} = 5.44, t (81) = 0.716, p = .476).

3.4.2. Willingness to pay

To examine the effect of a tamper-evident seal on WTP through food quality, PROCESS Model 4 with 10,000 bootstrap samples was used (Hayes, 2017). A significant negative effect of a tamper-evident seal (0 = no seal, 1 = tamper-evident seal) on food quality was found (a = -0.665, p = .006), which in turn had a significant effect on WTP (b = 0.668, p < .001). In support of mediation, the indirect effect was significant (effect = -0.444, 95% C.I. from -0.784 to -0.150), while the direct effect was nonsignificant. See Table 1 for full results.

Table 1.

<table>
<thead>
<tr>
<th>Result of Study 1 Mediation Analysis</th>
<th>Effect</th>
<th>SE</th>
<th>t</th>
<th>p-value</th>
<th>LLCI</th>
<th>ULCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food Quality</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>5.790</td>
<td>0.174</td>
<td>33.302</td>
<td>&lt;0.001</td>
<td>5.444</td>
<td>6.135</td>
</tr>
<tr>
<td>Tamper Seal (TS)</td>
<td>-0.665</td>
<td>0.237</td>
<td>-2.800</td>
<td>0.006</td>
<td>-1.137</td>
<td>-0.192</td>
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<tr>
<td><strong>Willingness to Pay (WTP)</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Constant</td>
<td>0.589</td>
<td>0.840</td>
<td>0.701</td>
<td>0.485</td>
<td>-1.083</td>
<td>2.261</td>
</tr>
<tr>
<td>Tamper Seal (TS)</td>
<td>0.069</td>
<td>0.312</td>
<td>0.221</td>
<td>0.826</td>
<td>-0.552</td>
<td>0.689</td>
</tr>
<tr>
<td>Food Quality (FQ)</td>
<td>0.668</td>
<td>0.140</td>
<td>4.765</td>
<td>&lt;0.001</td>
<td>0.389</td>
<td>0.947</td>
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<tr>
<td><strong>Direct Effect</strong></td>
<td></td>
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<tr>
<td>Tamper Seal (TS)</td>
<td>0.069</td>
<td>0.312</td>
<td>0.221</td>
<td>0.826</td>
<td>-0.552</td>
<td>0.689</td>
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<tr>
<td><strong>Indirect Effect</strong></td>
<td></td>
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</tr>
<tr>
<td>TS → FQ → WTP</td>
<td>-0.444</td>
<td>0.165</td>
<td>-0.790</td>
<td>-0.142</td>
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</tbody>
</table>

Notes: PROCESS Model 4, 10,000 bootstrapped samples

3.5. Discussion

The results of Study 1 offer support for H1_{Alt}. Though food quality increased consumer WTP, the presence of a tamper-evident seal had a negative effect on food quality. The results suggest that when the third-party delivery experience included a tamper-evident seal on food and beverage packaging, consumers perceived the food quality to be lower compared to when no seal
was present. This suggests that, rather than sending the intended message of food safety, the tamper-evident seal may have made the idea of contamination more salient to consumers.

To explore this further, we followed up qualitatively with a sub-sample of Study 1 participants via a focus group. As the primary purpose of the focus group was to provide a more meaningful explanation of the Study 1 experimental results, we used a nested sampling design and a heterogeneous sampling approach (Ivankova, 2014; Suri, 2011). A total of 20 participants from the experiment were recruited for the focus group: 10 from the “no seal” condition and 10 from “tamper-evident seal” condition. The focus group session was held in a private meeting space on the university campus, which was set up to allow all participants to see and interact with each other. Upon arrival, the focus group moderator debriefed participants as to the purpose of Study 1, showed the packaging used in both conditions, and explained the objective of the focus group. The moderator also emphasized that all ideas, opinions, and feedback were welcome and encouraged interaction among participants. Questions guiding the focus group discussion included “Please tell us about your experience participating in the study”, “If you received a yogurt parfait with the tamper-evident seal, what was most memorable about the seal for you?/If you are received a yogurt parfait without the tamper-evident seal and are seeing it for the first time today, what stands out the most the seal for you?”, and “What does ‘safe food’ mean to you? When you order food from a restaurant, how do you determine the food is safe?”. The focus group session lasted 75 minutes.

The predominant themes which emerged from the focus group were the concepts of warning and risk. Several of the participants from the “tamper-evident seal” condition revealed that the thought of someone touching or tampering with their food had not occurred to them until they saw the seal. In other words, the seal acted as a warning, which led participants to think about the potential food safety risks associated with consuming the food. Interestingly, participants from the “no seal” condition expressed no concerns for contamination or consumption risk – until some saw the tamper-evident packaging used in the “tamper-evident seal” condition. These participants also commented on the seal raising their awareness of the possibility for food tampering. The focus group feedback shed light on the experimental results, highlighting the role of perceived risk. Accordingly, based on the results of Study 1, we attempted to replicate this effect in Study 2 as well as examine the boundary condition of risk perception in the third-party delivery context.

4. Study 2
Risk perceptions are intuitive judgments (Slovic, 2016). Critically, when a situation is perceived as high risk, consumers rely on various sources of information. Consumers tend to exaggerate the likelihood of a negative outcome if they are made aware of its possibility (Kahneman & Tversky, 1979) and are often willing to pay a premium to reduce risk (Angulo & Gil, 2007). For example, across two experiments, Gürhan-Canli and Batra (2004) demonstrated that company innovation and trustworthiness influenced product evaluations more when customers perceived the product purchase to be high (vs. low) risk.

Food safety risk perception (FSRP) specifically reflects an individual's belief regarding the level of health risk inherent in a food consumption situation (Nardi et al., 2020; Tonsor et al., 2009). FSRP plays a critical role in the decision-making process when consumers are purchasing food (Frewer et al., 2009). Along with food and beverage packaging and labels, which influence WTP by informing consumer perceptions and judgments of quality and safety (Hawley et al., 2013; Neff et al., 2019), FSRP has also been shown to influence consumer choice and WTP (Nardi et al., 2020; Sharma et al., 2012). Relevant to the third-party delivery context, Kitsikoglou et al. (2014) demonstrated that consumers have higher levels of FSRP when purchasing food online, as compared to in-person, because they are unable to directly view product freshness online. Additionally, Hong et al. (2021) noted that concerns associated with the online restaurant food delivery model, including control of packaging, exposure to additional touchpoints via third-party delivery drivers, and potential for contamination and tampering, may lead to increased FSRP for consumers utilizing third-party delivery. Since tamper-evident packaging is associated with food safety and minimizing contamination (Pascall et al., 2009), this packaging format should be desired by consumers with a high degree of FSRP, enhancing evaluations of food quality. Thus, we propose:

**H2:** The indirect effect of a tamper-evident seal (presence vs. absence) on willingness to pay through food quality is moderated by consumers’ food safety risk perception. Specifically, for individuals a high level of food safety risk perception, the indirect effect will be attenuated.

### 4.1. Participants and design

A single-factor between-subjects experiment with two conditions (tamper-evident closure: no seal vs. seal) was conducted at a university in the southeastern United States. A total of 243 participants (72.8% female; M\(_{\text{Age}}\) = 21 years) completed the study in exchange for course lab credit.
in a “food lab research activity”. Participants were informed in advance the research study involved the evaluation of food products but were not aware of the specific purpose of the study.

4.2. Procedure

The study site set-up and procedure for Study 2 was the same as Study 1; participants were seated at individual workstations in two rooms, provided with a QR code, and followed a scenario-based ordering process. For Study 2, the focal stimulus was a yogurt parfait packaged for delivery in a 9 fluid ounce, 4-piece clear plastic to-go cup with a 2 fluid ounce insert, a flat lid, and a dome lid. The to-go cup contained 6.5 ounces of vanilla yogurt and the insert set inside the cup contained 1 ounce of granola. The cup and insert were covered with the flat and dome lids which contained 2.5 ounces of blueberries. All food items were purchased from a national retailer. For the “no seal” condition, the yogurt parfait was placed inside a white paper bag with a wrapped 4-piece cutlery set (fork, knife, spoon, napkin). For the “tamper-evident seal” condition, two red-and-white tamper-evident seals, each measuring three inches in diameter, were placed on the outside of the parfait container where the lid attached to the cup. The sealed parfait was then placed in the same white paper bag along with the wrapped cutlery set used in the “no seal” condition (see Appendix B). The yogurt parfaits were assembled and prepped for delivery by three trained culinary assistants each morning the study was conducted.

Approximately 20 minutes after placing their “order”, a yogurt parfait was delivered to each participant by the research team. All participants in the same session received the same focal stimulus (no seal or tamper-evident seal). A total of 14 sessions were held, with 16-20 participants per session. Once the parfaits were delivered, participants were directed to review and sample as much or as little of the item as they liked and then complete an online questionnaire.

4.3. Measures

Participants completed the same two-item measure of quality (S-B = 0.91) and open-ended WTP item used in Study 1. To assess FSRP, participants completed two items from Lando et al. (2016) and Tsiros & Heilman (2005). Item wording was modified to align with the focal stimulus and delivery context (“What is the likelihood that consuming the product when it’s delivered may lead to a health risk?”; “Do you think that it is unlikely or likely that the yogurt parfait you received could have germs that could make you sick?”; 1 = Very Unlikely, 7 = Very Likely; S-B = 0.68). The same three-item attractiveness measure used in Study 1 was also included (α = .90). See
Appendix B for means and standard deviations for all measurement items. The questionnaire concluded with demographic questions.

4.4. Results

4.4.1. Attractiveness

An independent samples t-test found no significant difference in perceived attractiveness of the yogurt parfait without a seal (M_{No seal} = 5.31) and with a tamper-evident seal (M_{Seal} = 5.16, t(241) = 0.831, p = .407).

4.4.2. Moderated Mediation

To examine the indirect effect of a tamper-evident seal on WTP to pay through food quality at levels of FSRP, PROCESS Model 7 with 10,000 bootstrap samples was used (Hayes, 2017). The index of the overall model was significant (moderated mediation index = 0.100, 95% C.I. from 0.010 to 0.210). The results replicate the findings of Study 1, with a significant negative effect of a tamper-evident seal (0 = no seal, 1 = tamper-evident seal) on food quality (a = -0.944, p = .006). The interaction of a tamper-evident seal and FSRP on food quality was significant (a_3 = 0.217, p = .027). In turn, the effect of food quality on WTP was also significant (b = 0.462, p < .001). The indirect effect of a tamper-evident seal on WTP through food quality was significant when FSRP was low (effect_{@1.50} = -0.286, 95% C.I. from -0.525 to -0.088). For high FSRP, the indirect effect was nonsignificant (effect_{@5.00} = 0.066, 95% C.I. from -0.153 to 0.298), as was the direct effect. Taken together, the results demonstrate that, in the third-party delivery experience, a tamper-evident seal (vs. no seal) decreases quality evaluations of the food item when FSRP is low (vs. high), while food quality has a positive effect on WTP. Please see Table 2 to view full results.
Table 2.
Results of Study 2 Moderated Mediation Analysis

<table>
<thead>
<tr>
<th></th>
<th>Effect</th>
<th>SE</th>
<th>t</th>
<th>p-value</th>
<th>LLCI</th>
<th>ULCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food Quality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>6.067</td>
<td>0.234</td>
<td>25.982</td>
<td>&lt;0.001</td>
<td>5.607</td>
<td>6.527</td>
</tr>
<tr>
<td>Tamper Seal (TS)</td>
<td>-0.944</td>
<td>0.341</td>
<td>-2.768</td>
<td>0.006</td>
<td>-1.615</td>
<td>-0.272</td>
</tr>
<tr>
<td>Food Safety Risk Perception (FSRP)</td>
<td>-0.195</td>
<td>0.064</td>
<td>-3.055</td>
<td>0.003</td>
<td>-0.320</td>
<td>-0.069</td>
</tr>
<tr>
<td>TS*FSRP</td>
<td>0.217</td>
<td>0.097</td>
<td>2.233</td>
<td>0.027</td>
<td>0.026</td>
<td>0.409</td>
</tr>
<tr>
<td><strong>Johnson-Neyman Critical Value</strong></td>
<td>@3.029</td>
<td>-0.286</td>
<td>0.145</td>
<td>-1.970</td>
<td>0.050</td>
<td>-0.572</td>
</tr>
<tr>
<td><strong>Willingness to Pay (WTP)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.146</td>
<td>0.397</td>
<td>2.885</td>
<td>0.004</td>
<td>0.364</td>
<td>1.929</td>
</tr>
<tr>
<td>Tamper Seal</td>
<td>0.015</td>
<td>0.160</td>
<td>0.090</td>
<td>0.928</td>
<td>-0.301</td>
<td>0.330</td>
</tr>
<tr>
<td>Food Quality</td>
<td>0.462</td>
<td>0.070</td>
<td>6.584</td>
<td>&lt;0.001</td>
<td>0.324</td>
<td>0.601</td>
</tr>
<tr>
<td><strong>Direct Effect</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tamper Seal</td>
<td>0.015</td>
<td>0.160</td>
<td>0.090</td>
<td>0.928</td>
<td>-0.301</td>
<td>0.330</td>
</tr>
<tr>
<td><strong>Indirect Effect</strong></td>
<td>Effect</td>
<td>Boot SE</td>
<td>Boot LLCI</td>
<td>Boot ULCI</td>
<td>Significant?</td>
<td></td>
</tr>
<tr>
<td><strong>Food Safety Risk Perception</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16th percentile (@1.50)</td>
<td>-0.286</td>
<td>0.113</td>
<td>-0.525</td>
<td>-0.088</td>
<td>Yes</td>
<td></td>
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<tr>
<td>50th percentile (@3.00)</td>
<td>-0.135</td>
<td>0.072</td>
<td>-0.286</td>
<td>-0.007</td>
<td>Yes</td>
<td></td>
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<tr>
<td>84th percentile (@5.00)</td>
<td>0.066</td>
<td>0.114</td>
<td>-0.153</td>
<td>0.298</td>
<td>No</td>
<td></td>
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<tr>
<td><strong>Index of Moderated Mediation</strong></td>
<td>Effect</td>
<td>Boot SE</td>
<td>Boot LLCI</td>
<td>Boot ULCI</td>
<td>Significant?</td>
<td></td>
</tr>
<tr>
<td>Food Safety Risk Perception</td>
<td>0.100</td>
<td>0.051</td>
<td>0.010</td>
<td>0.210</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Notes: PROCESS Model 7, 10,000 bootstrapped samples. Percentiles represent the points within the distribution of food safety risk perception where the indirect effect was examined (1.50 = low, 3.00 = moderate, 5 = high).

5. General Discussion

The current research reveals how tamper-evident packaging impacts consumer WTP for food and beverage products. Two experimental studies and a focus group demonstrate that tamper-evident packaging reduces consumers’ WTP. We also show that food quality underlies this effect, which is moderated by consumer FSRP. These findings offer both theoretical and practical implications for food and beverage managers.

5.1. Theoretical implications

The current work makes three significant theoretical contributions. First, we extend research on signaling theory by identifying a context in which signals intended to send a positive message may be misinterpreted. Prior research suggests the effectiveness of signals can be dependent upon characteristics of the receiver (Dunham, 2011). In the case of third-party food
delivery, rather than increasing consumers’ quality evaluations of food products, visual cues intended to signal food safety instead signal lower quality, and thus indirectly lower WTP. This is especially true for consumers who normally would be less concerned about food safety, thus providing further evidence that the intended signals are misunderstood.

Second, by focusing on the context of third-party food delivery, we contribute to the nascent literature on tamper-evident food and beverage packaging (Orlowski et al., 2022). Prior studies of tamper-evident packaging have focused on food and beverage items sold in the retail environment, such as convenience foods, shelf-stable grocery items, and ready-to-eat deli items, and such studies suggest consumers are willing to pay more for an item with tamper-evident features (Jinkarn & Suwannaporn, 2015; Pascall et al., 2009; Theobald, 2012). However, our results offer contradictory evidence in the context of third-party food delivery and suggest that the presence of a tamper-evident seal reduces WTP due to reduced food quality evaluations.

Lastly, by identifying the moderating role of FSRP in the third-party food delivery context, which mitigates the negative effect of tamper-evident packaging, we present a more granular perspective of health communications and risk perception. Although from a consumer view safety is a fundamentally non-negotiable attribute of food (Nardi et al., 2020), this boundary condition reveals the importance of individual beliefs regarding the amount of food safety risk involved in third-party food delivery. The results of Study 2 emphasize that such tamper-evident packaging can be a deterrent for those consumers whose food safety risk perception is low. Study 2 found consumers with low FSRP were willing to pay less for tamper-evident packaging, a result that contradicts extant literature, which suggests that the value consumers place on protective packaging results in higher WTP (Jinkarn & Suwannaporn, 2015).

5.2. Managerial implications

Our results also provide relevant managerial implications as the use of third-party food delivery services continues to rise and restaurant operators continue to enhance their food safety efforts. The results of our research suggest that consumers will focus on negative signals such as possible contamination when exposed to tamper-evident packaging features. Ironically, Study 2 suggests that consumers with low FSRP are impacted by these signals while those with high FSRP may not be impacted.

Importantly, while the findings may lead restaurant operators using third-party food delivery providers to believe it would be advantageous to avoid tamper-evident packaging
altogether, we would argue this is not the case. Instead, the broad implication is that operators must carefully consider how they implement tamper-evident closures. Utilizing tamper-evident closures (such as seals), but in a manner less obtrusive for the consumer (e.g., smaller), could minimize the contamination cues or signal the packaging sends to consumers, thus addressing issues related to highlighting the potential for food tampering while simultaneously reassuring high-FSRP consumers that the food or beverage item is safe.

Our findings also provide marketers with guidance on pricing. According to our results, the addition of tamper-evident packaging negatively influences WTP. Given our consistent findings regarding WTP, restaurant operators must be prepared to absorb any additional costs associated with tamper-evident packaging (e.g., seals and labor associated with their application), rather than passing such costs on to their customers through price increases.

5.3. Limitations and future research

While our research provides novel insights into the use of tamper-evident closures, some limitations should be noted, and further research is necessary to fully understand consumer reactions to the use of tamper-evident packaging in third-party delivery. First, while the current research focuses solely on tamper-evident seals, other methods of reducing potential contamination are now available to restaurant operators. Packaging features which encompass the entire food container, such as breakaway closures or bands/wraps, can also be used to reduce food tampering (Marsh & Bugusu, 2007; Theobald, 2012). Additionally, special ink systems which react chemically when opened to change the color of packaging or leave behind a message such as “VOID” can also be used to indicate tampering (Innopack, 2021; Theobald, 2012). Future research should examine other tamper-evident packaging methods to provide additional support for our conceptual model.

Second, while we ruled out attractiveness as a potential alternative explanation, other possibilities could still exist. For instance, tamper-evident packaging could be viewed as difficult to open. When product packaging presents a challenge, consumers are more likely to experience dissatisfaction. For example, tamper-resistant, difficult-to-open, heat-sealed plastic blister or clamshell packaging can provoke “wrap rage”, a state of anger which transfers to the product itself (Wever & Del Castillo, 2006). Our packaging was also a plastic material for both items. With the wide variety of food packaging materials available to food operators (e.g., cardboard, foil), future research should consider other packaging materials. The nature of the products may have also
impacted our findings; for example, yogurt parfaits and smoothies are health-conscious products often consumed as smaller non-hedonic meals or snacks. Future research should explore whether our results hold for food products with other dimensions such as those that are hedonic or typical entree meals (e.g., chicken parmesan, turkey sandwich). In addition, both smoothies and yogurt parfaits are fluid-based products; thus, future research should also explore a wider range of products commonly ordered in food delivery contexts.

Third, our studies focused on third-party delivery services, which is a specific segment within the larger channel of online food delivery. Future research should explore additional restaurant delivery and carryout formats, such as quick service drive-thru windows or full-service restaurant curbside pickup/takeout service, to identify other boundary conditions. Consumer perceptions of food safety risk and comfort levels regarding the expected amount of contamination may differ depending on foodservice context. Additionally, a consumer’s experience with or knowledge of a restaurant may also alter their food safety risk perception of that particular establishment.

Lastly, design characteristics of the label itself, such as the shape, font, or color, may alter the consumer experience with tamper-evident seals. As noted by Dunham (2011), presenting the signaling message (e.g., the tamper-evident seal) that appeal to receiver psychology is the crux of signaling theory, and prior research suggests that font and typeface selections influence consumer perceptions (see Velasco & Spence, 2018, for a review). For example, handwritten (vs. machine-written) fonts increase trust for warmth-focused (vs. competence-focused) messages (Huang & Liu, 2020). Moreover, evidence suggests that font style influences perceptions of quality, such that consumers perceived restaurants with italicized menu listings to be more upscale and capable of delivering exceptional service (Magnini & Kim, 2016). This prior work suggests that non-standard font usage may moderate the effect of tamper-evident seals on WTP. The selection of wording has also been shown to impact consumer perceptions of and experiences with food items. For instance, the use of sensory and nostalgic food names on menus resulted in the perception of warmer service as compared to general menu names (Kim & Magnini, 2020) and descriptive menu names (vs. regular menu names) returned higher ratings of appeal, taste, and calories (Wansink et al., 2005). Thus, the specific wording used on tamper-evident seals may alter consumer perceptions of the product.
Furthermore, negative quality evaluations could be attributed to the red color of the tamper-evident seal. There is considerable evidence suggesting that colors elicit feelings (Labrecque et al., 2013), and red has specifically been found to provoke avoidance motivation (Genschow et al., 2012) and suggest the need for vigilance (Gnambs et al., 2015). Consumers consider products touched by others less favorably due to feelings of disgust (Argo et al., 2006), a food-related emotion triggered not by sensory properties of a product, but instead by ideas of where the product has been (Haidt et al., 1997). Consumers are particularly sensitive to contamination cues, or signs that the product has been touched by others, which increases the salience of contamination (Argo et al., 2006). It is possible that the use of the color red serves as a cue alerting consumers to the potential for contamination. Thus, future research should consider tamper-evident packaging which utilizes other colors or less intense colors.

In conclusion, the current research demonstrates how tamper-evident closures, specifically seals, impact consumer evaluations of food quality and their subsequent willingness to pay. Given that third-party delivery has increased exponentially due to the COVID-19 pandemic, we trust that continued exploration of this topic offers important implications for food packaging research.


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Appendix A

Study 1 Stimuli
Appendix B

Table B1. Study 1 and Study 2 means and standard deviations by condition

<table>
<thead>
<tr>
<th>Measure</th>
<th>Study 1 No Seal (N = 39)</th>
<th>Study 1 Seal (N = 44)</th>
<th>Study 2 No Seal (N = 121)</th>
<th>Study 2 Seal (N = 122)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Quality</td>
<td>5.78 (0.91)</td>
<td>5.39 (1.30)</td>
<td>5.43 (1.22)</td>
<td>5.19 (1.05)</td>
</tr>
<tr>
<td>WTP</td>
<td>$4.45 ($1.60)</td>
<td>$2.42 ($1.34)</td>
<td>$3.65 ($1.47)</td>
<td>$3.56 ($1.22)</td>
</tr>
<tr>
<td>Attractiveness</td>
<td>5.62 (1.08)</td>
<td>5.44 (1.24)</td>
<td>5.31 (1.50)</td>
<td>5.16 (1.26)</td>
</tr>
<tr>
<td>Food Safety Risk Perception</td>
<td>--</td>
<td>--</td>
<td>3.76 (1.59)</td>
<td>4.17 (1.46)</td>
</tr>
</tbody>
</table>
Appendix C

Study 2 Stimuli