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The effects of consumer experience and disconfirmation on the timing of online review: Field evidence from the restaurant business

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The effects of consumer experience and disconfirmation on the timing of online review: Field evidence from the restaurant business

Abstract: This study investigated the effects of consumer experience and disconfirmation on the timing of online reviews. Based on a unique dataset of restaurant reservations and online reviews, the empirical results indicate that (1) there is a reverse U-shaped relationship between consumer experience and online review posting timing, i.e., consumers who have strongly dissatisfying or satisfying experiences tend to post online reviews earlier than consumers who have moderate experience; (2) the disconfirmation between a customer's experience and the average rating of prior reviews has a negative effect on his or her online review posting speed; and (3) the effect of disconfirmation on review posting speed is substantial for consumers who have strongly dissatisfying or satisfying experiences, while it is weaker for consumers who have moderate experience.

Keywords: online review timing, consumer experience, disconfirmation, restaurant

Highlights

- This study explores the effects of consumer experience and disconfirmation on the timing of online review.
- A paired data set of consumer reservation records and online review was used.
- There is a reverse U-shaped relationship between consumer experience and online review posting timing.
- Disconfirmation has a negative effect on the consumer's online review posting speed.
- There is a significant interaction effect between disconfirmation and consumer experience on review posting timing.

1. Introduction

With the advent of the internet and social media, online reviews have become increasingly popular as an important source of word-of-mouth (WOM) (Li et al., 2018), which can influence product sales and profitability (Chevalier & Mayzlin, 2006; Ye, Law, & Gu, 2009; Zhu & Zhang, 2010). Therefore, understanding the factors behind consumers' online review posting behavior is essential for business success and theoretical development. One important aspect of consumers' online review behavior is review timing (or temporal contiguity), i.e., when consumers post online reviews. With the rapid development of information and smartphone technology, consumers' experience in sharing information on social media has been reshaped (Law et al., 2014; Wu et al., 2017). Currently, consumers can share their consumption experiences at any time. Some consumers choose to write a review immediately after consumption, while others post reviews after a lengthy delay. Despite the growing scholarly interest in this research topic, the existing literature only provides a limited understanding of individuals' decisions to provide product reviews and the factors that contribute to these decisions (Moe & Schweidel, 2012).

Review timing is important to businesses and consumers in several ways. First, review timing can influence readers' perspectives of reviewers' posting intentions (Chen & Lurie, 2013). Readers are more likely to attribute a positive review to a true positive experience, rather than the reviewer, if the temporal distance between the time of consumption and review posting is short. Therefore, review temporal contiguity[1] can reduce negativity bias and improve the value of positive reviews. Second, review timing can moderate the social influence of prior reviews on subsequent review ratings (Li et al., 2019). Specifically, a shorter review temporal distance helps

[1] The temporal contiguity refers to the temporal closeness between product/service consumption and the time at which a review is posted (Chen & Lurie, 2013; Yang et al., 2018, p.120).

decrease social influence/bias from prior reviews. Therefore, review timing matters because the time lapse affects the perceived accuracy and freshness of online reviews. Third, Yang, Wu, and Yang (2018) claimed that the time when a review is posted is important, as for a negative service experience, consumers are more likely to rate hotels extremely poorly if they post a review immediately after their negative experience; with the passage of time, reviews of negative experiences tend to become neutral. Similarly, Huang et al. (2016) reported a temporal distance boosting effect, that is, temporal contiguity has a positive effect on review rating. Fourth, consumers' post-consumption review intentions may decline substantially over time. Consumers become less motivated to post online reviews about their experiences as time passes. It is possible that more reviews will be generated if reviewers can be motivated to post their reviews soon after the consumption experience. In fact, "more reviews" (consequences of review timing) matter to businesses, because it has been found that the number of reviews has a positive effect on product awareness (Dellarocas et al., 2007) and product sales (Dellarocas et al., 2007; Zhu & Zhang, 2010).

Research has shown that consumers' behavior when posting reviews and ratings can be influenced by several factors: personal consumption experiences (Anderson, 1998; Dellarocas & Narayan, 2006; Ho, Wu, & Tan, 2017); social influence, particularly from previous consumers' average review ratings (Ho, Tan, & Wu, 2017; Lee, Hosanagar, & Tan, 2015; Li & Hitt, 2008; Moe & Schweidel, 2012); and the interaction effect between a consumer's experience and social influence (i.e., disconfirmation). However, the factors influencing review timing have not received enough scholarly attention. This raises the following two research questions: (1) Does consumer experience matter in review timing? (2) Does the disconfirmation between consumer experience and average prior review rating affect review timing? To better understand hospitality

consumers' online experience sharing behavior, this study aims to investigate the influences of consumer experience valence, experience disconfirmation, and their interaction effects on consumers' online review posting timing, using online review and reservation data collected from the entire body of restaurants in an international metropolitan city. By doing so, this study represents the first research effort to unveil the determinants of review timing/temporal contiguity. Moreover, our research findings are expected to provide important implications for restaurants in terms of online reputation management and how to decide when to solicit customer reviews.

2. Literature Review

2.1 Temporal contiguity and review timing/temporal contiguity

Temporal contiguity can be defined as the temporal closeness between two events (Chen & Lurie, 2013). In the context of hospitality and tourism management, temporal contiguity refers to the temporal closeness between travel/hotel/restaurant consumption and the time at which a review is posted (Chen & Lurie, 2013; Li et al., 2019; Yang, Wu, & Yang, 2018, p. 120). Temporal contiguity cues are "peripheral information cues or the presence of words that imply the temporal closeness/proximity of product consumption and review posting" (Wu et al., 2017, p. 651; Chen & Lurie, 2013, p. 463). Psychology literature has reported that individuals are more likely to judge the following event to be caused by an earlier event if the two events occur closely (Buehner & May, 2003; Einhorn & Hogarth, 1986). Because of this psychological attribution, temporal contiguity cues influence people's causality judgments (Buehner & May, 2003; Burtch & Hong, 2014; Chen & Lurie, 2013; Wu et al., 2017). For instance, based on three experiments, Shanks, Pearson, and Dickinson (1989) tested the role of temporal contiguity in the relationship between two events in causality judgment, and found that increasing delays between the action and outcome led to reduced causality judgement. Similarly, Topolinski and Reber (2010) revealed that the faster a solution to a cognitive problem succeeds, the more likely the solution is to be perceived as accurate. The limited literature on the effects of review temporal contiguity articles in social media is summarized in Table 1.

Table 1. Chronological Summary of Literature on Review Temporal Contiguity

Author (year)	Journal	Title	Research context	Measurement	Method	Main findings
Chen and Lurie (2013)	*Journal of Marketing Research*	Temporal contiguity and negativity bias in the impact of online word of mouth	*Yelp* online restaurant reviews	Temporal contiguity cues, which indicate that review writing closely follows consumption, are measured using a binary variable, which equals 1 when a review contains temporal contiguity cues (such as "today" and "just got back") and 0 otherwise	Mixed methods of experimental design and econometric modeling based on online secondary data	Temporal contiguity cues increase the value of positive reviews and can decrease negativity bias through changing the reader's attribution of positive reviews.
Huang, Burtch, Hong, and Polman (2016)	*Journal of Consumer Psychology*	Effects of multiple psychological distances on construal and consumer evaluation: A field study of online reviews	Restaurant reviews from *TripAdvisor*	The number of months between the month of the consumption date and the review date	Econometric modeling based on online secondary data	There is a distance boosting effect, that is, writing a review after a lengthy delay (vs. immediately) increases review positivity.
Wu, Shen, Li, and Deng (2017)	*International Journal of Contemporary Hospitality Management*	Sharing information now vs later: The effect of temporal contiguity cue and power on consumer	Online reviews of a resort hotel	Same as Chen & Lurie (2013)	Experimental design	For powerless consumers, the presence of temporal contiguity cues can enhance their purchase intention of the reviewed product

		response toward online reviews				through the increased perceived trustfulness of the review. For powerful consumers, temporal contiguity cues will decrease their perceived trustfulness of the review and consequently decrease their purchase intention toward the reviewed products.
Yang, Wu, and Yang (2018)	*International Journal of Hospitality Management*	Does time dull the pain? The impact of temporal contiguity on review extremity in the hotel context	Online review data for Manhattan hotels on *TripAdvisor*	Same as Huang, Burtch, Hong, and Polman (2016)	Econometric modeling based on online secondary data	Temporal contiguity positively influences review extremity. This effect is only significant for negative experiences, and it increases as reviewer expertise decreases.
Stamolampros and Korfiatis (2018)	*International Journal of Contemporary Hospitality Management*	Exploring the behavioral drivers of review valence: The direct and indirect effects of multiple psychological distances	Hotel review data from *TripAdvisor* and *Booking.com*	Same as Huang, Burtch, Hong, and Polman (2016)	Econometric modeling based on online secondary data	Temporal distance has a positive influence on review valence. However, social distance can amplify this influence.
Li, Zhang, Meng, and	*International Journal of*	"When you write review" matters:	Restaurant review data	The duration between the actual dining time and the	Econometric modeling	Review temporal distance increases the

Zhang (2019)	*Contemporary Hospitality Management*	The interactive effect of prior online reviews and review temporal distance on consumers' restaurant evaluation	from *Xiaomishu.com*	review time of a specific dining experience, in day units (accuracy to the minute)	based on online secondary data	social influence of prior reviews on subsequent review ratings.

In summary, there is only very limited literature on review temporal contiguity, which has not attracted enough research attention (Wu et al., 2017). Based on the literature review shown in Table 1, three research gaps are identified. First, the literature focuses only on the consequences of consumer review timing/temporal contiguity, but neglects its antecedents. Second, consumer review timing/temporal contiguity is measured either by using information extracted from the review text or measured at the month level. The current study is the first to quantitatively measure the temporal distance at the day/hour level by combining both restaurant reservation and review datasets, making it more accurate than previous literature. Third, the extant studies examined the timing of management responses but focused less on the timing of reviews. Therefore, to fill these research gaps, this study aims to explore the antecedents of review timing/temporal contiguity, specifically, the influences of consumer product experience and disconfirmation, and their interaction effect.

2.2 Research Hypotheses

Customer online reviewing behavior is jointly decided based on personal experience (Anderson, 1998; Dellarocas & Narayan, 2006) and the social influence from prior customers' opinions (Moe & Trusov, 2011; Li et al., 2019). However, the interaction effect between personal experience and social influence on customer online reviewing behavior, especially review post timing, has never been studied. A recent study (Ho, Wu, & Tan, 2017) investigated the effect of disconfirmation between the prior average review rating and the focal customer's post-purchase evaluation of the same product on the consumer's online review behavior in terms of willingness to post online reviews and review ratings. Therefore, it is reasonable to presume that disconfirmation may influence consumers' online review posting behavior in terms of review post timing as well.

Social influence theory suggests that people are likely to experience conformity pressure from others in a social group (Cialdini & Goldstein, 2004). According to Cialdini (2009), there are three main reasons for conformity behavior: (1) making fewer mistakes, (2) investing lower mental effort, and (3) avoiding losing reputation if deviating from others. However, in addition to conformity needs (Sherif, 1936), individuals in a social group may simultaneously experience uniqueness needs (Fromkin, 1970) and even normative conflict (Packer, 2008). People conform with peers they know, as well as those they do not know (Darley & Latane, 1968), while uniqueness motivation is activated when people feel too similar to other group members (Snyder & Fromkin, 1980). However, when people perceive a substantial discrepancy from the group norm and believe the group's opinion to be harmful, they may exhibit a strong tendency toward normative conflict and resist pressure to conform (Hornsey, Oppes, & Svensson, 2002).

According to social influence theory, when disconfirmation happens, it is possible that consumers face a difficult decision between following others and being themselves (i.e., sticking to their own opinions), thus leading to them taking more time to post reviews of their experience on online review platforms. By contrast, when confirmation happens, lower mental effort is needed, and consumers experience a much easier decision and quickly post their own opinions on online review platforms. This happens because posting similar opinions to prior consumers poses a low risk of making a mistake and losing reputation. That is, the discrepancy between personal experience and social reference may discourage people from posting a review. The higher the discrepancy between a customer's experience and others' opinion, the slower he/she tends to voice such discrepancy by posting an online review. On this basis, we propose the following research hypothesis:

Hypothesis 1 (H1): *Disconfirmation has a negative influence on online review posting speed.*

On one hand, studies have shown that an individual's product experience can influence his/her post-consumption willingness to post online reviews. For example, Anderson (1998) identified a U-shaped relationship between consumer satisfaction and WOM intention in offline settings, such that consumers who are either highly satisfied or highly dissatisfied tend to engage in greater WOM than those who are moderately satisfied. Similarly, Dellarocas and Narayan (2006) reported that compared to consumers with moderate opinions, those with extremely positive or negative viewpoints are more likely to post online reviews of movies. Along these lines, Dellarocas et al. (2010) further suggested that moviegoers are more likely to post reviews for the most or least popular movies, as measured by box office revenue. Most recently, Ho, Wu, and Tan (2017) indicated that consumers with extremely positive or negative viewpoints are more likely to post online reviews, i.e., there is a U-shaped relationship.

On the other hand, excitation transfer theory asserts that residual excitation generated by a prior event can escalate subsequent emotional responses (Zillmann, 1971). Based on this theory, Alhabash et al. (2015) found that individuals may need to release residual excitation at a certain point after watching a video, which increases arousal (i.e., the intensity of emotional responses) and excitation. The transfer of residual excitation can lead a person to click a 'like' button, share the video, or comment on the video's content and even take action offline to alleviate residual arousal (Alhabash et al., 2015). Therefore, drawing on excitation transfer theory, we argue that a product experience that becomes highly positive or negative will increase participants' experienced arousal, which will then transfer to their expressed intentions and accelerate the time within which they engage in product rating and commenting online.

Temporal motivation theory (TMT) suggests that people prioritize activities possessing greater utility, at least for a certain period (Siaputra, 2010). In other words, people tend to

procrastinate on completing a task when its perceived utility is low. Steel and König's (2006) findings related to TMT coincided with Schraw, Wadkins, and Olafson's (2007) study on procrastination theory, which unveiled three factors influencing procrastination: unclear directions, lack of incentives, and lack of deadlines. Based on TMT and procrastination theory, we contend that as a product experience becomes highly positive or negative, participants' experienced arousal will increase, and timely expression about their product experiences online (e.g., compliments or complaints) will help release excess arousal and raise the product's perceived utility. By contrast, with a neutral product experience (i.e., one containing positive and negative attributes), the unclear direction of consumers' experience valence and lack of emotional incentive may compel customers to procrastinate in posting product reviews online. On this basis, we propose the following direct influence of experience valence on consumer review timing:

> **Hypothesis 2 (H2):** *There is a reverse U-shaped relationship between consumer experience and online review posting timing. Specifically, consumers who have a strongly dissatisfying or satisfying experience are likely to post online reviews earlier than consumers who have moderate experience.*

Previous research (Beswick, Rothblum, & Mann, 1988; Ferrari, Johnson, & McCown, 1995) has consistently tied procrastination to conflict and inability to make decisions, marked by pessimism about reaching a satisfactory solution. According to procrastination theory and normative conflict theory (Packer, 2008), when disconfirmation occurs, consumers may face a difficult decision between following others or adhering to their own opinions. This discrepancy can lead customers to take more time to post reviews of their experience on online review platforms. However, this disconfirmation effect on review timing may be especially powerful for

consumers who have had positive or negative experiences compared to consumers who have had moderate experiences; that is, a potential interaction effect exists between disconfirmation and experience valence on consumers' review timing.

When an individual has a moderate product experience with simultaneous positive and negative attributes, s/he is more likely to encounter uncertainty when quantifying the product's quality (Li, 2018). Comparatively, the correspondence judgment literature has shown that people are more confident utilizing salient information (e.g., opinions with clear direction) in making more formal judgments (Kruglanski, 1989). Prior studies (Cialdini, 2009; Cialdini & Goldstein, 2004; Walther et al., 2002) have indicated that the uncertainty of an individual's judgment corresponds to strong social influence, whereas certainty reduces social influence substantially. When an individual has a highly positive or negative experience that deviates from existing reviews, s/he is more likely to experience normative conflict (Ashforth, Kreiner, & Fugate, 2000). In this case, the consumer is certain about his/her own product experience and may weigh presenting his/her opinion against conforming with others' views when evaluating the product on an online review platform. This decision process requires more time and extend the time the reviewer takes to post his/her review. However, when an individual has a moderate product experience that disconfirms existing reviews and ratings, s/he is less likely to experience normative conflict given uncertainty about his/her own experience; that is, part of the customer's moderate experience (i.e., with simultaneous positive and negative attributes) is consistent with others' opinions. Therefore, this individual can make decisions more easily, leading him/her to post reviews online without much procrastination. To explore this effect (as shown in Figure 1), we propose the following research hypothesis:

Hypothesis 3 (H3): *The effect of disconfirmation on review posting speed is substantial*

for consumers who have a very dissatisfying experience (point 1), weak for consumers who have moderate experience (point 2), and substantial for consumers who have a very satisfying experience (point 3).

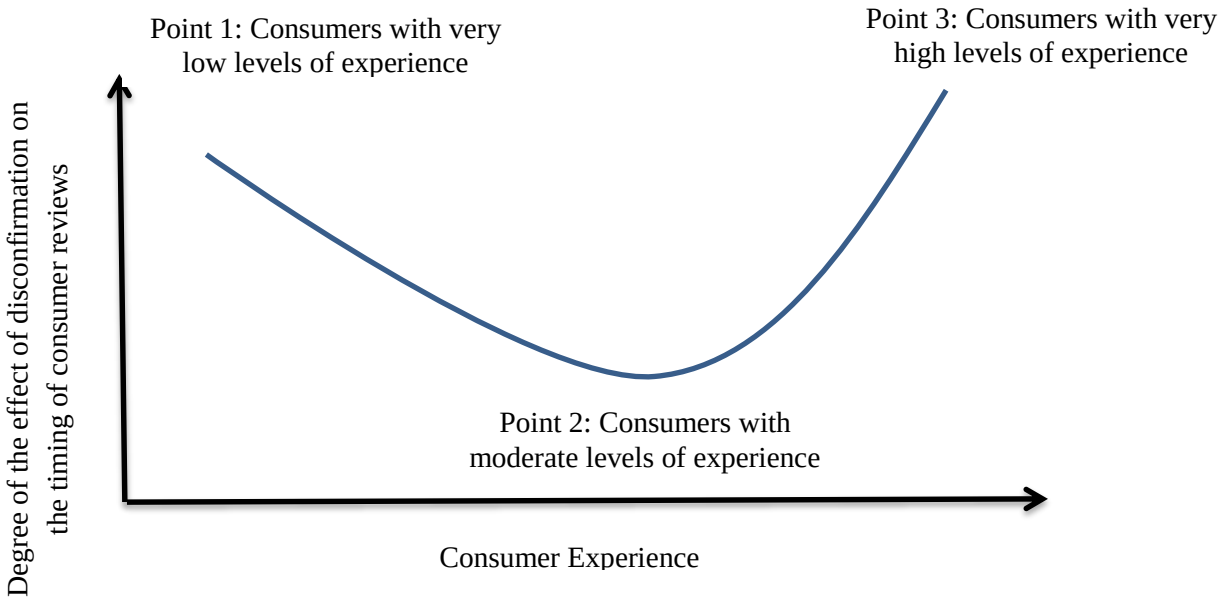

Figure 1. The proposed three extreme points that determine the disconfirmation

The research framework is summarized in Figure 2, as follows:

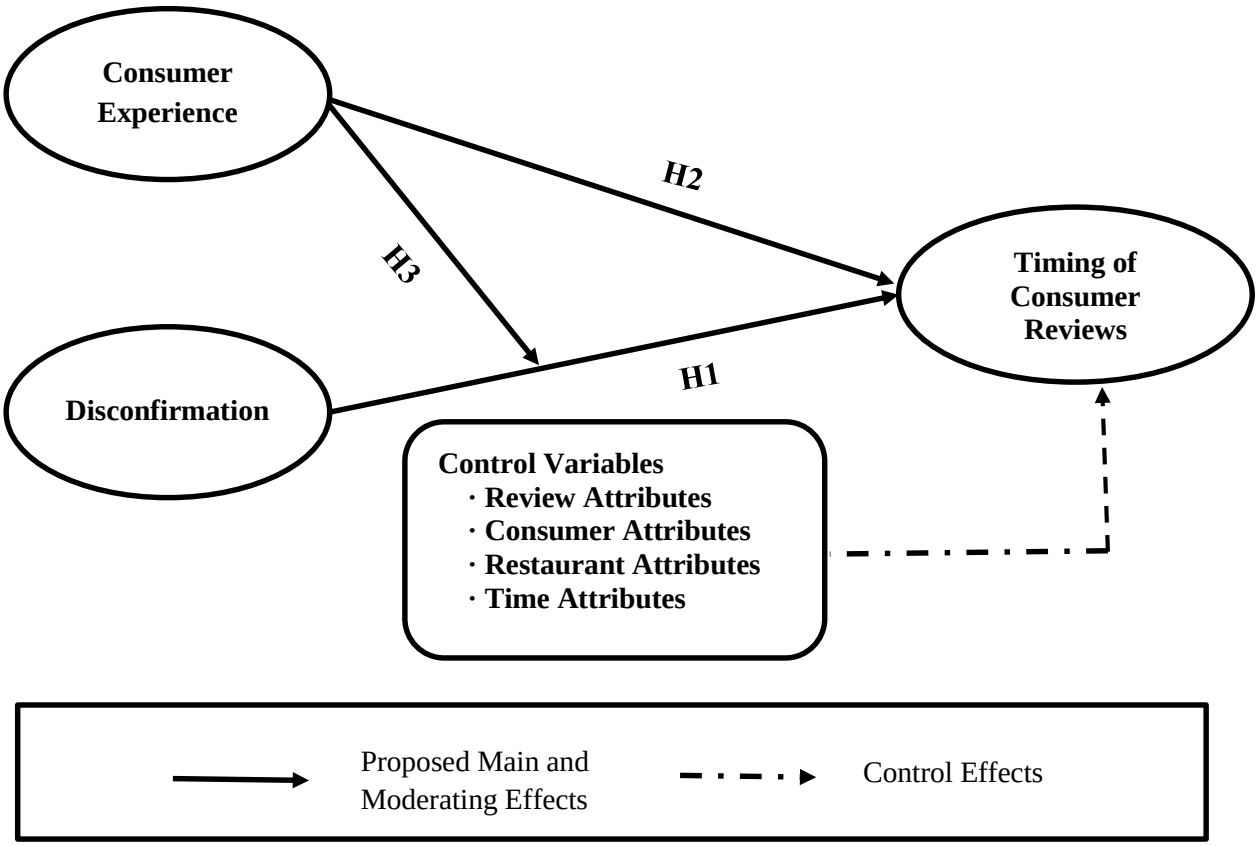

Figure 2. Research Framework

3. Methodology

3.1 Data Collection

The data for this study was collected from Xiaomishu (http://www.xiaomishu.com), which is a leading restaurant reservation website in China. Users can search for available tables and confirm reservations with a Xiaomishu account, and they can post restaurant reviews on the site. As such, their dining information, such as dining date and time, can be linked to a specific review. In general, there are two types of restaurant reviews on Xiaomishu: reservation reviews and regular reviews. Reservation reviews are reviews pertaining to a restaurant reservation made through Xiaomishu, thereby allowing us to calculate the duration of time between the dining experience and its correlative review posting. Regular reviews are reviews posted by any consumer after logging into the website; their reservations cannot be found on Xiaomishu.

For both regular reviews and reservation reviews, we gathered the review rating, review time and date, review text and number of pictures, and the device through which the review was posted. We also extracted the dining time and date for each reservation review. Restaurant-level variables were also collected, including the lowest price of per capita consumption, the highest price of per capita consumption, and the cuisine style of each restaurant.

In March and April 2017, we obtained all of the review data for restaurants in Shanghai from November 2008 to April 2017. We only used the reservation reviews in the formal data analysis. Reservation reviews with no review rating, that were the first review of a restaurant, or in which the temporal distance between the dining experience and review posting were longer than 366 days were removed. Reservation reviews that were the first review of a restaurant were removed due to the lack of a prior average review rating. As a result, 130,809 reservation reviews from 4458 restaurants and 24,722 consumers were included in the final data analysis.

3.2 Variable Operationalization and Summary Statistics

The dependent variable was review timing (*ReviewTime*), measured by the duration between dining time and review time (i.e., the time lapse before posting reviews after dining). The independent variables were customer review rating (*Rating* and *RatingSqu*) and customer disconfirmation (*Disconfirm*), i.e., the absolute difference between a customer review rating and the prior average review rating.

To avoid spurious regression, factors identified as important in the literature were controlled. Similar to Huang et al. (2016) and Li et al. (2019), the control variables were divided into three levels: the review level (*Device*, *RevText*, and *RevPic*), the consumer level (*ConAveRating* and *ConRatingNum*), and the restaurant level (*AvePrice* and *CuisineStyle*). Review-level control variables encompassed the device through which a review was posted (*Device*) and the number of characters (*RevText*) and pictures (*RevPic*) in a customer review. To explain the consumer-level heterogeneity effect, we controlled for consumers' past review experience, including his/her average review rating prior to writing a review (*ConAveRating*) and the cumulative number of restaurant reviews before writing a review (*ConRatingNum*). Restaurant-level variables were also controlled, including the restaurant's per capita consumption (*AvePrice*) and the restaurant's cuisine style (*CuisineStyle*). Detailed descriptions of all variables are shown in Table 2.

Table 2. Variable Measurement and Description

Variable	Measurement and Description
Dependent variables	
ReviewTime (in days)	The duration between the review time and the dining time (days)
ReviewTime (in hours)	The duration between the review time and the dining time (hours)
Primary independent variables	
Rating	The rating of a customer review for his/her dining experience, ranging from 1 to 5 (1 = most dissatisfied; 5 = most satisfied)
RatingSqu	The quadratic form of a customer review rating
Disconfirm	The absolute difference between the rating of a customer's review and the average rating of prior reviews for a specific restaurant
Control variables	
(1) Review level	
Device	The device through which a customer review is posted. 1 = a review posted through a smartphone or tablet; 0 = a review posted through a personal computer
RevText	The number of characters in a customer review
RevPic	The number of pictures in a customer review
(2) Consumer level	
ConAveRating	The average rating of a customer's past restaurant reviews prior to writing a review
ConRatingNum	The cumulative number of a customer's past restaurant reviews prior to writing a review
(3) Restaurant level	
AvePrice	The restaurant's per capita consumption
CuisineStyle	The restaurant's cuisine style (a categorical variable, which includes 130 cuisine styles)

Table 3 presents the summary statistics for all of the variables. Figures 3-5 show the distribution of the main variables. Specifically, Figure 3 shows that 30.43% of reviews were posted on the same day as the dining experience, and 60.28% of reviews were posted within one week of the dining experience. Figure 4 shows that most review ratings are four stars (41.24%), followed by five stars (36.92%), three stars (18.55%), two stars (1.99%) and one star (1.30%). Figure 5 shows that the majority of customers have similar evaluations to prior customers, i.e., customer disconfirmation less than one accounts for 76.70% of customers.

Table 3. Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
ReviewTime (in hours)	866.8771	1698.723	.024	8783.928
ReviewTime (in days)	36.11988	70.78014	.001	365.997
Rating	4.104862	.8605866	1	5
Disconfirm	.6650199	.550945	0	4
RevText	40.81696	66.20809	0	2106
RevPic	.1591597	1.032412	0	32
Device	--	--	0	1
ConAveRating	4.026114	.594675	1	5
ConRatingNum	41.98653	293.8052	0	32806
AvePrice	176.3069	123.6773	14	3250
CuisineStyle	--	--	1	136

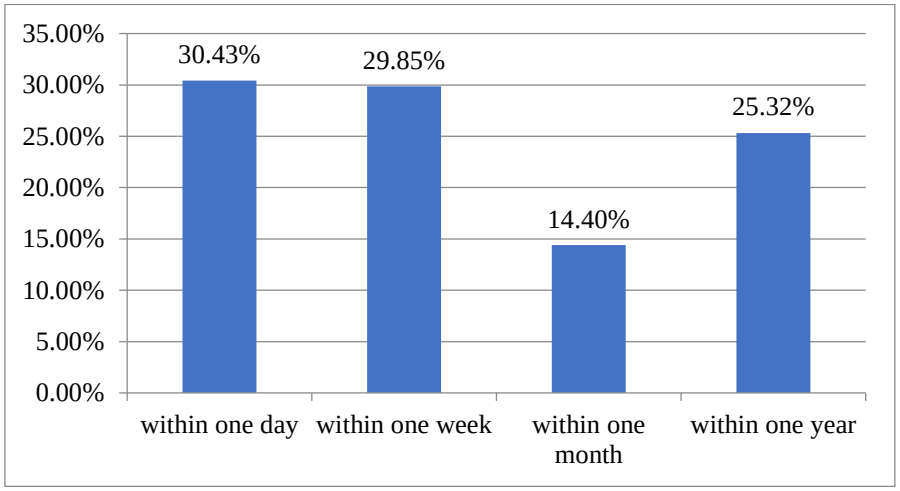

Figure 3. Distribution of timing of customer reviews

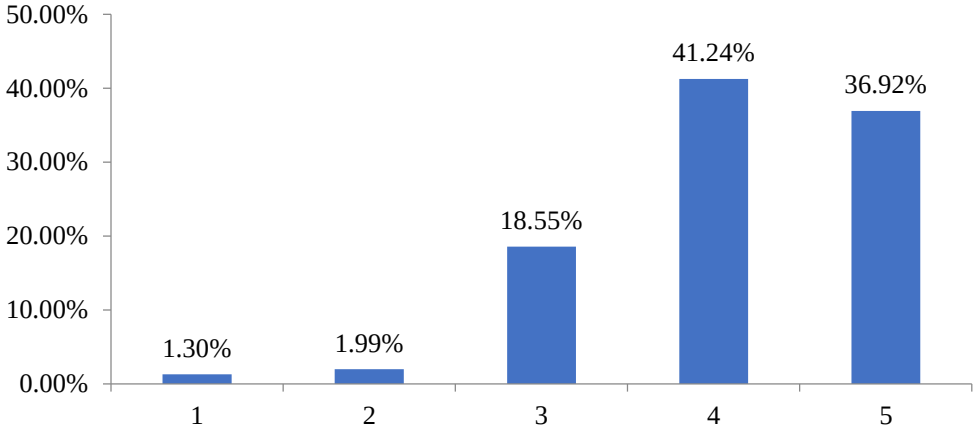

Figure 4. Distribution of customer review rating (1 star – 5 star)

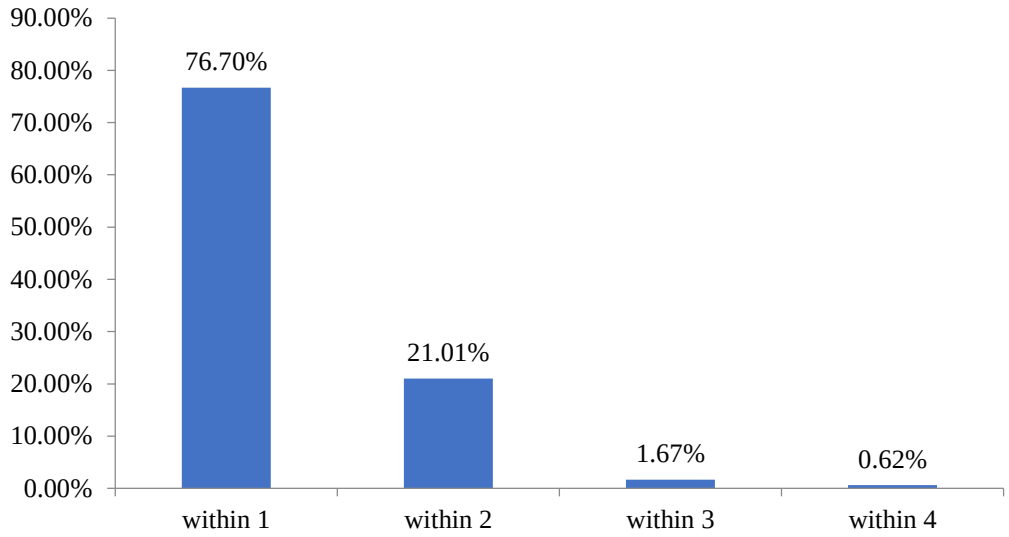

Figure 5. Distribution of customer review disconfirmation (1 star – 5 star)

The results given in Table 4 indicate that the correlations among the variables in this study are relatively weak. The weak correlations among the independent variables reduce the multicollinearity problem and improve the reliability and validity of the estimation results.

Table 4. Correlations among Variables

Variable	(1)	(2)	(3)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) ReviewTime	1.000									
(2) Rating	0.0252	1.0000								
(3) RatingSqu	0.0207	0.9869	1.0000							
(4) Disconfirm	-0.0331	-0.1939	-0.0638	1.0000						
(5) RevText	-0.0666	-0.0796	-0.0643	0.0846	1.0000					
(6) RevPic	-0.0604	0.0168	0.0163	-0.0056	0.1454	1.0000				
(7) Device	-0.1100	-0.0774	-0.0810	0.0040	-0.1751	0.0894	1.0000			
(8) ConAveRating	0.0219	0.3622	0.3759	0.0225	-0.0511	0.0032	-0.0219	1.0000		
(9) ConRatingNum	-0.0102	-0.0378	-0.0411	-0.0148	0.0173	0.0442	0.0211	-0.0349	1.0000	
(10) AvePrice	0.0035	0.1089	0.1140	-0.0081	-0.0048	0.0194	0.0397	0.0247	0.0006	1.0000

3.3 Model Specification

Based on the research framework illustrated in Figure 2, the econometric model is specified as follows:

$$
\begin{aligned}
ReviewTime_{ijt} = {} & \alpha_1 Disconfirm_{ijt} + \alpha_2 Rating_{ijt} + \alpha_3 Disconfirm_{ijt} \times Rating_{ijt} \\
& + \alpha_4 RatingSqu_{ijt} + \alpha_5 Disconfirm_{ijt} \times RatingSqu_{ijt} \\
& + \alpha_6 RevText_{ijt} + \alpha_7 RevPic_{ijt} + \alpha_8 Device_{ijt} \\
& + \alpha_9 ConAveRating_{it} + \alpha_{10} ConRatingNum_{it} \\
& + \alpha_{11} AvePrice_j + \sum_{T_1} \lambda_j * CuisineStyle_j \\
& + \sum_{T_1} \tau_t * Month_t + \sum_{T_2} \delta_i * Consumer_i + u_{ijt} \qquad (1)
\end{aligned}
$$

where *i* refers to the consumer; *j* refers to the restaurant; *t* refers to the time; *ReviewTime* represents two measures of the timing of reviews being posted, one in days and the other in hours; $Consumer_i$ refers to the customer-specific fixed effects that capture the time-invariant inherent characteristics of each consumer; and $Month_t$ refers to the timing-specific fixed effects that capture the temporal trend and seasonality. These fixed effects enable us to control for unobserved time-invariant heterogeneity across customers and time periods (Rishika et al., 2013).

4. Estimation Results

We exploit a polynomial regression model with review timing (*ReviewTime*) as the dependent variable. Table 5 presents the estimated effects of disconfirmation and online rating, and their interaction terms on review timing, with the heterogeneity of the reviews, restaurants, reviewers and time controlled. For comparison, we first present the main model for review timing measured in days (Column 1), followed by an alternative model for review timing measured in hours (Column 2). Using two measures of review timing as the dependent variables enabled us to observe how the timing of reviews across time granularity was affected by disconfirmation and online rating, separately and together. The findings in Column 2 were qualitatively consistent with those in Column 1. Next, we discuss the results reported in Column 1.

Table 5. OLS Estimation Results

D.V. = *ReviewTime*	**Unit=Day**	**Unit=Hour**
	Model 1.1	Model 1.2
Block 1: Linear effects		
Disconfirm	6.354848*	152.5163*
	(3.623722)	(86.96933)
Rating	18.21516***	437.1638***
	(5.665597)	(135.9743)
Block 2: Interaction effects (rating)		
Disconfirm × *Rating*	-5.829168***	-139.9***
	(1.890252)	(45.36604)
Block 3: Quadratic effects (rating)		
RatingSqu	-2.66644***	-63.99456***
	(.6914504)	(16.59481)
Block 5: Cubic effects (evaluation)		
Disconfirm × *RatingSqu*	.9472714***	22.73451***
	(.3021025)	(7.250461)
Block 6: Control variables		
RevText	-.1040632***	-2.497518***
	(.0049805)	(.1195319)
RevPic	-2.121044***	-50.90505***
	(.1918703)	(4.604888)
Device	-21.93527***	-526.4465***
	(.7393471)	(17.74433)
ConAveRating	.2627699	6.306477
	(.8352345)	(20.04563)
ConRatingNum	.0056657***	.1359776***
	(.0013795)	(.033107)
Aveprice	.0035289	.0846933
	(.0022485)	(.0539639)
Cuisine style	Yes	Yes
Month Fixed Effects	Yes	Yes
Consumer Fixed Effects	Yes	Yes
Constant	23.78967**	570.952**
	(12.10756)	(290.5815)
Observations	130,809	130,809
R-squared	0.3579	0.3579
Adj R-squared	0.2071	0.2071

Notes. Values in parentheses indicate the robust standard errors; Asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.

As shown in Column 1, disconfirmation positively affects review timing (6.354848* for *Disconfirm*). In other words, the greater the disconfirmation, the longer the time delay before posting reviews after dining. Specifically, a one-unit difference from the average rating of prior reviews makes a customer postpone their review posting by about 6 days. This finding indicates that when disconfirming the evaluation of restaurant quality by previous users, it takes a few days for a customer to provide his/her own judgment publicly on social media, confirming the theory of social influence. Therefore, H1 (disconfirmation has a negative influence on online review posting speed) is supported.

In terms of the direct effect of customer experience with the restaurant, we find a reverse U-shaped relationship between the online rating (indicating customer experience) and the review timing (18.21516*** for *Rating* and -2.66644*** for *RatingSqu*). Customers who have the most negative or positive experiences with a restaurant tend to post reviews faster than those who have average experience. More specifically, the slowest review speed corresponds to customer experience with an online rating of approximately three stars[2], which represents moderate evaluation of the restaurant experience, being at the midpoint of the range from most negative (one star) to most positive (five stars). The results reveal a quasi-asymmetry in the quadratic effect of online rating between the upward increase from the most negative experience to the average experience, and the downward decrease from the most positive to the average experience. This asymmetric pattern implies that review speed slows down when the customer experience changes from the most negative (one star) or the most positive (five stars) to the average (three stars), supporting H2.

To test the third hypothesis in this study (the non-linear interaction effect between

[2] The online rating value that corresponds to the inflection point of the reverse U-shaped curve is calculated as -18.21516/-2.66644^2 ≈ 3 (stars).

consumer experience and disconfirmation on review timing), the interaction term between the quadratic form of a customer review rating and disconfirmation is included in the econometric model, as shown in the cubic effects in Table 5. The results further suggest a significant quadratic moderating role of customer experience on the effect of disconfirmation (.9472714*** for *Disconfirm* × *RatingSqu*). The effect of disconfirmation on review timing is substantial and salient for consumers who have the most negative and most positive experiences, supporting H3. Specifically, when a customer's experience with a restaurant becomes very negative, the positive effect of their disconfirmation of prior customers' evaluations on their review timing is enhanced, suggesting that it will take more time for them to post a review. Similarly, disconfirmation slows down review speed, even when customers have a very positive experience, plausibly due to customers' tendency to surrender to the opinion or "social norms" established by previous customers (Cialdini & Goldstein, 2004; Cialdini, 2009). When customers have average experience with a restaurant, it takes less time for them to post disconfirmation of previous customers' opinions. These results point to the fact that social influence dramatically slows reviews that carry a different opinion from previous ones. When it comes to online ratings, consumers' herd instincts, combined with their susceptibility to "social influence", likely suppress the promptness of opinion expression on social platforms.

5. Robustness Check

To reduce the skewness of data, we take natural logarithms of all skewed variables before including them in the estimation. These include the number of characters (*RevText*), number of pictures in a review (*RevPic*), a customer's cumulative past restaurant reviews (*ConRatingNum*), and the restaurant's per capita consumption (*Aveprice*). In general, we obtain consistent results when including these variables in the estimation without log transformations, as reported in Table 6. The only inconsistency is the influence of disconfirmation on review timing, which becomes insignificant at the 10% level, although its interaction effects with consumer dining experience remain statistically significant.

Table 6. Robustness Check

D.V. = *PostSpeed*	**Unit=Day**	**Unit=Hour**
	Model 1.1	Model 1.2
Block 1: Linear effects		
Disconfirm	4.934944	118.4387
	(3.593821)	(86.25171)
Rating	13.51134**	324.2723**
	(5.660558)	(135.8534)
Block 2: Interaction effects (rating)		
Disconfirm × *Rating*	-4.69797**	-112.7513**
	(1.865641)	(44.77539)
Block 3: Quadratic effects (rating)		
RatingSqu	-2.106888***	-50.56531***
	(.6885942)	(16.52626)
Block 5: Cubic effects (evaluation)		
Disconfirm × *RatingSqu*	.7680382***	18.43292***
	(.299461)	(7.187065)
Block 6: Control variables		
logRevText	-14.3647***	-344.7528***
	(.3551017)	(8.522441)
logRevPic	-9.863316***	-236.7196***
	(.6170048)	(14.80812)
Device	-25.07265***	-601.7436***
	(.7751783)	(18.60428)
ConAveRating	.4180398	10.03295
	(.8312592)	(19.95022)
logConRatingNum	-.5735803*	-13.76593*
	(.2965731)	(7.117754)
logAveprice	.8954512	21.49083
	(.5815282)	(13.95668)
Cuisine style	Yes	Yes
Month Fixed Effects	Yes	Yes
Consumer Fixed Effects	Yes	Yes
Constant	75.29054***	1806.973***
	(12.39414)	(297.4594)
Observations	130,809	130,809
R-squared	0.3648	0.3648
Adj R-squared	0.2157	0.2157

Notes. Values in parentheses indicate the robust standard errors; Asterisks indicate that the coefficient is significant at the *10%, **5%, and ***1% level.

6. Conclusion and Implications

Based on combined restaurant online review and reservation data, we examine the effects of consumer experience valence, disconfirmation, and their interaction on consumers' online review posting timing. Different from previous studies that focused solely on the consequences of consumer review timing/temporal contiguity (Chen & Lurie, 2013; Huang et al., 2016; Li et al., 2019; Wu et al., 2017; Yang et al., 2018; Stamolampros & Korfiatis, 2018), this study makes an initial attempt to unveil the determinants of review timing/temporal contiguity. The major findings of this empirical study are as follows.

First, we identified a negative influence of disconfirmation—the discrepancy between a focal customer's experience and prior customers' average review rating of the same restaurant—on the timing of customers' online reviews. This finding echoes expectation-disconfirmation theory (EDT) (Oliver, 1977, 1980), which introduces the concept of disconfirmation and has been widely used to explain customer satisfaction in tourism and hospitality (e.g., Alan, 2003; Pizam & Milman, 1993), repeat purchases (Anderson & Sullivan, 1993; Bhattacherjee, 2001), and post-purchase complaints (Bearden & Teel, 1983). A recent study (Ho, Wu, & Tan, 2017) investigated the effect of disconfirmation between prior average review ratings and focal customers' experiences on consumers' willingness to post online reviews and review ratings. Our study distinguishes itself from and supplements earlier work (Ho, Wu, & Tan, 2017) by examining the effect of disconfirmation on consumers' online review timing.

Second, we found a reverse U-shaped relationship between consumer experience and online review posting timing. That is, customers with polarized dining experiences (strongly dissatisfied and strongly satisfied) tend to review their experience faster than those who have moderate experience. Previous studies only found that an individual's product experience can

influence his/her post-consumption willingness to post online reviews and review ratings (Anderson, 1998; Dellarocas & Narayan, 2006; Dellarocas et al., 2010; Ho, Wu, & Tan, 2017). This finding extends the research stream regarding the influence of product-based experiences on consumers' online review timing.

Additionally, the effect of disconfirmation is non-uniform. Coupled with the reversed U-shaped relationship between consumer experience and online review posting speed, the effect of disconfirmation on review posting speed is substantial for consumers with strongly negative or positive experiences, while it is weaker for consumers with moderate experiences. This research adds insights to the literature about online review timing/temporal contiguity and generates actionable strategies for restaurant marketers.

6.1 Theoretical Contributions

The early research on online reviews focuses on the impact of posted reviews on subsequent ones from a dynamic social standpoint (Lee et al. 2015; Moe & Schweidel, 2012; Ho et al., 2017). Our work adds to this stream of literature by first confirming that customer behavior in posting online reviews is jointly influenced by personal experience and social influence (i.e., prior customers' opinions). Additionally, we propose a novel perspective in which the discrepancy between the personal experience and the social reference stimulates subsequent reviews. By integrating the personal opinion and the social influence as two determinants in individual online review posting behavior, we make a first attempt to demonstrate the critical impact of disconfirmation on posting behavior empirically. Finally, we argue that the disconfirmation effect may help correct the bias of online reviews. Every new review with a different opinion about the dining experience adds to the "wisdom of the crowd" (Lorenz et al., 2012). It is, therefore, possible that through disconfirming previous reviews, a customer can

update a restaurant's evaluation with up-to-date information and make the restaurant's reviews more relevant.

The literature shows that social influence can bias customer opinions and manipulate how customers review a product (Aral, 2014; Hu et al., 2009). We offer a new perspective, showing that social influence can also affect the timing of customers' reviews and affect the promptness of new reviews that disconfirm previous ones. Review timing or temporal contiguity is less discussed in the literature than other metrics of online reviews, such as valence (Xie, Zhang, & Zhang, 2014; Zhang, Zhang, & Yang, 2016), volume (Xie & So, 2017), and variance (Chintagunta et al., 2010; Zhang et al., 2019). One exception is Yang, Wu, and Yang (2016), who investigate the impact of temporal contiguity on review extremity. The literature can certainly benefit from more research on the timing of online reviews, because the recency of information ensures that a restaurant is evaluated in a timely manner. Our study sheds light on the role of disconfirmation, which serves as an underlying driver of timely online reviews, thus adding to the emerging body of literature on review timing.

Finally, our research reveals the moderating factors that condition the effect of disconfirmation on review timing: the positivity and negativity of the customer's experience. This moderation is important because it realistically articulates customers' decision-making surrounding posting online reviews; they not only refer to others' opinions as a benchmark but also stick to their own perceptions. Despite the fact that the polarized distribution of online reviews is widely accepted in the literature (Hu et al., 2017), research on how disconfirmation affects review timing given different customer experiences is sparse. Our work considers the polarized conditions of customer experience reflected in reviews, and investigates how the timing effect of disconfirmation varies under these conditions. We find that the effect of

disconfirmation on review timing is substantial for consumers with a strongly negative or strongly positive experience, while it is weak for consumers who have average experience. This empirical evidence fills a void in the literature and deepens our understanding of the heterogeneity of disconfirmation in influencing the timing of online reviews.

6.2 Practical Contributions

In today's business world, the online reputation of restaurants is critical. Reputation plays a dominant role in consumers' decision-making (i.e., customers tend to check online reviews before visiting a restaurant). Given the velocity of online review production in this digital world, managing their online reputation and soliciting timely reviews from customers is thus becoming a central focus for many restaurants. Reflecting such practical urgency, we have investigated two managerial questions that have not been adequately answered by the existing hospitality literature: Do customer experience and disconfirmation matter to the timing of posting reviews online? If yes, how should restaurants handle the timing issue in online reviews? Accordingly, three hypotheses were developed to answer these questions. Relevant findings have important implications for practice. Table 7 provides a summary of related implications for industry practitioners, especially restaurant managers who wish to survive and thrive in the digital age where online reputation is paramount. Industry impacts associated with our findings are considered in terms of three aspects, each of which corresponds to a hypothesis.

Table 7. Summary of Findings-based Implications

Hypothesis Testing		**Finding**	**Action-driven Implications**
H1	Disconfirmation negatively influences online review posting speed.	When disconfirming evaluations of restaurant quality by previous users, customers take a few days to voice their judgments publicly on social media.	• Closely monitor reviews, detect unfavorable sentiments in previous negative reviews, and promptly respond to these reviews with effective service recovery approaches. • Consider adopting a real-time review inspection algorithm or automated machine learning for rapid detection and responsiveness to online reviews.
H2	An inverted U-shaped relationship exists between consumer experience and the timing of online review posting.	Review speed slows when the customer experience changes from most negative (one star) or most positive (five stars) to average (three stars).	• Check in frequently on consumers' dining experiences and actively take care of customers while they are on site (i.e., before they leave the restaurant). • Management should intervene in the customer experience to prevent a negative experience from eliciting a negative (one-star) review.
H3	The effect of disconfirmation on review posting speed is substantial for consumers with a highly dissatisfying experience, weak for consumers with an average experience, and substantial for consumers with a highly satisfying experience.	When a customer's experience with a restaurant becomes highly negative (or positive), and in disconfirmation with others' experience, the customer will take longer to post a review. When customers have an average experience with a restaurant, they take less time to disconfirm previous customers' opinions.	• Minimize the chance of satisfied customers waiting to post positive reviews to counter prior negative reviews. • Design effective incentives to encourage satisfied customers to post positive reviews on site (i.e., without a waiting period).

Our findings reveal a time lapse (roughly a few days) before a customer posts a review disconfirming prior consumers' opinions. Such a time window is crucial for restaurant managers because they have an opportunity to actively influence upcoming reviews in eliciting a positive outcome. Due to the publicity of social media, managers' responses to prior reviews are readily available online, as are the reviews themselves. Within this time window, managers can closely monitor previous reviews, identify unfavorable sentiments within them, and respond promptly to these reviews using effective service recovery approaches. This managerial reaction has great potential to modify a restaurant's image depicted through earlier negative reviews and serve as new information that new customers may consider when posting disconfirming reviews. In this "now or never" scenario, our results should encourage restaurant managers to react to user reviews quickly. Restaurant managers in particular should consider employing a real-time inspection algorithm or automated machine learning techniques to monitor posted customer reviews.

We have also captured the heterogeneity of review speed in terms of levels of customer satisfaction, thus offering restaurant managers a specific target in online reputation management. Specifically, review speed appears to slow when the customer experience shifts from highly negative (one star) or highly positive (five stars) to average (three stars). Polarized or extreme reviews (one or five stars) are usually written by the most or least satisfied customers. Following extremely satisfying or dissatisfying service experiences, consumers are more likely to post reviews immediately after, or even during, a dining experience. Positive reviews are favorable, whereas negative reviews are not and should be addressed by restaurant managers. We suggest that negative experiences can potentially be detected and addressed in an early stage of development. While customers are still on site, managerial check-ins regarding their dining

experiences, coupled with catering to customers' needs, may effectively prevent negative experiences that could otherwise elicit one-star reviews. These customer experience interventions could be extremely valuable in enabling managers to co-construct positive experiences with customers to transform a potentially negative review into a neutral (or even positive) one. To maintain a good reputation, we suggest that restaurant managers focus on perception reinforcement and recovery opportunities and proactively maintain or alter customers' perceptions while consumers are still on site. By doing so, managers' efforts can encourage timely online reviews in favor of their restaurants.

Finally, our findings indicate that social influence dramatically slows the generation of online reviews espousing opinions that differ from others'. This consumer behavior may polarize review sentiments as either highly positive or highly negative in the long term, magnifying the dearth of neutral reviews. To encourage customers to provide timely and positive opinions that may differ from those of prior consumers, managers should actively identify satisfied customers who may be restaurant advocates. Through incentives such as discounts and free drink coupons, restaurant managers can nudge these customers to publish reviews on site without waiting or likely perusing others' opinions on social media before posting a review. One such incentive could be a 10% discount to satisfied customers who leave positive reviews immediately during or after their dining experience. Restaurant managers should also realize that timing is essential in encouraging satisfied customers to post prompt reviews, regardless of how different (i.e., negative) previous customers' opinions are. If such managerial actions are not taken promptly, restaurants may encounter challenges in eliciting positive reviews that are posted quickly and available for subsequent customers. Overall, we have presented several managerial actions for restaurant managers to consider in leveraging disconfirmation and timing in reviews. Useful

takeaways pertaining to online reputation management are evident in our recommendations and warrant close managerial attention.

6.3 Limitations and Future Directions

This study is not without limitations. Many other factors affect review timing (e.g., whether the reviewer is offered a reward, to incentivize fast reviews), which we could not observe from online data. Such missing variable issues could potentially bias our estimation. We encourage future researchers to collect more information from online and offline settings to avoid missing variable bias. Additionally, although we make the first attempt to study the effects of customer experience and disconfirmation on review timing, there are many exciting future directions worthy of exploration. For example, besides review speed, other review characteristics (e.g., text length, readability, the balance between factual and emotional content, and inclusion of photos) will likely be influenced by customers' experiences and disconfirmation of other reviewers' opinions. It will be valuable to study the details of how an online review is constructed given personal perceptions and social references. Future scholars can use text mining and analysis techniques to develop research exploring these possibilities. We expect the body of research related to the timing of online reviews to grow for many years to come.

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