



Exploring consumer perceptions of green restaurants using structural topic models on customer reviews

Eunhye (Oliva) Park¹, Bongsug (Kevin) Chae², Junehee Kwon¹

¹Department of Hospitality Management, Kansas State University, USA

²Department of Management, Kansas State University, USA



Introduction and Literature Review





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Snooze, an A.M. Eatery



Select your rating.

Start your review...

Been to this place in Houston? What's your take on it?



0

0

Eunhye P.

Manhattan, KS



0 useful votes



0 cool votes



0 funny votes



0 compliments

Recent Activity

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Your Activity



Jasmine B. added a photo for El Trompo

6 minutes ago



Review of the Day



Nkechi M. wrote a review for Celebration Seabrook

5 stars 11/20/2016

What a fun little festival! My friend had an extra ticket, and asked if I wanted to tag along. I loved the idea of having a... [Read more](#)

Archive



KANSAS STATE UNIVERSITY

Department of Hospitality Management
College of Human Ecology

Why green practices?

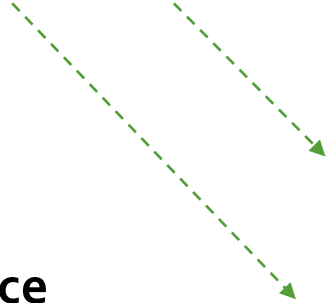
- Foodservice industry is an **energy-intensive** sector, that accounted for approximately 4% of industrial energy consumption (U.S. Energy Information Administration [EIA], 2016).
- With **increasing public awareness** of environmental issues, more customers have **demanded** sustainable business practices and purchased products which are less harmful for the environment (D'Souza & Taghian, 2005; Laroche, Bergeron, & Barbaro-Forleo, 2001; Wolfe & Shanklin, 2001)





Why green practices?

Benefits of green practice implementation

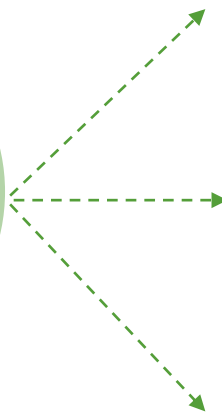


- Saving operational costs
(Graci & Dodds, 2008; Michigan Department of Environmental Quality [MDEQ], 2010)
- Enhancing favorable customer impressions toward the firms
(Namkung & Jang, 2013; Tan & Yeap, 2012)

Green practices in the restaurant industry



(Kwok et al., 2016)



Food-focused green practices

Environment-focused green practices

Administration-focused green practices





Green restaurant perspectives are related to the Green Restaurant Association's (GRA) standards

(Shubert et al., 2010; GRA, 2016)

Food-focused

- Local, vegan, and organic ingredients/ menus

Environment-focused

- Energy, water use, waste, chemicals & disposables, and sustainable goods

Administration-focused

- Managerial efforts
- Green certification, train employees





In the current study





Customer perceptions of green practices

Food-focused

- More salient for customers (Jeong et al., 2014)
- Health-conscious customers (Jang et al., 2011)

Environment-focused

- Mostly back-of-the-house operations (Kassinis & Soteriou, 2003)
- Environmentally conscious customers (Namkung & Jang, 2013)





Changes in green perceptions over time

Manager's engagement

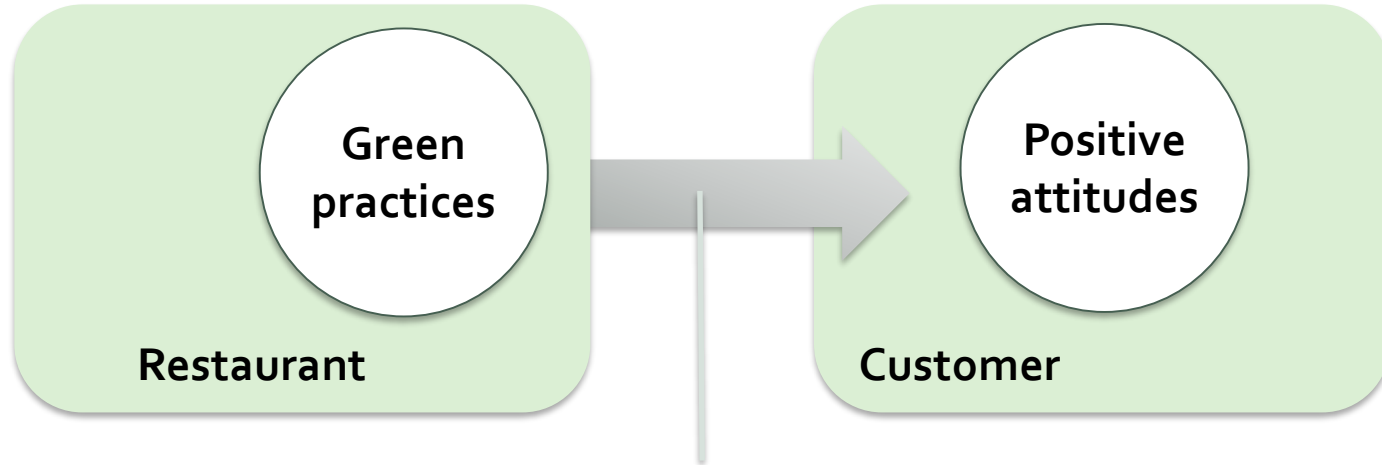
- Proactive participation in sustainable practices

Customer's engagement

- Consciousness
- Knowledge



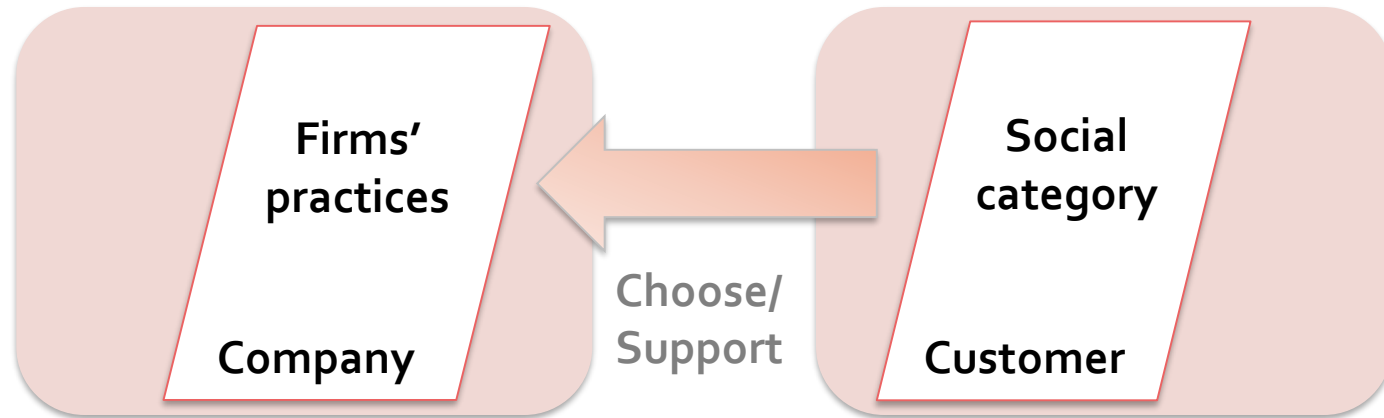
Green attributes and customer attitudes

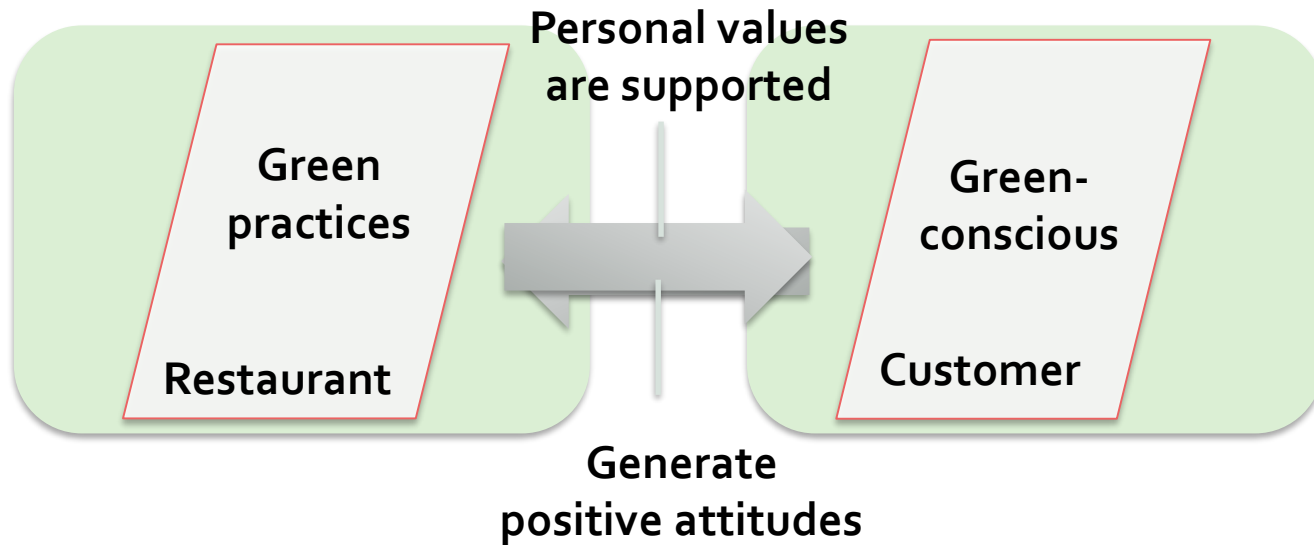


Social identity theory (Tajfel & Turner, 1986)

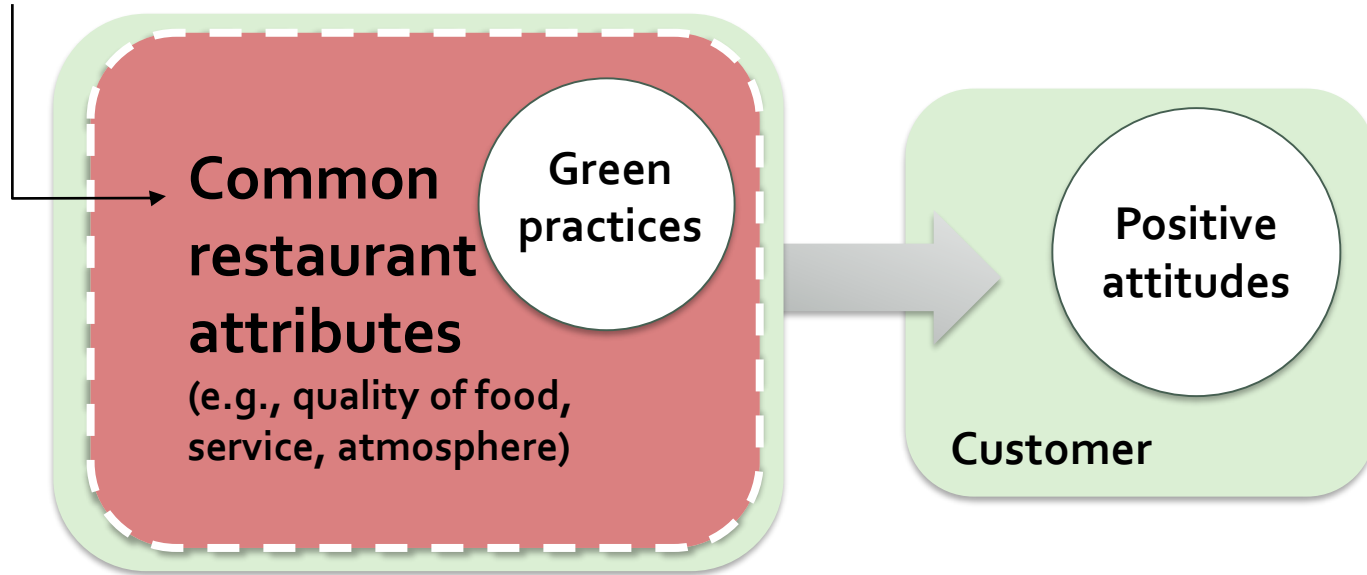


Social identity theory (Tajfel & Turner, 1986)

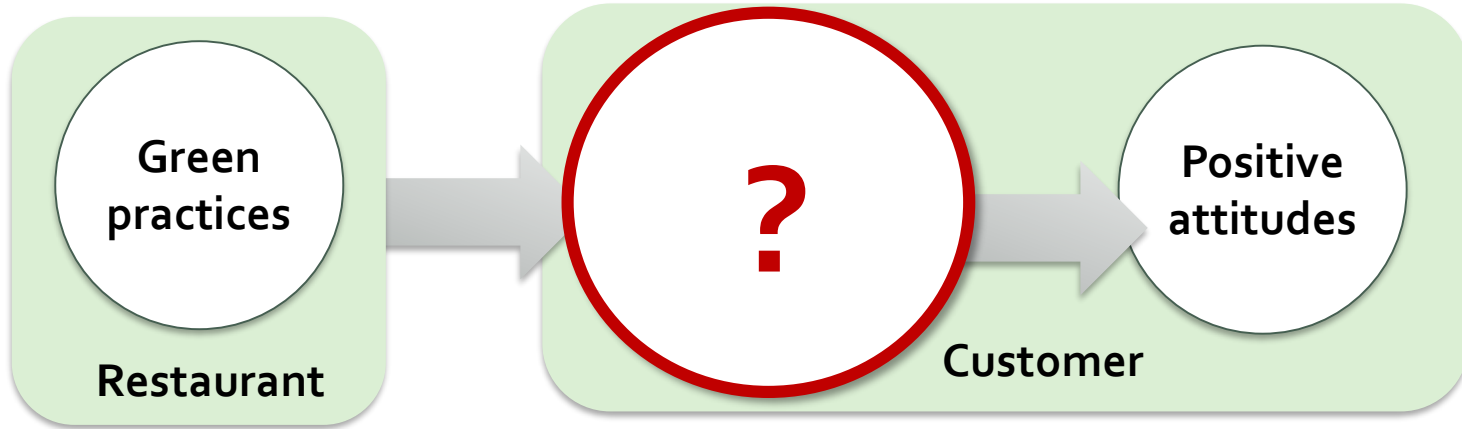




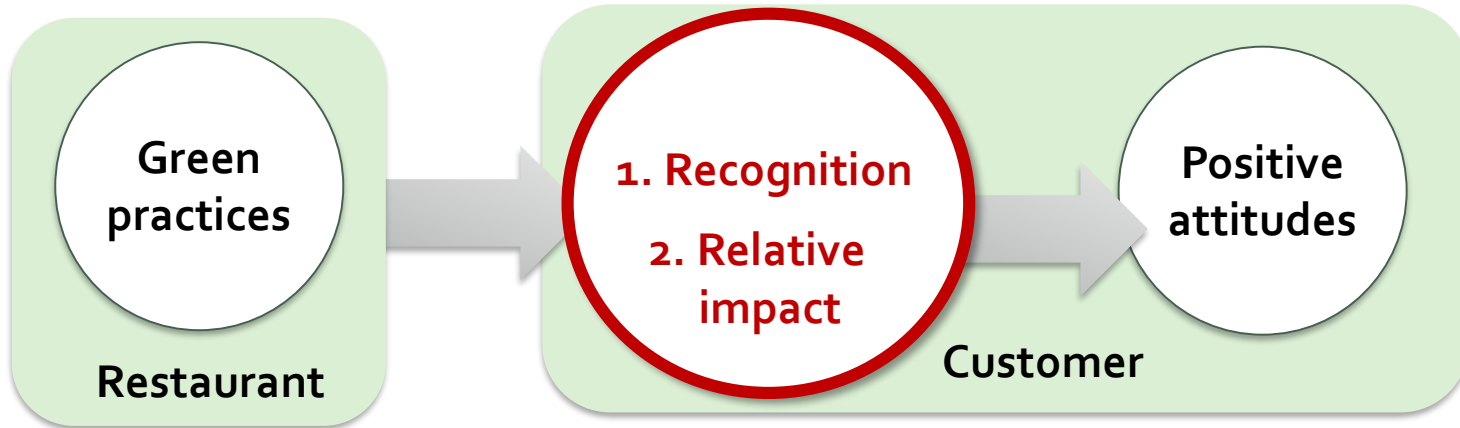
Do not want to give up



Research gap



Research gap



Online reviews

- Online reviews are **post-visit** user generated contents
- People write online reviews based on the restaurant attributes which they **experienced** or **recognized**
- Customers tend to include **important** information into online reviews
(Huang, Rogers, & Joo, 2014)





Online reviews are used to measure:

Recognition of
restaurant
practices

Perceived and
relative
impact



Customer's *actual experience*



The purpose of the study

To explore consumer perceptions of green restaurants, utilizing Yelp.com online reviews and topic modeling.



Hypotheses

- 1 Food- and environment-focused green practices in restaurants will appear in user-generated contents.
- 2 Electronic WOM related to green practices will increase over time.
- 3 Perceived green practices will positively influence customer satisfaction ratings.
- 4 Common restaurant quality attributes will more significantly influence satisfaction ratings than green attributes will.





Methodology





Samples & text pre-processing

- Data were collected from Yelp.com in April, 2016
- 85,505 online reviews from 2005 to 2016 for 255 green certified restaurants
- Text pre-processing was applied to clean and transform the text for further text mining





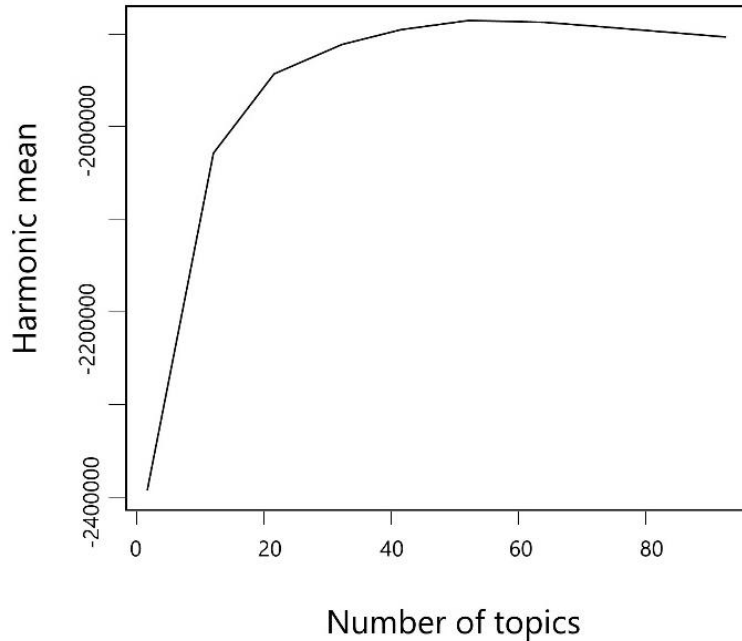
Data analysis: Structural topic modeling (STM)

- Topic modeling is a statistical modeling method to extract **latent topics or themes** from large collections of texts such as online reviews and social media data
- Structural topic modeling incorporates covariates or additional review-level information in the process of inferring topics (Roberts et al., 2016).
- In the present study, **the date each review was written** was included as a covariate

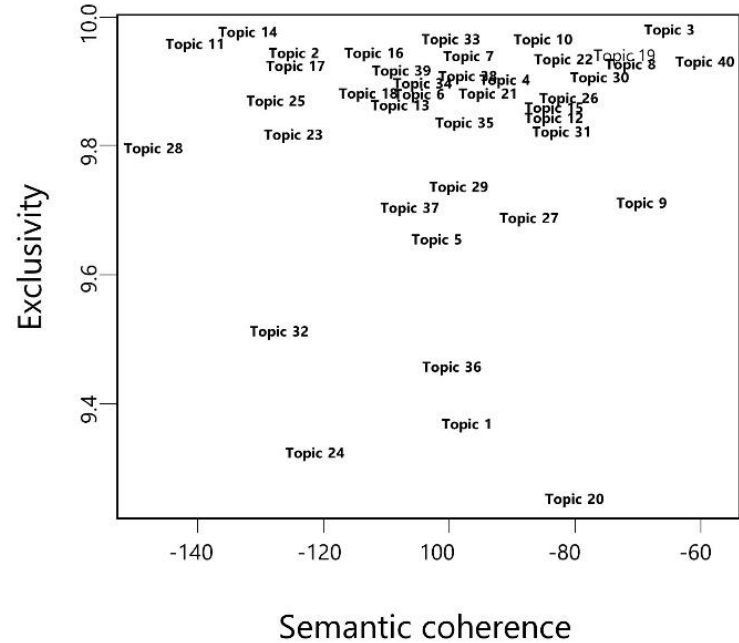




Harmonic Mean & Number of Topics



Cohesiveness and Exclusivity ($k = 40$)





Descriptive statistics

- SPSS 20.0
- Due to the large datasets, the statistical significance was set at $p < .001$

• Frequencies, means, standard deviations



Data profile

• ANOVA test



Identify changes in green perceptions over time

• Regression analysis



Predict star rating scores



Regression analysis

- Variables:
 - **Independent variable:** 39 topics
(Topic 40 was excluded)
 - **Dependent variable:** customer star rating
 - **Control variable:** the average food price, the aggregated ratings of each restaurant, the number of total reviews.





Results and Discussion



Data profile

Characteristics	n	%
<i>Year of customer reviews</i>		
Before 2010	15,745	18.4
2011 - 2012	19,608	22.9
2013 - 2014	26,935	31.5
2015 - 2016 (April)	23,217	27.2
<i>Star ratings (Mean ± SD = 3.88 ± 1.16)</i>		
1	4,647	5.4
2	7,662	9.0
3	13,010	15.2
4	28,519	33.4
5	31,667	37.0

The majority of customer reviews:

- 2013 – 2014 (31.5%)
- 5 star (37.0%)





Characteristics	n	%
Price range		
Less than 10 dollars	40	17.8
11-30 dollars	135	60.0
31-60 dollars	39	17.3
Over 60 dollars	11	4.9
Aggregated star ratings		
2.5 – 3.0	29	12.9
3.5 – 4.0	164	72.9
4.5 – 5.0	32	14.2
Total number of total reviews		
Less than 100	76	33.8
101-200	47	20.9
201-500	51	22.7
More than 500	51	22.6

The majority of green restaurants:

- 11-30 dollars (60.0%)
- 3.5 – 4.0 star (72.9%)
- Less than 100 total reviews (33.8%)





Perceived green practices in green restaurants

- Among 39 topics, two topics (13 and 17) were identified as food-focused green practices
 - : **Topic 13 local/organic ingredients**
 - : **Topic 17 vegan menus**
- However, topics related to environmentally focused green topics did not appear

Partially supported

H1. Food- and Environment-focused green practices in restaurants will appear in user-generated contents.





Local/organic ingredient

“**Green certified** food establishment. Say what?! This is awesome. And the food is equally as exciting as the idea of going to an establishment like this. They help **support (region) farmers** and buy **local** when they can. There's a *small extra-charge* for the **local** grass fed meat and or cheese but it is worth it!”

(in 2016, ID:86420, 5-star rating)





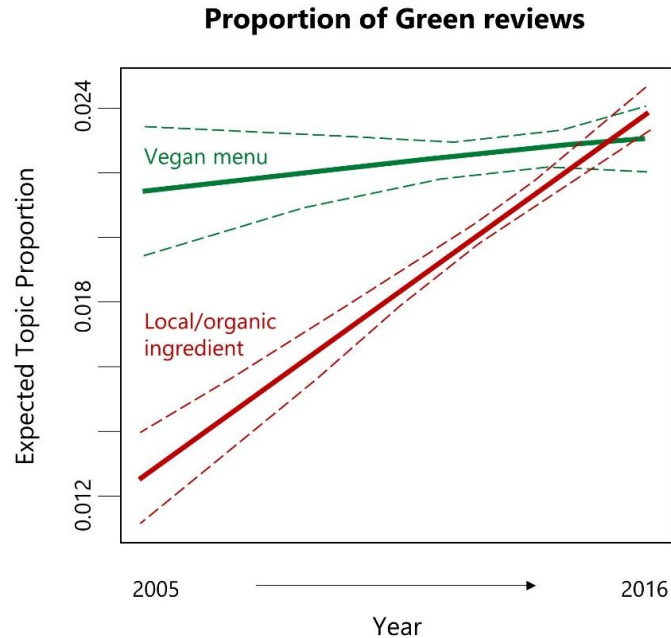
Vegan menu

“(...) I also discovered they now have **vegan and gluten free desserts** and I had a slice of **vegan chocolate cake**. It was incredible and my **non-vegan friends** were in disbelief that it was **vegan**. I will be visiting there more often now that they can satisfy my **nutritional needs** and satisfy my insatiable sweet tooth (...)”

(in 2013, ID:83669, 5-star rating)



Changes in green perceptions over time (2005–2016)



Changes in green perceptions over time (2005–2016)

	Prior to 2010 (<i>n</i> = 15,745)		2011 to 2013 (<i>n</i> = 31,743)		2014 to 2016 (<i>n</i> = 38,017)		F-Value
	Mean	SD	Mean	SD	Mean	SD	
Local/ organic ingredients (T ₁₃)	0.016 ^a	0.029	0.018 ^b	0.038	0.022 ^c	0.047	149.455*
Vegan menus (T ₁₇)	0.017	0.041	0.018	0.043	0.017	0.041	2.560

Note. Means in a row sharing subscripts are significantly different from each other. For all measures, higher means indicate higher proportion. * $p < .001$

Partially supported

H2. Electronic WOM related to green practices will increase over time.



Regression analysis

Rank	Number of reviews	Topic name (Topic number)	<i>b</i>	<i>SE</i>	β	<i>t</i>
17	2237	Vegan menu (T17)	1.100	.089	.036	12.415*
21	1172	Local/organic ingredient (T13)	.874	.087	.028	10.037*

$R^2 = .377, * p < .001$

Supported

H3. Perceived green practices will positively influence customer satisfaction ratings.





Rank	Number of reviews	Topic name (Topic number)	<i>b</i>	<i>SE</i>	β	<i>t</i>
1	4612	Bad service (T31)	-6.035	.056	-.328	-107.545*
2	3475	Bad food and service (T9)	-6.114	.068	-.265	-89.285*
3	8953	Good food and service (T19)	2.923	.048	.200	60.422*
4	1888	Mediocre experience (T10)	-5.713	.103	-.158	-55.318*
5	875	Bad taste (steak or meat) (T1)	-8.189	.147	-.154	-55.528*
6	2675	Online review (T36)	-3.595	.076	-.137	-47.043*
7	3940	Bad service (long wait) (T22)	-2.955	.068	-.132	-43.753*
8	2337	Bad taste (T29)	-3.497	.079	-.129	-44.514*
9	2025	Satisfaction (T26)	3.592	.115	.090	31.349*
10	3529	Satisfaction (T8)	2.223	.081	.082	27.416*
		...				
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IV. Results



Rank	Number of reviews	Topic name (Topic number)	<i>b</i>	<i>SE</i>	β	<i>t</i>
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10	3529	Satisfaction (T8)	2.223	.081	.082	27.416*

Supported

H4. Common restaurant quality attributes will more significantly influence satisfaction ratings than green attributes will.





Conclusion





Theoretical implications

- Explored experiences of green restaurant customers by identifying the latent topics, which were expressed through online reviews.
 - Identified customers' real-life perceptions toward actual green restaurant experiences
 - Identified customers' recognition and perceived importance of green practices between food- and environmentally focused green practices



Theoretical implications

- Assessed the changes in consumers' perceptions toward green attributes of restaurants using a longitudinal approach
- Identified the relative importance of green practices compared to the common restaurant attributes



Practical implications

- In order to improve the customers' recognition of green practices and enhance positive attitude, the restaurant managers should **highlight their implementations of food-related green practices** such as providing vegan menus or organic
- While customers' positive perceptions of green initiatives should increase, **common restaurant attributes should not be neglected**





Limitation and future study

- Only online reviews from Yelp.com were utilized in this study, and customer sentiments shared offline were not included in the data
 - **It is suggested to include various online platforms to collect data or apply mixed methods**
- Only include green certified restaurants, which are actively engaged in green practices, therefore the results might not be applicable for restaurants with low engagement in sustainable activities.
 - **Non-green restaurants should be included in future studies**





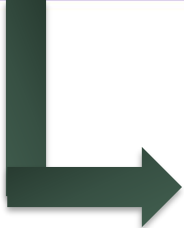
- Previous studies found that customers perceive green practices differently depending on customers' personal characteristics, such as gender, income, or self-perceptions (Kwok et al., 2016).
 - **Future research is recommended to include customers' demographic information and other covariates**
- This study only illustrated customers' standpoint
 - **Future research should test the antecedent variables of customers' green perceptions, such as restaurateurs' or employees' engagement in green practices.**



Thanks! Questions?

Eunhye (Olivia) Park
eunhyepark@ksu.edu





Based on the input of 40 topics

Mexican	Japanese	Food taste	Food price
Taco	Soy	Terrible	Price
Chips	Gyoza	Never	Option
Guacamole	Wasabi	Worst	Over
Burrito	Sushi	Awful	Restaur
Salsa	Nigiri	Disgusting	Food



Mexican	Japanese	Food taste	Food price
Taco	Soy	Terrible	Price
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Guacamole	Wasabi	Worst	Over
Burrito	Sushi	Awful	Restaur
Salsa	Nigiri	Disgusting	Food

A customer review 1:

The burrito was terrible

Instead, I had Sushi.

I like soy sauce and Gyoza

Topic 1 14.5%

Topic 2 60.0%

Topic 3 25.1%

Topic 4 0.04%

* The probabilistic scores: the sum of the all 40 topics' probabilistic scores is one.





Topic 1 14.5%
Topic 2 60.0%
Topic 3 25.1%
Topic 4 0.04%

Probabilistic distribution of words over each topic

	Topic 1	Topic 2	Topic 3	Topic 4	Total
R1	0.145	0.600	0.251	0.004	1

 **Recode**

	Topic 1	Topic 2	Topic 3	Topic 4	Star rating
R1	0	0.600	0	0	4



Typical restaurant attributes	T1. Bad taste; steak or meat (N = 2,133)	T21. Wine (N = 3,096)
	T2. Buffet/brunch (N = 1,860)	T22. Bad service long wait (N = 9,038)
	T3. Partly positive (N = 15,092)	T23. Italian in New York (N = 2,082)
	T4. Fried/grilled foods (N = 5,448)	T24. Physical environment (N = 2,488)
	T5. High price (N = 3,226)	T25. Spanish (N = 1,899)
	T6. Burger (N = 1,620)	T26. Satisfaction (N = 5,318)
	T7. Bar (N = 3,860)	T27. Physical environment (N = 3,255)
	T8. Satisfaction (N = 8,661)	T28. Beer (N = 3,055)
	T9. Bad taste and service (N = 8,200)	T29. Bad taste (N = 4,139)
	T10. Mediocre experience (N = 4,920)	T30. Satisfaction, Revisit intention (N = 2,813)
	T11. Sushi/seafood restaurant (N = 1,513)	T31. Bad service (N = 8,923)
	T12. Buffet/Brunch (N = 4,244)	T32. Mexican (N = 2,877)
	T14. Gluten free menu (N = 1,140)	T33. Steak (N = 1,921)
	T15. Pizza (N = 4,001)	T34. Dessert (N = 1,929)
	T16. Physical environment (N = 3,215)	T35. Mexican (N = 4,116)
	T18. Cheese and wine (N = 1,619)	T36. Online review (N = 6,718)
	T19. Good food and service (N = 16,976)	T37. Italian (N = 5,858)
	T20. Fine dining (N = 3,972)	T38. Good food (N = 2,623)
		T39. Breakfast menu (N = 3,534)
	Green topics	T13. Local ingredients (N = 2,242)



Rank	Number of reviews	Topic name (Topic number)	<i>b</i>	<i>SE</i>	β	<i>t</i>
		(Constant)	3.078	.037		83.478
		Food price	-.001	.005	.000	-.160
		Aggregated restaurant star ratings	.224	.009	.068	23.822*
		The number of total reviews	.000	.000	.027	9.447*





Rank	Numberofreviews	Topic name (Topic number)	<i>b</i>	<i>SE</i>	β	<i>t</i>
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10	3529	Satisfaction (T8)	2.223	.081	.082	27.416*
11	2426	Fine dining (T20)	1.681	.070	.072	23.992*
12	880	Satisfaction (Revisit intention) (T30)	3.658	.177	.058	20.716*
13	1967	Buffet/Brunch (T12)	1.363	.089	.044	15.372*
14	1841	Mexican (T32)	-.916	.065	-.040	-14.038*
15	971	Italian (in New York) (T23)	1.787	.134	.037	13.380*
16	674	Burger (T6)	2.475	.190	.036	13.044*
17	2237	Vegan menu (T17)	1.100	.089	.036	12.415*
18	3286	Mexican (T35)	.549	.052	.031	10.536*
19	852	Sushi/seafood restaurant (T11)	1.378	.130	.030	10.639*
20	1195	Good food (T38)	1.533	.148	.029	10.344*



IV. Results

Rank	Number of reviews	Topic name (Topic number)	<i>b</i>	<i>SE</i>	β	<i>t</i>
21	1172	Local/organic ingredient (T13)	.874	.087	.028	10.037*
22	3429	Italian (T37)	.559	.072	.024	7.772*
23	1408	Overpriced menus (T5)	-.957	.119	-.023	-8.061*
24	704	(1) a menu name (2) Gluten-free menu (T14)	1.237	.156	.022	7.944*
25	866	Cheese and wine (T18)	.931	.147	.018	6.354*
26	1907	Beer (T28)	.443	.083	.015	5.362*
27	1449	Spanish (T25)	.422	.085	.014	4.945*
28	2076	Breakfast menu (T39)	.392	.094	.012	4.180*
29	3245	Fried/grilled foods (T4)	.285	.075	.011	3.802*
30	1546	Physical environment (T27)	-.472	.126	-.011	-3.737*
31	877	Buffet/brunch (T2)	.536	.154	.010	3.470*
32	1003	Steak (T33)	.389	.131	.008	2.977
33	2458	Pizza (T15)	-.220	.078	-.008	-2.818
34	1462	Bar (T7)	.318	.128	.007	2.473
35	6028	(+) food, location, service (-) price, portion (T3)	-.141	.070	-.006	-2.003
36	1362	Dessert (T34)	-.148	.081	-.005	-1.820
37	1130	Wine (21)	-.254	.151	-.005	-1.687
38	1056	Physical environment (T24)	.169	.148	.003	1.146
39	1686	Physical environment (T16)	.091	.095	.003	.964

