

# Towards Easy Comparison of Local Businesses Using Online Reviews

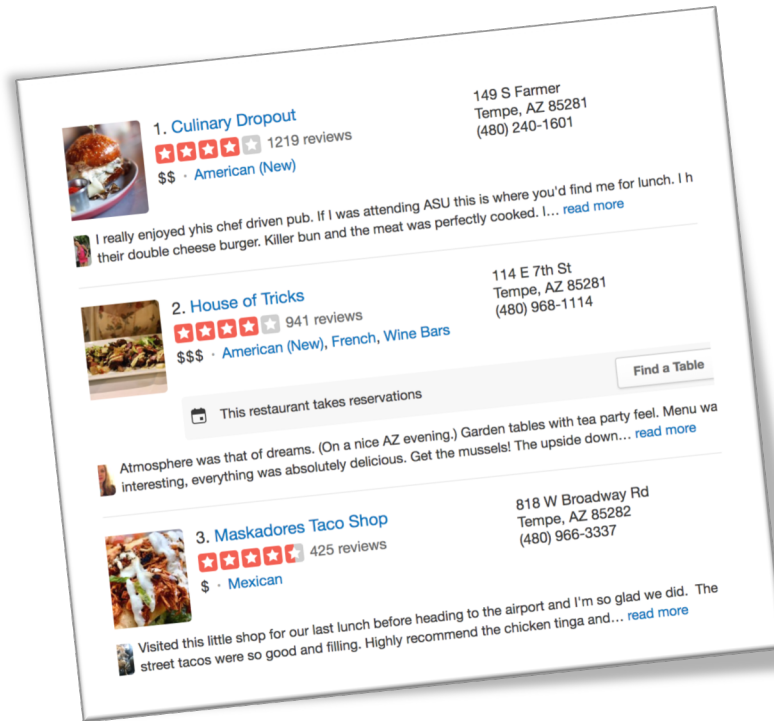
**Yong Wang**<sup>1</sup>, Hammad Haleem<sup>1</sup>, Conglei Shi<sup>2</sup>, Yanhong Wu<sup>3</sup>, Xun Zhao<sup>1</sup>, Siwei Fu<sup>1</sup>  
and Huamin Qu<sup>1</sup>



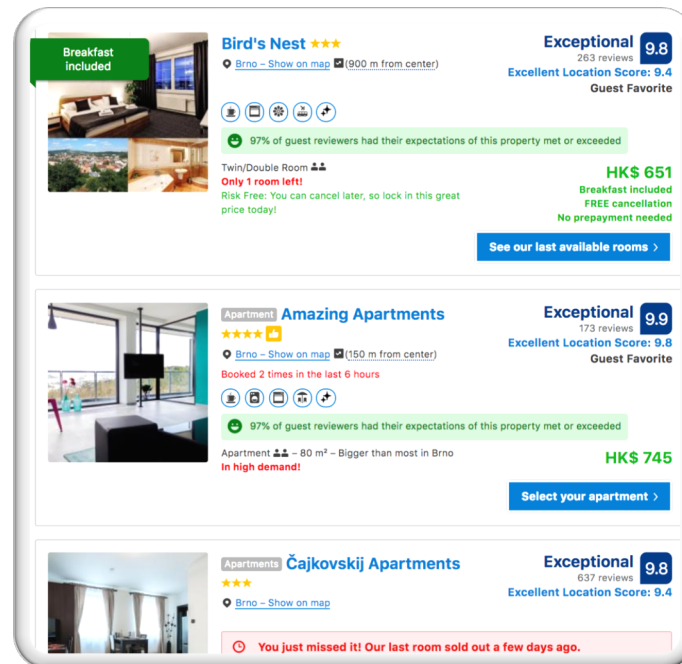
***Background***

# Review Platforms

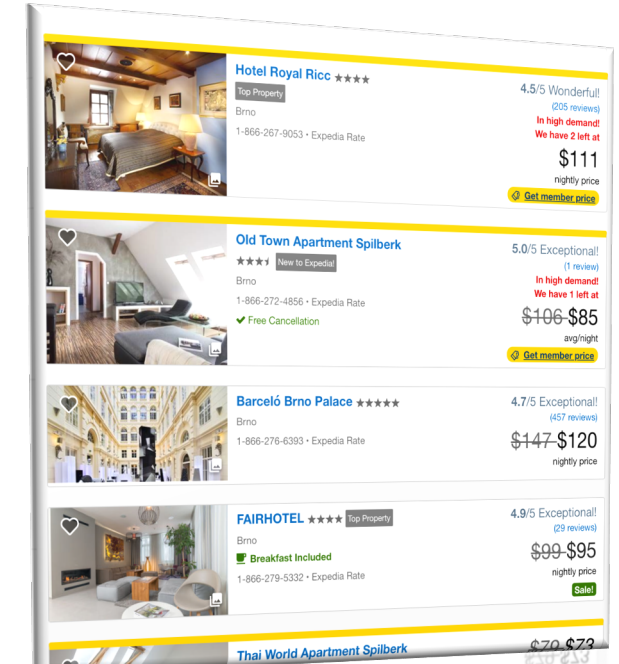
## Yelp



## Airbnb



## TripAdvisor



# Online Reviews vs Purchase Decisions



*Three-quarters of travelers have considered online reviews when planning their trips <sup>[1]</sup>*

[1] Gretzel, U., & Yoo, K. H. (2008). Use and impact of online travel reviews. *Information and communication technologies in tourism*, 35-46.



# Online Reviews

**Best Restaurants in New York, NY**

\$

\$\$

\$\$\$

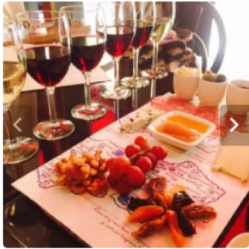
\$\$\$\$

🕒 Open Now

🛵 Order Delivery

📦 Order Takeout

📅 Make



1. **Amélie**

★★★★★

2032 reviews


Greenwich Village  
22 W 8th St

\$\$ · French, Wine Bars, Belgian

"hands down my favorite wine bar in the city! there are of course tons and tons of wine bars in NYC, but this place is the best. happy hour is until 7, and..." [read more](#)

📅 This restaurant takes reservations

Find a Table



2. **Thai Villa**

★★★★★

1554 reviews


Flatiron  
5 E 19th St, G Floor

\$\$ · Thai, Asian Fusion, Vegetarian

"Thai Villa didn't disappoint!! Some of the best Thai food I've ever had, and the menu is huge. I can't wait to come back and try more of their options. The..." [read more](#)

🛵 This restaurant accepts takeout and delivery

Start Order



3. **Upstate**

★★★★★

1536 reviews

East Village  
95 1st Ave

\$\$ · Seafood, Wine Bars, Beer Bar

🕒 Current wait time: 57 - 77 mins

"Just thinking about this place makes my mouth water... Came here for Happy Hour Oysters which was great but ended up fallin in love with two dishes here. "Uni:..." [read more](#)

Overview

Reviews


About

Photos

Nearby

Q&A

Room Tips



ninenoname  
Bangkok, Thailand  
📍 217 📌 51

📅 Reviewed 4 days ago

📱 via mobile

### Very bad than 5 star hotel


I'm book 2 room and request connecting room since booking.Come to check-in since 12:00, staff said will set up room come back to pick up 15:00. I'm come back 17:00 but no connecting room for me and will separte to difference floor, i reserve 2... [More](#)

👍 Thank ninenoname

Response from DalipSingh\_GM, General Manager at Marco Polo Hongkong Hotel

Responded 2 days ago

Dear ninenoname, Greetings from the Marco Polo Hongkong Hotel. Thank you for taking the time to share your experience with us during your recent stay. Please accept our sincere apologies for not being able to assign you to two connecting rooms per your preference. Much... [More](#)



JH6566  
Corby, United Kingdom  
📍 4 📌 1

📅 Reviewed 5 days ago

📱 via mobile

### Amazing location - great hotel


Although a very busy hotel, staff were attentive , good sized room and perfect location with harbour and shopping being literally on the doorstep. The surrounding area was very busy ( you are in major shopping area) however it felt very safe and I often... [More](#)

👍 Thank JH6566

Response from DalipSingh\_GM, General Manager at Marco Polo Hongkong Hotel

Responded 5 days ago

Dear JH6566, Greetings from the Marco Polo Hongkong Hotel. Thank you for taking the time to share your experience with us during your recent stay. Your comments are indeed valuable to us, as they help us in our committed effort to exceed guest expectations and... [More](#)



Robbie R  
Beersheba, Israel  
📍 137 📌 29

📅 Reviewed 1 week ago

### Not bad if you want to go non stop shopping

Pros: Location, location Spacious rooms Overall good value for prebooking fares effective staff in most cases close to the star ferry Cons: Slow check-in process The bathroom sink was outside the bathroom Outdated bathrooms - the bath actually had 2 separate faucets knobs,... [More](#)

👍 Thank Robbie R

Response from DalipSingh\_GM, General Manager at Marco Polo Hongkong Hotel

Responded 1 week ago

# Challenges

- There are usually **many candidates** satisfying users' requirements
- The online reviews are **dynamically changing**
- The **information overload** due to the large volume of review texts, different review focuses, etc.
- The possible **standard inconsistency** across different customers

**How can we achieve easy comparison of local businesses using online reviews?**

# Our Approach: *E-Comp*

Control Panel

City:

Type:

Area Selection: ☐

Price Level:

Customer:

Rating:

Link:

Selection:

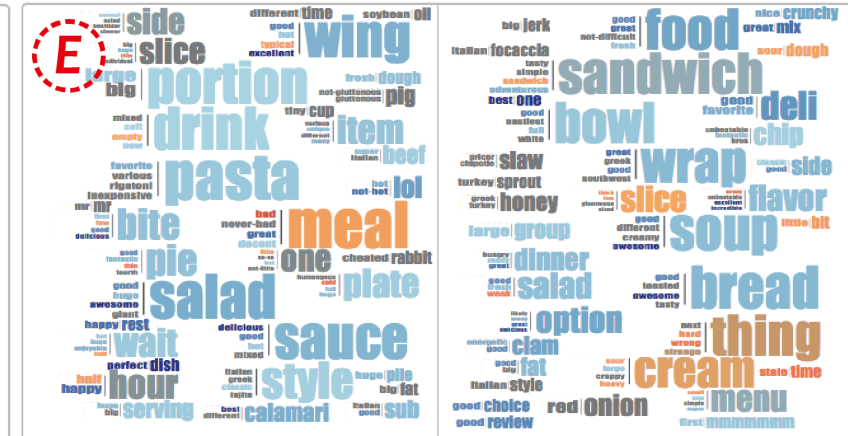
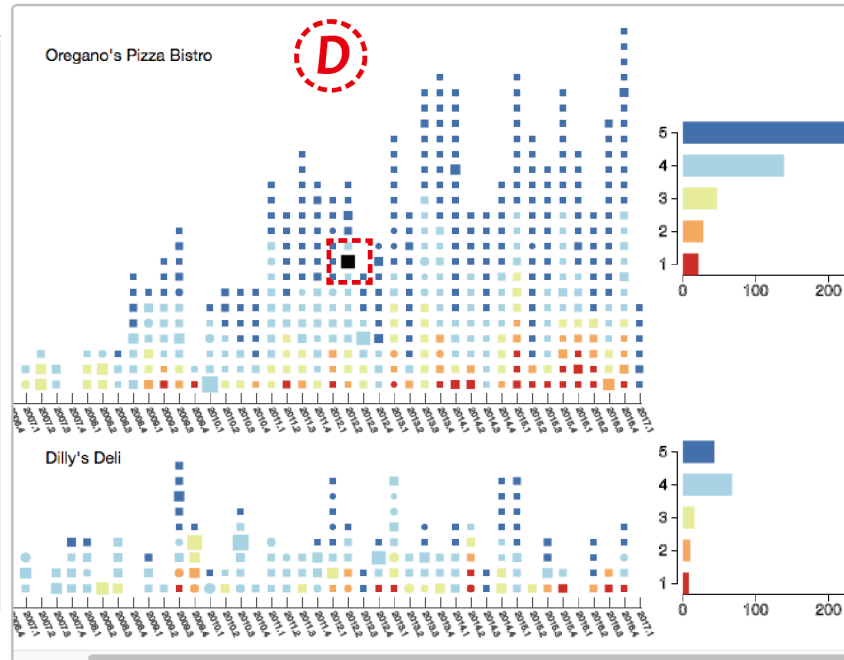
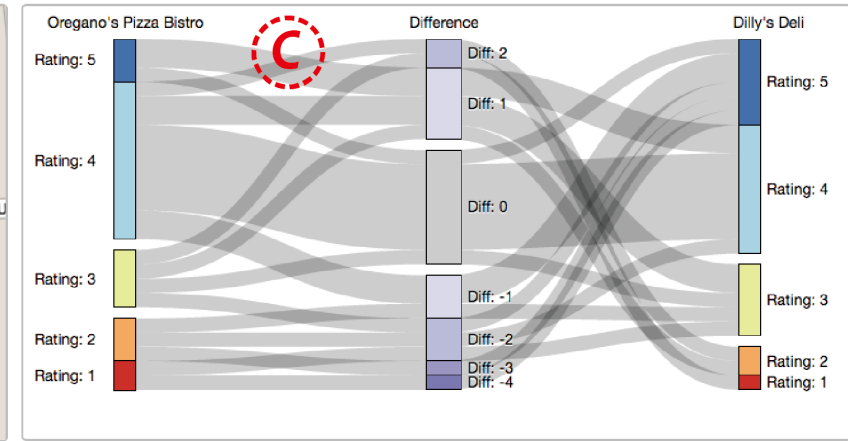
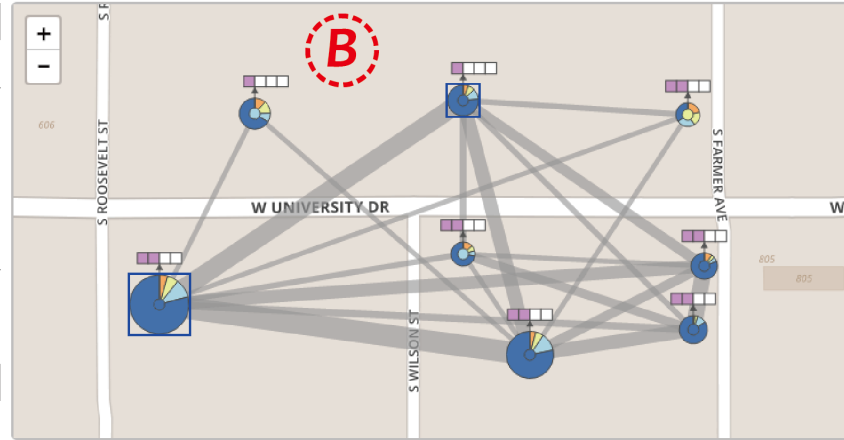
Time Unit:

Layout:

Feature:

Business Table

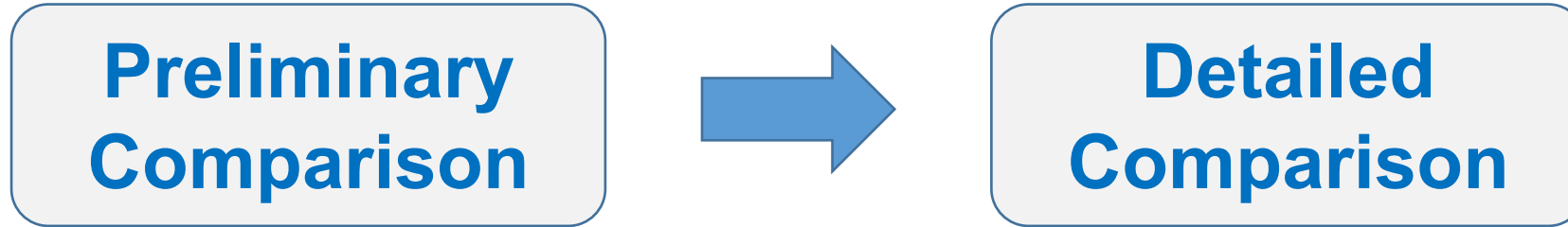
Name	#Rev	Star	Type
Oregano's Pizza Bistro	461	4	restaurants
Thai Basil	326	4	restaurants
Little Szechuan	147	3.5	restaurants
Dilly's Deli	145	4	restaurants
Taste of Tops	113	4	restaurants
Top's Liquor	94	4	restaurants
Loving Hut Tempe	72	4.5	restaurants
Tessio's Pizza	68	3.5	restaurants
Boston's Restaurant	64	3	restaurants
Biscuits Cafe	40	4	restaurants
The Pedal Bike Shop	33	5	health
Chill's	32	2.5	restaurants
Fired Pie	30	4	restaurants



**Business Name:** Oregano's Pizza Bistro      **Customer Name:** Mohammad  
**Review Date:** 2012-05-31      **Rating:** 4   
**User Votes:** 22  
**Review Text:** There is a great amount of effort that goes into eating at this particular Oregano's. First of all, arriving between the times of 430-6ish means you will be arriving near the time where there is limited parking space. I'm not sure how many people Oregano's seats, but it's 3x the amount of parking spots available. Secondly, the wait time can be killer. They do not accept reservations so you can easily wait up to 45 minutes during a non-weekend dinner rush. It's up

# Design Requirements

- General exploration procedures:



*R1. Quick overview for filtering out candidates*

*R2: reliable comparison between businesses*

*R3: temporal analysis of user reviews*

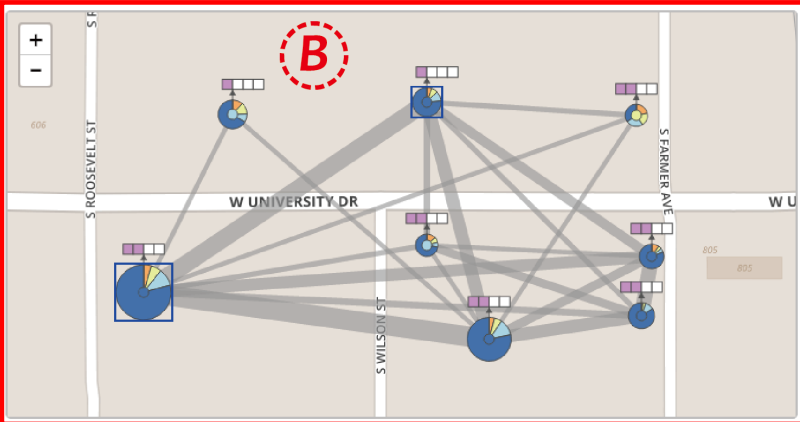
*R4: insightful details of important features*

*R5: detailed review text on demand*

*R6: intuitive visual designs*

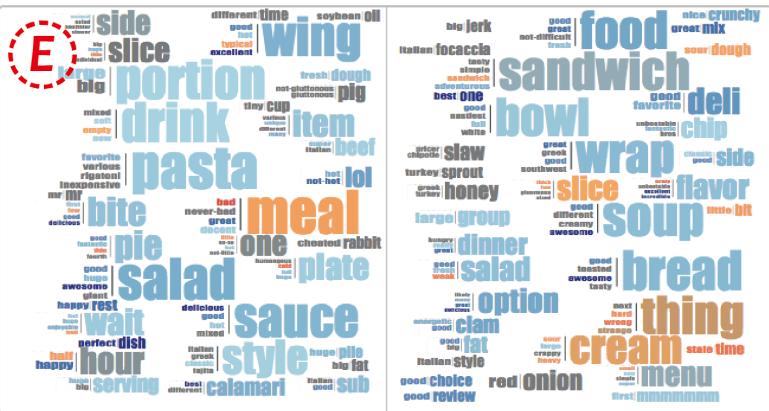


## Map View: Preliminary Comparison



Oregano's Pizza Bistro

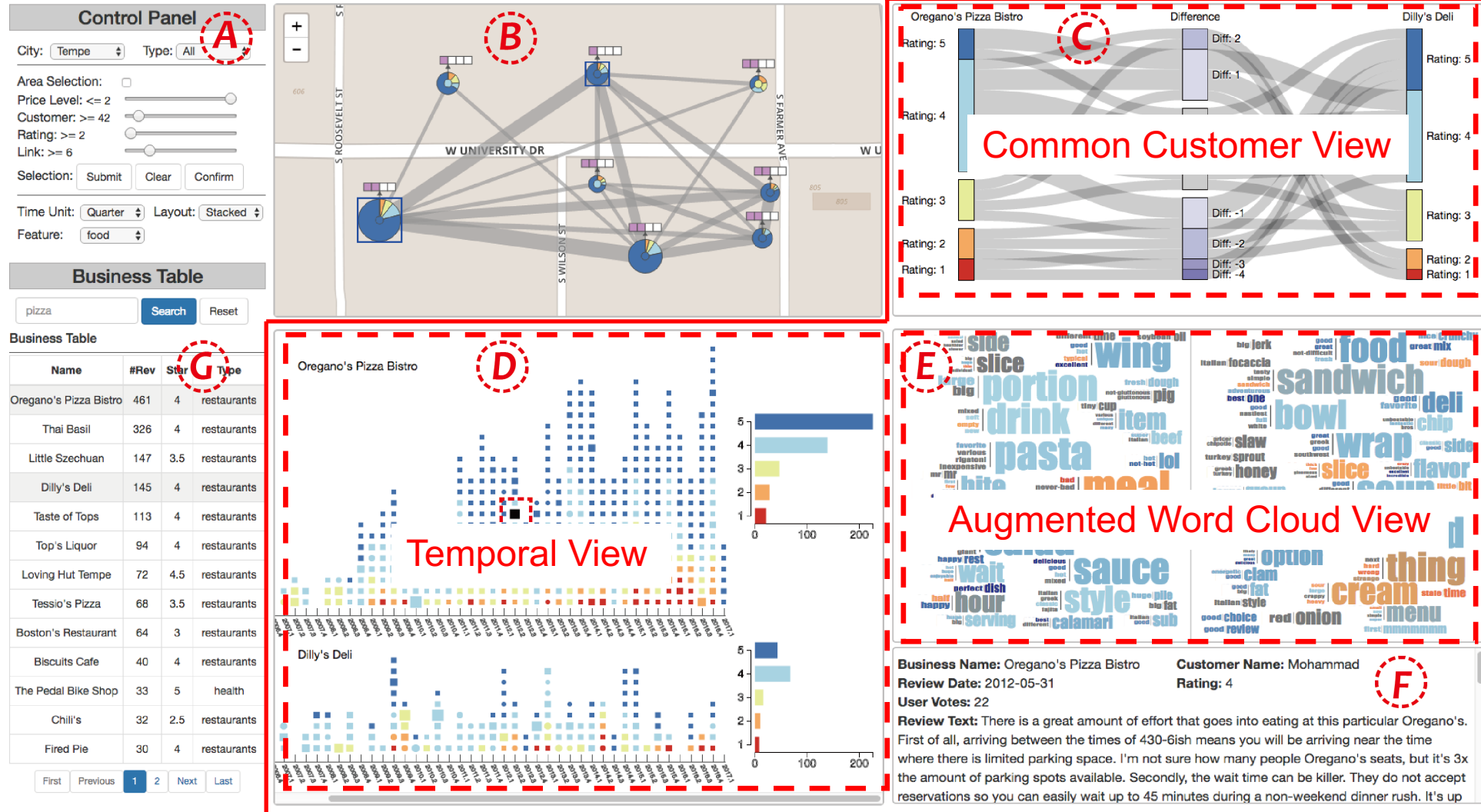
Dilly's Deli



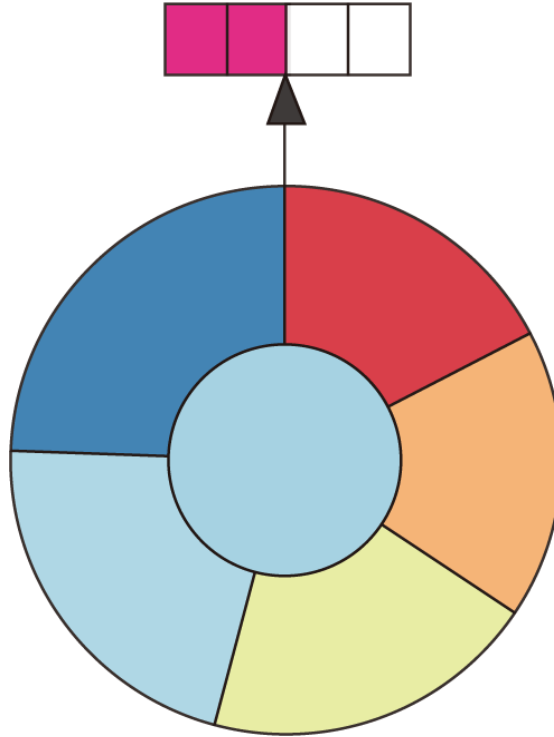
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# Our Approach: *E-Comp*

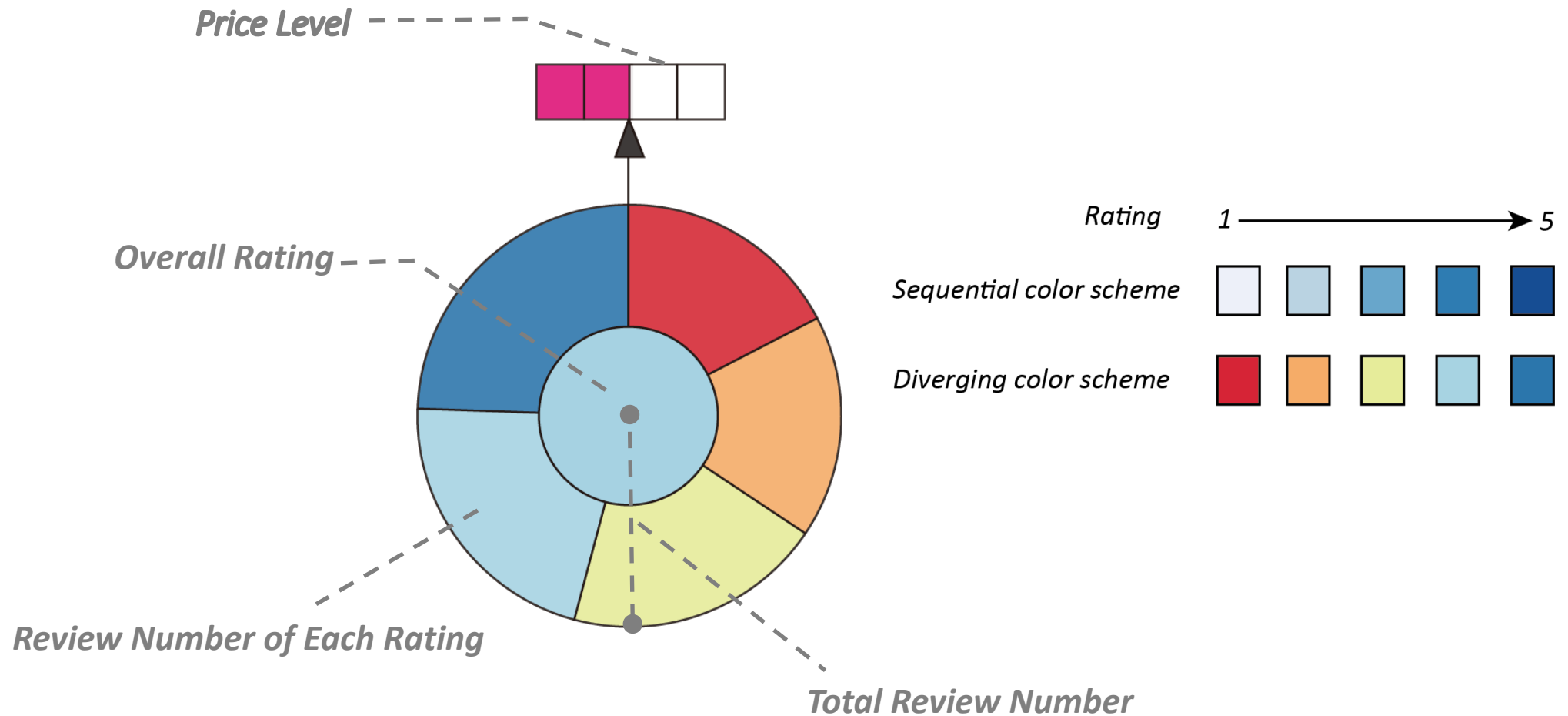
Detailed Comparison



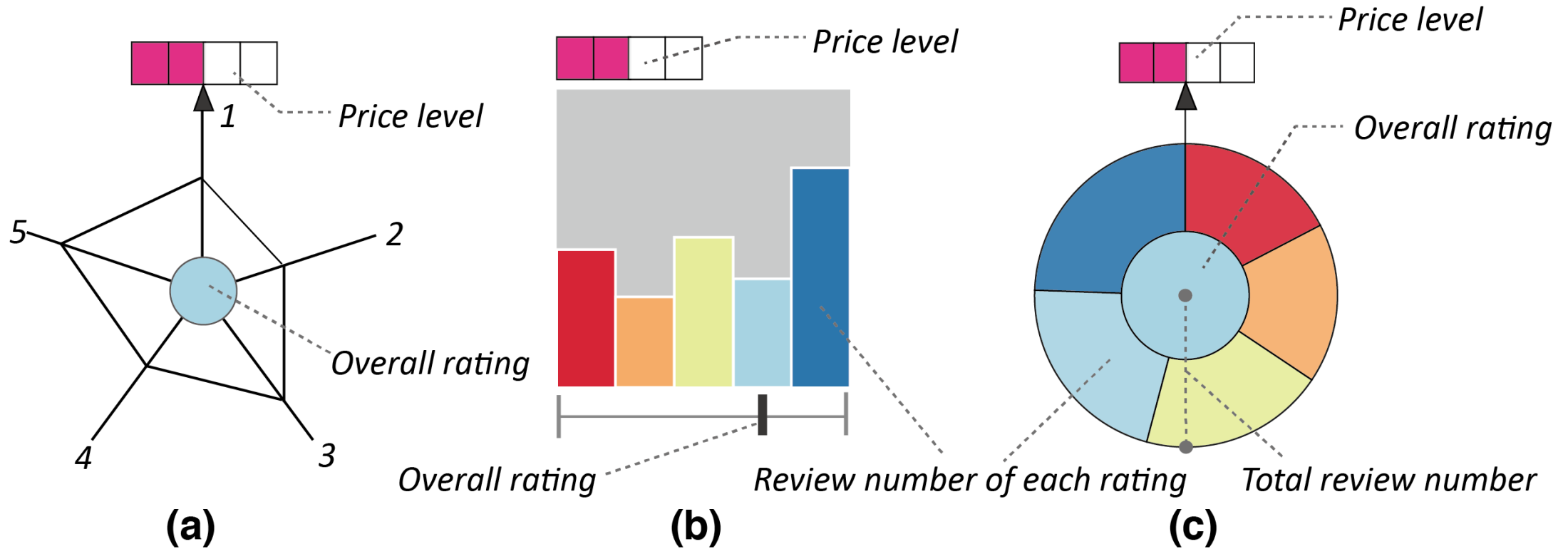
# Preliminary Comparison – Glyph Design



# Preliminary Comparison – Glyph Design



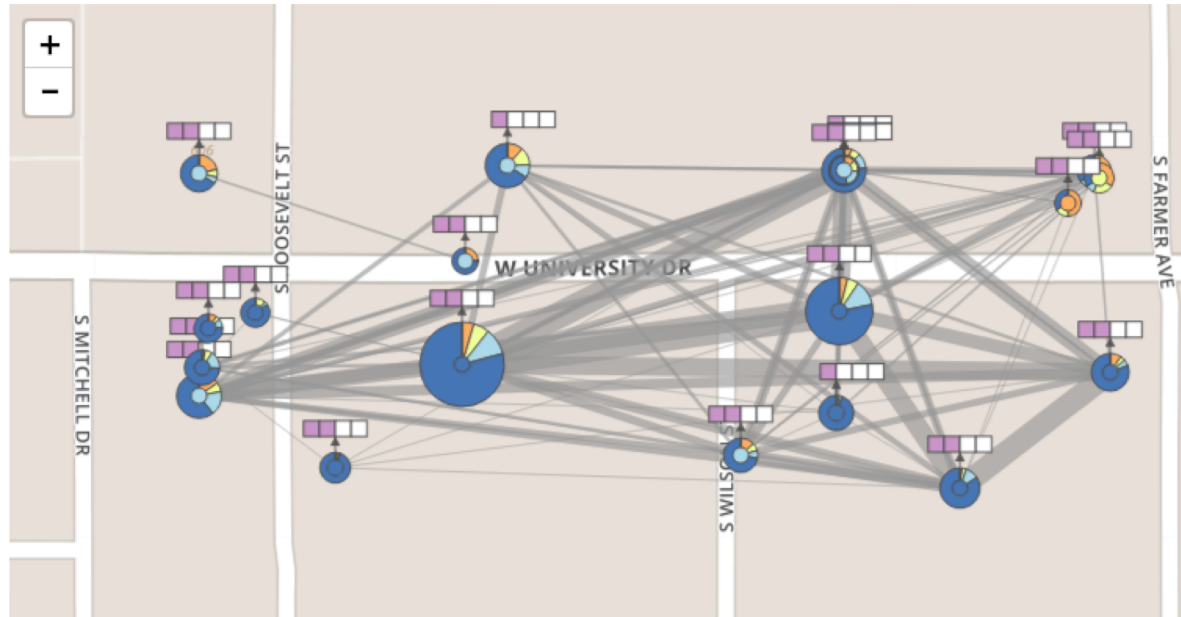
# Preliminary Comparison – Glyph Design



Alternative Designs

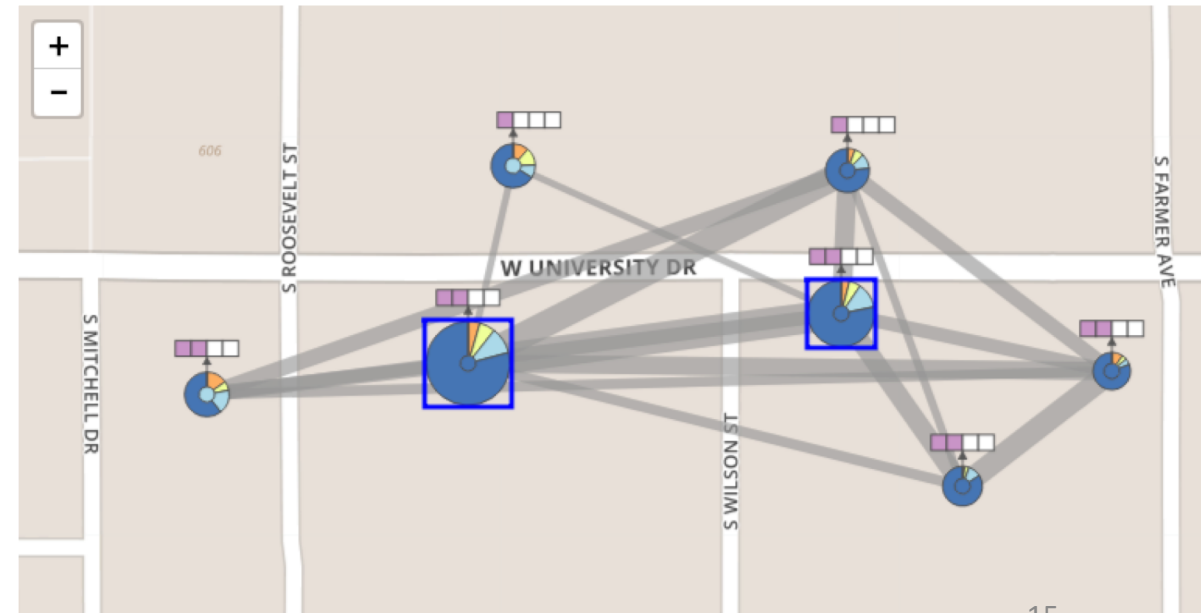


# Preliminary Comparison



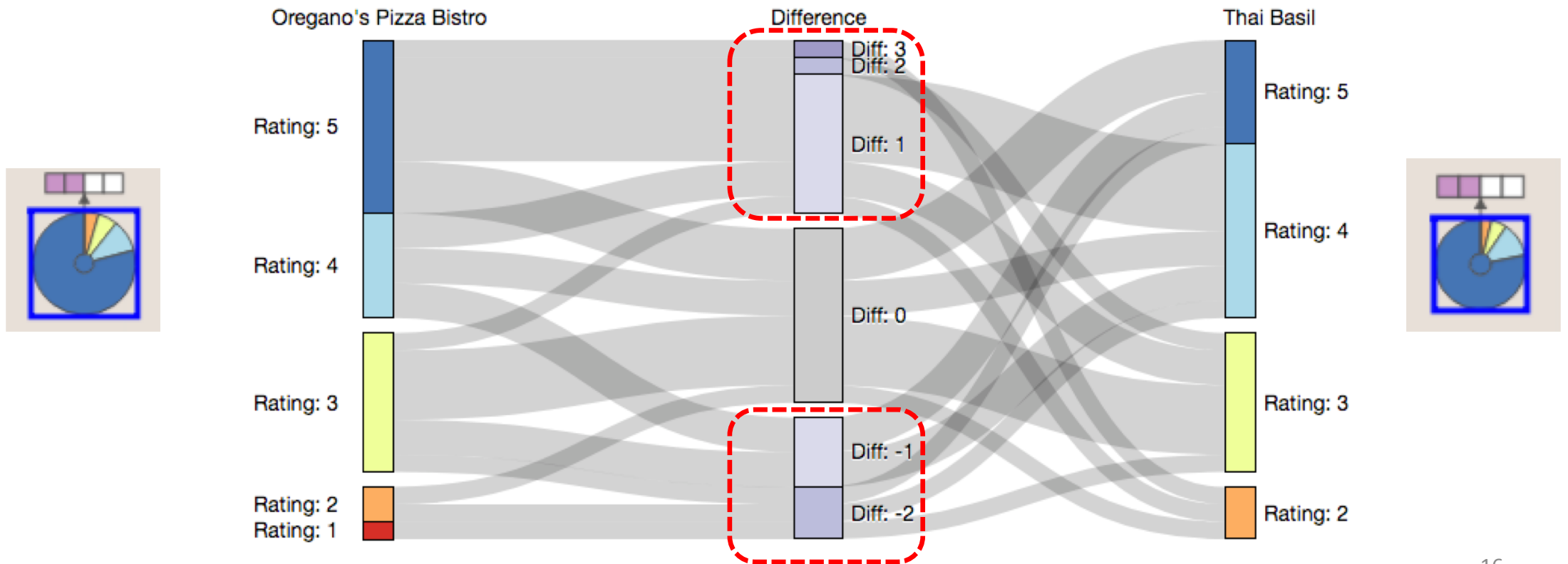
Interactive Filtering

The link width encodes the number of common customers



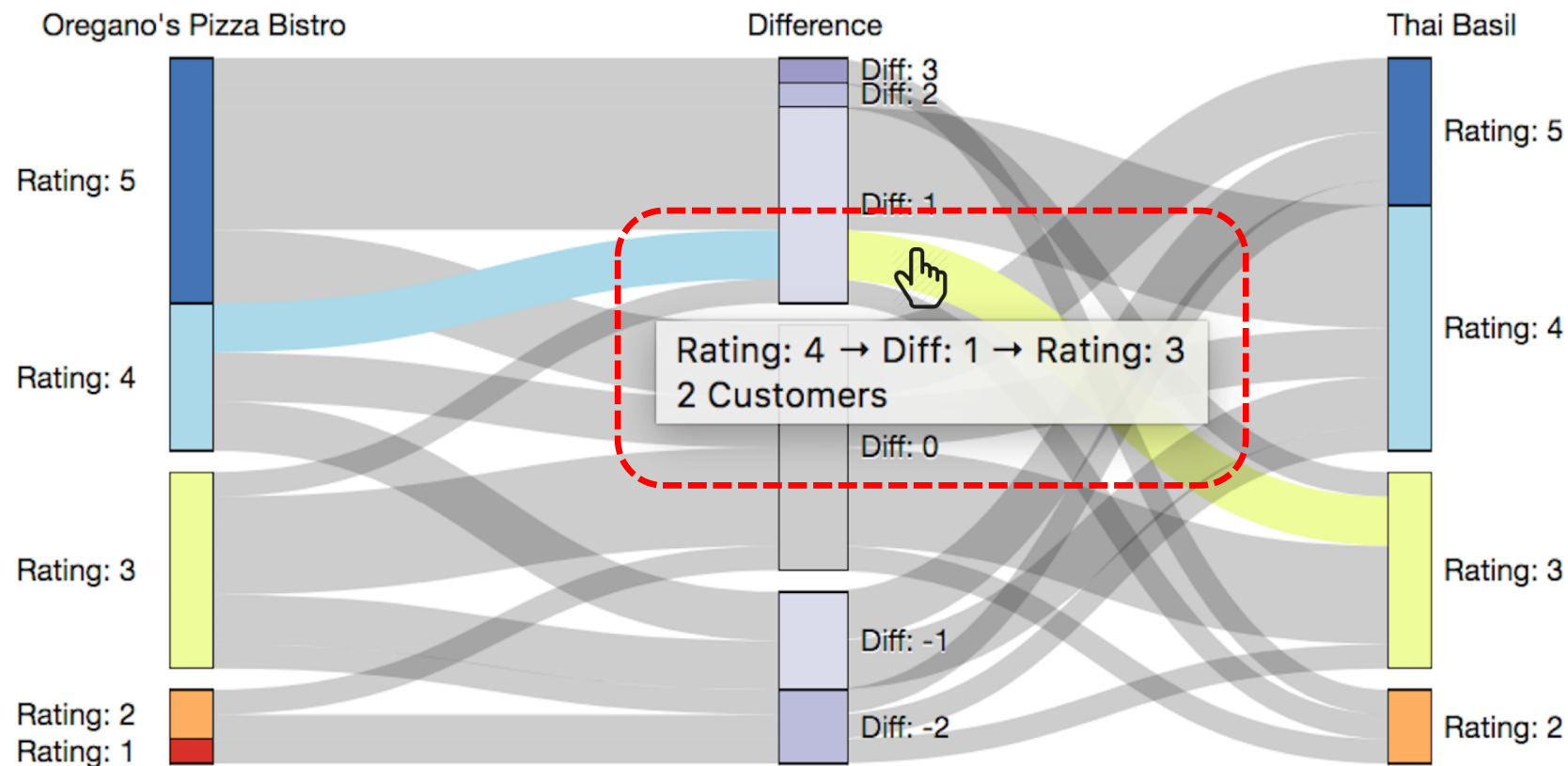
# Detailed Comparison

- **Common customer comparison view**
  - The review standards by the same customers are relatively **stable**



# Detailed Comparison

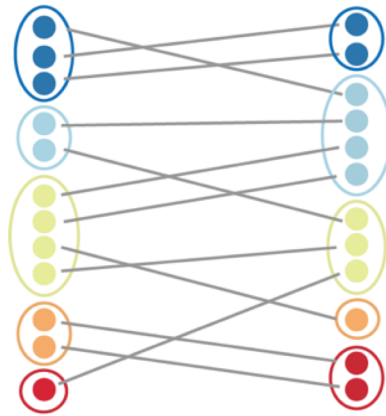
- Common customer comparison view



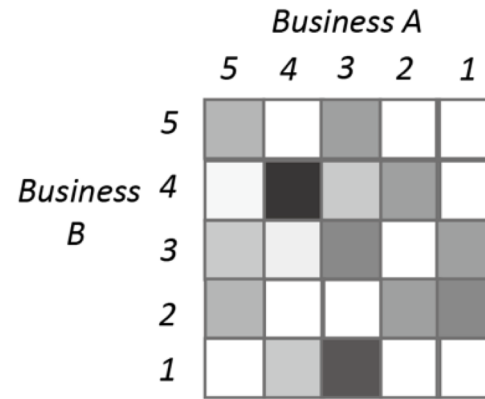
Interactive Exploration

# Detailed Comparison

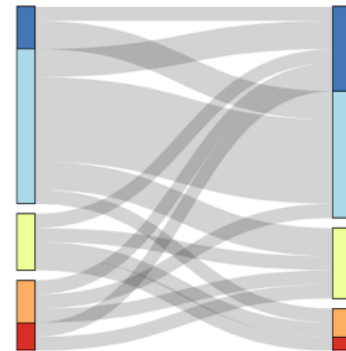
- Common customer comparison view



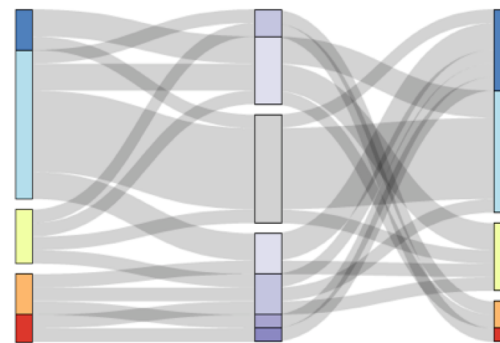
(a)



(b)



(c)

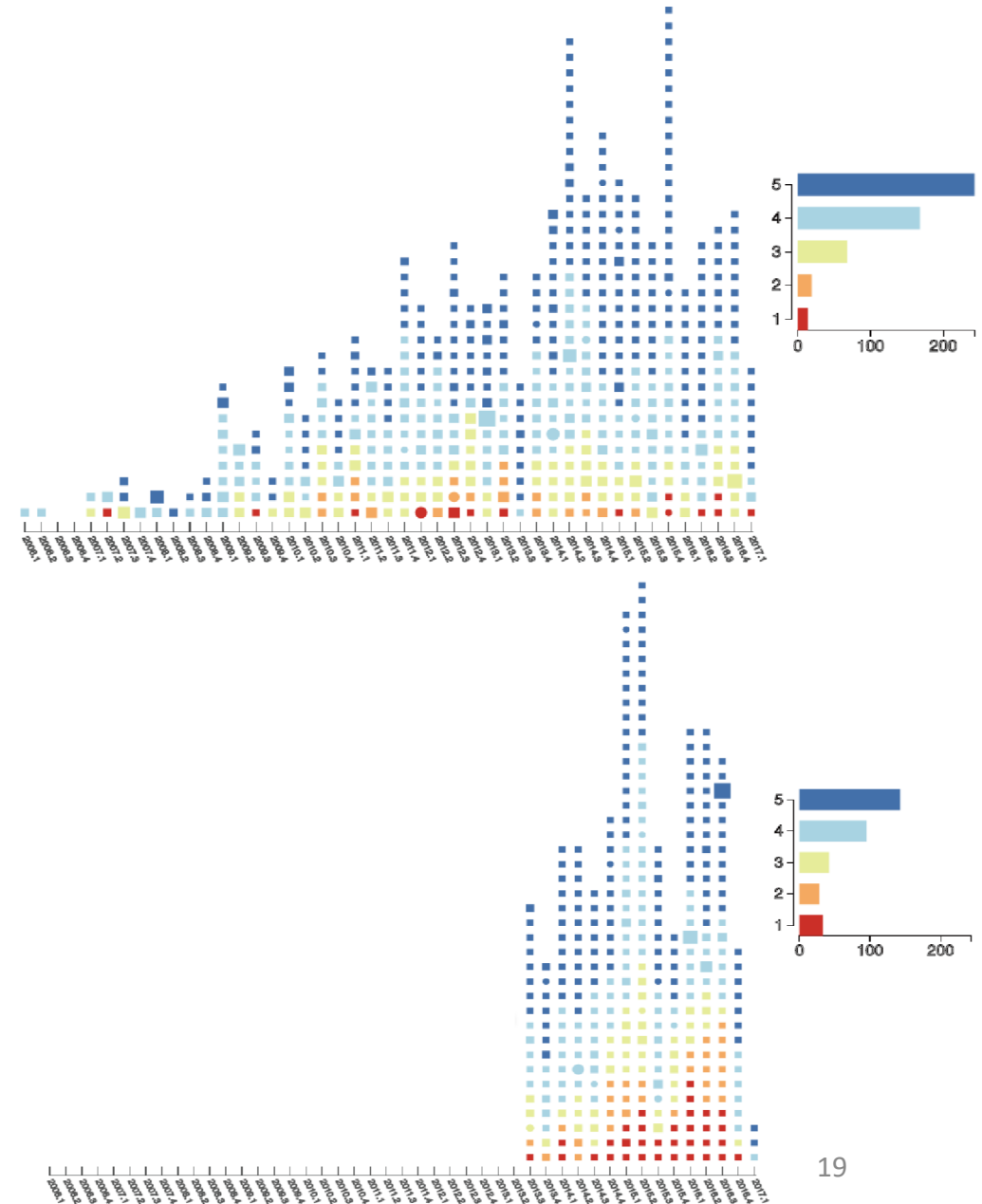


(d)

Alternative Designs

# Detailed Comparison

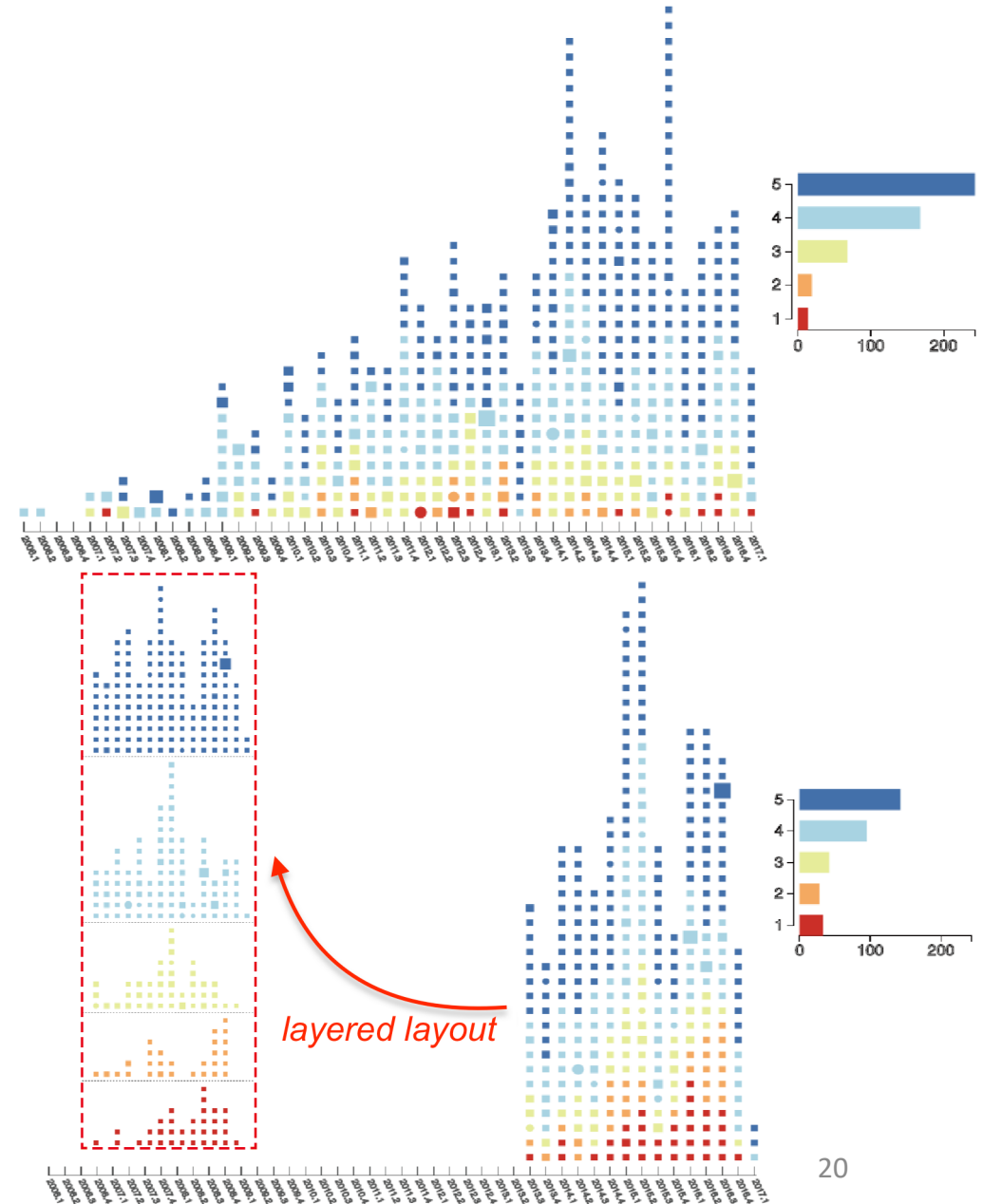
- Temporal view
  - Temporal trend of reviews





# Detailed Comparison

- Temporal view
  - Temporal trend of reviews



# Detailed Comparison

- Temporal view
  - Review helpfulness

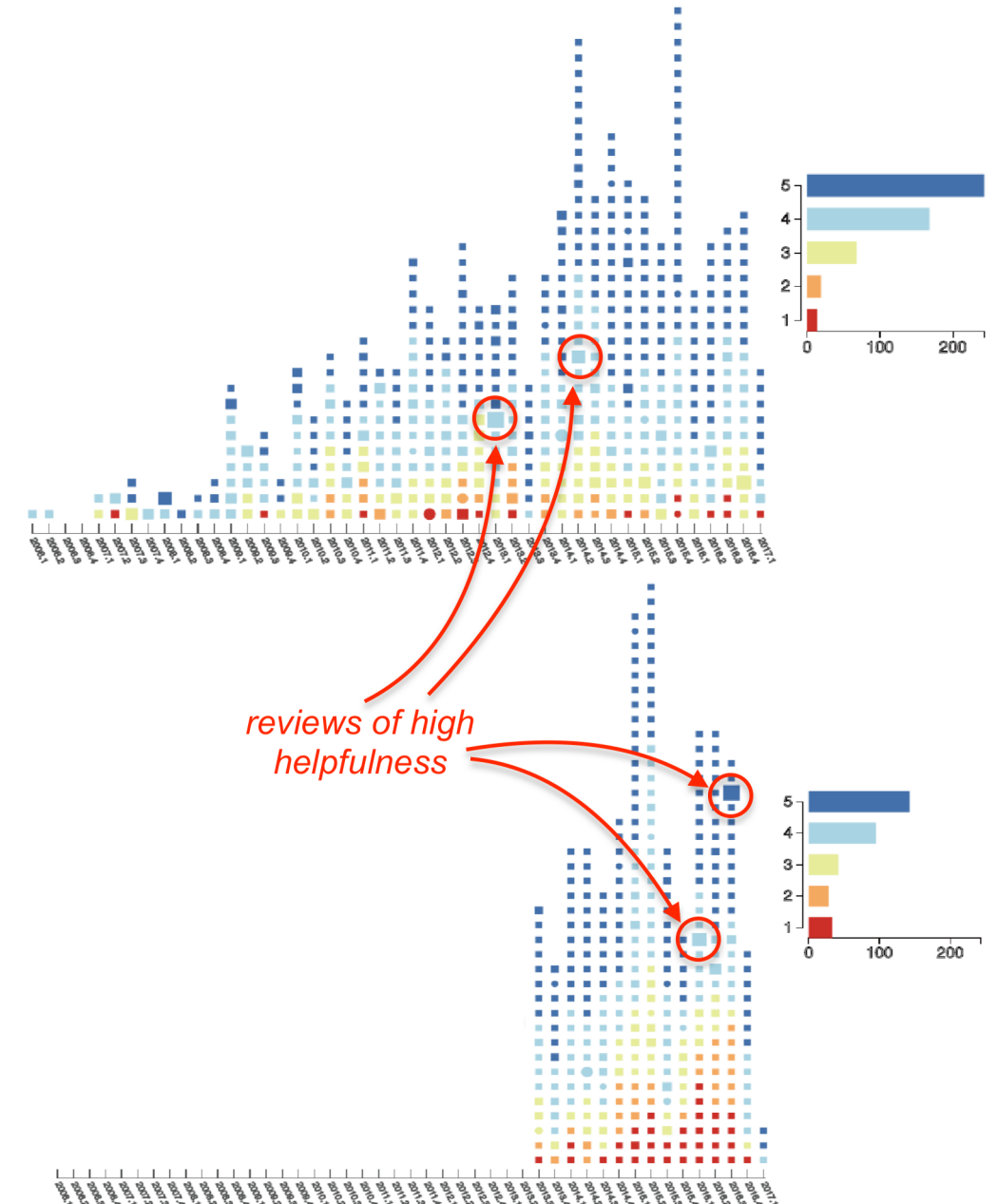
$$H = \alpha \cdot R_e + \beta \cdot R_d + \gamma \cdot R_v$$

*Review extremity*

$$R_e = 3 - |r - 3|$$

*Review depth*

*Helpfulness votes*



# Detailed Comparison

- Temporal view
  - Review helpfulness

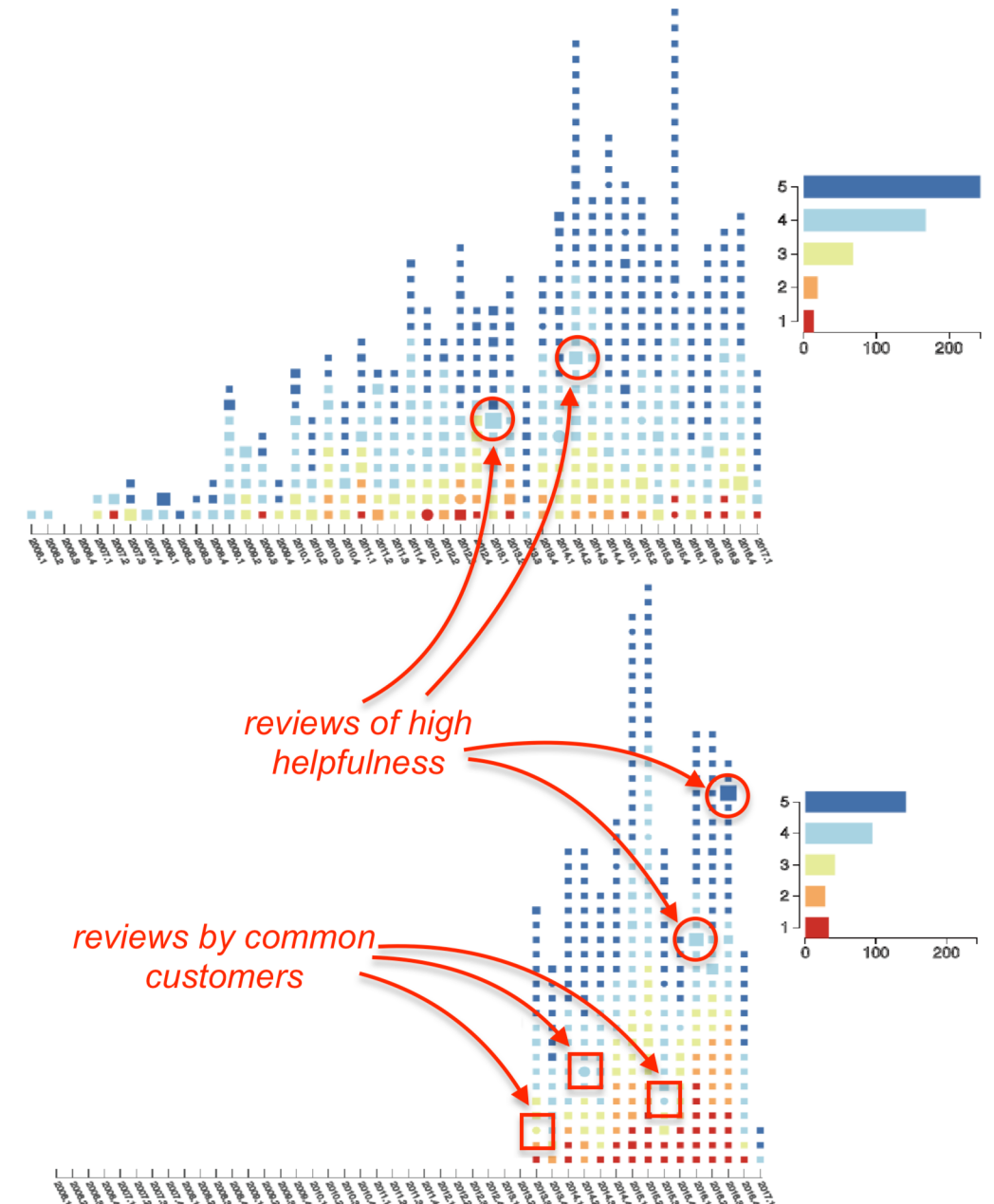
$$H = \alpha \cdot R_e + \beta \cdot R_d + \gamma \cdot R_v$$

*Review extremity*

$$R_e = 3 - |r - 3|$$

*Review depth*

*Helpfulness votes*



- **Augmented word cloud view**

# What is great?

[illegible]

best sf  
baked sea bass  
best sushi  
sure in striped bass  
other person  
fresh fish  
slow service  
sushi bar  
sushi chef  
baked mussel  
more hour  
only thing  
long wait  
long time  
sushi restaurant  
good food  
long line  
hawaiian roll  
reasonable price  
baked mango  
small place  
delicious everything

<http://firstmonday.org/article/view/5436/4111>

# Detailed Comparison

- **Augmented word cloud view**

# Service





# Detailed Comparison

- **Augmented word cloud view**
  - **Extract adjective+noun word pairs**

1. *Use part-of-speech (POS) tagger in NLTK*

2. *A heuristic approach to keep the noun and the corresponding adjective that modifies it*

*(Specifically process the case of negative expressions)*

# Detailed Comparison

- Augmented word cloud view
  - Extract adj+noun word pairs
  - **Classify word pairs into meaningful categories**
    1. *Manually label a set of representative words for each category*
    2. *Classify new words by computing the similarity between them and the labeled words using **word2vec***

# Detailed Comparison

- Augmented word cloud view
  - Extract adj+noun word pairs
  - Classify word pairs into meaningful categories
  - **Group the word pairs and do the layout of clustered word pairs**
    1. *Group the word pairs with the same noun into a cluster*
    2. *Use standard NLTK library to detect the sentiment of each word pair*
    3. *Layout: collision detection + Archimedean spiral*

- Augmented word cloud view



***Evaluation***

# In-depth User Interview

- 12 participants with at least 3 years online shopping experience
- Procedures:
  - Introduce our prototype system
  - Free exploration
  - Finish tasks of comparing local businesses
  - Feedback collection and questionnaire

# In-depth User Interview

- Feedback
  - ***Effectively supporting easy comparison***: more insightful information is provided for both preliminary and detailed comparison
  - ***Good usability***: visual designs are easy to learn
  - ***Limitations & suggestions***: scalability, potential occlusion, NLP accuracy

# Conclusion and Future Work

- We present a carefully-designed visual analysis system to support easy comparison of local businesses using online reviews
- Case study and in-depth user interview provide support for its effectiveness and usability
- Further improve the language processing accuracy and study the images in the reviews



# Towards Easy Comparison of Local Businesses Using Online Reviews

**Yong Wang**<sup>1</sup>, Hammad Haleem<sup>1</sup>, Conglei Shi<sup>2</sup>, Yanhong Wu<sup>3</sup>, Xun Zhao<sup>1</sup>, Siwei Fu<sup>1</sup>  
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