

How Opinions are Received by Online Communities: A Case Study on Amazon.com Helpfulness Votes

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Jon Kleinberg¹
Lillian Lee¹

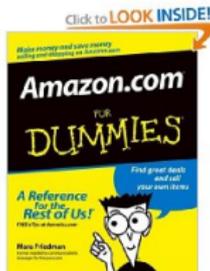
¹Department of Computer Science, Cornell University

²Google Inc. (formerly at the Department of Sociology, Cornell University)

04-23-2009

WWW2009

Opinion vs. Meta-Opinion



Amazon.com for Dummies (Paperback)

by [Mara Friedman](#) (Author) "No one (except maybe Amazon.com founder Jeff Bezos) ever imagined that one day there would be a way that you could buy everything from books..." ([more](#))

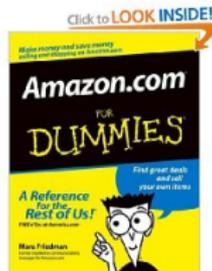
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12 new from \$3.13 **15 used** from \$2.93

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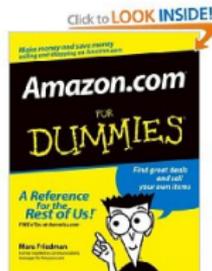
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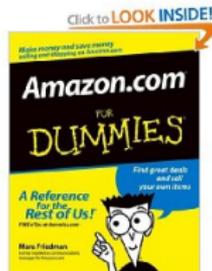
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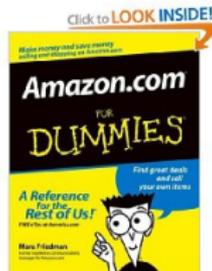
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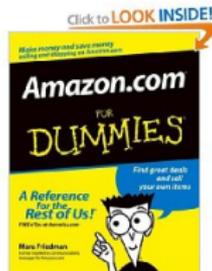
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No

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Opinion vs. **Meta-Opinion**

Opinion:

“What did Gary think of the book?”

Meta-Opinion:

“What did the users think about Gary’s opinion of the book?”

Opinion vs. **Meta-Opinion**

Opinion:

“What did B think of A?”

[survey by Pang and Lee, 2008; Wu and Huberman, 2008]

Meta-Opinion:

“What did C think about B’s opinion of A?”

[Ghose et al., 2008; Kim et al., 2006; Liu et al., 2007]

Opinion vs. **Meta-Opinion**

Meta-Opinion:

“What did C think about B’s opinion of A?”

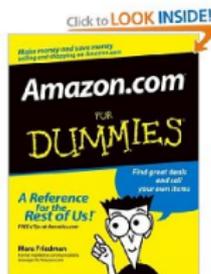
Widespread in everyday life (e.g., political polls, market research) and in online communities (e.g., Amazon.com, Facebook).

In this work we analyze and model the factors influencing meta-opinions.

Amazon.com as a Testbed for Meta-Opinion Analysis

Data

4,000,000 reviews
700,000 products



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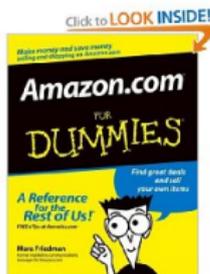
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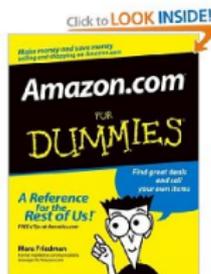
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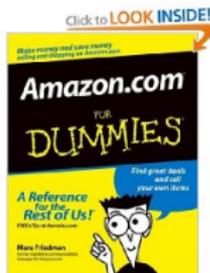
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Factors

Textual



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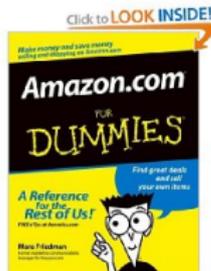
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Textual
Non-Textual



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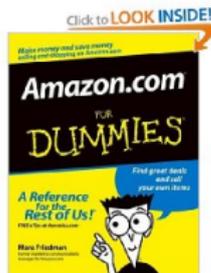
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Yes

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Thought Exercise

A product has a average star rating of 3:



Suppose your aim is to write a helpful review for that product.
You can only alter the star rating of the review.
Which would be your star rating choice?



Social Psychology Hypotheses

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias

Social Psychology Hypotheses

Hypotheses:

Conformity

Brilliant-but-cruel
Individual-bias

Conformity Hypothesis

Social psychology of conformity
[Bond et al., Psych. Bulletin, '96]

→ A review is evaluated as more helpful when its star rating is closer to the average star rating for the product.

Social Psychology Hypotheses

Hypotheses:

Conformity

Brilliant-but-cruel

Individual-bias

Brilliant-but-cruel Hypothesis

[Amabile, J. Exp. Social Psych. '83]:
"negative reviewers are perceived as more intelligent, competent, and expert than positive reviewers."

→ A review is evaluated as more helpful when its star rating is below to the average star rating for the product.

Social Psychology Hypotheses

Hypotheses:

Conformity

Brilliant-but-cruel

Individual-bias

Individual-bias Hypothesis

When a user considers a review, he or she will rate it more highly if it expresses an opinion that he or she agrees with.

→ A review is evaluated as more helpful when its star rating reflects the evaluators' personal opinion about the product.

Deviation from the mean

Hypotheses:

Conformity

Brilliant-but-cruel

Individual-bias

$absolute\ deviation = |star\ rating - avg.\ star\ rating|$



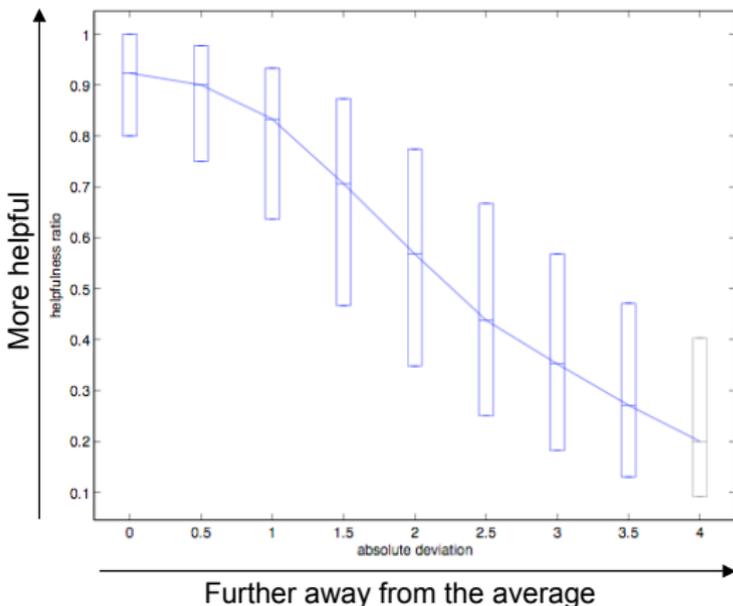
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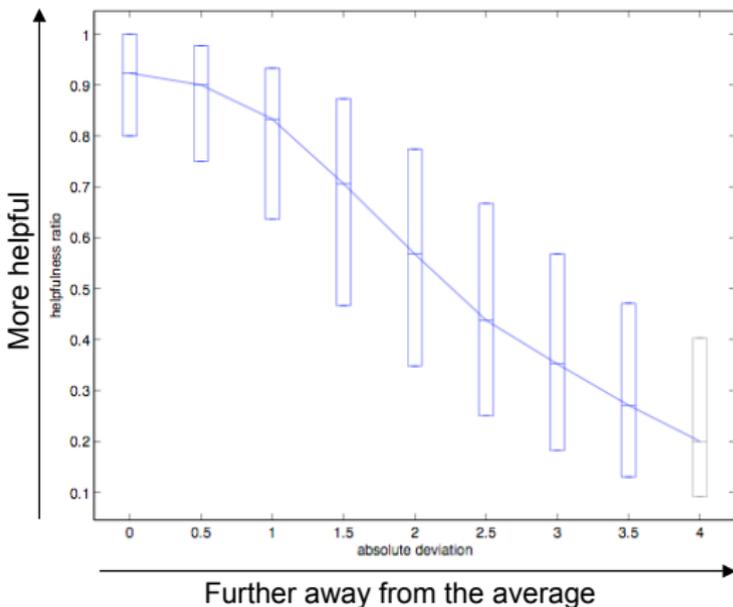
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Deviation from the mean

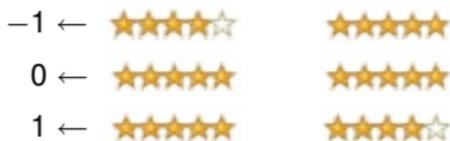
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signed deviation = star rating – avg. star rating



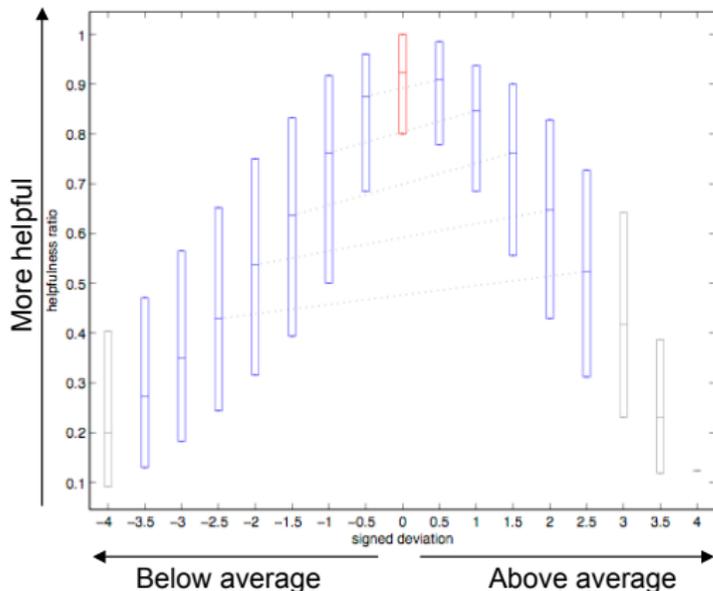
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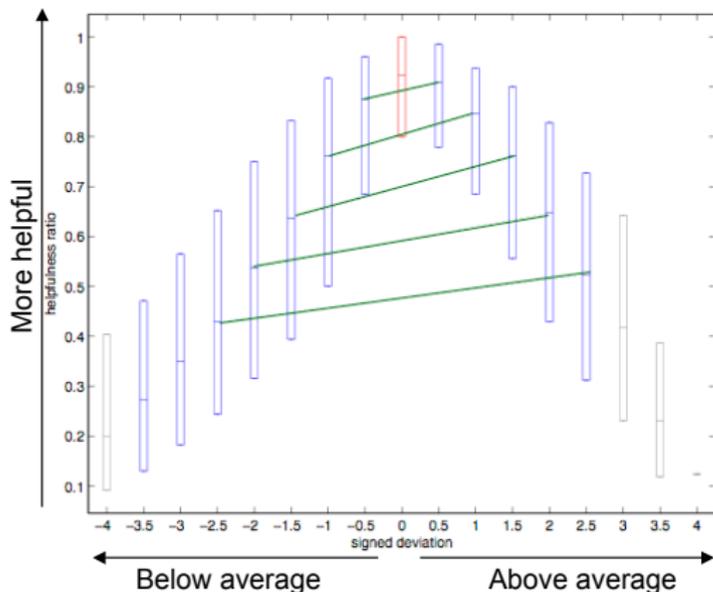
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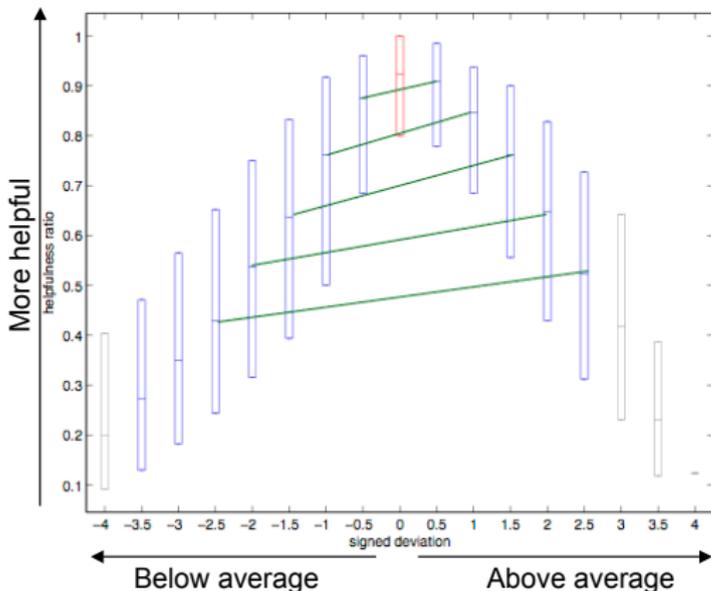
Deviation from the mean

Hypotheses:

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Individual-bias



Individual-bias Hypothesis

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias

Individual-bias Hypothesis

→ A review is considered more helpful when its star rating reflects the **evaluators' personal opinion** about the product.

Individual-bias vs. Conformity

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias

Recall: Conformity Hypothesis

→ A review is considered more helpful when its star rating reflects the **reviewers' average opinion** about that product.

Individual-bias Hypothesis

→ A review is considered more helpful when its star rating reflects the **evaluators' personal opinion** about the product.

Individual-bias vs. Conformity

Hypotheses:

Conformity

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Individual-bias

Recall: Conformity Hypothesis

→ A review is considered more helpful when its star rating reflects the **reviewers' average opinion** about that product.

Individual-bias Hypothesis

→ A review is considered more helpful when its star rating reflects the **evaluators' personal opinion** about the product.

Individual-bias = Conformity ?

Undistinguishable if everybody agrees.

Variance

Hypotheses:

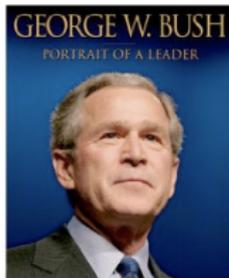
Conformity

Brilliant-but-cruel

Individual-bias

Individual-bias = Conformity ?

Undistinguishable if everybody agrees.



George W. Bush: Portrait of a Leader (Hardcover)

by [Epicenter Media](#) (Creator), [Tyndale](#) (Creator)

★★★★☆ (34 customer reviews)

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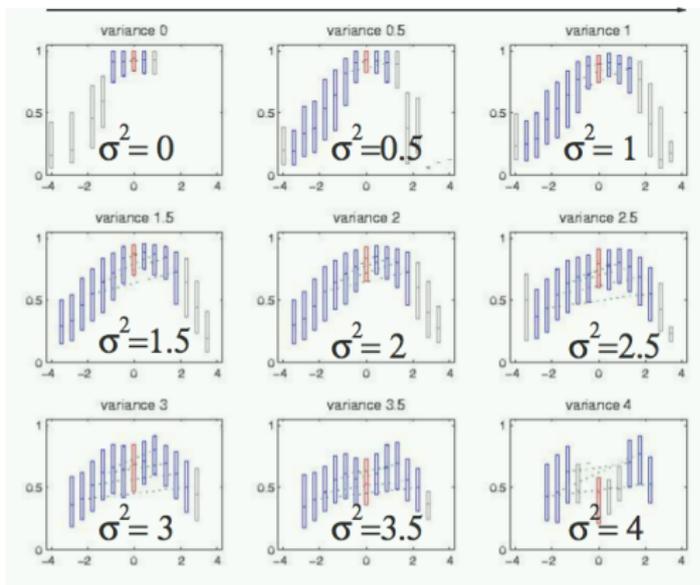
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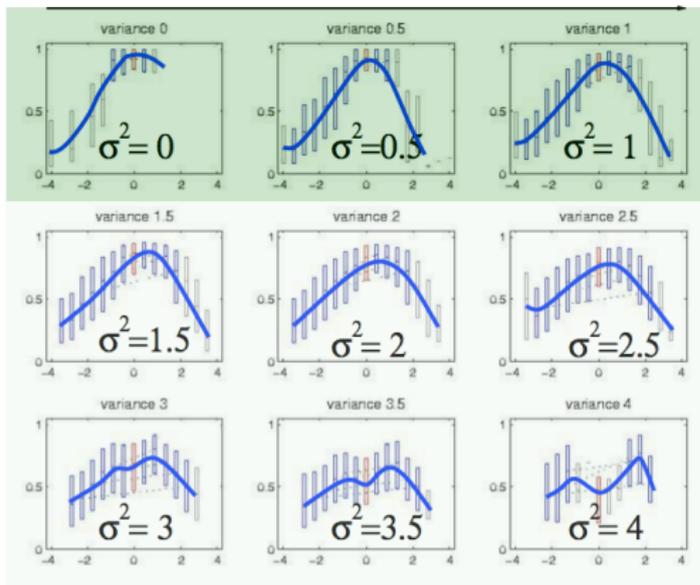
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16 new from \$10.21 **15 used** from \$7.39 **1 collectible** from \$24.99

Variance

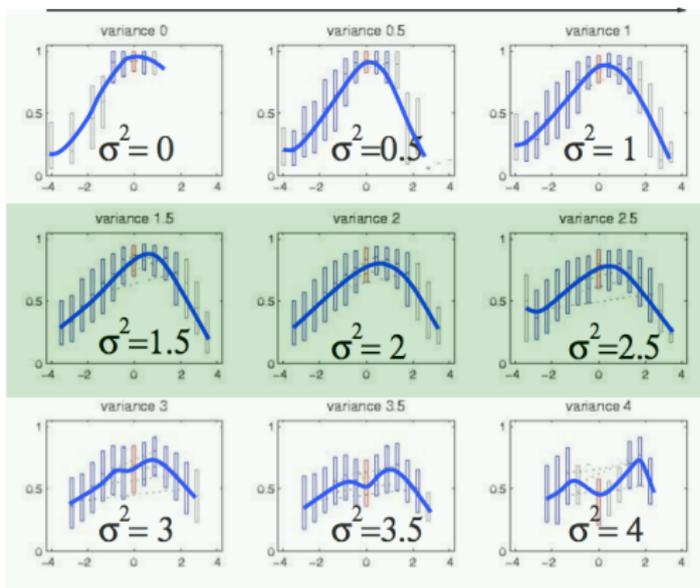


Variance



→ “Go with the average.”

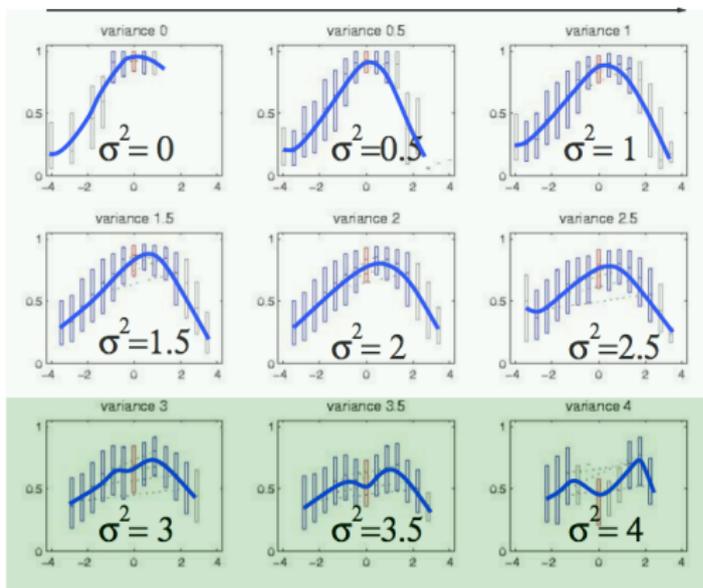
Variance



→ "Go with the average."

→ "Go slightly above the avg."

Variance



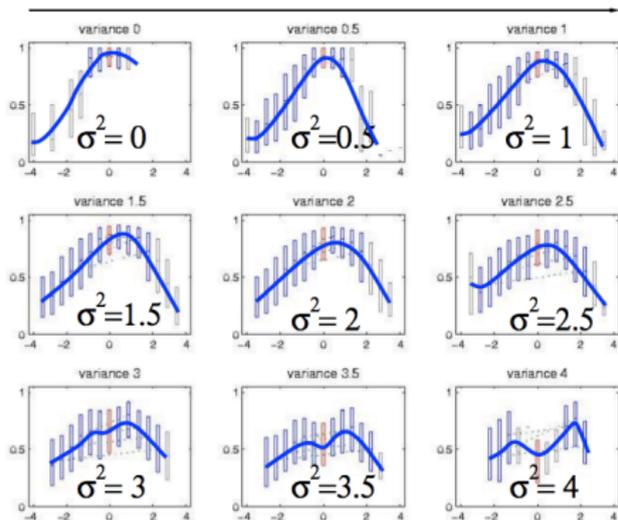
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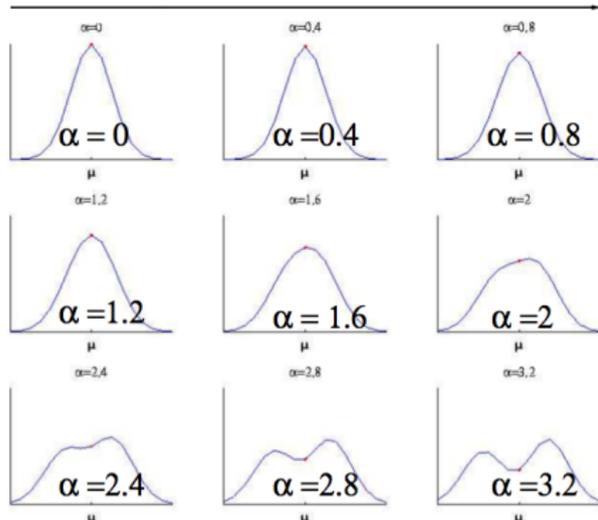
→ "Avoid the average."

Mixture of Opinion Model

Empirical observation:



Model generated:



What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Text-only Hypothesis

Helpfulness is evaluated purely on the textual content of the review.

The non-textual factors are simply correlates of textual quality.

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Controlling for Text

- Manual re-evaluation of the text helpfulness

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Controlling for Text

- Manual re-evaluation of the text helpfulness
 - human effort
 - subjectivity

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Controlling for Text

- Manual re-evaluation of the text helpfulness
- Use Machine Learning to evaluate text helpfulness

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Controlling for Text

- Manual re-evaluation of the text helpfulness
- Use Machine Learning to evaluate text helpfulness

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Controlling for Text

- Manual re-evaluation of the text helpfulness
- Use Machine Learning to evaluate text helpfulness
 - How to interpret the mismatches between predicted and actual helpfulness?
ML alg. errors and non-textual influence are indistinguishable.

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Controlling for Text

- Manual re-evaluation of the text helpfulness
- Use Machine Learning to evaluate text helpfulness

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Controlling for Text

- Manual re-evaluation of the text helpfulness
- Use Machine Learning to evaluate text helpfulness
- Seed reviews in different non-textual contexts

What about the actual text?

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

Controlling for Text

- Manual re-evaluation of the text helpfulness
- Use Machine Learning to evaluate text helpfulness
- Seed reviews in different non-textual contexts
 - wait for a few years...
 - submit to WWW 2011

Plagiarism!

Hypotheses:

Conformity
Brilliant-but-cruel
Individual-bias
Text-only

26 of 30 people found the following review helpful:

★★★★★ **Skull-splitting headache guaranteed!!**, June 16, 2004

By **A Customer**

If you enjoy a thumping, skull splitting migraine headache, then Sing N Learn is for you.

As a longtime language instructor, I agree with the attempt and effort that this series makes, but it is the execution that ultimately weakens Sing N Learn Chinese.

To be sure, there are much, much better ways to learn Chinese. In fact, I would recommend this title only as a last resort and after you've thoroughly exhausted traditional ways to learn Chinese. . . .

7 of 11 people found the following review helpful:

★★★★★ **Migraine Headache at No Extra Charge**, May 28, 2004

By **A Customer**

If you enjoy a thumping, skull splitting migraine headache, then the Sing N Learn series is for you.

As a longtime language instructor, I agree with the effort that this series makes, but it is the execution that ultimately weakens Sing N Learn series. To be sure, there are much, much better ways to learn a foreign language. In fact, I would recommend this title only as a last resort and after you've thoroughly exhausted traditional ways to learn Korean. . . .

Plagiarism!

Hypotheses:

Conformity

Brilliant-but-cruel

Individual-bias

Text-only

Controlling for Text

About 1% of the reviews are plagiarized!

[David and Pinch, 2006]

$i \backslash j$	0.5	1	1.5	2	2.5	3	3.5
0		Y	Y	Y	Y	Y	Y
0.5		Y	Y		Y	Y	Y
1			Y		Y	Y	Y
1.5					Y	Y	Y
2						Y	Y
2.5						Y	Y
3							

(MH statistical significance test)

Plagiarism!

Hypotheses:

- Conformity
- Brilliant-but-cruel
- Individual-bias
- Text-only**

Controlling for Text

About 1% of the reviews are plagiarized!

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$i \backslash j$	0.5	1	1.5	2	2.5	3	3.5
0		Y	Y	Y	Y	Y	Y
0.5		Y	Y		Y	Y	Y
1			Y		Y	Y	Y
1.5					Y	Y	Y
2						Y	Y
2.5						Y	Y
3							

Y: the plagiarized reviews with deviation 0 are significantly more helpful than those with deviation 3
 (MH statistical significance test)

Conclusions

- We have analyzed how the helpfulness of a review depends on the other **star ratings** of the respective product.
- This dependence contrasts with theories from **social psychology**.
- We have discovered the important effects of **variance** on meta-opinions.
- We proposed a simple mathematical **model** that can account for this apparently complex dependence.
- By **taking advantage of plagiarism** we proved that helpfulness evaluation does not only depends on the text, but also depends directly on **non-textual** factors.

Thank you!