Influence on opinion of news comment sections

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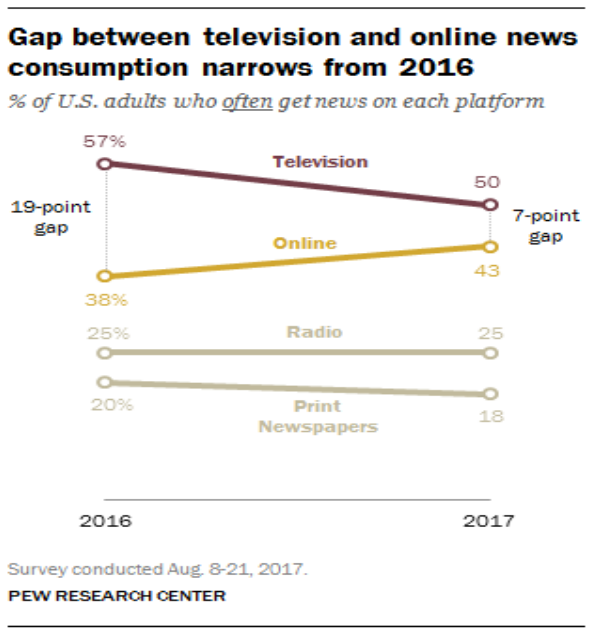
***Abstract*— Prior research has shown that comments underneath articles can cause perceptions about the article itself to change. Our aim in this project is to study the cognitive processes that cause this change of opinion and build a computational rules based model that can simulate human behavior.**

***Keywords*— News comments; cognition; online comments; comment moderation; bias**

I. Introduction

An increasing percentage of people are getting their news online. A pew research survey [5] from Aug 8-21 in 2017, found that the percentage of American adults who often get news online increased from 38% to 43% year-on-year, narrowing the gap with television from 19 percentage points to 7.



This shows the increasing importance and influence of online news. In addition to this, a study by the engaging news project[6] found that 'Just over half (50.7%) of Americans do not read news comments or leave comments on news sites' which implies that almost 50% have read comments on news articles online. These stats show the importance of understanding the effects of these comments on people's perception of the article, and also on their own opinion. Hostile states were reported to have armies of commentators [7], who infest online comment boards and try to influence readers during election time. As such, this is important not only from a cognitive science point of view, but also sociologically. This is a very interesting topic from the point of view of cognitive science, as it concerns a fundamental aspect of learning theory, i.e. what role does the environment play in our opinions and also, how exactly do we form and hold on to opinions in face of opposition from others. Prior research has shown the ability of comments to influence opinion. For example[3], it is found that exposure to uncivil blog comments can polarize risk perceptions of nanotechnology along the lines of religiosity and issue support. Also, [4] it is found that that cues about comment moderation, even without any change in the comments themselves, have the potential to alleviate the effect of in-civil comments. This enables us to form our hypothesis.

II. Problem Statement

Our initial hypothesis here is

H0: People's opinion about an article/topic can be changed after reading the comments that follow the article.

Our primary objective here is to build a computational model for the cognitive processes that lead to people changing their opinion. We aim to come up with a rules based system, which is dependent on the initial state of the individual as regards to the topic of the article. The initial state contains four variables namely, opinion about the topic, confidence level in the opinion, interest level

in the given topic and the attention level for the topic at that point of time. We will then ask five questions related to the article and the comments, and with this information our system will output whether the individual will change his/her opinion or not. We validated the result though one interview. Even if it's insufficient to validate the results, we can check to see to what extent it validates our process and at least if we are on the right track.

III. Data Collection & Rule

Data was collected by conducting face-to-face interviews with 8 students, with both genders equally represented. We didn't interview anyone who had heard the questions earlier i.e. within earshot of another interview.

The standard interview was composed of the following questions:

1. Do you read news online?
2. Do you read political news?
3. Does the article often have a bias?
4. How do you determine if the article is biased?
5. Do you read the comments?
6. How do you feel if majority comments are having the opposite opinion to you?
7. How do you feel if majority comments are having the same opinion to you?
8. Has your opinion been strengthened or weakened after reading the comments?
9. Have you ever changed your opinion after reading the comments?
10. Can you describe the circumstances where this change happened?
11. Can you explain the process about how to reach to the point where you decided to change your opinion?

We weren't able to follow the exact script every time, and had to improvise as and when required. For example, if the subject didn't read political news, or comment we asked about related activities, like reading Youtube comments, or comments after movie reviews. Also, we focused on understanding how they formed and changed their opinions, even if it didn't involve reading the news/comments.

The actual data (including only the key words and phrases, and has been paraphrased) is as follows:

Person 1 (Female):

Do you read news online? Yes

Do you read political news? Yes

Does the article often have a bias? Yes

How do you determine if the article is biased : the same point is repeatedly stressed

Do you read the comments? :

How do you feel if majority comments are having the same opinion to you: Feel as if I am on the right track if majority agrees with me

How do you feel if majority comments are having the opposite opinion to you: it causes a little self doubt

Has your opinion been strengthened or weakened after reading the comments? Only strengthened, never been weakened

Have you ever changed your opinion after reading the comments? No

Can you describe the circumstances where this change happened? Never after after reading comments. Only changes after reading solid facts, debating

Person 2 (Male):

Do you read news online? Yes, sometimes

Do you read political news? No

Does the article often have a bias? Yes

How do you determine if the article is biased : the political stance of well-known websites is common knowledge

Do you read the comments? : No

(Here I shifted track: we didn't stick to comments under news articles, but broadened our horizons to include Youtube, movie reviews etc)

How do you feel if majority comments are having the same opinion to you: Validated

How do you feel if majority comments are having the opposite opinion to you: Do more research on the topic.

Disrespectful comments are ignored, and strengthen the argument against them

Has your opinion been strengthened or weakened after reading the comments? No

Have you ever changed your opinion after reading the comments? No

(Here again the last question changed to 'Tell us how you form your opinions')

Tell us how you form opinions on new topics? Opinion of friends matters a little but always research the topic thoroughly

Person 3 (Male):

Do you read news online? Yes, via social media

Do you read political news? Yes

Does the article often have a bias? Yes

How do you determine if the article is biased : the stance of the article makes it clear

Do you read the comments? : Yes, sometimes

How do you feel if majority comments are having the same opinion to you: Opinion is strengthened

How do you feel if majority comments are having the opposite opinion to you: Causes me to rethink, especially if some good points have been made

Has your opinion been strengthened or weakened after reading the comments? Only strengthened, never been weakened

Have you ever changed your opinion after reading the comments? Sometimes will reconsider position, but not completely change opinion

Can you describe the circumstances where this change happened? If there are a number of comments, well reasoned that against my position. Number of likes does not matter

Person 4 (Female):

Do you read news online? Not usually

Do you read political news? Yes

Does the article often have a bias? Yes, every newspaper has a bias

How do you determine if the article is biased : the tone of the article

Do you read the comments? : Do not usually read comments since they are really biased

How do you feel if majority comments are having the same opinion to you: Don't affect me much

How do you feel if majority comments are having the opposite opinion to you: Causes me to rethink, take them as additional information

Has your opinion been strengthened or weakened after reading the comments? No, not just because of comments, will do own research

Have you ever changed your opinion after reading the comments? No, immediately do my own research to obtain the correct facts. Longer, well reasoned comments draw more attention. Ignore if abusive

Can you describe the circumstances where this change happened? After researching the facts thoroughly

Person 5 (Male):

Do you read news online? Not usually, get notifications from the CNN app

Do you read political news? Some

Does the article often have a bias? Yes, bias exists on both sides, left and right

How do you determine if the article is biased : The publication, the tone of the article, hence I don't believe that it's 100% accurate

Do you read the comments? : No

(Here again we decided to explore non-news situations like YouTube)

How do you feel if majority comments are having the same opinion to you: Doesn't affect me much

How do you feel if majority comments are having the opposite opinion to you: Causes me to rethink

Has your opinion been strengthened or weakened after reading the comments? Yes

Have you ever changed your opinion after reading the comments? Yes

Can you describe the circumstances where this change happened? The argument was compelling. As per usual, sampled comments on both sides of the issue and then made a decision to modify my opinion (after further research)

Person 6 (Female):

Do you read news online? Yes, straight from the source, never from social media

Do you read political news? Yes

Does the article often have a bias? Yes, but data itself is correct in the sources that I read (mostly liberal)

How do you determine if the article is biased : The publication, and if there are strong opinions

Do you read the comments? : No, because don't want to prejudice my opinion as commentators are usually those who have strong opinions, hence it's not randomly sampled

How do you feel if majority comments are having the same opinion to you: Feels good

How do you feel if majority comments are having the opposite opinion to you: Not bothered

Has your opinion been strengthened or weakened after reading the comments? Appreciate well reasoned comments and their point of view but doesn't affect me much

Have you ever changed your opinion after reading the comments? No

(Here we asked her to consider a situation (actual or hypothetical) when she hadn't fully formed an opinion and the process of its forming)

Can you describe the circumstances If I don't have strong opinions on the topic I may change if there are good points and if they have more likes, I pay more attention

Person 7 (Male):

Do you read news online? Sometimes

Do you read political news? Yes

Does the article often have a bias? Yes, in general all the article has a bias

How do you determine if the article is biased: The comments without any fact but emotion is considered as biased comments

Do you read the comments? : Yes

How do you feel if majority comments are having the same opinion to you: it does not mean anything to me

How do you feel if majority comments are having the opposite opinion to you: Feel sad, lead me to rethink but do not change my opinion

Has your opinion been strengthened or weakened after reading the comments? Yes

Have you ever changed your opinion after reading the comments? No

Can you describe the circumstances where this change happened? If majority opinion is different from mine, go search additional information. Then if I still find my opinion is different from majority opinion. I feel less confident and amy change my opinion.

Person 8 (Female):

Do you read news online? Yes, BBC and NPR (least unbiased)

Do you read political news? Yes

Does the article often have a bias? Yes, NPR has a slight left wing bias

How do you determine if the article is biased : The publication to which the article belongs and the tone of the article

Do you read the comments? : No

(Asked about forming opinions in general)

How do you feel if majority comments are having the same opinion to you: No effect

How do you feel if majority comments are having the opposite opinion to you: No effect

Has your opinion been strengthened or weakened after reading the comments? No and no external information about external influences etc will change my confidence level in an article.

Have you ever changed your opinion after reading the comments? No, but hypothetically the website and its reputation will affect my trust in those comment

Can you describe the process of your forming opinions in general? Most opinions have been formed subconsciously. Peer group influences play a part.

After the data collection exercise, we modified our initial hypothesis to:

H1: People's opinion about an article/topic can be changed after reading the comments that follow the article very rarely, and under very specific circumstances.

From the data certain points became clear namely

1. People are convinced that all news sources are biased. (All persons)
2. That they can discern this bias with not much effort i.e. bias is pretty apparent (All persons)
3. They don't change/modify/revisit their opinion except under exceptional circumstances and a lot of research (equivalent to reading all comments) (All except 5)
4. If you agree with article, you are less likely to change your opinion than if you disagree (Person 1 and 2)
5. Strongly held opinions are less likely to change (All persons)
6. Offensive comments are ignored (Person 1,2,4,6,8)
7. Sampling both sides of the argument (Person 5) facilitates the process

Our system is composed of 4 initial state variables. These signify the person's state before he reads the article and comments.

1. Opinion - (totally disagree, disagree, neutral, agree, totally agree)
2. confidence level (cL)- (Low, Medium, High)
3. attention level (aL)- (Low, Medium, High)
4. interest level (iL)- (Low, Medium, High)

We then ask a set of five questions (explained in the software scheme). We modify the four state variables using our rules and the input from the five questions

The rules can be understood in principle from the following points

1. Offensive comments lead to a decline in the attention level, provided your interest level is not 0.
2. Attention level increases if comments are 'not at all' offensive
3. Only if the input is either the sequence 'no, all, not at all, strongly against you, very' or 'no, sampled both sides, not at all, strongly against you, very' will the opinion state change along with the confidence level.
4. Opinion change is less likely if you agree with the article, and is proportional to strength of opinion. For example, if your initial state is 'disagree' then you're most likely to change your opinion.

IV. Software Scheme

As shown in the previous section, there are four state variables; "opinion" representing a person's opinion towards an article, "confidence_level" representing how confident a person's opinion is, "attention_level" representing how much attention the person is paying to the article, and "interest_level" representing the how much interest the person have about the political issue the article brings. Each of them can have the following values.

- opinion
  - strongly agree, agree, neutral, disagree, strongly disagree
- confidence_level
  - high, mid, low
- attention_level
  - high, mid, low
- interest_level
  - high, mid, low

In addition to these four state variables, there are five environment variables. These five variables represent the quality of comments and the majority opinion. Environment variables are derived by four questions below.

- q1: Does the article have a bias?
  - yes, no, can't Say
- q2: Which comments did you read?
  - all, sorted by likes, sampled both sides of argument, unsorted, never
- q3: Are the comments offensive?
  - not at all, little, neutral, quite, very
- q4: Which way is the comment section leaning?
  - strongly against you, against you, neutral, with you, strongly with you
- q5: Are the comments well-reasoned?
  - not at all, little, neutral, quite, very

As shown in the previous section, we have 95 rules in total. To express the Let “oRate”, “cRate”, “aRate”, and “iRate” be defined as follows.

- oRate = the rate of change in opinion after firing a rule.
- cRate = the rate of change in confidecne_level after firing a rule.
- aRate = the rate of change in attention_level after firing a rule.
- iRate = the rate of change in interest_level after firing a rule.

Now each rule is now translated into the format using four state variables, 5 environment variables, and four rates of change in state variables. The example format is shown as below.

If

- opinion == “strongly agree”
- confidence_level == “high”
- attention_level == “mid”
- interest_level == “low”
- q1 == “yes”
- q2 == “all”
- q3 == “not at all”
- q4 == “strongly against you”
- q5 == “not at all”

Then

- oRate = from “strongly agree” to “agree”
- cRate = from “high” to “mid”
- aRate = “None” (it does not change)
- iRate = from “low” to “high”

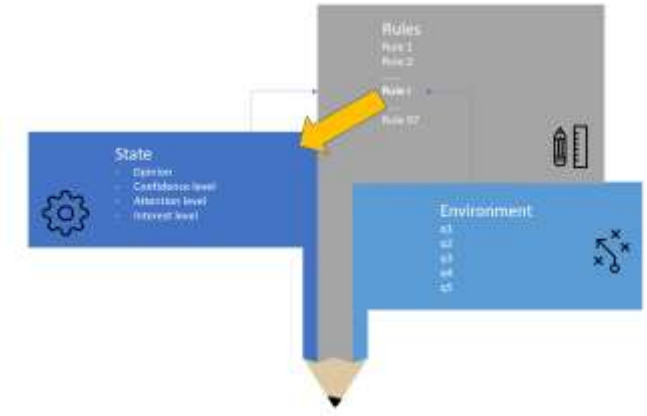


Fig. 1 Overview of software consisting of three components; State, Environment, and Rules

Fig.1 shows the schematic of the software. State machine is used to represent the change in state variables, “opinion”, “confidence_level”, “attention_level”, and “intererst_level”. In every iteration, one rule fires and changes the state variables. This iteration continues until there is no more rule that satisfies the condition. Then “opinion” is check and compared against the original opinion to see if the person changes his or her opinion such as the person changes from “disagree” to “agree”.

As mentioned in the lecture, the resolution strategies of firing rules are as follows.

- Don’t fire twice on the same input
- Fire on more recently changed data
- Fire more specific rules (rules with more conditions)

To achieve the first strategy, one attribute call “isUsed” is added to the rule class to keep track if the rule is already fired or not. To achieve the third strategy, priority_queue is used to store rules as the data structure for rules.

V. Result & Analysis

A. *Methodology*

The total number of cases is 253125. It is the huge number, however, there are only limited number of cases where a person changes his or her opinion. For example, as we found out through the interview and the research [1], a person may change his or her opinion if the person found out the majority of people actually have opposite opinion. Similarly, a person may change his or her opinion only if the comments are well reasons and they show additional statistical data.

Also, many interviewees mentioned that if there are comments which uses either emotional or offensive word, they ignore these comments, which results in their sticking to their opinion. Similarly, if they think comments are biased, they tend to ignore these comments as well.

As the primary goal for this report is to simulate our brain process to change our opinion, the cases

with following environmental variables are now intensely examined.

- q1 = “no”
- q2 = “all” or “sampled both sides of argument”
- q3 = “not at all”
- q4 = “strongly against you” or “against you”
- q5 = “very”

In terms of state variables, all combinations which are 135 in number are examined to see how each state variables affect if a person changes his or her opinion at the end.

B. Analysis

Now, in total 540 cases are tested. Among 540 cases, 38 cases show that a person changes his or her opinion. In other word, if we run 253125 cases which is full cases, only 38 cases would show that a person changes his or her opinion. This ratio (38/253125 = 0.02%) matches to the result from the interview in which almost no one said that he or she have never changed their opinion.

1) Opinion

Initial and final opinion of these 38 cases are summarized as below.

initial opinion

- strongly disagree = 0
- disagree = 22
- neutral = 0
- agree = 16
- strongly agree = 0

final opinion

- strongly disagree = 0
- disagree = 8
- neutral = 24
- agree = 6
- strongly agree = 0

As shown, people who change their opinions do not have strong opinion. They change their opinion from either “agree” or “disagree” to “neutral”.

2) Confidence Level

Initial and final confidence level of these 38 cases are summarized as below.

initial opinion

- low = 2
- mid = 20
- high = 16

final opinion

- low = 30
- mid = 0
- high = 8

As shown here, when people change their opinion, their confidence level in their opinion decreases from “high” to “low”. However, the fact that the number of cases with “high” confidence level is larger than that of cases with “low” confidence level does not match to the experimental result [1] in which people with higher confidence in their opinion do not change their opinion frequently.

3) Attention Level & Interest Level

Initial and final attention level of these 38 cases are summarized as below.

initial attention_level

- low = 0
- mid = 20
- high = 18

final attention_level

- low = 0
- mid = 20
- high = 18

Similarly, initial and final interest level of these 38 cases are summarized as below.

initial interest_level

- low = 6
- mid = 16
- high = 16

final interest_level

- low = 6
- mid = 16
- high = 16

Based on the data above, higher initial attention level and interest level increases the chance of peoples’ changing their opinions. But these level do not change itself even after rules fired.

C. Sample Result

Here we show two sample results. Table 1 shows the case where a person sticks to his or her opinion. The environment states here is set as the one where a person does not think the article has a bias, read all comments, and find out that they do not use offensive words but are strongly against to the person with well-established reasoning.

As first row in Table 1 shows, an initial state condition is that the person strongly agrees with the article, has medium confidence level, and high interest & attention level. As shown in the excel sheet we attached to the report, Rule 6 is that if a person strongly agrees with the article and has medium confidence level and high interest level and attention level, the person loses the confidence level to low confidence level. Similarly, rule 9 says that if a person strongly agrees with the article and has low confidence level and high interest level and attention level, the person changes the opinion to "agree with the article" from "strongly agree with the article". Again similarly, rule 21 says that if a person agrees with the article and has low confidence level and high interest level and attention level, the person changes the opinion to "disagree with the article" from "agree with the article". By firing rule 6 and 9, the person's confidence level decreases. Then the two steps in which the person changes the opinion follows.

However, our scheme continues firing rules until there is no more rules whose conditions are satisfied as we assume it is common that the person keeps reading comments and changing opinions. Rule 36 is that if a person disagrees with the article and has low confidence level and high interest level and attention level, the person changes the opinion to "agree with the article" from "disagree with the article". By firing rule 36, the person flips back the opinion to the original opinion. Thus, after all the person stick to the original opinion.

TABLE I
A CASE WHERE A PEOPLE STICKS HIS OR HER OPINION

rule ID	opinion	confidence level	attention level	interest level
	2	1	2	2
6	2	0	2	2
9	1	0	2	2
21	-1	0	2	2
36	1	0	2	2

Table 2 shows the case where a person changes his or her opinion. Same environment states are used as the case with Table1.

As first row in Table 2 shows, an initial state condition is that the person agrees with the article, has medium confidence level, and high interest & attention level. As shown in the excel sheet we attached to the report, Rule 17 is that if a person agrees with the article and has medium confidence level and high interest level and attention level, the person loses the confidence level to low confidence level and changes the opinion to "disagree with the article" from "agree with the article". That way, the person changes the opinion. However, our scheme continues firing rules until there is no more rules whose conditions are satisfied as we assume it is common that the person keeps reading comments and changing opinions. By firing rule 36 and rule 21, the person flips back the opinion to the original opinion once and flips once again. After all, the person changes the opinion.

TABLE 2
A CASE WHERE A PEOPLE CHANGES HIS OR HER OPINION

rule ID	opinion	confidence level	attention level	interest level
	1	1	2	2
17	-1	0	2	2
36	1	0	2	2
21	-1	0	2	2

D. Validation

Just as a test, we validated our result with one interview. The interview was conducted over call and required the subject to read the article 'Harvard defends integrity of its admissions in response to allegation of bias against Asian Americans'. His initial state on reading was:

Opinion-neutral

cL: high

aL: medium

iL: high

The answers to the questions were:

q1: No

q2: Unsorted

q3: not at all

q4: with you

q5: little

As expected, his opinion did not change.

VI. Conclusion

In this research, rules are created only based on the interviews performed to 8 people, mostly randomly selected in Clough Commons Georgia Tech. As shown in the result section, the important features such as the relationship between the confidence level and people's changing his or her opinion can be captured. So, a model that validates hypothesis H1 has been successfully built.

As for future work, validation need to be done by actually asking more interviewees to read articles and comments. That way, we can check our rule-based system illustrates human think process. Also, the point that some of our results do not match to the precedent research result [2] in which supportive action by other reader have negative influence needs to be mentioned. To improve our model, more rules may be necessary to illustrate human thought process more accurately. In addition, all of the interviewees this time are Georgia Tech students. Some of the rules such as "If comments use statistical data, people pay more attention to it" may not be universal rule as I believe that students here tend to think in a more academic way than the people outside of the school. A wide variety of interviewees will be a key factor in the future work.

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