# HOW SOCIAL CONTEXT AFFECTS DECISION-MAKING PROCESSES TO BELIEVE IN FALSE INFORMATION

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## DEDICATIONS

To my beloved family.

To Rob, for being this much amazing.

To Bahador, who has always been someone more than a teacher for me.

To Fereshteh who is always been there for me.

To Ian, the kindest, precious person.

## ABSTRACT

The rise of fake news is posing an increasing threat to societies worldwide, but little is known about the cognitive processes that influence acceptance of false information. Here we report that social context influences such judgments. One hundred and eight participants went through 32 statements and were asked for each, “how likely is that the statement is true?” In half of the trials, the participants were provided with the opinion of a survey population and in half they were not. They were told the number of the people who believed that the statement is true and the number of the people who believed that the statement is false. The participants were asked to answer the same question again after getting the social feedback. The results show that individuals were reliably influenced by social feedback with a reaction proportional to the direction of the feedback.

## PREFACE

I am so delighted to have the chance to work on my interest in this study. Dr. Rob Sutherland, gave me any support that I needed to make this happen and helped me to thrive independently and manage to finish this project. The idea of this project came to my mind as a very immature research plan and Dr. Sutherland gave me the opportunity to learn and work around this and gave me freedom to get special advice from experts in the research area outside of the university. We had some adversity in pursuit of this aim and unfortunately, the critical part of my data collection overlapped the COVID-19 pandemic and closure of the university, however, in spite of changing the basics of the experiment, the results of this experiment are very promising.

This experiment was approved by the Human Participant Research Committee, University of Lethbridge office of ethics on February 25 with the protocol number of 2020-021 (the document is appended).

## ACKNOWLEDGEMENT

Special thanks to Dr. Bahador Bahrami for his generous assistance in every part of this study. The idea of this study was sparkled in conversations with him and literature review with his help. His role in guiding me in this study became bolder during the COVID-19 pandemic, which lead to the complete change of the study design.

Special thanks to Dr. Megan Peters for her input in mathematical approaches of model fitting and changes of the experiment design. Thanks to Surjeet Sing and HaoRan Chang for their contribution to data analysis and programming. Thanks to Dr. Michael Kyweriga for taking time and helping with choosing the stimulus sets.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATIONS

| | |
|---|---|
| MTurk | Mechanical Turk |
| CM | Change of Mind |
| FB | Feedback |
| RT | Response Time |
| GLM | Generalized Linear Model |

# CHAPTER 1: INTRODUCTION

> 'The FAKE NEWS media (failing @nytimes, @NBCNews, @ABC, @CBS, @CNN) is the enemy of the American People!'
>
> – Donald J. Trump, Twitter

## Literature review

The widespread prevalence and persistence of misinformation in contemporary society is a matter of public concern. Contemporary media provide people convenient access to more information than before. Such diffusion of information to the public, accompanied by ease of access, affords anybody the ability to sway opinions. Exposure to increasingly open communication also may affect the quality of information and ultimately cause misinformation and a false belief; e.g., such as belief that there is a link between childhood vaccinations and autism.

Misinformation is defined as false information that is communicated without deliberate malice. Disinformation is false information that is communicated with the intent to deceive (O'Connor & Murphy, 2020). The motivation behind creating these messages related to false beliefs is unclear, but it might relate to attention seeking behaviour and conspiracist ideation (Wang, McKee, Torbica, & Stuckler, 2019; White, Engen, Sørensen, Overgaard, & Shergill, 2014; Weigmann, 2018).

A very good example of the effects of misinformation on human lives and societies is fake news spread about Corona virus and COVID-19 during the pandemic of 2020. On Saturday 14 March, while the COVID-19 pandemic spread widely in Europe, the French Minister of Health, Oliver Véran tweeted:

> "*The intake of anti-inflammatory drugs (ibuprofen, cortisone,...) could be a factor in worsening the infection. If you have a fever, take acetaminophen. If you are already taking anti-inflammatory drugs or if in doubt, ask your doctor for advice."*
> *(https://twitter.com/olivierveran/status/1238776545398923264).*

After a few hours, the tweet got the attention of more and more 'followers.' Three days later, re-tweets were over 40,000. In response, the University Hospital of Vaud in Lausanne, among others, considered the news as authentic and correct and so claimed:

> "*For the current state of knowledge, the use of anti-inflammatory drugs (Ibuprofen, ketoprofen, naproxen, diclofenac, etc.) is not recommended in case of influenza-like illness possibly caused by COVID-19. Paracetamol is recommended for fever requiring treatment.*"

In the transmission of the news, one of the accused classes of drugs was exonerated (e.g., any reference to cortisone disappeared). At the same time, preference given to paracetamol became quite a strong recommendation (Centre hospitalier universitaire vaudois. Informations sur le coronavirus COVID-19. https://www.chuv.ch/fr/chuv-home/en-bref/informations-sur-le-coronavirus-covid-19/). The British Medical Journal also felt compelled to repeat the news, reporting some expert opinions on this matter (Day, 2020).

The Medical University of Udine claimed that there was no record or no document of scientific publications supporting the news ("Infodemic and the spread of fake news in the COVID-19-era," n.d.). At the time of their study, they found some related articles dealt with antiviral drugs with anti-inflammatory properties (Stebbing et al., 2020) or showed increased survival in patients with COVID-19-related acute respiratory distress syndrome treated with methylprednisolone (Wu et al., 2020). It is now clear that this information, and similar news related to it, is mostly based on individual opinion with no validity, mostly based on their medical knowledge and experience.

Erroneous beliefs are difficult to correct, especially if a large percentage of the public believes in something that is factually incorrect. The misinformation may form the basis for political and societal decisions that run counter to society's best interests. If individuals are misinformed, they may likewise make decisions for themselves and their families that are not in their best interest and that can have serious adverse consequences. Little is known about the cognitive factors of generating misinformation nor the rectification of misleading influence.

Experimental psychologists claim that people apply five key criteria as they evaluate the accuracy of information, the most important one being social consensus: Do others believe in that (Schwarz, Newman, & Leach, 2016)? Leon Festinger theorized that people often turn to social consensus as a reference for what is likely to be correct in facing unclear or conflicting statements (Festinger, 1954). In 1970s, the terms "risky shift" and "group polarization" were introduced to label the effect. This field of study turned into the most studied phenomenon before echo chambers became fashionable through social media.

Risky shift occurs when a group collectively agrees on a course of action that is more extreme than they would have made if asked individually. In group conditions, people with relatively moderate viewpoints tend to assume that their groupmates hold more extreme views, and to alter their own views in compensation, a phenomenon known as groupthink (Kuklick & Janis, 1973). This can occur simultaneously and in isolation: *all* group members might adjust their views to a more conservative or liberal position, thus leading to a "consensus" that is totally false. Risky shift is one side of a more general phenomenon called group polarization (Myers &Bishop, 1970). Depending on the initial tendencies of group members, a group discussion may lead to a riskier decision or a more conservative decision. Decisions taken by a group after discussion display more experimentation, are less conservative, and are riskier than those made by individuals

acting alone prior to any discussion (Lamm, Germany, Myers, & College, 1978).

As an example, suppose a group of friends give a slightly higher chance to Donald Trump over Joe Biden of winning the 2020 election. Having a "*Trump vs Biden*" debate in the group will probably make them more certain about Trump. A more recent study used anonymous computer mediated communication to study group polarization. The result showed that in this type of communication, group polarization will be increased, although in this context, there are different factors that affect the level of it (Sia, Tan, & Wei, 2002).

In general, people are more confident in their beliefs and their memories if they are held in common with others (Harris & Hahn, 2009; Ross, Buehler, & Karr, 1998; Visser & Mirabile, 2004). This reliance is so powerful that we often re-evaluate our own perceptions, preferences, and memories when they contradict a larger consensus (Hirst & Echterhoff, 2012; Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012; Meade & Roediger, 2002) There are several perspectives on why social context affects individual judgments of perception and decision making specifically on the act of fact-checking. For example, because people are more frequently exposed to widely shared information, the familiarity of it is often a valid indicator of social consensus since repeated exposure to a statement known to increase its acceptance as a truth (Begg, Anas, & Farinacci, 1992; Hasher, Goldstein, & Toppino, 1977). Group decision-making studies inform other theories on why collective settings suppress fact-checking. One study found that individuals tend to make less effort in the presence of other members, especially if their own input is minor and unidentifiable to the group, allowing them to "hide in the crowd" (Latané, Williams, & Harkins, 1979). Such behaviour resembles that described in research on diffusion of responsibility and the bystander effect, wherein people fail to intervene when surrounded by others or simply imagining they are in a group (Garcia, Weaver, Moskowitz, & Darley, 2002).

Another possibility is conversational norms and social conformity. People often choose by default to take others' perspectives in accordance with social conventions. This tendency may be intensified in the perceived presence of others. To the degree that the act of fact- checking signals skepticism, individuals may not express doubt about a speaker's trustworthiness in a social context (Grice, 1975; Schwarz, 2007). Finally, it is claimed that being in a crowd decreases vigilance, consistent with a "safety in numbers" observed in animal and human behavior (Clark, Russell D, 1974; Roberts, 1996).

According to social impact theory (Karau & Williams, 1995), individuals tend to feel less pressured in a social setting because they perceive the impact of an unknown outcome to be proportionally diffused as it gets divided among others group members. In other words, it is easier to make risky decisions in social context in comparison with individual decision-making. In a recent study, people were shown to be less likely to fact-check statements when they feel that they are evaluating them in the presence of others, compared with when they are evaluating them alone. Previous studies show that social settings and social context cause change of mind in the individual belief and sometimes mistaken belief in memory tests by shifting confidence and level of uncertainty (Edelson, Dudai, Dolan, & Sharot, 2014.

**Theory:**

Being in a social context influences an individual's judgment, reasoning, and decision-making compared to taking decisions individually and without knowing about others' opinion. This means that people change their mind when they are in a social context that informs them about others' decision (Jun, Meng, & Venkataramani, 2017).

**Hypothesis:**

Hypothesis 1: People will change their opinion in response to social feedback. In other words, they will make another decision if they compare their individual decision to the group trend.

Hypothesis 2: The change of mind will be consistent with the direction of social feedback. If the social feedback approves of their decision, they either do not change their mind or their opinion will be stronger. But if the social feedback is opposed to their opinion, they will change their opinion or will have less tendency in the direction of their previous opinion.

Hypothesis 3: Change of mind will be proportional to the set size (odds) in social feedback.

## CHAPTER 2: METHODS AND MATERIALS

### Participants

One hundred and twelve people with the age range of 18 to 70 (mean = 34.36, female = 56, male = 52) were recruited via Amazon Mechanical Turk. The data of four participants were excluded from the study, because their average Response Time were significantly higher than the average of the population (exclusion criteria: mean > STD). Fifty-three participants took part in the experiment with Stimulus Set 1 and 53 people took part in the test with Stimuli Set 2. All of the participants were recruited from Canada. This experiment was only conducted with Canadian population in order to decrease the potential cultural confounds.

### Stimuli

Participants were asked to evaluate a series of 32 statements. These statements are either general facts or news headlines in 1-2 sentences. The statements were gathered from fact-check websites including, Statistics Canada (statcan.gc.ca), Factcheck.org, Snopes.com, Fullfact.org, and Eufactcheck.eu.

There were also two card games: 1) fake news game (Purple Donkey Fake News Game - Political Version by Paladon) and 2) fake news/real news card game (by Licensed 2 Play), and some of them are borrowed from a previous study (Jun, Meng, & Venkataramani, 2017).

All statements were pre-tested in an initial online survey that I conducted on 150 subjects on each set. The population of the pre-test was 300. The pre-test asked the participants to decide on the veracity of the statements on a two-option question; true or false. The aim of this pre-test was:

1) To have the average performance on each stimulus.

2) To create sets of stimuli which could include normal distribution of statements with

different average of performance.

The data of this pre-test is appended alongside of the sets of the stimuli. In the study, 2 sets of 32 statements were used separately. Set 1 for an experiment recruiting 55 participants and set 2 for the other experiment recruiting 52 different participants.

**Test design**

The test was designed using the Testable online platform (www.testable.org). The testable platform allows one to design a psychophysical test and generates the link to publish and recruit participants across other platforms. All of the participants in this study were recruited from MTurk Canadian population. Prior to the test, participants signed a consent form for participating in this study and filled out a demographic questionnaire. This demographic information includes age, job, habits of using social media and tracking the news (fig 1). This information is meant to be used for further investigation.

After completing the questionnaire, participants read instructions for how to take the test. Before the main test, the participants went through eight practice trials (fig 2).

Participants were randomly presented the news statements. They were asked to indicate how probable the statement they are shown is true. They were supposed to read the statement and report their answer by moving the pointer on a slider bar by mouse. The slider bar was scaled from 0 to 100 (0 means the statement is definitely NOT true, 100 means the statement is TOTALLY true).


**Figure 1 –** Testable virtual space, demographic data collection

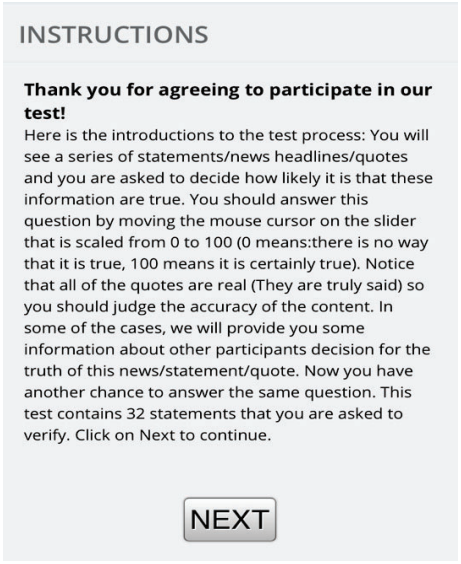
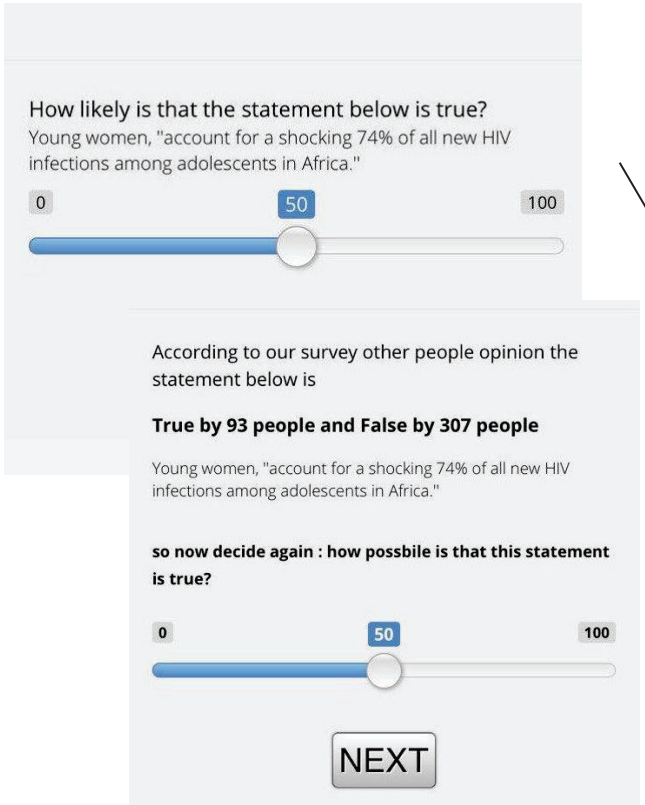



**Figure 2 –** Testable virtual space: instructions

A


B




C

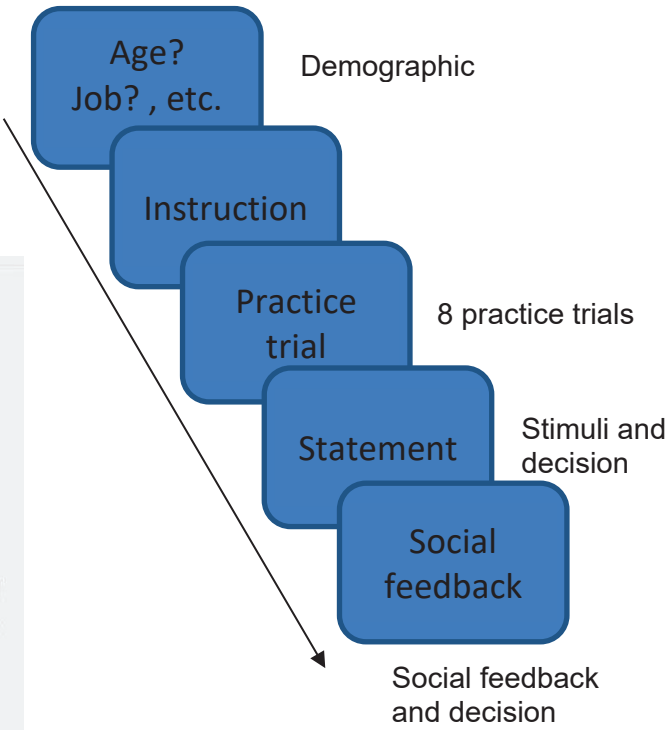



**Figure 3** – One trial of the test presenting social feedback. A) Trial without social feedback B) trial with social feedback C) sequence of the test.

**Procedure**

For half of the trials, participants received information on how many other participants have chosen each of the choices and they were asked to once again, indicate how likely is it that the statement is true. These trials were randomly chosen. The social information that was given to the participants as a feedback was contrafactual. It was said to the participants that according to the experiment's survey, *n* number of the participants thought that statement is true and *m* people think that the statement is false. These numbers were defined by a function to randomly choose a number from 1 to 100 and then b = 100 -a as a percentage of the total population, therefore n = total population* a and m = total population* b. To study the effect of the size of the population, 4 numbers for it: 50, 100, 200, 400 (Amir, Amir, Shahar, Hart, & Gal, 2018).

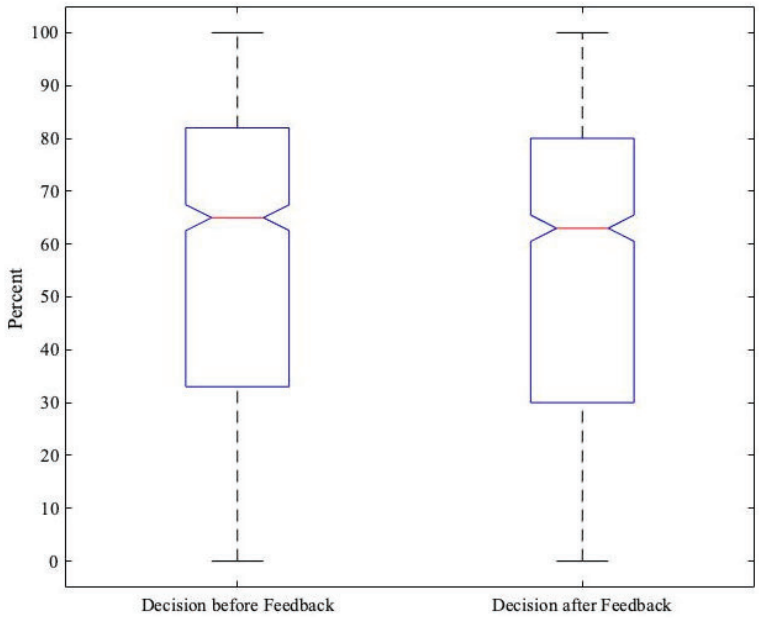
Participants were asked to read the social feedback and the statement and were asked to indicate how likely is that the statement is true. They gave their answer with a slider bar exactly as previously instructed (fig 3).

All data were saved by the website in a CSV file for each participant. The data analysis was done using MATLAB R2019a. General Linear Model was used to test the covariant coefficient regression and correlation.

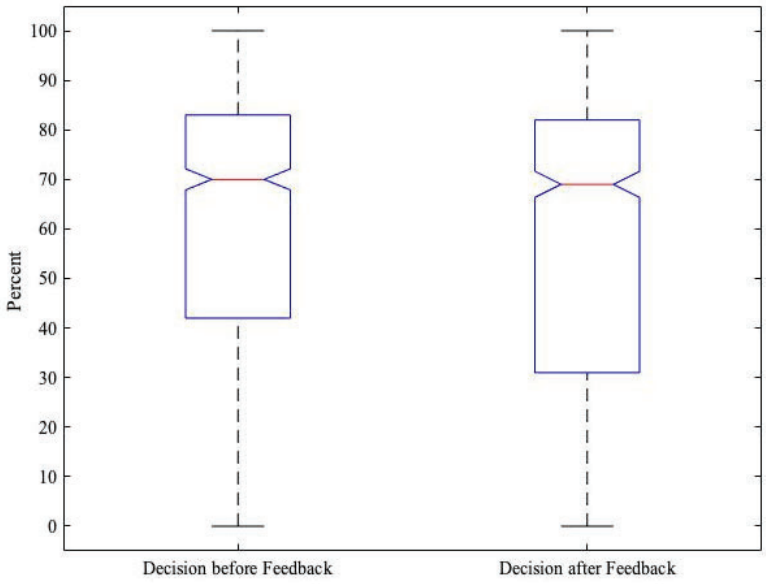
## CHAPTER 3: RESULTS

Of the 112 participants, four participants' data were excluded for their outlier responses, meaning that their reaction times were significantly higher than the average. The remaining 108 normal people had the age range of 18 to 70 (mean = 34.36, female = 56, male = 52). All the participants were recruited via Amazon Mechanical Turk. Fifty-three participants participated in experiment with stimuli set 1 and 53 people took part in the test with stimuli set 2. All of the participants were recruited from population of Canada.

The separate analysis on pooled data of experiment with statement set 1 (hereafter referred to as set 1) and experiment with Statement Set 2 (hereafter referred to as Set 2) shows that people change their mind after being exposed to the feedback, however, this change shows no significant difference in comparing the average of the responses in this second condition (fig 4, table 1). The trial by trial analysis in individual participants would be more helpful to show the significant difference in the participants' responses confirming that people react to being exposed to social feedback by changing their decision. Our analysis here is based on the average of the decision in each condition, whereas the change of mind is dependent on many other factors which vary in each trial.




A




B

**Figure 4 –** Comparison of the average of change of mind (CM) in pooled data of A: set 1 and B: set 2.

**Table 1.** Kruskal-Wallis ANOVA Table of result for the average of the decision before getting social feedback and after that in A) Set 1 and B) Set 2.

A

| source | SS | df | MS | Chi-sq | P-value |
|---|---|---|---|---|---|
| Columns | 309338.2 | 1 | 309338.2 | 0.95 | 0.3287 |
| Error | 639433335.8 | 1972 | 324256.3 | | |
| Total | 639742674 | 1973 | | | |

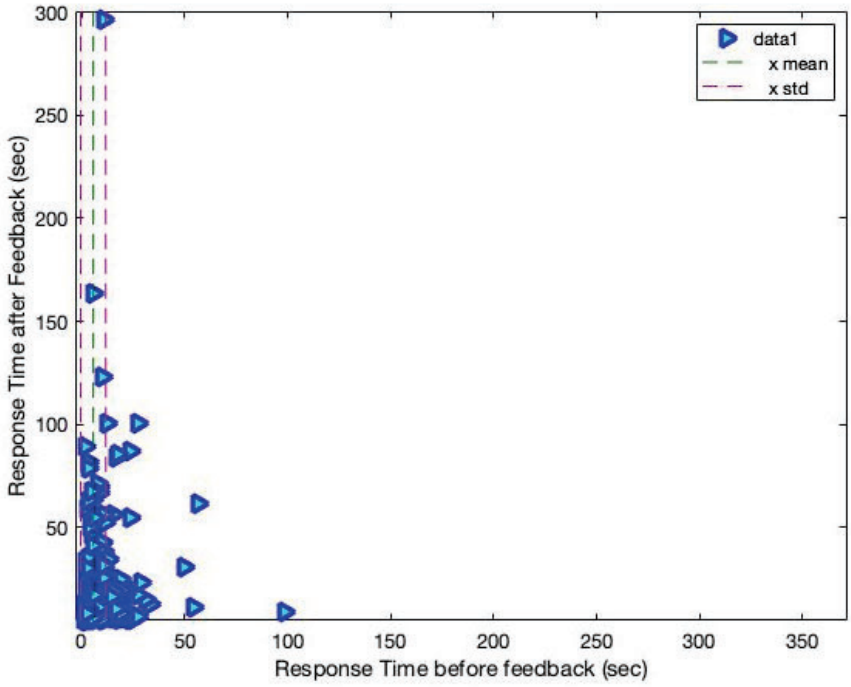
B

| source | SS | df | MS | Chi-sq | P-value |
|---|---|---|---|---|---|
| Columns | 1.87159e+07 | 1 | 18715863.9 | 67.47 | 2.14038e-16 |
| Error | 4.86984e+08 | 1822 | 267280 | | |
| Total | 5.057e+08 | 1823 | | | |

Another measurement for this experiment was the Response Time (RT) in both conditions, before getting the feedback and after getting the feedback. This analysis is to check the overall performances of the participants and monitor their consistent attention to the test. The RT is different in these two conditions. There are many factors that were not possible to control, mainly the nature of the trial information. For example, the question we ask from the participant in the first part of the trial without giving them the social feedback is only the statement and presentation of the slider bar, in the second part of the task, the same statement is presented which may take less time for the participant to read and comprehend the content, however, the new information that

conveys the social feedback is also presented at the same time. In this situation, there was no way to calculate the pure reaction time. We preferred to present the statement at the second phase of the task, in order to rule out the effect of the memory. Figure 5 shows the scatter plots of the reaction time.

Set 1




Set 2

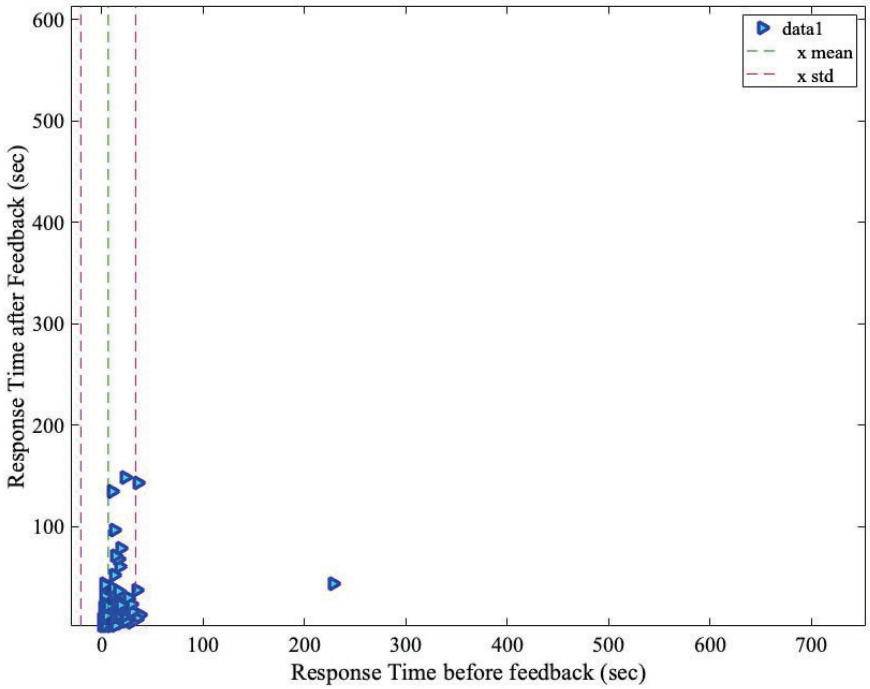
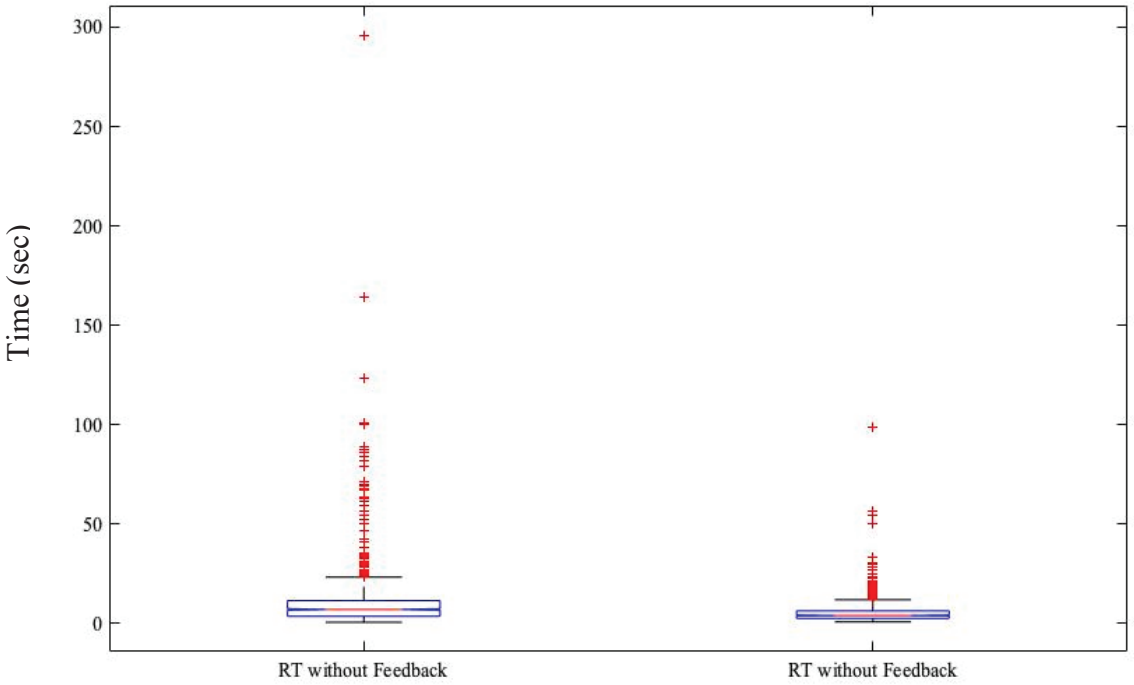
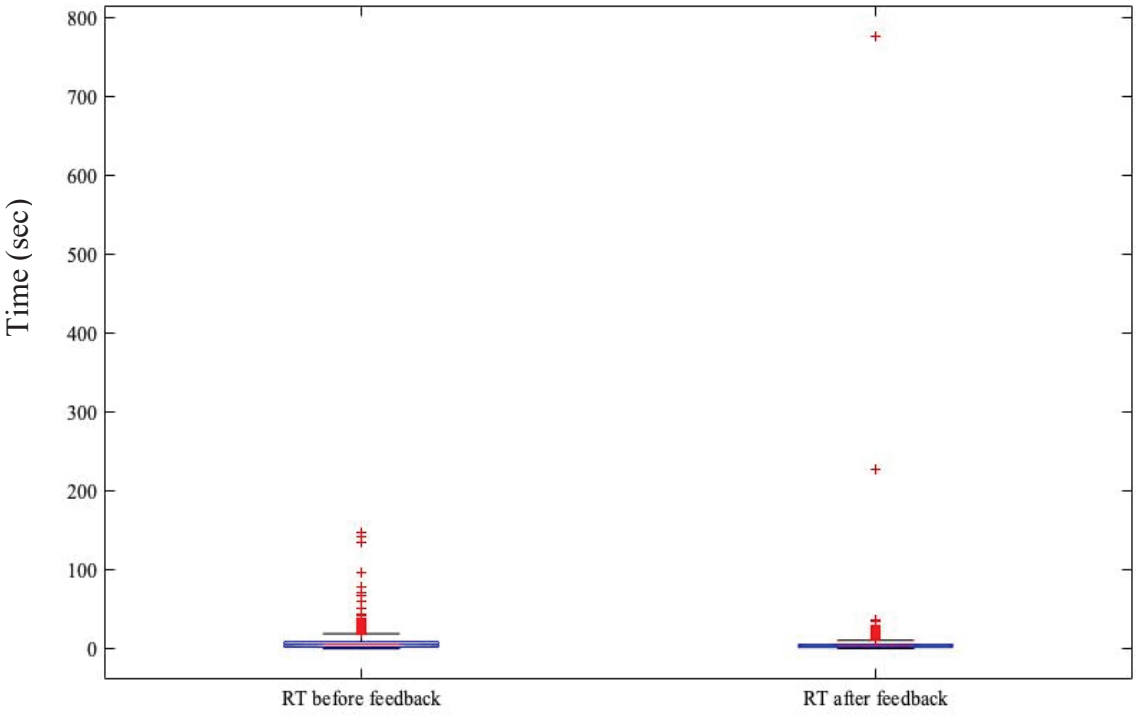



**Figure 5 A –** scatter plot of Response Time in in phase of with social feedback and phase of without social feedback set 1 and 2.




Set 1




Set 2

**Figure 5 B** – box plot of Response Time in trials with no social feedback and those with social feedback in set 1 and 2.

**Table 2.** Kruskal-Wallis ANOVA test result of RT in A) set 1 and B) set 2.

A

| source | SS | df | MS | Chi-sq | P-value |
|---|---|---|---|---|---|
| Columns | 4.7034e+07 | 1 | 48034010.7 | 144.77 | 2.41105e-33 |
| Error | 5.93969e+08 | 1972 | 301201.3 | | |
| Total | 6.41003e+08 | 1973 | | | |

B

| source | SS | df | MS | Chi-sq | P-value |
|---|---|---|---|---|---|
| Columns | 1.87159e+07 | 1 | 18715863.9 | 67.47 | 2.14038e-16 |
| Error | 4.86984e+08 | 1822 | 267280 | | |
| Total | 5.057e+08 | 1823 | | | |

In order to see if the change of mind is proportional to the social feedback (FB), it was necessary to define the proportion of the feedback towards a constant direction. Therefore, we considered the odds of the choosing the option “true” of the social feedback counterfactual population. To clarify the meaning of odds, here is a brief explanation.

The odds are defined as the probability that the event will occur divided by the probability that the event will not occur. If the probability of an event occurring is Y, then the probability of the event not occurring is 1-Y. For example, if the probability of an event is 0.80 (80%), then the probability that the event will not occur is 1-0.80 = 0.20, or 20%. The odds of an event represent

the ratio of the (probability that the event will occur) / (probability that the event will not occur). This could be expressed as follows:

Odds of event = Y / (1-Y)

So, in this example, if the probability of the event occurring = 0.80, then the odds are: 0.80 / (1-0.80) = 0.80/0.20 = 4 (i.e., 4 to 1).

If a racehorse runs 100 races and wins 25 times and loses the other 75 times, the probability of winning is 25/100 = 0.25 or 25%, but the odds of the horse winning are 25/75 = 0.333 or 1 win to 3 loses.

In this experiment, if in a specific trial, we reported to our subject that for the news headline, *n* people believe that it was true and *m* people think that it is false, the odds for choosing the true in that population = n/m.

If the odds are bigger that 1, it means n >m so that the given feedback is more pushing towards the item true, meaning that the participants probably will move their mouse to choose a number in the right side of the slider bar further compared to their first answer which was before getting the social feedback. If the odds are smaller than 1, it means that n<m so the feedback is more pushing towards the item false, meaning that the participants probably will move the cursor to choose a number in the left side of the slider bar further than their first round of making their decision before exposure to the social feedback. Here, because of the large distance between numbers smaller than 1 and numbers larger than one, we used log(odds) in our analysis as a way of normalization.

$$\log(\mu) = Xb$$
*or*
$$\text{odds} = \log(nT/nF)$$

In this case we will have:

if odds >0 → feedback pushes individual towards true side of the slider bar

if odds <0 → feedback pushes individual towards false side of the slider bar

To calculate the Change of mind, we used this formula:

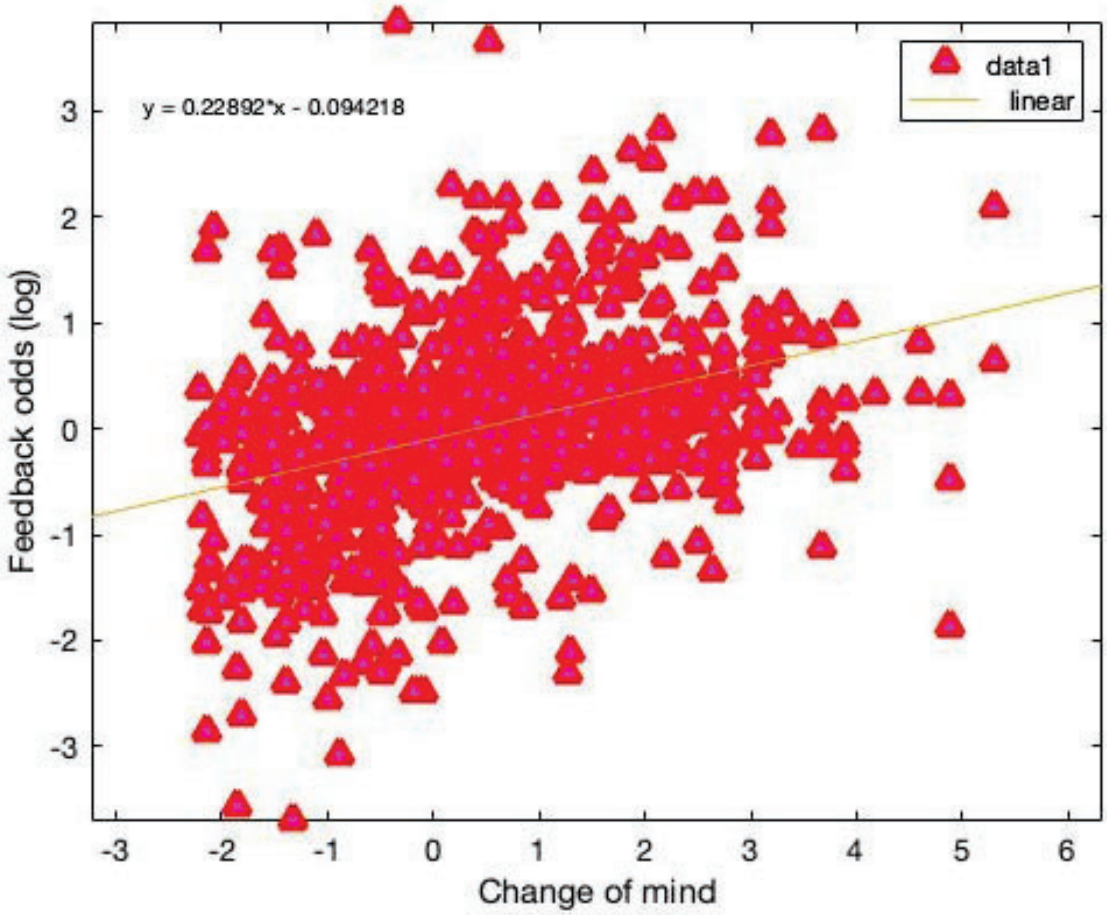
Change of mind (t) = choice after the feedback – choice before feedback

To normalize change of mind, we calculated the standard score ( Z score) which is :

change of mind = change of mind (observed) – change of mind (average)/STD

The regression analysis of magnitude change of mind and the odds showed a positive correlation between these two variables. In the figure 6, the pooled data of set 1 and set 2 is illustrated. The details are shown in table 2 and table 3.

**A**


data1
linear
y = 0.22892*x - 0.094218
Feedback odds (log)
Change of mind
3
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3
4
5
6

**B**

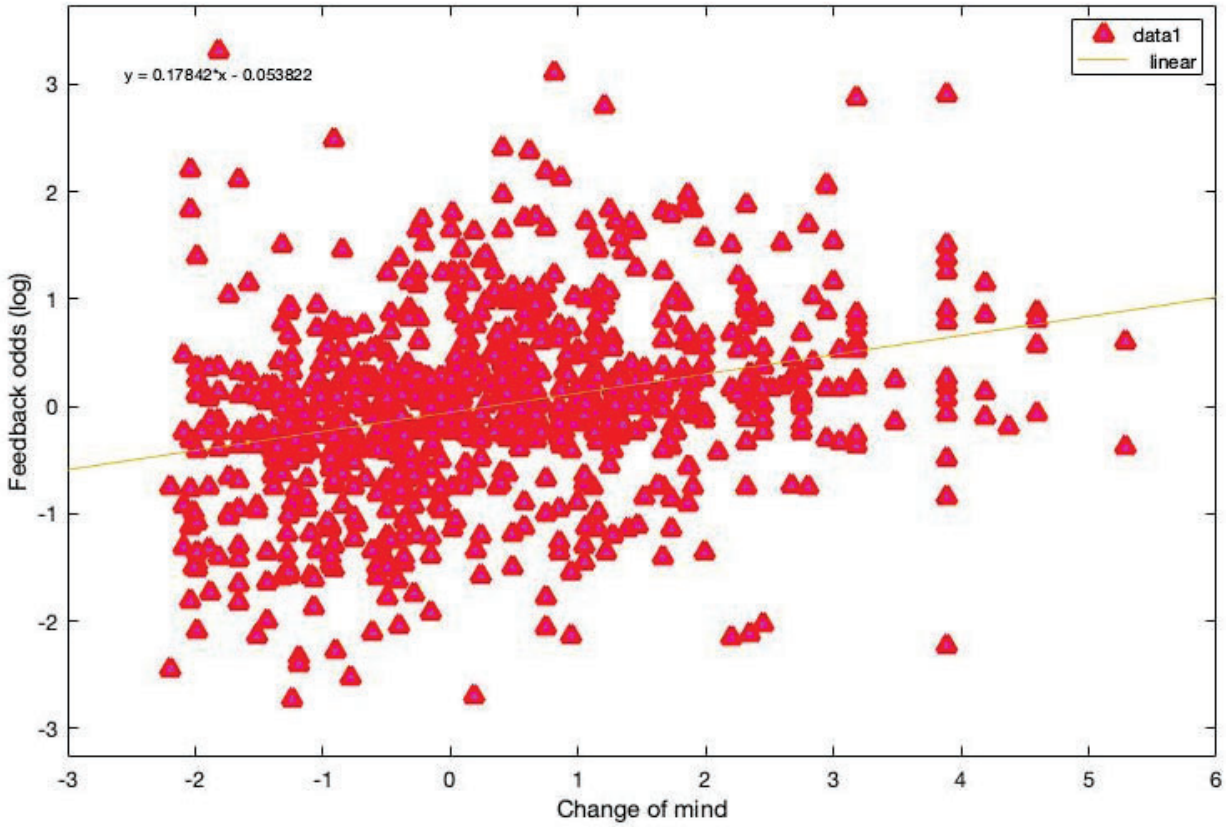



**Figure 6 –** Scatter plot of odds vs change of mind. A) set 1 and B) set 2

For showing the correlation between these variables we performed a Generalized Linear Model analysis. We fitted the model defaulted a Poisson distribution to see re result of regression between odds, RT without FB, RT with FB and change of mind.

**Table 3.** GLM fit stats

| | beta | dfe | sfit | s | estdisp | t | p |
|---|---|---|---|---|---|---|---|
| Set 2 | -0.0538 | 838 | 0.852 | 0.8525 | 1 | -1.7781 | 0.0758 |
| | 0.1784 | | | | | 8.7043 | 1.678802631339083e |
| Set 1 | -0.0942 | 858 | 0.834 | 0.8347 | 1 | -3.1707 | 0.001574467635471 |
| | 0.2289 | | | | | 11.7930 | 7.439182079403580e-30 |

beta: Coefficient estimates b

dfe: Degrees of freedom for error

sfit: Estimated dispersion parameter

s: Theoretical or estimated dispersion parameter

estdisp: 0 when the 'estdisp' name-value pair argument value is 'off' and 1 when the 'estdisp' name-value pair argument value is 'on.'

Here is the estimated covariance matrix of b (covb),vectors of standard errors of the coefficient estimates b (se), and correlation matrix for b (coeffcorr) mentioned.

**Table 4.** The estimated covariance matrix of b (covb)

| Set 1 | |
|---|---|
| 0.00088296 | -0.0001657 |
| -0.0001657 | 0.0003768 |

| Set 2 | |
|---|---|
| 9.162464175687437e-04 | 47346316e-04 |
| -1.464216847346316e-04 | 4.201483669196695e-04 |

**Table 5.** The vectors of standard errors of the coefficient estimates b (se)

| Set 1 | Set 2 |
|---|---|
| 0.020497520994 | 0.030269562559 |
| 4927 | 9172 |

**Table 6.** The correlation matrix for b (coeffcorr)

| Set 1 | | Set 2 | |
|---|---|---|---|
| 1 | -0.287324 | 1 | -0.2359 |
| -0.287324 | 1 | -0.2359 | 1 |

Our result shows that the magnitude of the change of mind is consistent with the direction of the feedback and the proportion of the feedback as we have fitted a linear model here, and the

statistics show the success of the model fitting in both Set 1 and Set 2. Figure 6 and GLM analysis can support our three hypotheses: 1) People change their mind in exposure to social feedback. 2) The direction of the change of mind is consistent with the direction of the odds. 3) Change of mind is proportional to the odds. In the figure and the statistics of the linear model fitting shows that there is positive correlation between the magnitude of the odds and the magnitude of the change of mind. The line fitted to the data has a positive slope showing that the negative odds cause a negative change of mind meaning that in the cases that the social feedback is in favor of “false”, people also change their mind in order to move the cursor to the left side of the slider bar and vice versa.

# CHAPTER 4: DISCUSSION

In this study, I tested three hypotheses: 1) individuals tend to change their mind about the veracity of a piece of information after becoming aware of other people's opinion; 2) The direction of the change of mind is consistent with the direction of the given social feedback; and, 3) the magnitude of the change of mind is proportional to the odds of the given social feedback. These hypotheses are based upon the notion that deviation in opinions from the majority view can create an aversive state that can be reduced by adopting an opinion closer to the common view. My results showed that the change of mind is consistent with both direction and strength of the social feedback. My data also suggest that in special conditions of the social feedback or the individual's initial extremity of response, the trend of the change of mind is different.

The widespread dissemination of 'fake news' or false information that mimics news media has become a major threat to societies worldwide (Lazer et al., 2018; Lewandowsky et al., 2017; van der Linden et al., 2017). The phenomenon itself is not entirely new, false or misleading information has always played a role in human societies throughout the ages (Taylor, 2003).

Misinformation is a phenomenon that most people became familiar with it by the famous controversial study of vaccination and its side effects. In 1998, Lancet journal published an article presenting data showing that autism occurred after MMR vaccination in a consecutive series of 12 pediatric patients linked to gastrointestinal tract biomarkers. This article caused a significant decrease of vaccination compliance, first in United Kingdom and then in other countries in the world. This sharp drop of compliance in vaccination caused large outbreaks of the diseases in different societies. The article was retracted a few years after its publication because of data misrepresentation and ethics violations. However, the misperception persists and the fight against

this false information is still going on. The widespread dissemination of "fake news" – false information that mimics news media has become a major threat to societies worldwide. The phenomenon itself is not entirely new.

Yet, the internet and social media are proving to be particularly fertile soil for fake news. For example, a recent paper by Vosoughi et al. (2018) indicates that stories declared "false" by numerous fact-checking organizations spread farther, faster, and deeper than any other type of news content. Crucially, they argue that such stories proliferate, not primarily because of bot activity, but rather because humans bear a large share of the responsibility for the spread of fake news and misinformation. Being one of the critical concerns of contemporary societies, counteracting the misinformation is a challenge. There is a loud call for educational interventions to help citizens navigate credible, biased, and false information. According to the World Economic Forum (2018), online misinformation is a pervasive global threat. UNESCO underscored how all citizens need better up-to-date knowledge, skills, and attitudes to critically assess online information (Carlsson, 2019).

Common approaches to tackling the problem of online misinformation include developing and improving detection algorithms (Monti et al., 2019), introducing or amending legislation (Human Rights Watch, 2018), developing and improving fact-checking mechanisms (Nyhan & Reifler, 2012), and focusing on media literacy education (Livingstone, 2018). However, such interventions present limitations. In particular, it has been shown that debunking and fact-checking can lack effectiveness because of the continued influence of misinformation: once people are exposed to a falsehood, it is difficult to correct (De keersmaecker & Roets, 2017; Lewandowsky et al., 2012). Overall, there is a lack of evidence-based educational materials to support citizens' attitudes and abilities to resist misinformation (European Union, 2018; Wardle

& Derakshan, 2017). Importantly, most research-based educational interventions do not reach beyond the classroom (Lee, 2018).

Recent research has explored the possibility of building attitudinal resistance against online misinformation through psychological inoculation. The inoculation metaphor relies on a medical analogy: by pre-emptively exposing people to weakened doses of misinformation cognitive immunity can be conferred. A recent example is the *Bad News* game, an online fake news game in which players learn about six common misinformation techniques.

Based on the literature of collective decision-making, people are less willing to do fact checking in the social context. The feedback of believe from the society, in some ways, arises the conformity and proceeding consensus. Believing in false news is not separate from this. Taking this into account, making people resistant to misinformation, requires more knowledge of the relevant underlying cognitive process.

Collective decision making has an enormous literature, trying to explain how being in a social context results in changing your decision. The majority of the social neuroscience literature is based on perceptual tasks. Here we tried to define the judgment on the veracity of a piece of information as a decision-making task and study the social context on this basis. Our design provides the social context in a framework similar to the social media. In the social media, there is no face-to-face communication, and it is mostly the social "presence" that is implied by the reactions such as "like" or "comment" in the Twitter, Facebook, etc.

My results are consistent with the previous studies in collective decision making, showing that verifying the news/ information on the internet or the social media can be generalized to the theories of collective decision-making, even though there is no certainty about the original veracity of the information. The odds and direction of the feedback has positive correlation with

the individuals' change of mind. This result can be implemented in further studies investigating the uncertainty and the change of confidence in the same context. Knowing the details of how social information will change the people's decision, can help to modify the social media, and help to beat the misinformation.

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## APPENDIX 1: SETS OF STIMULI AND PRE-TEST RESULTS

The percentage reported for the T or the F in each stimulus, is the percentage of the people who chose the option true and the percentage of the people who chose option false in our pre-test experiment. This pretest was done on total population of 300 people recruited via MTurk Canadian population.

### Practice Set

| Veracity | Content |
|---|---|
| T | US President Trump tweets "Despite the constant negative press coverage, which confused everyone as it went viral. |
| T | US President Donald Trump claimed that any negative poll results are fabricated "just like the CNN, ABC, NBC polls in election" |
| T | An Iraqi journalist threw his shoes at US President George W. Bush, but missed. |
| F | US President Donald Trump offered free one-way flights to Mexico and Africa to those who oppose his presidency. |
| F | A cookie resembling US President Donald Trump sold for $5,000 on eBay to an anonymous supporter |
| F | A UK Tory Member of Parliament writes erotic vampire fiction under fake name. |
| T | It is illegal to import chewing gum into Singapore. |
| F | US Senator John MacInnes, was criticized for claiming "all women are disgusting demons". |

### Set 1

| Veracity | Content | T% /F% |
|---|---|---|
| F | If you swipe a chipped card ,debit or credit, at a point-of-sale terminal instead of inserting it into the reader, you become liable for any fraudulent transactions. | 22/78 |
| F | A diet rich in vitamin D can reverse tooth decay and regrow portions of teeth lost to cavities. | 30/70 |
| F | A man sued the state of Alabama for the right to own slaves, as permitted in a document from 1865. | 68.8/31.2 |

| | | |
|---|---|---|
| F | Less than 24 hours after cannabis became legal in Canada, the federal government announced they had made so much money in tax revenue from the sale of legal weed that they were able to pay off the country's entire $650 billion debt. | 90.6/9.4 |
| T | A Texas law requires government contractors to swear they won't boycott Israel. | 34.4/65.6 |
| T | Tear gas was used on average once a month during the Obama administration for very similar circumstances. | 25/75 |
| T | Donald J. Trump declared a $916 million loss on 1995 tax records. | 80/20 |
| T | Young women account for a shocking 74 percent of all new HIV infections among adolescents in Africa. | 70/30 |
| F | Nobel laureate Dr. Tasuku Honjo said that COVID-19 was "man-made" at a lab in Wuhan, China. | 51/49 |
| F | One in three American women will have had an abortion by the time she reaches the age of 45. | 47.5/52.5 |
| F | Today, it is more difficult to enlist in the U.S. military than it is to enroll in college. | 40/60 |
| F | Drug overdoses are the No. 1 form of accidental death in the U.S. | 56/44 |
| T | Some 22 million official White House emails, the majority of which were sent and received via private, non-government servers, were reported as lost or missing during the George W. Bush administration. | 55/45 |
| T | America has the lowest percentage of Americans working today of any year since 1977. | 50/50 |
| T | The Mall of America is owned by Canadians. | 49/51 |
| T | The number of Border Patrol agents is near an all-time high at more than 20,000. | 58/42 |
| T | Canada is the largest producer of uranium in the world. | 45/55 |
| T | In the 1990s, senator Bernie Sanders voted against the Brady Bill, which required background checks on gun purchases. | 44/56 |

| | | |
|---|---|---|
| T | 30 years ago, America was the leader in quantity and quality of highschool diplomas. | 58/42 |
| T | The United States is ranked 5th in the world in terms of number of college-degree holders amongst the age group of 25 to 64-year-olds. | 55/45 |
| T | People who get the death penalty, tend to live in places with overaggressive prosecutors and defense lawyers who aren't up to the task of defending against them. | 49/51 |
| T | The United States accepted fewer than 1,700 Syrian refugees in fiscal year 2015. | 48/52 |
| T | The U.S. is the only developed country in the world that doesn'tguarantee workers in private businesses any paid days off at all. | 55/45 |
| F | Scientists have officially declared the Great Barrier Reef - the world's largest coral reef system that lies off the coast of Queensland, Australia - to be dead. | 41/59 |
| F | More than 40 Virginia state troopers resigned as volunteer chaplains in 2008 because of a departmental rule requiring that prayers at public events be non-denominational. | 44/56 |
| F | First volunteer in UK coronavirus vaccine trial has died. | 31/69 |
| F | In 1986, the founder of the Times Square Church prophesied that he saw "a plague coming on the world and the bars and church and government will shut down" with New York City especially hard hit. | 59/41 |
| F | President Barack Obama has taken less vacation days than any other president in a generation. | 52.5/47.5 |
| F | The number of police officers killed in the line of duty has risen by almost 50 percent compared to this point last year. | 50/50 |
| F | The 2013 immigration bill expanded President Obama's ability to bring Syrian refugees to this country without mandating any meaningful background checks. | 46/54 |

| | | |
|---|---|---|
| F | A long-forgotten Christmas tradition, women once used to beg their husbands for forgiveness from all of their wrongdoings and mistakes that they made throughout the year. | 34.4/65.6 |
| T | Americans have invaded Canada twice, in 1775 and 1812. They lost both times. | 48/52 |

**Set 2**

| Veracity | Content | T % / F % |
|---|---|---|
| T | 97% of low-income students rely on school for internet access. | 70/30 |
| F | Melania Trump was the first First Lady to visit U.S. troops in a combat zone. | 13/87 |
| F | Pope Francis declared that gun owners "cannot call themselves Christian." | 25/75 |
| T | The United States has had more mass shootings than Australia, Canada, China, England, Finland, France, Germany, Mexico, Norway and Switzerland combined. | 93.0/7 |
| F | Under the current procedure, if someone on a terror watch list tries to buy a gun, authorities are notified, even if it's through a private dealer. | 55/45 |
| F | Emma Gonzalez, a Parkland shooting survivor, ripped up the Constitution for a photo shoot. | 46.9/53.1 |
| F | President Trump: Amazon is bankrupting the U.S. Postal Service. | 43.8/56.2 |
| F | A person was hospitalized after an Apple Airpod earbud exploded in their ear. | 59.4/40.6 |
| F | Ultraviolet Radiation is administered into the body as a disinfectant to kill bacteria and viruses and this has been used for a while now. | 37/63 |
| F | President Trump: Saudi Arabia has ordered $450 billion in goods and services from the United. | 56.3/43.7 |
| F | Barack Obama tried many times to meet with Kim Jung Un, but was rebuffed. | 40.6/59.4 |

| | | |
|---|---|---|
| F | Walmart is the largest private employer of African Americans in the country.42 percent of its associates are black. And it pays its employees below a living wage — even while the Walton family owns more wealth than the bottom 40 percent of Americans. | 65.6/34.4 |
| F | President Trump: "I want clean air. I want crystal clean water. And we've got it. We've got the cleanest country in the planet right now, there's nobody cleaner than us, and it's getting better and better." | 46.9/53.1 |
| F | Donald Trump: "In seven years that (nuclear) deal will have expired,and Iran is free to go ahead and create nuclear weapons." | 46.3/56.7 |
| F | Hillary Clinton sold 20 percent of America's uranium to Russia and then "the Russian government gave $145 million to the Clinton Foundation." Former FBI Director and special counsel Robert Mueller "delivered it." | 34.4/65.6 |
| T | Canada and Denmark have been fighting over an uninhabited island by leaving each other bottles of alcohol and changing their flags since the 1930s. | 59/41 |
| T | Young women, "account for a shocking 74% of all new HIVinfections among adolescents in Africa." | 65.6/34.4 |
| T | Donald Trump: "Senator Cryin' Chuck Schumer fought hard against the Bad Iran Deal, even going at it with President Obama, & then Voted AGAINST it! Now he says I should not have terminated the deal" | 59.4/40.6 |
| T | Only 12% of legal immigrants are selected based on skill or based on merit. In countries like Canada, Australia and New Zealand, and others, that number is closer to 60, and even 70 and 75% in some cases. | 62.5/37.5 |
| T | Under the North American Free Trade Agreement, U.S lost thousands of plants. | 43.8/56.3 |
| T | Ontario appeared unlikely to host a mandatory anti-racism conference in 2019, prompting fresh accusations that Premier Doug Ford’s government doesn't take the anti-racism file seriously. | 59.4/41.6 |
| T | A Russian Minister wanted to ban the Disney film Beauty and the Beast for promoting "perverted sexual relations". | 65.9/34.1 |

| | | |
|---|---|---|
| T | An American soldier held and tortured for five years by the Taliban was labelled as a "no good traitor" by US Republican presidential candidate Donald Trump. | 56.8/43.2 |
| T | US President George W. Bush gave German Chancellor Angela Merkel a surprise neck rub at the G8 Summit in St Petersburg. | 41.1/58.9 |
| T | US President Donald Trump praised Philippine President Duterte for encouraging mass murder of all drug dealers. | 63.2/36.2 |
| T | Voters in Underhill, Vermont, USA elected Kevin Tarrant for a three-year term despite the fact that he was dead. | 58.9/41.1 |
| F | Each week, 21 fathers die by suicide influenced directly by "child access issues" or child81 custody disputes. | 65.6/34.4 |
| T | The poverty rates for African Americans and Hispanic Americans: it's been incredible, they've all reached their lowest levels in the history of this country. | 37.5/62.5 |
| T | United States secretly moved a huge stockpileof Uranium yellowcake over a two-week period, from Iraq to Canada in 2003. | 34.4/65.6 |
| F | A United Nation translator was fired for altering text in a document. | 75.7/24.3 |
| T | In 1988, in response to Iran's attack on the U.S.S. Samuel Roberts, President Ronald Reagan, destroyed half of Iran's Navy. | 48/52 |
| F | First volunteer in UK coronavirus vaccine trial has died. | 31/69 |

## APPENDIX 2: DEMOGRAPHIC QUESTIONNAIRE

Please answer the following questions to the best of your ability. Where you are given several choices, please fill the circle of the option that best describes you.
Age:

Are you a: -Female -Male -Transsexual. -Others

What is your education level?
-High School -College Diploma -University Degree -Masters -Doctorate and higher

What is your job?

What is your nationality?

How do you follow national and international news and events?
-newspaper -TV -news websites -social media

What is your favorite social media?
-Facebook -Twitter -Instagram -others ……
How often do you use social media such as Facebook, Instagram, etc.?
-never -rarely -monthly -weekly -daily -few times within a day
- other : -------

# APPENDIX 3: HUMAN PARTICIPAT RESEARCH ETHICS COMMITTEE APPROVAL

University of Lethbridge

Office of Research Ethics
4401 University Drive
Lethbridge, Alberta, Canada
T1K 3M4
Phone: (403) 329-2747
Email: research.services@uleth.ca
FWA 00018802 IORG 0006429

Tuesday, 25 February 2020

| | |
|---|---|
| Student Investigator: | Elnaz Alikarami, Neuroscience Department |
| Faculty Supervisor: | Robert Sutherland, Neuroscience Department |
| Study Title: | How social context affects individual's decision-making process to believe in false information? |
| Status: | Approved |
| HPRC Protocol Number: | 2020-021 |
| Approval Date: | February 25, 2020 |
| Term Date: | May 31, 2020 |

Dear Elnaz,

Your human research ethics application titled "How social context affects individual's decision-making process to believe in false information?" has been reviewed and approved on behalf of the University of Lethbridge Human Participant Research Committee (HPRC) for the approval period **February 25, 2020 to May 31, 2020**, and assigned Protocol #2020-021. The HPRC conducts its reviews in accord with University policy and the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (2018).

Please be advised that any changes to the protocol or the informed consent must be submitted for review and approval by the HPRC before they are implemented. A final report will be required and is due to the Office of Research Ethics no later than June 30, 2020.

We wish you the best with your research.

Sincerely,

Susan Entz, M.Sc., Ethics Officer
Office of Research Ethics
University of Lethbridge
4401 University Drive
Lethbridge, Alberta, Canada
T1K 3M4

## APPENDIX 4: CONSENT FORM AND WITHDRAWAL FORM

**PARTICIPANT INFORMATION AND CONSENT FORM**
**FOR PERMISSION TO BE CONTACTED FOR FUTURE RESEARCH**

Protocol:
Principal Investigator: Dr. Robert Sutherland

You are being asked for permission to be contacted in the future for participation in research studies relating to this project. Please take your time to review this consent form and discuss any questions you may have before you make your decision.

If you agree to be contacted in the future for research purposes, information about you will be entered into an electronic database. The database will be maintained by Dr.
Robert Sutherland at the University of Lethbridge.

The Database will have the following information about you:
-Name (first and last)
-E-mail address
-Telephone number
-Data collected from the current study

Confidentiality of your information will be maintained and ensured in the following manner:
-Only two individuals will have access to the database with your identifying information; Dr. Robert Sutherland, and Elnaz Alikarami.
-Data will be stored on encrypted storage devices and will never be sent electronically
-Hard copies of the data will be stored in a locked filing cabinet in the Sutherland Lab and will be shredded according to the institutional guidelines for data storage and destruction.
-Information will not be shared with any other researchers or institutions.
-Confidentiality or non-disclosure agreements will be required for all the individuals involved with the project.

Information will be retained for 5 years [data are kept online through MTurk for 120 days before they are destroyed and they will be downloaded and kept for the remaining time off-line by the Principal Investigator], or if you choose to change your decision to allow us to store your information, any data will be de-identified and your identifying information will be removed from the database.

Your decision to allow your information to be in the database is completely voluntary. While there may be no benefit to you, your information will help researchers to quickly identify individuals who may be suitable for a particular research study. If you change your mind after agreeing to this, your information can be removed from the database.

You will not be penalized in any way if you refuse to participate, or if change your mind and ask that your information be removed.

If you have any questions about this database, please contact: Dr. Robert Sutherland (403) 394-3978 or

If you have questions about your rights as a research participant, you may contact The University of Lethbridge Office of Research Ethics at research.services@uleth.ca or (403) 329-2747.
Permission for Future Contact Approved Jan 2018 2

Statement of Consent
I have read this consent form. I have had the opportunity to ask questions and discuss what is involved. I understand that my personal information will be kept confidential and in accord with the provisions of the Alberta Freedom of Information and Protection of Privacy Act.
Participant signature_____Date

_____
Participant printed name: _____

I, the undersigned, have fully explained the relevant details of this research to the participant named above and believe that the participant has understood and has knowingly given their consent.
Printed Name:_____Date_____
Signature: _____
Role: _____
**This must be done by an authorized/qualified member of the research team i.e. investigator, research assistant, etc.*

**Participation Withdrawal Form**
MTurk worker ID -------
Please indicate if you want your data be kept by the researcher:
-yes
-No
Please indicate the reason for your withdrawal (optional)
- - - - - - - - - - - - - - - -
Signature
If you have any concerns you can contact the researcher by email via elnaz.alikarami@uleth.ca