COMENIUS UNIVERSITY IN BRATISLAVA
FACULTY OF MATHEMATICS, PHYSICS AND INFORMATICS

Role of analytical thinking in susceptibility and sharing fake news

MASTER'S THESIS

2022 **BC. Hansoo Bae**

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Study Programme: Cognitive Science

Field of Study: Computer Science

Department: FMFI.KAI - Department of Applied Informatics

Supervisor: doc. PaedDr. Vladimíra Čavojová, PhD.

2022 **Bc. Hansoo Bae**

Univerzita Komenského v Bratislave
Fakulta matematiky, fyziky a informatiky

ZADANIE ZÁVEREČNEJ PRÁCE

Meno a priezvisko študenta: Hansoo Bae
Študijný program: kognitívna veda (Jednoodborové štúdium, magisterský II. st., denná forma)
Študijný odbor: informatika
Typ záverečnej práce: diplomová
Jazyk záverečnej práce: anglický
Sekundárny jazyk: slovenský

Názov: Role of analytical thinking in susceptibility and sharing fake news
Úloha analytického myslenia pri susceptibilite na falošné správy a ich šírenie

Anotácia: Pri náchylnosti na falošné správy a ich zdieľaní často hrá úlohu motivované uvažovanie. Avšak pri testovaní dvoch vysvetlení - motivované uvažovanie vs. nedostatok analytického myslenia, Pennycook a kol. (2019) našli väčšiu podporu v prospech "lenivého myslenia." Okrem toho v neskoršej štúdii tiež ukázali, že na zníženie šírenia dezinformácií spočíva sľubná metóda debiasingu v jednoduchom zásahu do zvýšenia analytického myslenia, ktorý by mohol pôsobiť proti intuitívnej reakcii založenej na emóciách alebo príslušnosti k nejakej skupine (Pennycook et al., 2020).

Cieľ: 1. Replikujte zistenia práce Pennycook a spol. (2019) v inom kultúrnom kontexte a použitím iného materiálu.
2. Otestujte jednoduchú analytickú intervenciu (Pennycook et al., 2020).

Literatúra: Lutzke, L., Drummond, C., Slovic, P., & Árvai, J. (2019). Priming critical thinking: Simple interventions limit the influence of fake news about climate change on Facebook. Global environmental change, 58, 101964.
Pennycook, G., & Rand, D. G. (2019). Lazy, not biased: Susceptibility to partisan fake news is better explained by lack of reasoning than by motivated reasoning. Cognition, 188, 2017, 39–50.
Pennycook, G., McPhetres, J., Zhang, Y., & Rand, D. (2020). Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable accuracy nudge intervention. Psychological Science, 31(7), 770–780.

Vedúci: doc. PaedDr. Vladimíra Čavojová, PhD.
Katedra: FMFI.KAI - Katedra aplikovanej informatiky
Vedúci katedry: prof. Ing. Igor Farkaš, Dr.

Dátum zadania: 11.03.2020

Dátum schválenia: 20.03.2020

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THESIS ASSIGNMENT

Name and Surname:	Hansoo Bae
Study programme:	Cognitive Science (Single degree study, master II. deg., full time form)
Field of Study:	Computer Science
Type of Thesis:	Diploma Thesis
Language of Thesis:	English
Secondary language:	Slovak

Title: Role of analytical thinking in susceptibility and sharing fake news

Annotation: Motivated reasoning often plays role in susceptibility to fake news and its sharing. However, when testing two accounts – motivated reasoning vs. lack of analytical thinking, Pennycook et al. (2019) found more support for lazy thinking account. Moreover, in a later study they also showed that for reducing the spread of disinformation, a promising debiasing method lies in a simple intervention for increasing analytic thought that might counteract the intuitive response based on emotions or partisanship (Pennycook et al., 2020).

Aim: 1. Replicate the findings of Pennycook et al. (2019) in different cultural setting and using different materials.
2. Test a simple analytical intervention (Pennycook et al., 2020).

Literature:
Lutzke, L., Drummond, C., Slovic, P., & Árvai, J. (2019). Priming critical thinking: Simple interventions limit the influence of fake news about climate change on Facebook. Global environmental change, 58, 101964.
Pennycook, G., & Rand, D. G. (2019). Lazy, not biased: Susceptibility to partisan fake news is better explained by lack of reasoning than by motivated reasoning. Cognition, 188, 2017, 39–50.
Pennycook, G., McPhetres, J., Zhang, Y., & Rand, D. (2020). Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable accuracy nudge intervention. Psychological Science, 31(7), 770–780.

Supervisor:	doc. PaedDr. Vladimíra Čavojová, PhD.
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Student

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Acknowledgement

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Abstract in English

Why do some people easily believe political fake news even though it is sometimes obviously unlikely to be true? One theory for this phenomenon involves bias. If an individual sees a statement that supports their ideology or identity, this individual would likely accept the information as true. On the other hand, if an individual sees a statement against his ideology or identity, this individual would reject the statement by using reasoning and by convincing oneself the statement is not true. This is referred to as motivated reasoning. Another theory, referred to as classical reasoning, explains that if an individual who tend to think analytically sees a statement, this individual would use reasoning to judge whether the statement is likely true or not, regardless of whether it is aligned with their ideology. The one type of motivated reasoning theory expects that the more an individual tends to use reasoning, the more biased their ideology is. Classical reasoning theory expects that the more an individual tends to use reasoning, the more likely they can reject false information regardless of their ideology. Here we replicate the study from Pennycook and Rand (2019), with a sample from the Slovak population. We test two compelling theories by using the Cognitive Reflection Test (the origina CRT) to measure their analytical thinking ability. The result does not show the effect both the theories predicted. Among all fake news, we found one correlation between the original CRT and pro-migrant biased fake news in the people who have a positive attitude toward migrants. Unlike the original research (Pennycook & Rand, 2019), the data shows that the identity of people and if fake news is aligned with or against their ideology play a key role in accepting fake news. Therefore, our finding suggests that the effect of bias may play role in discerning fake news depending on the topics of fake news, and further research about fake news with the various topics is required.

Keywords: Fake news, Social media, Analytic thinking, Cognitive reflection test, Intuition, Dual-process theory

Abstrakt po slovensky

Prečo niektorí ľudia ľahko uveria falošným politickým správam, aj keď je niekedy očividne nepravdepodobné, že by to bola pravda? Jedna teória ktorá vysvetľuje tento jav, zahŕňa zaujatosť.Ak jednotlivec vidí tvrdenie, ktoré podporuje jeho ideológiu alebo identitu, je pravdepodobné, že tieto informácie prijme ako pravdivé. Na druhej strane, ak jednotlivec vidí tvrdenie, ktoré ide proti jeho ideológii alebo identite, tento jednotlivec by toto tvrdenie odmietol dedukciou a presviedčaním samého seba, že tvrdenie nie je pravdivé. Iná teória, označovaná ako klasická dedukcia, hovorí, že ak jednotlivec, ktorý má tendenciu myslieť analyticky, vidí tvrdenie, tento jednotlivec by dedukciou posúdil, či je tvrdenie pravdivé alebo nie, bez ohľadu na to, či je v súlade s jeho ideológiou. Teória motivovaného uvažovania predpokladá, že čím viac má jednotlivec tendenciu uvažovať, tým je jeho ideológia zaujatejšia. Klasická teória uvažovania predpokladá, že čím viac má jednotlivec tendenciu uvažovať, tým je pravdepodobnejšie, že dokáže odmietnuť nepravdivé informácie bez ohľadu na svoju ideológiu. V tejto práci replikujeme štúdiu od Pennycook a Rand (2019) so vzorkou slovenskej populácie. Testujeme dve presvedčivé teórie pomocou testu kognitívnej reflexie (CRT) na meranie ich schopnosti analytického myslenia. Výsledok nepreukázal účinok ani pri jednej z predpovedaných teórií. Medzi falošnými správami sme našli jednu koreláciu medzi CRT a promigrantsky zaujatými falošnými správami u ľudí, ktorí majú pozitívny vzťah k migrantom. Na rozdiel od pôvodného výskumu (Pennycook & Rand, 2019) údaje ukazujú, že identita ľudí a či sú falošné správy v súlade s ich ideológiou alebo proti nej, zohrávajú kľúčovú úlohu pri prijímaní falošných správ. Naše zistenie preto naznačuje, že vplyv zaujatosti môže zohrávať úlohu pri rozlišovaní falošných správ v závislosti od tém, ktoré tieto správy nesú a preto je potrebný ďalší výskum falošných správ s rôznymi témami.

Kľúčové slová: falošné správy, sociálne médiá, analytické myslenie, test kognitívnej reflexie, intuícia, teória duálneho procesu

Contents

Research problem and outline of the thesis

We are living in a world where information can be found easily and quickly. However, simultaneously, we often encounter misinformation. Conspiracy theories, misinformation, and fake news are particularly prevalent on social media. This typically has a negative impact on our society. There are certain people who recognize and reject fake news on social media, whereas there are those who are susceptible to fake news. What are the cognitive factors that make people accept or reject fake news? In this research, we are going to replicate Pennycook and Rand's research (2019) conducted in the U.S.

There are three chapters in the theoritical part. In the first chapter, we address, using examples, why falling for fake news and inability to distinguish fake news from real news is problematic and examine the characteristics that make social media potentially harmful to society. We introduce the type of fake news that will be the focus of the research.The second chapter introduces the two theories explaining the acceptance of fake news based on the dual-process theory. In the final chapter of the theoretical part, we introduce the original research from Pennycook and Rand (2019) and compare how it is different from our research, and explain how we adapted the replication research to Slovakia.

Chapter 1

How did fake news spread and what are the implications?

Every day, we are exposed to a plethora of information. In particular, with the advent of social media, which exposes us to new information by the touch of a button. People use social media for various reasons, not only simply for communicating with friends but also for entertainment purposes, learning something new, and getting informed by reading the news. Many people currently get their news on social media, in particular, the younger generation who watch the news on social media more than any other media source (Radcliffe, 2020). On social media, there is an abundance of information that can be easily uploaded by anyone. Unfortunately, not all of the stories found online are true. There is not only pseudoscience and common misconceptions but also farcical fake news as well as plausible fake news, which has been exposed by many social media users. Meta(Facebook) announced that they have deleted over 15 million inaccurate posts related to Coronavirus Disease 2019 (COVID-19) and the vaccines(Rosen, 2020). Considering the number of deleted posts containing misinformation about COVID-19 and vaccination, the amount of misinformation could be staggering(Meta, 2022). Moreover, it would appear that the production of fake news or sharing of fake news is not going to decrease in the future. As the number of people who use and create content increases, more users are exposed to fake news which might have a negative social impact and cause confusion.

There are a few possible reasons why there is so much misinformation on social media. Firstly, people are motivated by the prospect of popularity. Getting attention and becoming popular can lead to financial benefits and emotional satisfaction. If content creators get popular enough, Youtube pays them directly. With regards to Facebook or Instagram, the creators have opportunities for sponsorship. It encourages content creators to use clickbait to get more attention or to consistently generate provoking content in order to get loyal fans. One extreme case occurred in the presidential election in 2017 in the U.S. A huge part of the fake news related to

the election was produced by one man living in Georgia (“The Columbus Dispatch”, 2016). It has been reported that he started producing fake news for enjoyment but after it got popular and he started to make money, he became more motivated to produce fake news. The falsified content he created could have influenced the result of the election. There are not only materialistic reasons but also psychological rewards, such as getting fame, which encourages people to make more provocative content as we can easily find on social media.

Another possible reason for fake news articles is that there are groups of people who want to achieve specific goals or purposes by making fake news such as propaganda, religious misbelief, conspiracy theories, and so forth. In the lead up to a major election, fake news can be found targeting specific candidates to manipulate public opinion. Not only does the fake news exaggerate the negative qualities of one candidate, but it also spreads misinformation and disinformation. These types of fabrications are often motivated by political opponents. Not only do they generate misinformation or disinformation, but they are also known to hire people who work for the party. Journalists or authors and people are hired in order to post and spread this content on social media. Additionally, comments with several accounts per person are made, in a way that is advantageous to the party. Furthermore, fake news is used in other aspects of politics, with specific regard to certain non-democratic countries, where intense censorship exists. A large number of people are hired to manipulate the public on social media justifying their political system and gaining support by boosting nationalism. In China, for example, there are more than 2 million people who are organized by the government to create fake news and manipulate the public on social media (King, Pan, & Robert, 2017). They produce huge numbers of pseudonymous and deceptive content on social media posts, posing as ordinary people giving genuine opinions. The number of fabricated posts and comments by the government on social media is estimated at around 448 million per year. It has been reported that the strategy of the Chinese regime is to avoid arguing with skeptics of the government and distracting from controversial issues.

Misinformation and disinformation go beyond politics. Many institutions and organizations aim to spread their identities and beliefs such as conspiracy theories, religion, and pseudoscience. Some of them could be considered harmless if

believed, whereas, in some cases, it is harmful and negatively impacts society. An example of this is fake news, including conspiracy theories surrounding COVID-19, which occurred in 2019 and have continued to the present day. COVID-19 brought about significant changes to many peoples' daily lives together with huge loss of life. Google news reported more than 6 million deaths from COVID-19 up to 2022 April. At the start of the pandemic, many countries were extremely concerned about the collapse of the medical system due to a dramatic increase in the number of patients as well as a shortage of medical personnel. Governments had to enforce new policies including quarantines, business hour restrictions, and making people work from home to stop and decelerate the spread of the virus. Not only has our society suffered casualties, but also there has been critical damage to the economy. With the restriction of traveling abroad and the decrease in pedestrians, a large number of airline companies faced massive financial losses and countless numbers of independent shops were forced to close. The situation could be comparable to war. However, even though governments did all in their power to overcome the situation, certain people aggravated the situation rather than being cooperative. Some simply violated the restrictions for COVID-19 but the larger problem was misinformation and fake news on social media. An innumerable amount of fake news has been produced and spread on social media. Certain types of fake news aimed to convince people to believe that COVID-19 was a hoax or that it was harmless, which encouraged certain members of the public to violate COVID-19 restrictions. Another common type of misinformation is that certain food can prevent COVID-19, such as garlic or lemon. Some religious institutions including Christians produced fake news that if one believes in God sincerely, they will avoid the virus because of protection by God. In addition to this, there was fake news insisting that vaccinations should be avoided. One type of fake news argued that vaccinations are useless and dangerous with cases showing side effects. Another conspiracy theory claimed that vaccinations contained a nanobot and once this enters the body, the government would be able to control the behavior. Needless to say, vaccinations are currently one of the best options when dealing with the pandemic. These types of fake news postings were broadly shared on social media. It not only confused the public but also discouraged many people from getting vaccinated. It has been reported that among more economically developed countries, millions of vaccines expired due to a massive number of people rejecting vaccinations(Barnéoud, 2022). Considering that the

vaccine could have saved many lives in other countries, and it may have contributed to stopping the pandemic, the fake news caused disruption beyond mere financial problems. In 2022, many countries began easing restrictions and opening their borders, returning to a new normal. If the fake news postings had not existed, we might have returned to normal sooner and fewer people would have died. In addition to COVID-19, there is also misinformation concerning medicine on social media, leading people to misdiagnose and incorrectly treat themselves and causing harm to their own health.

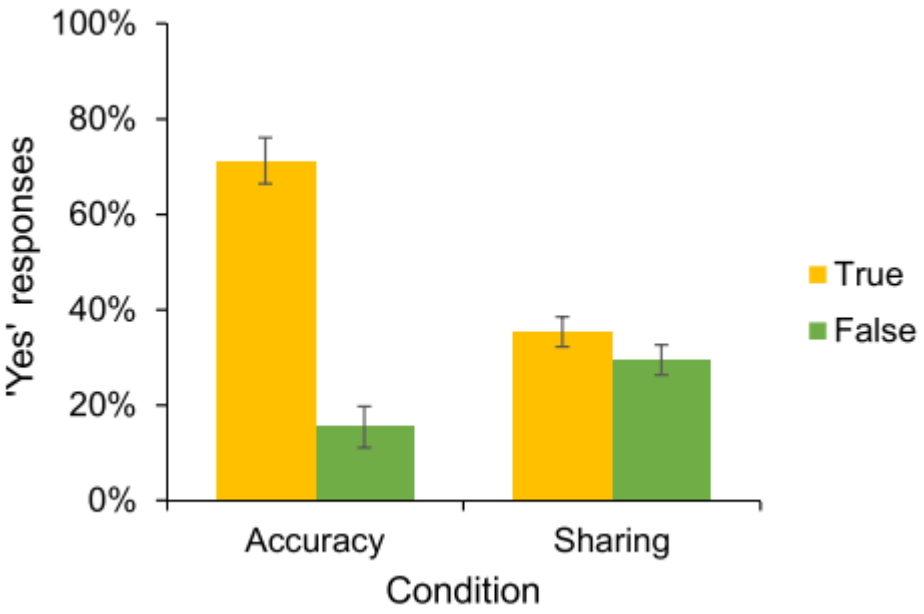
Another group of people using social media to spread their beliefs are religious organizations. Predominantly denying mainstream science, such as evolutionary theory, they post articles about creationism. A significant problem is that fake religious organizations, so-called “cult” religions, are spreading their ideas. One of the main reasons they using social media is to gather more people for their cult. These cults differ from typical religions because they exploit time, effort, and money from members; only a few people at the top of the organization benefit.

As an example, in Korea, there is a well-known cult called “Shincheonji” (the new land of heaven) which is allegedly Christian. The highest priest from the organization claims that he is a savior who will save all believers from hell. He insists that the people who believe and follow him will go to heaven in the name of God. Shincheonji already has over 200,000 members in Korea, and 30,000 outside of Korea. It has been reported that the organization owns 1529 real estate buildings including 74 churches (Lee, 2020). The number could be even higher, considering that they classify their information. This is because public opinions of the organization and their actions are generally very negative. The assets of the organization have been estimated between 500 million to 1 billion euros (Yang, 2020). The issue is their activities. The structure of the organization is designed in a way that a few people in positions of power benefit greatly from the regular members, which is sometimes portrayed as fraudulent. The members of Shincheonji with less power are brainwashed and forced to work for the organization. One of the main obligations of the members is to recruit new members. A large number of the regular members often work more than eight hours per day without any payment and are even fined if the quota is not met. The organization also has social media teams

that are responsible for sugarcoating posts about Shincheonji and fabricating comments. Unfortunately, it is not only a problem in Korea. The number of victims continues to increase as a result of the organization spreading across large cities in Europe such as Berlin.

What makes the situation more challenging is that finding accurate information online is extremely difficult. It is not always easy to find accurate and trustworthy information or news because there is a large amount of information without sources, thus making it hard to discern the validity of the information. It requires time and skills to locate the sources and check the validity of the information. It can be challenging to segregate the factual information from the non-factual for the general public and even for experts. Not only casual platforms such as social media or web communities but also official media deliver incorrect misinformation. There is a phenomenon called circular reporting. For example, Publication A published a piece of news with misinformation. Then publication B takes that news and republishes it in their press, assuming that the information is valid.The process is then repeated, publication A takes what publication B published as a source and publishes it again in their press. As this continues to happen, at some point, the information takes on the appearance of being legitimate. It is also considered circular reporting when multiple publications take initial misinformation and publish it at the same time. It is considered valid information due to the number of times it is reported by different publishers. For instance, In 1998 in the U.S, Andrew Wakefield and 12 of his colleagues published an article that the vaccination of children can cause autism. The original source of the article was from a prestigious journal but the research was quickly discredited by the scientific community. Despite the effort to disprove the information, many publications had already published the misinformation which consequently initiated a massive anti-vaccine protest. As a result of this, a large number of people refused to vaccinate their children (Tavlin N, 2015). Even for journalists, trained researchers, and scholars, finding and collecting verified data is not a simple task and can require a great amount of effort. This is something that the general public are not used to dealing with. Many of the people who post information and news often do not check the facts and verify the sources, or, if they do, these processes are poorly done. Furthermore, recent research has shown that the accuracy of the news article is not the major factor in deciding whether to share the

article (Pennycook et al, 2020;Pennycook et al, 2021). In the research, participants were asked to read a set of political headlines and judge how accurate the headlines were or if they would consider sharing them on social media. The participants were able to identify fake news among true news with fairly high accuracy. However, the veracity of the headline has little impact on the intention of sharing. Overall, the difference between the intention of sharing true news and false news was small. (Figure 1)



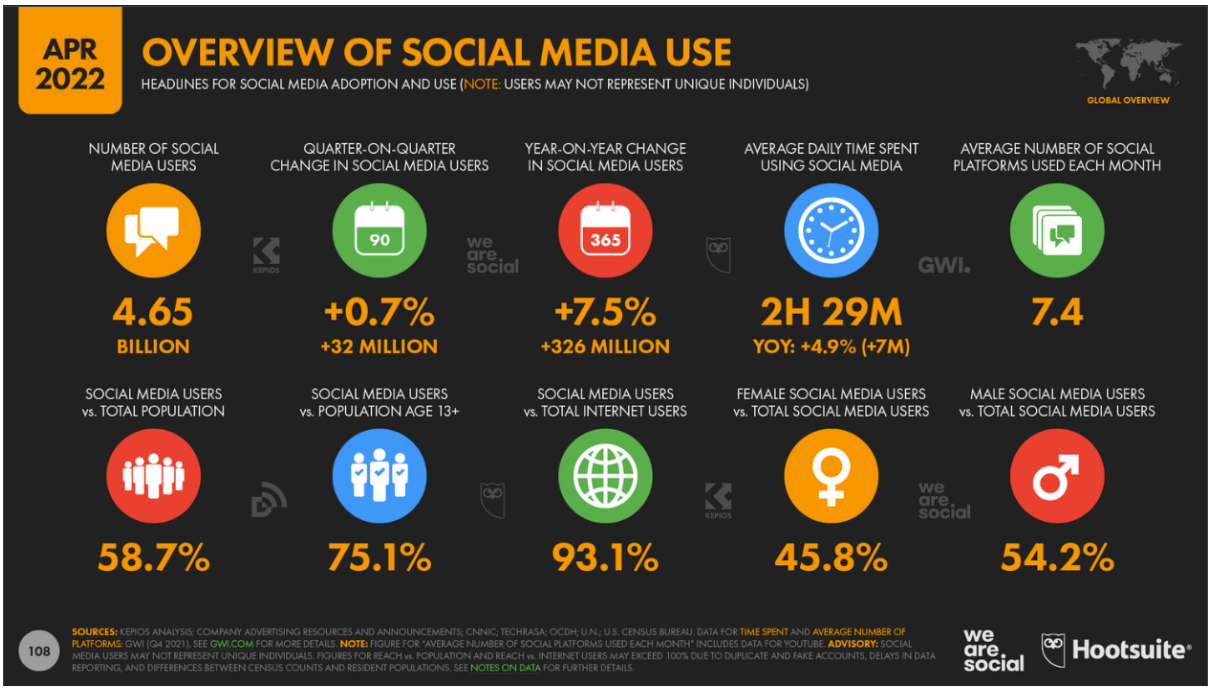
(Figure 1). In the research, the participants showed high accuracy in telling if the news is true or false when they see both true and false headlines. However, participants sometimes considered sharing false news even though they were aware that the news headline was not very accurate. (Pennycook et al, 2021, p.194)

Why social media can be particularly dangerous?

Unfortunately, it appears the public has difficulty in discerning misinformation on social media and fake news has a more powerful influence than real news. One investigation indicated that the top 20 fake news stories were greater than the top 20 real news stories in the three months leading up to the election(Silverman, 2016). Moreover, besides those mentioned above, there are various types of misinformation spreading on social media. Some well-known examples are the flat earth theory, global warming swindle, the Moon landing conspiracy theory, and reptilian conspiracy theory. Even though there is a large amount of high-quality evidence

showing these are not likely to be true, this misinformation continues to spread on social media rather than disappearing. Even in countries with high levels of education, millions of vaccines expire because of the rejection of vaccinations and protests against vaccinations. It implies that additional education on this topic is urgently required.

Needless to say, there has always been misinformation and disinformation throughout human history. However, advances in technology have led to this phenomenon being more widespread than in the past. Pre social media, propaganda was created simply by speaking. The development of printing techniques allowed us to spread information faster and more effectively by using books and newspapers. The radio and television gave us another means of disseminating information. In spite of this, none of the media before social media with smartphones could have the same impact. Datarepotal, a data collection website, reported that the number of people who use social media in 2022 is 4.65 billion, which is 58.7% of the global population. Moreover, social media easily connects people and information globally, whereas TV, radio, or newspapers are limited. Considering the connectivity and accessibility, social media could be a powerful tool for propaganda and misinformation. (Figure 2)



(Figure 2) The data shows that 4.65 billion people are use social media. The actual number of people who use social media might be smaller, considering the fact that there might be overlapping numbers because some

people have several accounts. It also shows that 93.1 percent of people who use the internet use social media and the average time of using social media is almos twot and a half hours per day (“Datarepotal”, 2022).

The second reason is that on social media, anyone has the opportunity to share and create content which can accelerate the speed of the information spreading. Before social media, the producers of news were journalists and authors. The number of people working is limited and therefore it takes time to produce news and deliver it to the public. On the other hand, on social media, anyone can easily upload a post and share it with their followers and contacts. People are exposed to this information from friends or acquaintances, which again accelerates the speed of information spreading.

Lastly, the algorithm for content recommendation on social media forces a certain type of information on people. It is not entirely clear how the algorithms on social media function, but it is known that when an individual selects a certain type of information, the algorithm recommends similar or favorable content to the people who clicked the same information. It means that if a user clicks certain misinformation or disinformation, they have a higher chance of being exposed to a similar type of information, while at the same time, a lower chance of seeing contrasting content against the misinformation or disinformation. Consequently, the social media user is at risk of being trapped in a cycle of misinformation or disinformation because of the mechanism of the algorithm. Once exposed to a few pieces of similar misinformation or disinformation, it becomes harder to think critically because there is no visible counterargument to the misinformation. As a result of this, they might fall into the misinformation easily or alternatively, become a new producer of misinformation or disinformation. The algorithm not only makes people biased but also transforms minor ideas and fake news into provocative mainstream ideas with a high possibility of gaining attention by the mechanism of the algorithm. This issue arose in October 2021 in America. One of the biggest social media companies “Meta”(Facebook) was accused of this problem. Frances Haugen, a former employee of Facebook who worked for two years as a product manager in the company’s civic integrity team, testified before Congress that Facebook prioritized profitability over its impact on the users and the public. She claimed that

even though Facebook has been aware that certain fake news and harmful provocative contents become popular by the recommendation algorithm of Facebook, the company chooses to ignore it, benefitting from it rather than stopping it as these types of content bring huge profits to the company. It resulted in some minor ideas, such as conspiracy theories related to vaccination, becoming mainstream and t having an incredibly negative impact on the communities. There are thousands of posts exaggerating side effects, and untrue theories such as vaccinations being nanobots, or coronavirus being caused by 5th generation technology in telecommunication. She also highlighted that children in particular are exposed to dangers because of the algorithm. She claimed that Facebook and Instagram are more dangerous than other social media such as TikTok and Snapchat, considering that the platforms are focused on “social comparison about bodies, about people’s lifestyles, and that’s what ends up being worse for kids” and makes them unhappy”. She added that, “There is no will at the top to make sure these systems are run in an adequately safe way. Until we bring in a counterweight, these things will be operated for the shareholders’ interest and not the public interest.”. She draws a comparison between social media and cigarettes, which should be restricted (Paul, K 2021). The U.S Federal Trade Commission (FTC) has started an examination of Facebook regarding this matter. Meta (Facebook) claimed that it is not true and that Facebook has nothing to do with spreading fake information and harmful provocative content. Mark Zuckerberg, the CEO of Meta (Facebook), said that it has invested 13 billion U.S dollars and has over 40,000 people to do one job: keep people safe on Facebook. Meta (Facebook) states that they are making an effort to stop spreading fake news and harmful content by blocking fake accounts, deleting posts that violate the safety policy, adopting a third-party fact-checking program, and labeling misinformation which aims to prevent misinformation from going viral. Instagram, run by Meta (Facebook) announced that they will make three options available in terms of the feed recommendation system as a reaction to criticism of the algorithm. One is keeping the algorithmically sorted posts that currently exist, another is “Favorites and Following” and the final one is ordering content chronologically.

However, the issue still remains as it is not only the problem of Facebook or Instagram because this kind of algorithm is often used in other types of Social media.

The algorithm leads us to a “filter bubble”. On social media, we are exposed to filtered information and we might quickly arrive at the conclusion that the bubble we see on social media is the mainstream or the whole world. Frances Haugen expressed in the testimony that “I am deeply concerned that they have made a product that can lead people away from their real communities and isolate them in these rabbit holes and these filter bubbles.”(Paul, K 2021). To some extent, we are regulated by the algorithm of social media by being regularly exposed to biased information, confusion and conflict in our communities as well as social cost and damage.

To sum up, with the growth of social media, more and more people are getting information from social media. However, there are countless pieces of misinformation and disinformation, so-called fake news. As a result of the accessibility and potential benefit to content creators, fake news on social media has more impact than other types of media. Fake news on social media is a crucial issue, sometimes causing real-life problems, damage, and confusion in our society which requires extensive resources to resolve the situation. However, we can not rely solely on social media companies to deal with this problem. The research and policies put in place to control this problem are insufficient. Therefore, a better understanding of this phenomenon is required along with the countermeasures to alleviate the situation and prevent the social damage and the cost.

The research focus

In our world, there are various types of fake information such as Conspiracy theories, propaganda, error, misinformation, and pseudoscience. Each of them contains specific characteristics and possible explanations. In this paper, it is not possible to cover all types of fake information since this topic is incredibly broad. The focus of this research is the occurrence of fake news on social media. Pennycook & Rand (2021) addressed shortly these types of fake information.

Pennycook, G., & Rand, D. G. (2021, p. 389)

Disinformation: information that is false or inaccurate, and that was created with a deliberate intention to mislead people.

Fake news: news content published on the internet that aesthetically resembles actual legitimate mainstream news content, but that is fabricated or extremely inaccurate. Also referred to as false, junk, or fabricated news.

Hyperpartisan news: news content that is not entirely fabricated, but which covers events that actually occurred with a strong partisan bias. As a result, hyperpartisan news is typically misleading, and we, therefore, include it as a form of misinformation.

Misinformation: information that is false, inaccurate, or misleading. Unlike disinformation, misinformation does not necessarily need to be created deliberately to mislead. Misinformation is sometimes used to refer exclusively to inaccuracies that are accidental; however, because it is difficult to ascertain the intentions of the unknown individuals who create falsehoods that spread on the internet, we use misinformation as a broader umbrella term here (i.e. much of the content used in the studies we discuss could be classified as disinformation and/or hyperpartisan news and/or propaganda, etc.).

Yellow journalism: content from newspapers, magazines, or websites that are poorly researched and sensationalist, and that is created with the goal of increasing sales or, on the internet, clicks. Roughly equivalent to tabloid journalism.

Since each of these phenomena has its own characteristics, there might be different cognitive mechanisms at play. The reasons why people believe conspiracy theories might be different to the reasons certain people are susceptible to misinformation. Van Prooijen & Van Vugt (2018) address the psychological mechanisms behind why people tend to believe in conspiracies. The mechanisms involved are: pattern

perception, agency detection, threat management, and alliance detection. Firstly, our brains are good at pattern perception. It is a high-level intelligence characteristic that gives us advantages for survival by discovering useful patterns within an environment. However, we are too good at finding patterns and sometimes we believe there are patterns among irregular items or coincidences (Gilovich, Vallone, & Tversky, 1985). Furthermore, Frank Ramsey, a philosopher and mathematician introduced the Ramsey theory. He discovered that if there are enough elements in a set, it is mathematically almost 100 percent guaranteed that will be a pattern hidden within it. People who believe a certain conspiracy theory claim that there is some evidence or patterns connected to an event, but it might be a misperception of patterns that do not actually exist. Secondly, humans are motivated to detect the intention of others' actions. We tend to interpret certain events as having been done for particular reasons (Van Prooijen, & Van Dijk, 2014). Thirdly, the threat management system of our brains reacts strongly to potential dangers. We tend to give greater importance to the negative emotions in order to reduce or avoid the potential dangers or threats to us (Neuberg, Kenrick, & Schaller, 2011). Lastly, conspiracy theories might be developed in order to have a common goal to one social group and cooperate with one's alliance (Bale, 2007). Whereas misinformation or yellow journalism are not necessarily related to these. Some types of misinformation contain far-fetched and provocative content with the sole aim being to get people's attention.

Our focus in this research is fake news, which is fabricated, highly salient, and extremely inaccurate information that is largely spread on social media. We are going to focus on fake news that contains moral and emotional content. Research has shown that they are considered the most spread stories on social media. Here, we will use the term 'moralized content' if it references "ideas, objects or events typically construed in terms of the interests or good of a unit larger than the individual" such as culture, society, or one's social network (Haidt, 2003; Brady, et al, 2020 p,978). This classification is sufficiently broad to include various types of moral content, regardless of cultural differences about what is perceived as "right" or "wrong." For example, a post related to gun control in America is often regarded as moralized content because the topic is a cultural discussion about how harsher gun laws could affect American society. In stark contrast to this, a social media post

concerning a cute animal such as a kitten or puppy is neither regarded as positive nor negative for society. Cute animal pictures would hardly influence the peoples' ideas and behaviors, which is contrary to moralized content. (Rozin, 1999; Van Bavel et al, 2012). On social media, emotional and moral content tend to be widely spread. It is common for people to post their emotional experiences. It leads people to perceive similarity and emotional convergence, which may increase social bonding (Locke & Nekich, 2000; Peters & Kashima, 2007). It has been reported that emotionally arousing content increases sharing (Berger & Milkman, 2012)(Guerini & Staiano, 2015) as well as on social media such as Facebook(Heimbach et al, 2015; Kramer, Guillory, & Hancock, 2014) and Twitter(Hansen et al 2011; Quercia et al, 2011; Stieglitz, & Dang-Xuan, 2013).

Moreover, the combination of moral and emotional content may be particularly effective for increased sharing. Stieglitz and Dang-Xuan (2013) showed that political discussions with emotional language were widespread. On Facebook and Twitter, content including emotional language and morality was the most widely shared. (Valenzuela, Piña, & Ramírez, 2017). Furthermore, a study investigating moral and political messages on Twitter using over 500,000 messages regarding political topics, showed that expressions of moral emotion were most associated with sharing (Brady et al 2017). These types of news, regardless of whether it is fake or not, may have a greater impact, such as influencing presidential elections and policies, than other topics. It is worth noting that when fake news is shared, there are people who engage with this type of information despite the likelihood of the event happening in real life being low. On the other hand, certain social media users are successfully able to discern such information. Why do people react differently even if they see the same news? What kind of cognitive mechanisms underlie the propensity to succumb to fake news?

Chapter 2

Our focus in this research is on fake news, which is fabricated, highly salient, and extremely inaccurate information which is spread on social media. There are people who easily fall victim to this type of information even though sometimes it is not likely to happen in reality. On the other hand, there are some people who successfully discern such information. Why do people react differently even if they see the same news? What kind of cognitive mechanisms are involved in this process?

Pennycook approached the mechanisms of accepting fake news in two main ways:

1. Social Identity Theory: People are motivated to protect their identity and easily accept fake news aligned with their identity, whereas they reject fake news well against their identity.(Motivated reasoning)

2. Reflections: People believe in fake news because they accept information without thinking analytically.(Classical reasoning)

Social Identity Theory and Motivated Reasoning

It is common to see people act stubbornly when they have an argument and who are unlikely to accept the opinion of others. They claim what they believe is right and attempt to rationalize their arguments, which can lead to an intense and one-sided discussion.

It is observed that it can be arduous to change or convince someone who has a strong opinion or ideology. The case above can be illustrated through this example: Person A builds their own identity and beliefs through personal experience. The way PersonA perceives the world would depend on how they shaped their views from the environment. Person A then encounters Person B who has a contrasting belief system that conflicts with A's beliefs, thus causing arguments between them. Person

A attempts to protect their identity which they have constructed and is reluctant to change it. Person B resists this and makes counterarguments to A. However, if Person B is someone with a similar identity, they feel like an alliance has been found.

The above example is related to a theory that will be introduced in the next chapter, Social Identity Theory.

What does fundamentaly mean that we see the news? News is a type of information that is not experienced directly. Theoretically, there is little difference from a statement or message from others, which is indirect. Believing or rejecting news can be seen as believing messages from others. If a piece of news contains content that goes against our identity or ideology, we might refute this information and choose to not accept it. On the other hand, it is possible for a person to accept fake news if it aligns with our identity. Over time, extreme views can lead to one eventually becoming an extremist. One possible reason why producers of fake news exist and people succumb to fake news might be related to our beliefs. Before continuing with this topic, I would like to shortly address the cognition regarding information and forming belief.

Social identity theory: Human, information, belief, and us

What is the origin of belief? Certain conditions are required for our beliefs to establish themselves. From a cognitive science perspective, memory, knowledge, and dynamic connection of these elements are needed. The way in which we obtain these elements is related to our information process system (body and brain) and the interaction with the world (environment). It is possible to divide the things that matter for processing information into two parts: inherent features and acquired features.

Fundamentally, humans have highly similar physical features to each other. Most human features are defined by DNA and RNA, the same as other species. Humans show 99% of similarity in terms of genetics, and we have the same metabolism and body structure. That means the way information perceived from the environment is similar among humans. The sensory information we obtain outside of the body is

limited by our capacity for the sensory organ(visible lights 400~ 700nm, Audible Frequency 20 Hz ~ 20000 Hz, a similar range of capacity of smell, taste, and all other senses). Moreover, perception and cognitive capacities such as memory and learning ability are almost identical to each other, omitting intellectual disorder. Expressions of emotion are also similar among people. To rephrase this, when we process the information from outside, the basic biological mechanisms we have are very similar to each other. Additionally, our personality traits are partly defined by our genes (Munafo & Flint, 2011; (Balestri et al, 2014). Before we interact with the environment, we already have a certain preset of how we are going to interact with the environment and how we are going to process the information from the outside world. These characteristics play a major role in interacting with the environment, they help form and develop our brains and identity.

On the other hand, the environment we experience after birth has a crucial impact on how we later process information. Our brains have plasticity. Depending on our experiences, the brain continues changing its neural network structures. Different types of stimulation cause different neural activities and neurons form different connections. From birth, we have continuous interactions with the environment which differ for each person throughout generations. Based on the information we acquire from our surroundings, we accumulate knowledge, and memory, and find patterns, therefore creating specific neural structures and beliefs. It then influences how we perceive future information. This process repeats itself throughout the duration of our lives. Then, we form our own beliefs depending on our genes, experiences, environment, and how we interact with the environment in the sequentially.

An additional point of importance is the sociability of humans who incessantly interact with each other through conversation, sharing information, and cooperation. As a result, communities, cultures, countries, and religions are formed. It has enabled us to shape the history and civilizations we currently have. Yuval Noah Harari, who is a historian and the author of “Sapiens: A Brief History of Humankind,” claims that the ability to form language and imagination plays a vital role in the development of humankind. In the book “Sapiens: A Brief History of Humankind”(Harari 2014), he addresses why sapiens are at the top of the food chain and how they have been able to advance human history. Sapiens were far from

being the strongest animal and the size of their brains was smaller compared to Neanderthal, who coexisted with Sapiens. However, Sapiens were able to communicate at complex levels, therefore they could cooperate well. Additionally, they had the ability to imagine what did not exist. Harari used Peugeot, the car manufacturer, as an example in his book. He posed this question to the readers: To what extent can we say that the company Peugeot exists? It is an automobile company that began as a family business in Sochaux, France. Peugeot has manufactured over 1.2 million cars up to 2019, their net worth has been estimated at €69.766 billion in 2019, and it has over 200,000 employees. However, all of these aspects can not fully represent the existence of the culture we call Peugeot. Are the buildings Peugeot? Are the factories owned by Peugeot, Peugeot? Or are employees of the company Peugeot? None of the above mentioned confirm the existence of Peugeot. We can not say Peugeot is the building where the headquarters is. If another company moves into the building, the building then bears no relation to Peugeot at all. Even if Peugeot lost all its factories for certain reasons, they can still build or buy a new one. Factories themselves have nothing to do with the existence of Peugeot. Would Peugeot cease to exist if all the employees were replaced?
Peugeot is a lawful corporation that can own real estate, land and it has certain rights the same as a person. Peugeot employs over 200,000 workers who all work towards the same goals, such as making a profit. As this example shows, the imagined reality can unify people in a huge community.

Through this ability, Sapiens have created common myths such as legend, mythology, and religions. It has involved the cooperation of a large number of people. Other species form a cooperating group of 50 members. Sapiens can make it three times larger or even bigger, such as the size of a town or country. It played a key role in the competition for survival and Sapiens could survive when other species of Homo became extinct. At a certain point in time, Sapiens started to make more sophisticated imaginary systems. They formed religions, cultures, and countries, eventually forming the society we live in today. Harari claims that human history has been built on the ability to imagine what does not exist. What is money fundamentally? Theoretically, money is just paper or a piece of metal. However, the value goes beyond that of the numerical price. People are committed to the belief

that money has a deeper significance than just a piece of paper representative of a monetary value. For example, the currency of the Czech Republic, the koruna, maintains its value as long as the government exists. If the government disappeared, the money would become no more than a piece of paper. The value of money is supported only by the imaginary system, the country. Money became the key element of capitalism. Empires erased and colonized cultures, rationalizing their heritage prior to others. It is clear that religions continue to affect the world and these imagined systems have a powerful impact on both human history and the present age.

We can view Harari's argument from the perspective of social identity theory and self-categorization theory (Tajfel & Turner, 1979; Turneret al, 1987). The community of imagination and the behaviors based on the community goal, such as fighting for the empire or sacrificing themselves for their God, imply that an individual's emotion and motivation can be extended to the group they belong to if their group identities of them are salient. Abrams & Hogg, 2004; Tajfel & Turner, 1979). Moreover, emotions are functional responses that regulate behavior to help individuals achieve their goals (Frijda, 1986; Keltner & Haidt, 1999), and emotions can also influence behavior based on group-level goals (Mackie, Silver, & Smith, 2004). As Individual-level emotions regulate behavior, group-based emotions also regulate behavior in ways that help people achieve the goal of the group.(Smith et al, 2007). For example, someone may experience a negative emotional response as if they were attacked personally. For example, if a person identifies as a member of the "*Obyčajní ľudia a nezávislé osobnosti"* party and the party is attacked by other media, they may try to protect the party they support by condemning other parties or praising their own parties.(Branscombe et al 1999; Ellemers, Spears, & Doosje, 2002)

We can find similar cases on social media. Social media is a gossip network, in which people interact by exchanging information such as posting content, sharing content, or commenting (Brady et al, 2020). The people who have a salient group identity or ideology may experience negative emotions if they see threatening posts

to their identity. They may attempt to protect their group identity by generating counterarguments or rationalizing that the post is untrue.

Considering Harari's claims surrounding social identity theory and Self-Categorization theory, possible cognitive factors that drive the belief in fake news may be that it is driven mainly by identity or partisanship (Berinsky, 2017; Kahan, 2017). The effects motivated reasoning has on various forms of judgment has been, among other things, shown in the way people passionately defend their beliefs in arguments that challenge their political ideology. At the same time, they would accept arguments that support their political ideology in an uncritical and passive manner in order to uphold their prior beliefs (Berinsky, 2017; Strickland, Taber, & Lodge, 2011). Additionally, there is a claim that individuals' opinions on political misconceptions might be resistant even to explicit corrections (Berinsky, 2017). Research conducted by Nyhan and Reifler (2010) implied that confronting citizens with the truth about false statements not only does not help to debunk such statements, but can also sometimes go as far as to backfire and reinforce existing misconceptions. Since fake news is often of a political nature, it is possible that similar motivated reasoning effects can be used to explain the amount of attention that numerous false claims get on social media. More specifically, people may tend to believe fake news stories that support their pre-existing political ideology (Kahan, 2017).

There is one form of motivated reasoning related to the Dual-process theory (Kahneman, 2011). It is called Motivated System 2 Reasoning (MS2R), which suggests that explicit deliberation can lead to individuals choosing to believe information that aligns with their ideological identity over information that does not - in other words, cognitive reflection increases the inclination for ideologically motivated reasoning (Kahan, 2013). Therefore, deliberation can deepen partisan differences and can further polarize people who are analytical thinkers instead of making them more accurate in their beliefs. The MS2R account can be also used when explaining people's beliefs in fake news and misinformation. A few pieces of research showed evidence that the propensity to think analytically increases political polarization in the context of climate change (Kahan et al, 2012; see also Drummond & Fischhoff, 2017), gun control (Kahan et al, 2017; see also Ballarini & Sloman,

2017), and selective exposure to political information (Knobloch-Westerwick, Mothes, & Polavin, 2017). The MS2R account predicts the higher propensity to think analytically people are, the more polarized they will be, rather than more able to tell if the news is fake or not.

Classical Reasoning account

Another theory that explains why people believe fake news is the Classical Reasoning Theory, which claims that the propensity to think analytically is the key cognitive factor in rejecting fake news. This approach is related to the presumption that reasoning supports sound judgment (Kohlberg, 1969; Piaget, 1932). The Idea is connected to the dual-process theory, which will be described in detail in the next chapter. In brief, the dual-process theory explains that human cognition can be divided into two types of systems: System 1(intuitive), and System 2 (analytical). The Classical reasoning theory explains that a human is a cognitive miser and people tend to avoid resource-demanding cognitive processes (analytical) (Fiske & Taylor, 2013; Stanovich, 1999; Stanovich & West, 2000). People typically think with System 1 when they process fake news and are therefore likely to believe it without criticizing. However, when they start to think analytically, they can override their intuitive thought processes from System 1 and can reach a rational perspective and there is a high chance that they will reject the fake news. As various cognitive tests show, there are individual differences in the propensity to override intuition and willingness to think analytically (Frederick, 2005; Haigh, 2016). The propensity to engage in reasoning processes is correlated to various types of beliefs. It has been suggested that the intuitive process is correlated to several types of beliefs, such as mind-body dualism (Bloom, 2007), psychological immortality (Bering, 2006), and mind perception (Kapogiannis et al, 2009), and supernatural agents. These are common elements in religions worldwide and Gervais & Norenzayan (2012) show that analytical thinking plays a significant role in being w negatively associated with religious beliefs. Analytical thinking also increases the acceptance of some scientific claims such as astronomy, evolution, geology, mechanics, perception, and thermodynamics (Shtulman & McCallum, 2014). Additionally, people who have a

high propensity for analytical thinking tend to reject conspiracy theories (Swami, et al 2014). The classical reasoning account suggests that analytical thinking is associated with forming accurate beliefs when they read fake news. Therefore, people who are willing to engage their analytical thinking may successfully reject fake news regardless of whether the news is consistent with or against their ideology or identity.

How dual-process theories explain the propensity to fall for fake news

Dual-process theories

Every day, our brains are busy constantly sifting and processing information and tasks. Our brains process information not only for simple, routine tasks but also for complex problems. In fact, even for very basic and simple behaviors, we apply sophisticated mechanisms to deal with them.

Imagine we want to get a coffee in the morning after we wake up. In order to get out of bed, we need to use the strength of our core and arm muscles in a precise sequence. We need fine control of our leg muscles which make micro-adjustments in timing and effort, to keep our body in balance so we can walk to the kitchen. When we arrive at the kitchen, we automatically scan our surroundings to identify the location of the coffee cups. We use our situational awareness and past experience to select an appropriate container for our needs: in other words a cup or a mug. Then water must be boiled which means that we need to draw on the memory of how to do this: which appliance can boil water, and the sequence we have to carry out to make coffee. Let us say we pour water into a kettle. Soon, we notice that the water is boiling: we observe the visual and auditory cues - the bubbles as the water heats up, the sound of the water starting to boil, and the click as the kettle turns off after the water reaches the right temperature. Based on these observations we know the

water is ready for coffee. The next thing we need to do is to pour boiling water into the cup with the coffee powder. We need to hold the kettle and carefully move it to the precise location of the cup. When the cup is filled with enough water, we need to stop pouring immediately. Even when we finally drink the coffee after stirring it, we need to lift up the cup of coffee by identifying the spatial location of the cup and our hand, the distance from the hand to the cup, and move our hand to reach the cup. Then we need to lift the cup and move it to our mouth with a millimeter level of accuracy, otherwise, we might “drink” the coffee with our hair or nose.

Of course, we don’t actually think like this. We just go to the kitchen and get a coffee, and make coffee as we usually do, even if we are not yet fully awake. No sophisticated or deliberate thinking is required to do these simple actions. However, the example above is actually a simplified version of what our brains do all the time. Even though we are not consciously aware of these information processes, our brains do them automatically and intuitively. If we had to do all the tasks above consciously and deliberately rather than automatically, our daily lives would be challenging. Imagine if we built a robot that looks fairly similar to a human, but we had to program it to control every single thing as in the coffee example above. When we wanted to make the robot walk, we would have to control the robot's legs very accurately in real-time, depending on the center of gravity and the balance of the robot. To manage to carry the cup of coffee, we would need to identify the current position of the robot’s hand and cup and then would need to move the robot’s hand in that exact direction and distance. It would certainly be more difficult than simple tasks we frequently do in daily life. If we had to control every single movement and process consciously and deliberately to do such tasks, we would get a headache in 30 minutes or less.

Fortunately, our brains deal with all of this automatically and intuitively. In fact, we automatically deal with many difficult things in our daily lives based on prior knowledge and experiences that we have been repeatedly exposed to and have become used to. For example, when we read simple sentences, drive a car on an empty road, or do simple calculations such as 2+2, we can do such tasks without deliberately thinking. However, this automatic process has a limit. There are tasks

and problems we cannot get the solution to intuitively or automatically. See the math equation below:

35x13 =?

Most of us cannot answer this question automatically or intuitively. Still, we can partly use our intuition, we know that the correct answer is neither 3 nor 12593. However, if someone asks if the correct answer is 475 (which is a close estimate, but still incorrect), we can not answer it quickly. We can indeed figure out the correct answer if we focus and think deliberately with a pen and paper. As we can see in this case, we are able to think beyond our automatic and intuitive thinking and solve more complex problems. Moreover, we can use our deliberate thinking by paying attention to more complex tasks such as focusing on the voice of a particular person in a crowded noisy room, searching our memory to identify a sudden random sound, or comparing the value of two different products. However, to do these kinds of actions we need to maintain deep focus, which requires effort and energy. In psychology, humans are described as cognitive misers. Unless we face a situation where such deliberate thinking is needed, we have a propensity to use our intuition. Yet, it seems that there are individual differences in the propensity to use intuition. This phenomenon seems highly related to decision-making.

The theories that explains our cognitive process through these two types of thinking is called Dual-process theories (DPT). The former type of thinking, which is automatic, rapid, unconscious, effortless and high-capacity is called System 1. The second type of thinking, which is conscious, slow, controlled, effortful, and analytic, is called System 2 processes (Evans, 2008; Kahneman, 2011). Despite the recent developments for the sake of simplicity we refered to them by the old names as Kahneman did in his book Thinking fast and slow. The two types of processes are also referred to as ‘intuitive’ or ‘heuristic’(System 1) vs. ‘deliberate’ or ‘analytical’(System 2) (Stanovich & Toplak, 2012).

System 1 is convenient and effortless. However, it also sometimes causes errors or cognitive biases. For example, some people think that traveling by plane is more dangerous because they have seen several aviation accidents on the news, even though statistics show that aviation accidents occur much less often compared to automotive accidents. People tend to think or make decisions based on how easy it

is to bring something to mind. This is called availability bias in psychology. Also, the “Linda problem” shows another heuristic bias, see the text below.

Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.

In the research done by Tversky and Kahneman (1983), 85 percent of people answered that the probability of her being a feminist and bank teller at the same time is higher than the probability of her just being a bank teller. However, logically, the probability that two events occur at the same time cannot be bigger than one of these events occurring. People sometimes falsely assume that the similarity of objects or events means that they are also closely correlated. Besides that, there are many heuristic-based cognitive fallacies.

On the other hand, System 2 sometimes figures out the error that occurred by System 1 and finds more logical and correct answers by overriding our intuitive thinking. When it comes to accepting or refuting fake news, MS2R theory and the Classical reasoning hypothesis offer different interpretations regarding the Dual-process theory. MS2R theory predicts that when we see fake news that aligns with our identity, we do not interrogate it much and automatically accept the news, even though the probability of it being true is unlikely. On the other hand, when we see fake news that conflicts with our identity, we deliberately think about counterarguments and rationalize it to protect our identity. In other words, for news that aligns with our identity, we would use System 1, and for news that threatens our identity, we would use System 2. If an individual has a more developed System 2 faculty, this propensity would be greater, resulting in more biases in their identity. On the other hand, Classical reasoning predicts the main factor why we accept fake news which is that we use heuristic or intuitive thinking. If we successfully override the heuristic and then think analytically, we have more chances to reject fake news. It means that if an individual has a stronger System 2, they would be less biased because they are likely to successfully reject fake news, no matter whether the news conflicts or aligns with their identity.

Pennycook and Rand (2019) adopted an instrument called the “Cognitive reflection test” to test this hypothesis.

CRT (Cognitive reflection test)

The cognitive reflection test (the original CRT) was presented by Frederick (2005, p.35) with the purpose of measuring the construct cognitive reflection, which he defined as “the ability or disposition to resist reporting the response that first comes to mind”. To paraphrase, it is designed to measure the tendency to override an intuitive, but incorrect response with a more analytical correct response. It is one of the most widely used instruments in research about heuristics and biases.

The original CRT consists of the following three questions below:

(1) A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? _____ cents.
(2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? _____ minutes.
(3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? _____ days.

For the first question, the answer that quickly comes to our mind might be 10 cents. It does not require much time or deliberate reasoning to get this answer, people often intuitively think the answer would be 10 cents. However, the correct answer is 5 cents if we think analytically. It is not mathematically difficult to come to the correct answer. (If the ball is 10 cents, the total price would be $1.20.) In order to get the correct answer, we first need to override the intuitive answer, 10 cents. Then we need to calculate the actual price in order to get the correct answer. The other questions also have a similar structure. For question number two, people often answer 100 minutes because they simply multiply the number. They see the number

as 100, and intuitively think that it takes 100 minutes to make widgets rather than them seeing the problem as being proportional. Whereas the number of machines increases proportionally, together with the number of widgets, there is no difference in how much time it takes. The correct answer is five minutes. For the third question, people often gave an incorrect answer, “24 days”. It is probable that they are confused that the word “half” has something to do with half, and they simply divided 48 which is the days it takes to cover the lake. However, logically it should take 47 days to cover half of it due to the fact that the lily pads double in size every day. A noteworthy aspect of the original CRT is that all three questions do not require a high level of mathematical ability. They call for us to override our intuitive answers and think analytically to reach the correct answers. It is expected to measure the propensity of how likely an individual would like to override their intuition and engage their analytical thinking. the original CRT can be a powerful instrument for measuring various cognitive tasks, considering that the original CRT is directly measured by miserly processing.

It has been reported that the performance of the original CRT is correlated to an extensive list of rational thinking tasks and resistance to various cognitive biases. For example, people with high performance of the original CRT showed less belief bias which is the tendency to be influenced by the belief when they evaluate the validity of logical arguments. Also, they showed less tendency to focus on the number of certain kinds of outcomes, rather than considering the total number of possible events and probability (Toplak, West & Stanovich, 2014). In addition, it has been reported that the original CRT scores are linked with other analytical performance, including the “Scholastic Aptitude Test” which is a standardized test widely used for college admissions in the United States (Frederick, 2005; Obrecht, Chapman & Gelman, 2009); probability updating (Hoppe & Kusterer, 2011); errors in Bayesian reasoning, framing effects (Toplak, West & Stanovich, 2011). Toplak, West and Stanovich (2011) found that in 15 separate rational-thinking tasks, the original CRT predicted the result with more accuracy than either intelligence measures or measures of executive functioning.

Motivated reasoning explains that if an individual has a strong tendency to think using System 2, they will show high performance in the original CRT, and if they are

likely to think analytically, they will successfully make counterarguments and rationalizations to protect their identity when confronted with an argument against their identity. When it comes to fake news, if a person encounters fake news aligned with their ideology, they easily accept the fake news. In contrast, if the fake news goes against their ideology, counterarguments will be made. As a result, in distinguishing fake news from real news, low accuracy will be shown for fake news that aligns with their identity, however, they will show high accuracy for fake news against their identity.

Classical reasoning, on the other hand, explains that when an individual has a strong propensity to think analytically, they will likely see all news analytically and how likely the news is true, overriding their intuitive thinking no matter whether the news is aligned or against their identity. In other words, if an individual shows high performance in the original CRT, they will show high accuracy in distinguishing fake news from real news.
We will conduct an experiment to test these two compelling hypothesis theories by using the original CRT and biased fake news.

Criticism of The Cognitive Reflection Test

One criticism of the original CRT is that it has been exposed for a significant amount of time through research, social media, and mainstream media. The original paper of the original CRT had over 5,300 citations on Google Scholar in 2022. The iconic question “bat and ball” has been introduced in best-seller non-fiction books such as Kahneman’s Thinking, Fast and Slow (Kahneman, 2011). Needless to say, the prior exposure to such questions influences the validity of the instrument.In particular, the original CRT has been used in Amazon’s Mechanical Turk (MTurk) which has been a useful instrument for research. It is reported that 72% of the participants in the research on MTurk have seen at least one CRT question (Thomson & Oppenheimer, 2016). Prior exposure can cause reduced effect sizes (Chandler et al, 2015) and practice effects have increased scores on the cognitive test such as the Wisconsin card sorting task (Basso, Bornstein & Lang, 1999). It has been shown that the scores of the original CRT could be predicted by the number of studies that participants had

previously completed (Chandler, Mueller & Paolacci, 2014). Moreover, one piece of research showed that roughly 50 percent of the participants had previously seen the test and participants who had been exposed to the original CRT outperformed compared to the participants who saw the original CRT the first time (2.38vs 1.46 out of 3) (Haigh, 2016; Stieger & Reips, 2015). Even though our research is conducted in Slovakia where the questions might not be exposed as much as MTurk or the U.S.A, we assumed that it would be insufficient to test our hypothesis only with the original CRT.

An additional criticism is that it has also been found that the origina CRT is highly related to numerical ability (Sinayev &Peters 2015).the original CRT can be divided into two parts, a cognitive reflection part, and a numerical calculation part. In the original CRT, a person gets an intuitive answer that comes to mind first then they have to reject it in order to further think analytically. This part would be on the propensity to reject intuition. After the first intuition is rejected, finding out the correct answer depends on numerical ability. The correct answer will not be found if mistakes are made or if there are insufficient skills to calculate the mathematical problem. Traditionally, the origina CRT exclusively measures if an individual gets the correct answer. Thus, it is partly limited to testing the actual propensity to override first incorrect intuition. Moreover, the numerical problem in the original CRT might be challenging for many people because, in order to get a correct answer after overriding intuition, specific knowledge may be required that had been learnt in school. Frederick (2005) found that only elite university students reached an average score above 1.5 and typically the average score of college students was between 0.5 and 1 out of 3 questions. Numerous research related to the original CRT has shown that a high score in the original CRT is correlated with less bias. Due to the relation between the original CRT and numeracy skills, it has been previously demonstrated that numeracy skills play a more important role in reducing various cognitive biases. Bruine de Bruin, Parker, and Fischhoff (2007) tested participants with the Adult decision-making competence scale to see the correlation between numeracy or cognitive reflection and other Cognitive Biases (Bruine de Bruin, Parker, & Fischhoff, 2007). The research found that numerical ability predicts less decision-making biases, less under/overconfidence in terms of asking about what general knowledge participants have, and fewer inconsistencies in terms of estimating the probability of

certain events (less framing inconsistencies and less conjunction fallacy). On the other hand, cognitive reflection was only related to the tendency to make safer decisions in gambling, like a high risk choice test (fewer high risk choice inconsistencies). It suggests that Cognitive reflection might be related to other biases or not related to any bias, but numeracy plays a crucial role in avoiding bias. Moreover, there is evidence showing that higher numeric populations are less sensitive to non-numeric information such as mood in decision making (Peter et al, 2009). Thus, there is a possibility that the previous research from Pennycook (2019) implies that numeric ability is correlated to the accuracy of distinguishing fake news rather than analytical thinking.

To sum up, the original CRT has been widely shared across various media including social media platforms. As a result of this, the participants may have been influenced prior to taking the test, which has a negative impact on the validity of the data. Secondly, the original CRT is entangled with numeracy skills. To test the correlation between cognitive reflection and either motivation reasoning or classical reasoning hypothesis, additional instruments may be required. We aim to introduce the other two types of cognitive reflection test.

An expansion of the Cognitive Reflection Test

Since the items of the original CRT have been exposed to the public, there have been movements to develop similar instruments with reasonable validity. Toplak, West, and Stanovich (2014) suggested an extended version of the original CRT that is similar and valid by an experiment.

Below are four additional questions:

(1) If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? _____ days

[correct answer = 4 days; intuitive answer = 9]

(2) Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class? _____ students
[correct answer = 29 students; intuitive answer = 30]

(3) A man buys a pig for $60, sells it for $70, buys it back for $80, and finally sells it for $90. How much has he made? _____ dollars
[correct answer = $20; intuitive answer = $10]

(4) Simon decided to invest $8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has:
a. broken even in the stock market
b. is ahead of where he began,
c. has lost money
[correct answer = c, because the value at this point is $7,000; intuitive response = b].

These also generate incorrect intuitive answers as the original CRT. These items have been tested with the original CRT and other cognitive ability tests and showed .58 correlation with the original CRT. These items are not as well known as the three items from the original CRT.

The CRT-2 (verbal CRT)

Thomson, & Oppenheimer introduced a different type from the original CRT, called “CRT-2”(Thomson, & Oppenheimer, 2016). The CRT-2 consists of four short questions. It generates an incorrect initial intuitive answer. However, unlike the original CRT, the CRT-2 does not require mathematical skills to generate the correct answer. In some research with the original CRT, most participants got 0 correct answers out of 3 questions because it is only three questions and can be difficult for some participants. Whereas the CRT-2 is a comparatively easier question to answer.

Therefore, we can expect that there may be a lower number of participants who end up with 0 which makes it challenging to analyze data. It has been tested that the CRT-2 questions are less exposed to the public and it has a similar mechanism to the original CRT. The questions of the CRT -2 are as follows:

(1) If you're running a race and you pass the person in second place, what place are you in? (intuitive answer: first; correct answer: second)
(2) A farmer had 15 sheep and all but 8 died. How many are left?
(intuitive answer: 7; correct answer: 8)
(3) Emily's father has three daughters. The first two are named April and May. What is the third daughter's name? (intuitive answer: June; correct answer: Emily)
(4) How many cubic feet of dirt are there in a hole that is 3' deep x 3' wide x 3' long?
(intuitive answer: 27; correct answer:none)

These questions are verbal rather than mathematical. It also generates intuitive answers and all of them are challenging to some extent. In order to get the correct answer, people should engage their analytical thinking and override their intuition, which is similar to the original CRT.

Having considered the two main criticisms, we have used both the extended CRT from Toplak, West, and Stanovich, K. E. (2014) and the CRT-2 (verbal CRT)from Thomson, & Oppenheimer, (2016) to test our hypotheses. The combination of all all eight items from both the extended CRT and verbal CRT is called the CRT in this research.

Chapter 3

Previous research by Pennycook and Rand

The following research was conducted in the United States of America. The research questions (Pennycook & Rand 2019) were: Is one's political preference influenced by accepting or discerning fake news?(motivated reasoning), Does thinking play a role in accepting or discerning fake news regardless of political preference? (classical reasoning). The participants were thousands of people from different backgrounds in terms of age, gender, and education. They were asked to do the original CRT, then they were shown news headlines with pictures in Facebook post format. Participants had to assess how likely the news was to be true. In three studies, two of them had four response options (not at all accurate/not very accurate/somewhat accurate/very accurate) and the other study had a scale of 1-7 (from 1 = Extremely unlikely to 7 = Extremely likely). There were 15 fake news headlines and 15 true news headlines. Among the 30 news headlines, 10 of them were consistent with Republicans, the other 10 were consistent with Democrats and the other 10 were neutral. The result showed that participants who have a high score in the original CRT have better accuracy in distinguishing fake news regardless of their political preference. The study did not find any polarization in terms of accepting fake news being dependent on a high original CRT score.

The political differences between Slovakia and the U.S.

The presidential election procedure in America is comparatively complicated. First, in the presidential election, there are two dominant political parties one can vote for. One is Democrat and the other one is Republican. There are other minor political parties but it is hard to expect the minor parties to have an impact on the presidential election. The two dominant political parties have a few affiliated parties but for the presidential election, one presidential candidate of each party is decided eventually through a procedure for a presidential election. Voters do not directly elect

candidates but voters vote for electoral colleges and then the electoral colleges would vote for the president.

In this environment, we can consider a few possibilities in terms of voters. One can support one political party even though he does not support the candidate from the party. One might not like both of the candidates from the dominant political party, but they might still vote for the one e they dislike the least. One can support a candidate from the dominant political party even though they do not like the political party where the candidate is from. Some voters might be adverse to all politicians but the voters gave votes to the politicians they hate the least in the presidential election. Considering these, a voter might not be motivated to rationalize and might not defend their “favored” candidate when they see news inconsistent with the candidate. The study might not get a significant effect size of motivated reasoning because the population in the data who seem supportive of one of the candidates and the political party might not be supportive enough to initiate motivated reasoning. Moreover, depending on how much people are interested in the news topic, political news in the previous research, for example, might influence the result. Other cultural contexts such as general level of education, mindset, religion, and nationality may additionally generate different results.

Therefore, it would be crucial to conduct a replica study with a different population, culture types of variables to test the motivated reasoning hypothesis and classical reasoning hypothesis.
Considering the view of motivated reasoning, it might not be necessary to take political preference as a variable. Any variable which can be divided into two groups (either support or against) would be appropriate to test the two theories. In this research, we tested the two theories in the Slovak population with a different variable.

The political situation in Slovakia

Slovakia has a more complex political system than in America in terms of the presidential election. Slovakia is a democratic republic with a multi-party system. The

Prime Minister plays a major role in the government and there is a President as the head of Slovakia. Both positions are elected by citizens in Slovakia and candidates can run for both positions from various political parties or independently.
It would be overly complicated to replicate the research of Pennycook and Rand with the same design because there are too many parties and candidates. There would be too many types of news and it would be difficult to conduct the survey. On the other hand, according to the motivated reasoning hypothesis, an individual would forcefully debate arguments that are inconsistent with their ideology. It would not be necessary to set supporting political parties as a variable as long as there are statements that are consistent or inconsistent with their ideology. Thus, we decided to set the independent variable with attitudes towards migrants.
We can expect a few advantages by setting the variable as the attitude to migrants. It is far simpler to design the experiment and analysis. Also, because participants would show how accepting they are of the migrants through the questionnaires, we can quantify some part of participants' ideology toward migrants. In the original research, it was challenging to discern how much one individual supports a certain political party. As previously mentioned, they might support party A simply because they object to party B. In the migrant case, the data would clearly show that one individual supports or is against migrants. If there is the effect of motivated reasoning, there is a possibility of seeing a strong correlation between polarization by the motivated reasoning effect and how much participants are polarized.

Migrants in Slovakia

Slovakia is not a traditionally popular country for immigration. The number of people who immigrated to Slovakia was negligible up to 1999, the year when Slovakia became independent from Czechoslovakia. Since Slovakia joined the European Union (EU) in 2004 and signed the Schengen agreement in 2007, the number of immigrants and emigrants has increased significantly. Still, Slovakia has greater numbers of people who leave for other countries than the number of people who come to Slovakia. However, the number of migrants in Slovakia is increasing rapidly, and compared to 2004, the numbers of migrants in Slovakia have increased eightfold by 2021 and the International organization for migrants (IOM) reported that there are

167,519 non-Slovak people living in Slovakia. This is three percent of the whole population in the country. This number is comparatively one of the lowest migration ratios in the EU, the lowest foreigner ratio belongs to Poland and Romania.
The majority of migrants come from neighboring countries. 52 percent of migrants are from countries around Slovakia such as the Czech Republic, Austria, Poland, and Ukraine. 33 percent of migrants are Ukrainian, which is the largest proportion. 18 percent of migrants are from eastern southern Europe like Romania, Bulgaria, and Serbia, and seven percent of migrants are from China, South Korea, and Vietnam. (“IOM”, 2021; Šoltés, & Boroš, 2019)

Among all migrants, around 66 percent are males in their mid thirties who are economically active. A major number of foreigners prefer to live in or around the capital city, Bratislava because of education and job prospects. Case in point, Slovak people who live in Bratislava have higher chances to see or interact with foreigners or migrants. For college students, it is not hard to encounter foreigners. On the other hand, in other cities, it is comparatively harder to encounter foreigners. To sum up, the Slovak population is relatively unfamiliar with foreigners compared to other countries. In certain areas, the familiality with foreigners is even lower.

It is known that Slovaks often treat foreigners differently depending on their race. According to a report from the U.S News, Slovakia is positioned 6th out of the top 10 worst racist countries, and the most racist country in the EU (U.S. News Staff, 2021). It has been reported that migrants experience discrimination not only by people in general, but also in the form of legal policies and within companies. The most disliked minority in Slovakia is the Roma people who have been estimated at 2.7~ 10 percent of the whole Slovak population. However, they are not counted as foreigners or migrants. The next most vilified group is Arabic Muslims, followed by African origin people and then Asians. The Slovak population is generally more amicable to the foreigners who come from neighboring countries of Slovakia such as the Czech Republic, Poland, Hungary, Austria, Ukraine, and so on, because they are of the same race and often share similar identities or religions.

There are various reasons why some people see migrants negatively. Firstly, people believe that many of the migrants do not pay taxes or take jobs from local people.

Secondly, some people think that migrants are not beneficial to their society and the government spends too much money on supporting migrants. Thirdly, some people think that migrants are different in terms of their culture and religion, thus causing social conflicts if the population of migrants increases too much. Sometimes migrants are considered by locals as potential criminals. However, this is mostly untrue. IOM reported that migrants bring more profit for the government than the government spends on migrants. Moreover, migrants sometimes create job opportunities and migrants also do the jobs that local people are unwilling to do or are not easily able to do because of skills or language barriers. On the other hand, people who support migrants believe that migrants can bring positive influences to societies, or at least they are not harmful. Motivated reasoning theory would expect that people who are against migrants believe the news articles talking negatively about migrants. On the other hand, people who support migrants would not easily agree with the news articles that talk negatively about migrants.

In the experiment, participants will be shown fake news biased toward pro-migrants and fake news biased against anti-migrants then be asked to the CRT. The MS2R theory, a type of motiveted reasoning, predicts that the higher scoring participants get in the CRT, the more biased they will be when they judge if the news is fake or true. The classical reasoning theory, on the other hand, predicts that the participants who get a high score in the CRT, are more able to judge if the news is fake or not, and therefore they will be less biased.

Methods

We decided to create news headlines which we pasted into a typical Facebook post format to test our hypothesis. There are a few reasons why we chose to use only headlines for this research. Firstly, using complete articles with lengthy text would be difficult to manage for our research. Participants might not pay attention to the whole article while reading, and since it takes a long time to finish one set of surveys, participants might lose focus. Secondly, using full articles might introduce difficulties in the design and control of the experiment. For example, if participants were not to read the whole article before answering the survey, this could skew our results and

lead to inaccurate conclusions. In longer texts, it is difficult to identify which sections actually influence the participants in their answers. Lastly, research has shown that repetition increases belief even for headlines that demonstrate bias, or ideology that goes against the ideas of the reader (Fazio, Perfors, & Ecker, 2020; Hasher, Goldstein, & Toppino, 1977) This is known as the “illusory truth effect”. This approach means there might be a higher possibility of people reading the whole article, rather than just seeing the headlines while scrolling on social media. Therefore, the potential impact of headlines would be greater than longer articles, which replicate real-life: social media users are more often exposed to headlines than whole articles.

For these reasons, we took news headlines from Facebook. Our approach is based on Pennycook and Rand’s research “Fake News: News content published on the internet that aesthetically resembles actual legitimate mainstream news content, but that is fabricated or extremely inaccurate. Also referred to as false, junk, or fabricated news.”(Pennycook & Rand, 2021 ,p 389). By this definition, we collected fake news headlines which look like actual news from the mainstream media but are fabricated and contain inaccurate information.

Another consideration for the experiment is how emotionally arousing the article is. Articles with different capacities to evoke emotion might result in different reactions for the people who see them. It has been reported that highly emotive fake news spreads faster. People have a tendency to share their emotional experiences with others (Rime et al, 1991). People interact with each other by sharing their emotions and telling their stories. When people share their emotional experiences with others, it can increase social bonding because they feel the similarities in perception and emotional convergence, which seems to play a crucial role in forming a community. It has been reported in research with around 7,000 news articles that emotionally arousing content including anger, fear, or anxiety is easily shared and spread (Berger & Milkman, 2012). Multiple studies, focused on social media, showed that emotional content tends to be shared on various platforms such as Facebook and Twitter (Heimbach et al 2015; Kramer, Guillory, & Hancock, 2014), Twitter (Hansen et al 2011; Quercia et al 2011; Stieglitz & Dang-Xuan, 2013). In order to make the

experiment accurate, we investigated the intensity of emotions on the material in the pre-test.

[Pre-test]

Participants

86 people from Slovakia participated in our pre-test.17 participants did not finish the survey, so the final sample consisted of 69 participants (20 men, 42 women and seven participants preferred not to disclose their gender). The average age of our sample was 23.3 (SD=5) .

Measures and material

Firstly, we collected five fake pro-migrant biased headlines, seven fake anti-migrant biased headlines, and five real news headlines. We had to construct some of the fake news headlines ourselves, especially pro-migrant biased headlines, because there is a limited amount of pro-migrant biased fake news articles, from Slovakia or elsewhere, that are suitable for this research. The pro-migrant fake news headlines were based on common arguments from those who support immigration to their country, such as: “immigration can bring benefits to our society”, “ immigrants are not likely criminals” or “racists are not smart” so that the headlines are aligned with their ideology. However, their arguments are sometimes true. Thus, we made pro-migrants biased fake news headlines by exaggerating the statistics or certain events which are not likely to happen, because we assumed the general public who support immigration might know about the arguments, but are unlikely to be aware of exact statistics unless they are professionals in this field.

We collected seven anti-migrant biased fake news headlines actually published in various countries and then changed the name of the country as though the report was from Slovakia. This was done because we were concerned that if the incident reported in the news headline happened in countries that are not very connected to the participants’ country, they might not pay attention or have an emotional

connection to the headline. We expected that Slovak participants would relate more to the news headlines and be more emotionally involved when they see that the incident happened in Slovakia. We also exaggerated the statistics in some of the anti-migrant biased fake news for the same reasons I stated above for pro-migrant biased news. We took five real news headlines from official media sources: three of them were unrelated to Slovakia and two of them were published in the Slovak press. We did not change anything in the real headlines.

After we collected all of the headlines, we designed the news headlines in the Facebook post form, together with pictures (Figure 3). For the real headlines, we used either the pictures from the actual articles or another appropriate picture that reflected the headline. Directly under the picture was written “NEWS.SK” as the source so that it resembled an authentic publication on Facebook. When people decide to accept or reject news, the source and media play an important role. Thus, we picked the actual news website “News.sk” because although it is not the most famous news website in Slovakia, it is still a reputable news website. A website called, “allyoucanread.com” lists “News.sk” as the 22nd most visited news website in Slovakia. Because we wrote some of the news headlines ourselves and added our own pictures, we decided to test if the headline posts were actually interpreted in the way we meant. We conducted a pre-test for the collected headlines with pictures. We tested whether the pro-migrant and anti-migrant headlines collected actually represented a bias for or against migrants to the participants in the study. We asked, “Suppose the title of this post is completely accurate. If you considered the headline to be completely accurate and true, how favorable would this article be to someone with a strong negative attitude toward immigrants than someone who has a strong positive attitude toward migrants?” The options for the answer were “1 = very favorable for someone who is against immigrants, 2 = a little favorable for someone who is against immigrants,3 = neutral, 4 = a little unfavorable for someone who is against immigrants, 5 = very unfavorable for someone who is against immigrants”. We were also concerned that if each headline evoked a different level of emotion to participants, it might affect how likely they were to agree or disagree with the headline. Therefore, in the pre-test, we asked participants how strong an emotion they felt on seeing the news headlines and pictures. After they had read the headlines, we asked participants about their attitudes toward immigrants. The

questionnaire about the attitude towards migrants consisted of seven statements such as “People from different ethnic groups enrich the cultural life in my country” and participants were asked to rate from 1 (strongly disagree) to 6 (strongly agree) (Figure 4). At the end of the survey, we asked about age, gender, and education. After we followed all of these steps, we informed participants about the experiment and explained which news headlines were fake. All of the pre-test process and materials, including the headlines and questions, were conducted in Slovak because the participants we were interested in are the Slovak population. The data was collected with a survey tool, Qualtrics. The news items for pre-test can be found in supplementary materials.

(Figure 3). One example of the news headline material for the survey. The picture is from other sources and there is a source website under the picture resembling typical Facebook news posts.

Please, indicate your agreement/disagreement with the following statements. 1 = totally disagree, 6 = totally agree

1. People from other ethnic groups enrich the cultural life of our country.
2. Migrants present a threat rather than an opportunity for Slovakia. (R)
3. Migrants cost our state too much money. (R)
4. We need immigrants to work in some fields of our industry.
5. I would probably mind having an immigrant for a neighbor. (R)
6. We should accept refugees to Slovakia and provide them help and protection if they fled their country because of severe problems.
7. The presence of people from other ethnical groups makes me feel insecure. (R)
8. Accepting immigrants to our country can effectively solve the problem of an aging European population.

(Figure 4) The questionnaire used to investigate the participants' attitudes toward immigrants. It is translated into Slovak in the pre-test and main research.

Result and discussion

Among the five types of pro-migrant news headlines, we picked the three pro-migrants headlines that were the most biased toward pro-migrant people. One problem was that the anti-migrant biased fake news headlines generally evoked stronger emotion than pro-migrant biased fake news headlines. We decided to choose the three anti-migrant biased fake news headlines which were the least emotionally evocative, even though they still evoked more intense emotion compared to the pro-migrant biased fake news headlines. We picked the three real news headlines which were most neutral for both sides in order to present the same number of pro and anti-migrant fake news headlines to the participants in the main study. These three real news headlines were also the least emotionally evoking. The for pre-test can be found in the supplementary materials.

[Main research]

Participants

194 people from Slovakia participated in our pre-test. 32 participants did not finish the survey, so the final sample consisted of 162 participants (29 men,133 women

and seven participants preferred not to disclose their gender). The average age of our sample was 37.18 (SD=9.73).

Measure and material

We used the nine news headlines determined through the pre-test. Three pro-migrant, three anti-migrant fake news headlines, and three real news headlines. We randomized the order of the news headlines and for every headline, participants were asked the same three questions as in Pennycook's research (Pennycook & Rand, 2019). The first question was "Have you seen or heard about this story before?", to which the answer could be either "yes" or "no". The second question was, "To the best of your knowledge, how accurate is the claim in the above headline?". The options for the answer were "1 Completely inaccurate, 2 Not very accurate, 3 A little accurate, 4 Very accurate". Lastly, the third question was " Would you consider sharing this story online (for example, through Facebook, Twitter or Instagram, and so on)?". The participants could choose "1. I would never share an article with this headline" (in this case we excluded the data for "sharing") "2. Rather not", "3 Possibly", and "4 Yes". After participants had answered all the questions about the headlines, they were asked to do the extended CRT and verbal CRT. There were eight CRT questions on the survey. Participants answered the same questionnaire about their attitude toward immigrants as we asked in the pre-test. Lastly, we asked about participants' age, gender, and education. We processed all the data in Slovak with the same survey tool, Qualtrics, and we also gave participants a debriefing in order to inform participants about our research and explain which information from the survey was not true. The news items for pre-test can be found in supplementary materials.

Result

Data organizing

The data has been reorganized in order to provide more accurate analysis. Participants were asked to judge if the fake news was accurate with a scale from 1 to 4 (completely inaccurate, not very accurate, a little accurate, very accurate). In the analysis, we decided to combine one and two, and three and four with three reasons. If an individual read a fake news article, and answered “completely inaccurate” while another person answered “not very accurate”, it may not necessarily mean the first person is better at distinguishing fake news than the other. Some participants might simply give extreme answers and put the number 1 or 4, which does not directly mean that they can discern which news is fake. Secondly, the scale is not ordinal which makes analysis more complicated. The difference between the responses one and two are not the same as the difference between the responses two and three, because number two means correct response and number three means incorrect response. Lastly, if we analyze the data on a scale from one to four, mathematically, some noise is generated in the data. We considered that if an individual answers either “completely inaccurate”, or “not very accurate”, then they are able to successfully reject fake news. We had three pieces of pro-migrant fake news and three pieces of anti-migrant fake news. In order to see the correlation between the CRT and accuracy in terms of attitudes towards migrants, we needed to calculate the mean for each group of fake news accuracy. In that case, there are some numbers overlapping in average accuracy and it is not easy to discern if a person is good at rejecting fake news or not. See the (Table 1). To prevent this, we decided to label all of the correct responses as number two and all the incorrect responses as number three. In this case, if participants have three or two correct responses out of three fake news, it will show 2 or 2.3 average accuracies and if participants get only one or zero correct responses out of three, their average accuracy will be 2.6 or 3, therefore the score graph will be ordinal without noise in data.

Pro-fake news 1	Pro-fake news 2	Pro-fake news 3	average accuracy
1	1	1	1
2	2	2	2
3	2	2	2.333333333
4	2	2	2.666666667
3	3	1	2.333333333
3	3	2	2.666666667
3	3	3	3

(Table 1) Above is an example of the overlapping problem. In the box, we will consider colored boxes as accurate participants. Either they get two or three correct answers out of three. 1 or 2 is considered as a correct response because it means participants answered the fake news is inaccurate. However, among the all probable average numbers, there are two numbers that can be interpreted as both correct and incorrect answers. For instance, the 2.3 average accuracy could be two correct answers and one wrong answer, or two incorrect answers and one correct answer.

We divided participants into the pro-migrant group and anti-migrant group based on the questionnaire about their attitude toward migrants. The score range of the questionnaire ranges from eight to 48. (8 questions 1-6 scale. The score eight in this questionnaire means they are extremely against migrants, and the score 48 means they have a extremly positive view toward migrants.) The theoretical median of the score is 28, thus we decided to consider the participants who have a score of 28 or below 28 as an anti-migrant group and participants who score above 28 as pro-migrants.

To avoid complications, we would like to simplify the terms. The group that looks at migrants in a favorable way is called ‘Pro-mig’, and for the group that appears to be critical of migrants will be called ‘Anti-mig’. The fake news that is biased towards the Pro-mig group will be called ‘P-fake news’ and the fake news that is biased towards the Anti-mig group will be called ‘A-fake news’. The same principle will be applied to real news, thus P-real news means pro-migrant biased real news. In the matter of the correlation table, ‘acc’ indicates accuracy.

We investigated the correlation between the CRT and the average accuracy towards P-fake news and A-fake news with Jamovi(Kim 2015; Jamovi 2021; R 2021) to test the hypotheses. As a result, four correlations were found; the average accuracy of P-fake & A-fake news in Anti-mig, and the average accuracy of P-fake & A-fake news in the Pro-mig.

CRT and fake news

No correlation was found between the CRT score and the participants' ability to discern fake news except in the Pro-mig toward P-fake news. The data showed that the higher the CRT score in the Pro-mig is, the lower the accuracy is towards P-fake news (p=0.05, r= .174). This can be explained using the MS2R theory. However, the other groups do not show any significant correlation and therefore we can not find the effect of both classical reasoning and MS2R. (Table 2)

		CRT_TOT
CRT_TOT	Pearson's r	—
	p-value	—
	N	—
Pro-mig P-fake news acc	Pearson's r	0.174
	p-value	0.050
	N	127
Pro-mig A-fake news acc	Pearson's r	0.092
	p-value	0.303
	N	127
Anti-mig P-fake news acc	Pearson's r	−0.350
	p-value	0.068
	N	28
Anti-mig A-fake news acc	Pearson's r	−0.026
	p-value	0.895
	N	28

(Table 2) This table illustrates the correlation table between the CRT and accuracy. When they reject fake news, they get lower socre in total average acc. When participants get a higher score in average accuracy when they give inaccurate answers. Therefore, the positive correlation here means the higher CRT score people get the more tendency to accept fake news. The ‘N’ here indicates the number of people in the group. The table indicates that in Pro-mig, if participants get a higher score in the CRT, they show a mild tendency to accept P-fake news. (p=0.05, r =.174)

		extended CRT			verbal CRT
extended CRT	Pearson's r	—	verbal CRT	Pearson's r	—
	p-value	—		p-value	—
	N	—		N	—
Pro-mig P-fake news acc	Pearson's r	0.201	Pro-mig P-fake news acc	Pearson's r	0.069
	p-value	0.024		p-value	0.438
	N	127		N	127
Pro-mig A-fake news acc	Pearson's r	0.121	Pro-mig A-fake news acc	Pearson's r	0.016
	p-value	0.176		p-value	0.862
	N	127		N	127
Anti-mig P-fake news acc	Pearson's r	−0.323	Anti-mig P-fake news acc	Pearson's r	−0.271
	p-value	0.094		p-value	0.163
	N	28		N	28
Anti-mig A-fake news acc	Pearson's r	−0.286	Anti-mig A-fake news acc	Pearson's r	0.272
	p-value	0.141		p-value	0.161
	N	28		N	28

(Table 3) This table shows the correlation of two types of CRT and fake news items. The CRT consists of extended CRT and verbal CRT. Extended CRT is more positively correlated to P-fake news acc in the Pro-mig group(p<0.024, r= .201). Contrarily, No correlation wass found with verbal CRT.

The CRT with real news

Real news consists of three categories; P-real news, A-fake news, and neutral news. Unlike with fake news items, when the participants were asked how accurate the news was, the correct response for real news was 3 or 4 (a little accurate, very accurate). In order to make the analysis consistent, we reversed the responses and combined the numbers 1&2 and 3&4 in the analysis. We investigated the correlation between the CRT and each real news item. In the Pro-mig group, there is negative correlation between the CRT and both P-real news (p<0.05, r= -.177) and A-real news (p<0.05, r= -.203). It means that in the Pro-mig group, a high CRT score might indicate better acceptance of both P-real news and A-real news. (Table 4).

		CRT_TOT
CRT_TOT	Pearson's r	—
	p-value	—
	N	—
Pro-mig P-real news acc	Pearson's r	−0.177
	p-value	0.046
	N	127
Pro-mig A-real news acc	Pearson's r	−0.203
	p-value	0.022
	N	127
Pro-mig natural real news acc	Pearson's r	−0.126
	p-value	0.158
	N	127
Anti-mig P-real news acc	Pearson's r	0.056
	p-value	0.777
	N	28
Anti-mig A-real news acc	Pearson's r	0.212
	p-value	0.279
	N	28
Anti-mig natural real news acc	Pearson's r	0.035
	p-value	0.860
	N	28

(Table 4) Pro-mig with P-real news and Pro-mig with A-real news are negatively correlated with the CRT. It means the participants supporting migration tend to recognize the pro-migrant biased real news and anti-migrant biased real news as accurate.

		extended CRT			verbal CRT
extended CRT	Pearson's r	—	verbal CRT	Pearson's r	—
	p-value	—		p-value	—
	N	—		N	—
Pro-mig P-real news acc	Pearson's r	−0.139	Pro-mig P-real news acc	Pearson's r	−0.165
	p-value	0.119		p-value	0.064
	N	127		N	127
Pro-mig A-real news acc	Pearson's r	−0.234	Pro-mig A-real news acc	Pearson's r	−0.081
	p-value	0.008		p-value	0.363
	N	127		N	127
Pro-mig natural real news acc	Pearson's r	−0.127	Pro-mig natural real news acc	Pearson's r	−0.077
	p-value	0.155		p-value	0.389
	N	127		N	127
Anti-mig P-real news acc	Pearson's r	0.173	Anti-mig P-real news acc	Pearson's r	−0.092
	p-value	0.380		p-value	0.643
	N	28		N	28
Anti-mig A-real news acc	Pearson's r	0.277	Anti-mig A-real news acc	Pearson's r	0.073
	p-value	0.154		p-value	0.712
	N	28		N	28
Anti-mig natural real news acc	Pearson's r	0.169	Anti-mig natural real news acc	Pearson's r	−0.126
	p-value	0.389		p-value	0.522
	N	28		N	28

(Table 5) This table shows the correlation of both extended CRT and verbal CRT with real news items. The only significant correlation is found in the Pro-mig group with A-real news. It indicates that in the Pro-mig group, the people who have a high score tend to accept A-real news.

The correlation between the CRT and all real news materials in each group was investigated. The data shows that in the Pro-mig group, the high CRT scores increase the acceptance of real news(*p*=0.01, r= - 0.227). The same effect was observed in extended CRT.

		CRT_TOT
CRT_TOT	Pearson's r	—
	p-value	—
	N	—
Pro-mig real news average acc	Pearson's r	−0.227
	p-value	0.010
	N	127
Anti-mig real news average acc	Pearson's r	0.147
	p-value	0.456
	N	28

(Table 6) The accuracy of all three real news items. The negative correlation between the CRT and Pro-mig real news indicates that when Pro-mig participants get a high score in the CRT, they tend to accept real news regardless of the way news is biased. (*p* <0.05, r= -.227)

		extended CRT			verbal CRT
extended CRT	Pearson's r	—	verbal CRT	Pearson's r	—
	p-value	—		p-value	—
	N	—		N	—
Pro-mig real news average acc	Pearson's r	−0.224	Pro-mig real news average acc	Pearson's r	−0.146
	p-value	0.012		p-value	0.101
	N	127		N	127
Anti-mig real news average acc	Pearson's r	0.299	Anti-mig real news average acc	Pearson's r	−0.069
	p-value	0.123		p-value	0.727
	N	28		N	28

(Table 7) Extended CRT shows a negative correlation with average accuracy in the Pro-mig group (*p*<0.05, r= -.224). It indicates that this group tends to recognize the real news as true, by the extended score increase.

The result implies that there is insufficient evidence to observe the effect of both classical reasoning and MS2R. With regards to fake news, the higher score of CRT in the Pro-mig group predicts a higher level of inaccuracy, which is aligned with MS2R. However, when it comes to real news, the higher score of CRT in the Pro-mig group increases the acceptance of real news, regardless of whether the news is biased toward the Pro-mig or Anti-mig groups. In the data of grouping of all biased

news, (real and fake) there was no significant correlation between CRT and biased news. It implies that there might be no effect of either MS2R or classical reasoning.

As well as the hypothesis conducted in connection to the CRT, we conducted further analysis with other variables to investigate if there are other factors that can influence one's ability to decipher whether news is accurate or not. We investigated 'attitudes toward migrants' with respect to the accuracy of the fake news material we used. It is notable that attitudes towards migrants play an important role in accepting or rejecting fake news (Table 8). The data shows that when people have a more positive attitude towards migrants, they tend to accept P-fake news, and reject A-fake news. It means if the news is aligned with their ideology, they tend to accept the information and if the news is against their ideology, they tend to reject the information. Therefore, the attitudes toward migrants is the best predictor of accepting or rejecting migrants biased fake news in this research.

		attitudes_pro
attitudes_pro	Pearson's r	—
	p-value	—
	N	—
All P-fake news acc	Pearson's r	0.248
	p-value	0.002
	N	155
All A-fake news acc	Pearson's r	−0.518
	p-value	< .001
	N	155

(Table 8) The table here indicates that attitudes toward migrants are a stronger predictor than the CRT or other variables. The lower numbers of accuracy indicate they are successful in rejecting fake news. A higher number in attitude means a more positive attitude toward migrants. Therefore, the positive correlation indicates that they tend to accept fake news, and the negative correlation indicates that they tend to reject fake news. P-fake news is positively correlated to the attitudes_pro, which means people with a positive attitude toward migrants tend to accept P-fake news. Contrarily, they tend to reject F- fake news.

Discussion and conclusion

The goal of this research is to test the MS2R hypothesis and classical reasoning hypothesis as the original research(Pennycook & Rand, 2019). MS2R hypothesis predicted that when participants have higher scores in CRT, they will be more biased because analytical thinking reinforces the ability to rationalize their identity, making participants more likely to reject ideas against their identity. Contrarily, the classical reasoning hypothesis predicted that when participants have higher scores in CRT, they will be less biased because they will successfully reject fake news regardless of their ideology, rather than accept what they want to believe.

The data showed that among the Pro-mig group, people who get high scores tend to accept P-fake news as the MS2R theory predicted. However, the same effect is not observed in other groups. The participants who got high scores in the CRT in the Pro-mig group also showed a tendency to accept real news regardless if the news aligned with or against their identities. This can be explained by the classical reasoning theory. However, we could not find any significant correlation between the CRT and acceptance of real news in the Anti-mig group. Therefore, the data of this research does not support both of the hypotheses.
With regard to acceptance or rejection of fake news, the most promising predictor was the attitude toward migrants. People tend to accept fake news if the news is aligned with their identity, and tend to reject fake news if the news is against their identity.

The result is different from the previous research (Pennycook & Rand, 2019). In the original research, they investigated the two theories in the U.S. with the political ideology such as Republicans versus Democrats. The result of the research shows that the higher CRT scores the participants get, the less biased they are, which supports the classical reasoning theory.

This research implies that in the matter of accepting fake news, the individual identity and the content of the news play a key role. Therefore, we concluded that our data

supports the social identity theory and motivated reasoning but it is difficult to identify the effect of either classical reasoning or MS2R.

This research showed different results from the original research. One of the possible reasons why the two pieces of research have different results may be because of the characteristics of the topics. The original research from Pennycook and Rand(2019) tested the hypothesis with general political bias, and this research tested the hypothesis with the attitude towards migrants. The attitude towards migrants may show a more clear bias or preference of belief compared to the general political ideology as we have described in chapter 3. The topic of migrants can be closely related to people's daily lives because they can directly meet migrants or get positive or negative experiences. Whereas, certain conservative or progressive policies do not necessarily have a direct influence on people as much as the migrant topic. This could be related to racism as well. For example, people who believe that migrants can directly or indirectly harm them may regard the migrants as an actual threat to their life in terms of safety or financial state. It can cause anxiety or fear which increases the acceptance and spreading of fake news (Salvi et al, 2021). With regard to the Pro-mig people, they may have intense negative emotions toward racism. It may result in rejecting any type of adverse description of foreigners. There is a possibility that these factors reinforced the effect of bias and influenced our result stronger than the effect of analytical thinking.

It implies that it could be crucial to consider how much the topic is related to anxiety and fear in fake news research. More specifically, in terms of accepting fake news, people may adopt different cognitive mechanisms to the topics that can be a direct threat to people, such as COVID-19 or war, compared to the topics that do not directly threaten their life, such as a presidential election.

Limits

We would like to address the limitations of this research in three aspects; participants, news items, and general issues.

Participants

The data of participants is highly biased. There are 128 Pro-mig people and only 28 Anti-mig people. One of the possible reasons why the data did not show any correlation of the CRT score in the Anti-mig group is because the number of people in the Anti-mig group is statistically insufficient. We might find a significant correlation if there were a sufficient number of people in the Anti-mig group. Additionally, the participants were mostly women (133 women out of 162 participants). The data may be insufficient to represent the whole population if there is a significant difference between genders.

News items

In the pre-test, there was uncertainty regarding the question concerning the favorability of the news. What we meant in the question was if the news articles are consistent with a certain identity or belief. With regards to the Anti-mig biased news(A-news), some people misunderstood. They believed the A-news was unfavorable to Anti-mig people because Anti-mig people would likely accept the A-news as a fact, but they would not like the “fact” that is happening. For example, one of the A-fake news was claiming that migrants in Slovakia are 20% of the whole population. Some of the participants answered as favorable to Anti-mig people because it aligned with one of their beliefs that there are too many foreigners. Some of the participants answered it is unfavorable to Anti-mig people because the participants thought Anti-mig people may tend to believe the claim but they will hate the “fact” that there are too many foreigners. Eventually, we observed noise from the pre-test data and it made it difficult to select appropriate materials, particularly for the A-news.

Another issue is that some claims from the news items are similar to the questionnaires on attitudes toward the migrants test. In this case, the news items

may be an indirect question to participants' beliefs. This might reinforce the effect of bias in the result.

The data of P-fake news implies that there might be the result that MS2R theory predicts. With the people who have high CRT scores in the Pro-mig group, there is a significant tendency to accept P-fake news. Additionally, in the Anti-mig group, people who have high CRT scores tend to reject P-fake news. Even though the p-value is insignificant, it is close to the significant level (p=0.068). The insignificance of the correlation in the Anti-mig group may be because the number of people in the Anti-mig group was too small to show a significant level of the correlation. Considering this, we may have found the result supporting MS2R theory with the P-fake news materials. Certainly, the opposite case is possible. The three P-fake news materials are correlated with the CRT in Pro-mig group by chance, or for different reasons from what MS2R explains.

One of the general criticisms of fake news research is that it is difficult to construct appropriate items working across different cultural settings. Various research has been conducted on fake news but the materials they used are not standardized. Therefore, the reliability and generality of the research have been criticized(Maertens et al, 2021). Apart from the limits of this research, more standardized materials are required for further research.

Lastly, the number of news items is not as high as in the original research. If there were more news items, more reliable data would have been obtained in terms of the participant's ability to distinguish fake news.

General issues

We found that the CRT score is positively correlated with a positive attitude toward migrants ($p < 0.05$, r= 0.185) (Table 9). It means when people have high scores in CRT, they are more biased towards migrants. The data showed that the attitude towards migrants plays a key role in accepting or rejecting fake news. The

correlation between the CRT and attitude may have generated noise in our data, and it can be a possible factor why we could not observe the effect of the CRT.
In addition to this, we did not observe any significant correlation with verbal CRT. It implies that the verbal CRT is not valid as CRT as it is already well known. Another possibility is that numerical ability is one of the key elements in terms of accepting or rejecting fake news, rather than the CRT itself.

		CRT_TOT
CRT_TOT	Pearson's r	—
	p-value	—
attitudes_pro	Pearson's r	0.185
	p-value	0.021

(Table 9) This table shows the positive correlation between the CRT and positive attitudes toward migrants.

Conclusion

Even though we did not observe the result that the two hypotheses predicted, the data showed the importance of the bias effect that is related to social identity theory unlike the original research (Pennycook & rand, 2019). Moreover, the result suggests that there may be different cognitive mechanisms depending on the characteristics of the topics. We expect that the data and the limits of this research will give positive effectl for future research on similar topics.

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